2014 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 contribute to ensuring food security for a growing world population, develop innovative means to improve profitability and productivity, protect environmental quality and heal damaged ecosystems. Emerging issues must also be addressed, including climate change, farmland losses to development, food safety, and social issues for families and youth such as reversing the growing epidemic of childhood obesity. Our plan of work includes the following eight programs intended to provide research-based solutions to the complex, global challenges facing Delaware today. It is important to note that divisions between these programmatic efforts are artificial. Our research and extension efforts are most commonly conducted by multi-disciplinary teams working across programs, in collaboration with colleagues in other disciplines. We also regularly plan and work with stakeholders in other University departments, other governmental agencies, foundations, community groups, universities, and political or policy-making positions.

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

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

scale crop management and farm marketing skills to ensure that farmers and the "green industry" remain profitable. Basic studies on plant adaptation to the environment and biotic and abiotic stress are priorities, as are studies on soil microbe-plant relationships and plant/soil interfacial reactions key to plant nutrient use and plant adaptation to contaminated soils. Environmentally sound management of soil resources requires that we address a range of issues impacting air, soil, surface and ground water quality such as efficient use of nutrients in animal and crop production; fate, mobility, speciation, and bioavailability of metals and organic chemicals in soil and water environments; efficient use of ground water for irrigation; safe use of pesticides and herbicides;, and emission of gases and particulates from soils and wastes that can affect air quality, climate change, and human and ecosystem health. We conduct basic research to increase our fundamental understanding of soil processes and applied research and extension programs to develop and implement management strategies that sustain agriculture and other land uses while protecting the quality of our air, soil, and water. Integrating economics with basic and applied research is a key aspect of this planned program. Our economics research foci are international trade and policy, with an emphasis on energy economics and economic development, and natural resource economics, particularly as this relates to land use change, such as conversion of farmland and forests to developed land uses and formulation of sound policies to preserve agricultural land for future generations;
(2) Biotechnology and Biotechnology-Based Agribusinesses: The University of Delaware, in conjunction with the state and private industry, has devoted nearly 25 years to developing research capacity and expertise in basic and applied biotechnology. Areas of existing strength are avian virology, physiology, and genomics and plant molecular biology and plant breeding. In our avian programs, biotechnology is used at the basic level to improve poultry health and immune competence and to understand fundamental mechanisms of avian diseases. At the applied level, biotechnology efforts focus on improving diagnostic testing methods, developing vaccines and other disease control methodologies, surveying for emerging avian disease causing agents, and developing disease resistant breeds of chickens. For plants, basic biotechnology efforts include understanding gene regulation in plants, particularly those associated with RNA turnover or small RNA-mediated gene regulation. Other efforts include understanding disease resistance and signal transduction pathways in plants, understanding nitrogen fixation via the application of molecular and proteomics approaches, and understanding, at the molecular and atomic levels, plant-soil interfacial relations important to nutrient and heavy metal uptake. Key elements of this program include: expanding fundamental, cross-disciplinary research in the avian and plant/soil research areas; applying basic biotechnology research to the development of diagnostic methodologies for plants and animals; investigating new opportunities to apply biotechnology knowledge, such as alternate, bio-based energy sources that make economic sense for Delaware; producing pharmaceuticals, vaccines, nutriceuticals and other products from plants; and a new, high priority - developing biotechnology-based agribusinesses by financial planning, risk management analysis, and evaluation of the marketability and consumer acceptance of biotechnology based products;
(3) Natural Systems, Biodiversity, and Wildlife Ecology: Maintaining and restoring renewable natural resources and the vital services provided by healthy ecosystems in Delaware after 400 years of urban and agricultural land use is our focus in this planned program. The impact of past and current land use changes, such as agricultural/forestry practices and encroachment of urban/suburban populations on native landscapes, is not fully understood but is thought to be contributing to the loss of many plant and animal species. Perturbation of ecosystems, such as by fragmentation of wildlife habitats due to development and nutrient enrichment of aquatic resources caused by greater runoff as impervious surface increases, are key areas where the interface between terrestrial and aquatic ecosystems is in need of more research and extension programming. New technologies in agricultural production that include control of insects, weeds, filamentous algae, and plant pathogens are needed to ensure sustainability of agriculture in Delaware while restoring and maintaining biodiversity and natural ecosystems located on farms. Finding ways to replace and sustain biodiversity in suburban landscapes, which today comprise 54% of Delaware, is another priority and is vital to future efforts to sustain natural resources in the face of increasingly rapid land use change from agriculture to more developed land uses;
(4) Family and Youth Development: The rapid economic and social changes occurring in Delaware today place high demands on families and communities. These problems are not only confined to rural areas

where development and urbanization of farmland are changing the nature of communities and the opportunities for youth, but also are found in our towns and cities. Strong families are the basic building unit for our future citizens, yet those charged with this important responsibility often do not have the time, money, or skills to carry out their family roles in a positive, productive manner. Preparing citizens to take prominent roles in shaping their future and the future of their communities is the fundamental goal of this planned program. Cooperative Extension activities are the major component of this program and focus on: helping Delaware youth develop the leadership and life skills needed to become productive, independent, contributors to our society; increasing educational opportunities in science, engineering, and technology for youth; providing guidance and training in areas important to financial security of families and to family well-being across the generations; safe community programs on drug and alcohol prevention and safety training for vehicles, bicycles, pedestrians, farm families, and businesses;
(5) Food Safety: The American food system provides consumers with an abundant supply of convenient, economical, high-quality, nutritious, and safe food products. However, foodborne illnesses still occur in the U.S. Outbreaks of foodborne illness due to microbial contamination continue to be a major but preventable public health problem. While advances in understanding and controlling foodborne pathogens have been significant, new pathogens, new food products, increases in imported foods, and increasing anti-microbial resistance present new challenges to the nation's food safety programs. Our research programs focus on understanding foodborne pathogens and reducing the occurrence of these microbes during pre- and post-harvest by intervention strategies (e.g., high pressure, ultraviolet light, antimicrobial packaging). Extension activities center on food safety education of food handlers and youth; emerging food safety and nutrition issues; and public education about how to respond to outbreaks of foodborne diseases;
(6) Childhood Obesity: This program revolves around development of healthy eating and physical activity patterns. These programs will be delivered by family and consumer science educators, youth agents, paraprofessionals, and trained volunteers. Special emphasis will be placed on minority, low-income and educationally disadvantaged individuals since nationwide data indicate these individuals have a disproportionate share of diet-related diseases, including being overweight. Although many diseases occur more frequently with advancing age, dietary practices in young people significantly affect the occurrence and onset of these diseases. Extension activities center on selecting foods from My Plate, meal planning, and food preparation to lose or maintain weight and increasing physical activity;
(7) Climate Change: Climate change will create major challenges for Delaware's agriculture and natural resource areas, due to a transition to a warmer climate, characterized by hotter summers and warmer winters, greater annual rainfall, and more extreme weather events. Predicted problems include prolonged droughts, disruptions of key farming operations such as planting and harvesting due to heavy spring and fall rains, higher incidences and more diversity in the types of animal and plant pests (insects, diseases), greater potential for water quality degradation as nutrients move more rapidly and more often to waters via leaching and runoff, and losses of biodiversity in forests, wetlands, and other areas as plants now native to Delaware become stressed and more susceptible to invasions by alien plants and gradually replaced by those more suited to a warmer climate. Sea level rise will lead to problems with salt water intrusion into ground waters used for irrigation, inundation of wetlands and other low-lying natural areas, and intensified flooding, particularly problematic for cropland near the coast that is only productive because of an extensive network of drainage ditches. Our research and extension focus in this planned program will be: (i) improving fundamental understanding of why and how a changing climate affects animal and plant physiological processes related to health and productivity, the transformations of carbon, nutrients, organic chemicals, and toxins in soils, and biodiversity of plants and wildlife in natural ecosystems; (ii) developing cost-effective management strategies to help animal and crop producers and natural resource managers respond to weather extremes, greater pressures from insects and diseases, and sea level rise; and (iii) contributing to the development of climate change policies (e.g., carbon trading) that provide farmers and others with resources needed to adopt practices to mitigate climate change problems.
(8) Sustainable Energy: Energyremains a primary concern of all stakeholders involved in agriculture and natural resources management. Research and extension programs related to bioenergy will include those focused on (i) Biomass crops: genetics and basic plant biology studies, plant-microbe interactions that enhance growth and water use efficiency of biomass crops; production and agronomic management

practices for current (corn, soy) and innovative new cropping systems (e.g., sweet sorghum, switchgrass, poplars); equipment changes and needs for new biomass crops, especially related to planting and harvesting; improving nutrient management BMPs mitigating potential environmental impacts of biomass energy crops and assessing their impacts on water quality relative to current cropping systems; and addressing economic, social and cultural issues related to changing from long-standing to new cropping systems; (ii) Bioenergy production systems and re-use of byproducts: evaluation of farm-scale anaerobic digestion for bioenergy production, using animal manures, cover crops (e.g., forage radishes), and other by-products; evaluation of gasification/pyrolysis technologies, especially those using poultry litter. Finding beneficial agricultural uses for the by-products of energy production such as distillers' grains; (iii)Water supply: managing regional water supplies to produce biomass energy crops, including better understanding of the impacts of climatic extremes, improving drought tolerance, increasing irrigation use efficiency, use of wastewaters, and developing cropping systems that foster efficient water use by crops; and (iv) Education and outreach: development of bioenergy and climate change curricula for youth (e.g., K-12, 4-H programs, Master Gardeners).

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

Year	Extension		Research	
	1862	1890	1862	1890
2014	54.0	19.0	115.9	5.4
2015	56.0	21.3	120.1	7.1
2016	57.0	22.8	121.5	9.0
2017	60.5	26.0	127.0	12.5
2018	62.0	29.0	129.0	13.5

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 7 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 eight 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 8 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

S. No.	PROGRAM NAME
1	Global Food Security and Hunger
2	Biotechnology and Biotechnology-based Agribusiness
3	Natural Systems, Biodiversity, and Wildlife Ecology
4	Family and Youth Development
5	Food Safety
6	Childhood Obesity
7	Climate Change
8	Sustainable Energy

V(A). Planned Program (Summary)

Program # 1

1. Name of the Planned Program

Global Food Security and Hunger

2. Brief summary about Planned Program

Delaware agriculture is fully integrated into the global economy and driven by the need to produce a safe and secure food supply for a growing world population. Longstanding components of agriculture in Delaware are animal production,, grain crops and vegetables, aquaculture, soil management and watershed protection, and agricultural and natural resource economics. Animal-based agriculture is one of the largest and most profitable enterprises in Delaware with poultry production and processing activities accounting for over $3.2 billion dollars, 13,437 jobs, and $911.6 million in value added. Livestock industries ($28M farm income from dairy, beef cattle, swine) are important with dairy production leading the way, producing $73.3M in industry output and providing 260 jobs, according to the UD study. Aquaculture has emerged as a new sector, in freshwaters and coastal areas with shellfish. For poultry, diagnosis and control of infectious avian diseases is a high research priority, while for all of animal agriculture, research and extension programs focus on key issues such nutrient management and water quality, air quality, food safety, labor, animal welfare, and community relations. Grain crops, vegetable crops for processing and fresh markets, and a growing horticultural industry dominate Delaware agriculture. Most cropland is used for corn, soybean, and small grains, mainly for animal feed; but interest grows in producing energy crops (barley, soybeans). Crop management depends more than ever on fundamental research on plant genomes and using genomic information to solve production problems. We address advances in field-scale crop management and farm marketing skills to ensure that farmers and the "green industry" remain profitable. Basic studies on plant adaptation to the environment and biotic and abiotic stress are priorities, as are studies on soil microbe-plant relationships and plant/soil interfacial reactions key to plant nutrient use and plant adaptation to contaminated soils. Environmentally sound management of soil resources requires that we address a range of issues impacting air, soil, surface and ground water quality such as efficient use of nutrients in animal and crop production; fate, mobility, speciation, and bioavailability of metals and organic chemicals in soil and water environments; efficient use of ground water for irrigation; safe use of pesticides and herbicides;, and emission of gases and particulates from soils and wastes that can affect air quality, climate change, and human and ecosystem health. We conduct basic research to increase our fundamental understanding of soil processes and applied research and extension programs to develop and implement management strategies that sustain agriculture and other land uses while protecting the quality of our air, soil, and water. Integrating economics with basic and applied research is a key aspect of this planned program. Our economics research foci are international trade and policy, with an emphasis on energy economics and economic development, and natural resource economics, particularly as this relates to land use change, such as conversion of farmland and forests to developed land uses and formulation of sound policies to preserve agricultural land for future generations.

3. Program existence : Intermediate (One to 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	20%	20%	10%	10%
112	Watershed Protection and Management	10%	10%	5%	5%
201	Plant Genome, Genetics, and Genetic Mechanisms	0%	0%	15%	15%
203	Plant Biological Efficiency and Abiotic Stresses Affecting Plants	0%	0%	5%	5%
205	Plant Management Systems	15%	15%	10%	10%
304	Animal Genome	0%	0%	10%	10%
305	Animal Physiological Processes	0%	0%	5%	5%
307	Animal Management Systems	15%	15%	5%	5%
311	Animal Diseases	10%	10%	15%	15%
601	Economics of Agricultural Production and Farm Management	5%	5%	5%	5%
605	Natural Resource and Environmental Economics	5%	5%	10%	10%
903	Communication, Education, and Information Delivery	20%	20%	5%	5%
	Total	100%	100%	100%	100%

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

1. Situation and priorities

Animal agriculture, and in particular poultry production, will remain the mainstay of Delaware's entire 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; interest in biofuel crops grows rapidly, vegetable and specialty crop production is growing as urban markets for these crops expands; and the need for horticultural plant production and landscaping will increase. To sustain crop production as a vital part of Delaware's economy, research priorities in the plant 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; improving the 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 cropping systems and consumer preferences; and developing environmentally sound horticulture programs emphasizing the use of native plant species. Protecting soils from degradation and managing them to sustain agricultural productivity are critical issues for all land uses. Priority areas for our soil and environmental quality research and extension programs are: contamination of soil and water resources with nutrients, metals, salts, radionuclides, organic chemicals, and pathogens; remediation of contaminated soils; reducing soil erosion; maintenance of soil productivity for food production; land use and preservation issues; preservation of wetlands to filter and clean surface waters; loss of biodiversity; waste disposal and/or beneficial re-use; atmospheric pollution via particulates caused by emissions from soils, agricultural operations, and landfills; and the chronic, deleterious effects of pollutants on human health.

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 in this area. Competitive funding will increase, cooperative interactions with the 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 a smaller land base. 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 and become a major economic force in the state; greenhouse production of a diverse variety of bioengineered plants for non-agricultural uses (e.g., pharmaceuticals, nutriceuticals) will emerge as new opportunities for Delaware agriculture. 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. Improved fundamental understanding of soil biology, chemistry, and physics will continue to be central to the development of best management practices for agricultural soils, soils in natural ecosystems, and for contaminated soils. Resource economists will develop land use policies that sustain agriculture and natural ecosystems and innovative outreach programs designed to resolve conflicts between farmers, rural citizens, and the urban/suburban populations that bring new, and often quite different, visions of land use to the rural

landscape.

2. Ultimate goal(s) of this Program

The ultimate goals of Planned Program 1 are improved efforts to contribute to the global need for a safe and secure food supply. To do this, we need to increase agricultural profitability, become more competitive in global markets, and ensure the environmental compatibility of all forms of agriculture. For animal production, our main goals are reduced disease losses, improved efficiency of animal production, and implementation of innovative approaches to address environmental and social conflicts. For crop production systems, our goals are to further our fundamental understanding of plant biology and apply this knowledge to the development of more efficient and environmentally sound management systems for agronomic, vegetable, and ornamental crops. Other key goals are more efficient crop and animal management systems, improved marketing skills, reduced costs of production, higher percentages of marketable product per acre, better cultural techniques, innovations in nutrient management, adoption of improved crop and vegetable varieties, and the development and release of new, improved germplasm for plant flavor, fragrance and medicinal uses. We also seek to increase knowledge about production practices and niche markets for vegetables, herbs, and essential oils, assist limited resource farmers and ranchers in identifying new crops and markets, develop and demonstrate efficient, economic, environmentally sound pasture-based animal production systems, and identify species or genotypes of grasses and legumes most suitable for the region for production and/or soil protection purposes. Sustaining and restoring our soil resource is another major goal, and we focus on improved understanding of the transport and fate of nutrients, metals, and organics through soil; development of new practices, technologies and educational programs to assist producers in managing plant nutrients and animal wastes; and integrating the basic principles of soil science into watershed scale efforts to improve surface and ground water quality in Delaware. Integrated into all of these goals is the commitment to develop research-based economic policies that sustain our agricultural land base in the face of pressures to convert farmland to developed uses and that provide Delaware agriculture with the knowledge and skills to compete internationally in the production, marketing and distribution of food and other agricultural products.

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
2014	19.1	7.7	63.9	1.4
2015	19.0	8.0	66.0	1.5
2016	19.0	8.0	67.0	1.5
2017	20.0	8.0	68.0	2.0
2018	20.0	9.0	68.0	2.0

V(F). Planned Program (Activity)

1. Activity for the Program

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. For crop production, key activities are: (1) Agronomic, Vegetable and Horticultural Crop Production - improving varietal selection, disease and pest resistance, seed technology, cultural and marketing practices; (2) New Crops - financial and environmental impacts of new crops or new varieties of existing crops, (3) Integrated Pest Management - control of insect pests, weeds, and plant pathogens via biological and chemical methods; (4) Engineering Technologies - improvements in harvesting and guidance systems and expanded research and extension programs on irrigation management; implementing recent advances in remote sensing, tillage, and pesticide application; (5) Plant Breeding, Crop Genomics, Proteomics, and Bioinformatics - basic research on how plants adapt to their environments and manage stress and the nature of soil microorganism-plant symbiotic relationships and plant/soil interfacial reactions affecting crop growth and quality; (6) Pasture and Forage Management - research on pasture-based animal production systems and forage research on improving biological control systems for alfalfa. Soil science programs focus on: (1)Fate, Transport, and Reaction Mechanisms - fate, transport and reaction mechanisms of plant nutrients, wastes, and organic chemicals in soils, and their effects on soil, air and water pollution (2) Cost-Effective, In-Situ Remediation - cost-effective, in-situ methods for the remediation and speciation of contaminated soils; (3) Nutrient Management for Water and Quality - fertilizer and waste management programs to ensure economic and environmental sustainability while considering crop needs, nutrient reactions in soils, alternative fertilizer sources, and government policies. Resource and international economics activity areas include: (1) Protection and Preservation of Agricultural Land - current strategies to protect and preserve agricultural land will be evaluated and promising new approaches will be investigated; (2)International Economics and Trade: improved understanding of factors controlling export-import markets, particularly poultry.

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

Extension

Direct Methods	Indirect Methods
● Education Class	● Public Service Announcement
● Workshop	● Newsletters
● Group Discussion	● TV Media Programs
● One-on-One Intervention	● Web sites other than eXtension
● Demonstrations	● Other 1 (Newspapers)

3. Description of targeted audience

For animal agriculture, primarily poultry integrators, growers, breeders, trade groups and allied industries; dairy and beef producers; livestock commodity groups; forage producers, equine owners, producers and interest groups; state and federal agencies; federal research laboratories; peer scientists in the U.S. and international colleagues, K12 teachers, and environmental and community groups.. For our resource economic programs the audience includes farmers, landowners, state agencies (Delaware Development Office; Land Use Planning and Preservation; Department of Agriculture; Department of Health and Human Services; Department of Natural Resources & Environmental Control; Department of Transportation; Economic Development Office), federal agencies (USDA, NRCS, USEPA), land use organizations (Conservation Districts, AFT), environmental organizations, business and community leaders, families, students, and the general public.

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

- Number of Competitive Grants Submitted
- Number of Competitive Grants Awarded
- Number of Research Projects Completed
- Number of Undergraduate Researchers
- Number of M.S. Graduate Students
- Number of Ph.D. Graduate Students
- Number of Post-Doctoral Research Associates
- Number of Refereed Journal Articles
- Number of Books and Book Chapters
- Number of Technical Reports
- Number of Extension Bulletins and Factsheets
- Number of Invited Presentations
- Number of Volunteered Presentations
- Number of Workshops Conducted

☑ 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	Increased number of poultry producers participating in surveillance, diagnostic testing, and vaccination programs for infectious avian diseases. Implementation of statewide plans to address major outbreaks of avian diseases and an increase in the number of diagnostic laboratories using advances in avian genomics to rapidly diagnose infectious diseases.
2	Sustainable production practices for the dairy and beef industries that link forage and pasture production practices with animal health, performance, and meat and milk quality.
3	Increased number of poultry and dairy farmers using feed management practices that increase nutrient utilization and feeding diets with lower concentrations of nitrogen and phosphorus.
4	Increased use of air quality best management practices that prevent odor, ammonia, and particulate emissions from poultry farms.
5	Cost-effective solar power technology to heat and cool poultry houses will allow farmers to reduce their reliance on natural gas, oil, and purchased electricity, increasing the energy efficiency of poultry production.
6	Increased number of farmers adopting new crop varieties and high value, niche market crops, (culinary herbs, spices and essential oils). Integrating innovations in cultural practices, biological and chemical pest management, harvesting equipment, and irrigation management into these systems, including feasibility studies of greenhouses to produce high value plants, such as those intended for pharmaceutical or nutriceutical uses.
7	Increase in the number of farmers and others (e.g., the "Green Industry" - greenhouses, nurseries, landscapers) implementing comprehensive nutrient management and conservation plans that are profitable and protective of ground and surface water quality, build soil quality, prevent soil erosion, and protect natural resource areas.
8	Increased use of soil management programs and best management practices for agricultural, natural, suburban/urban, and disturbed or contaminated settings that incorporate latest advances in research and greater adoption of watershed scale modeling to predict changes in the functions and environmental impacts of soils in mixed-used watersheds (agriculture, suburban, urban, forests) as land use changes from agricultural to suburban and urban uses.
9	Improved economic competitiveness of Delaware agriculture relative to other regions in the U.S. and global competitors with an emphasis on greater adoption of new innovations in marketing and risk management for farmers who must increasingly compete globally.
10	Increased interactions and long-range strategic planning efforts between research and extension staff and the diverse stakeholders (state and federal agencies, community groups, not-for-profit organizations, developers, farmers, etc.) involved in farmland preservation and land use conversion from agriculture to suburban and urban uses.
11	Disease Prevention and Control: basic and applied research on mechanisms of poultry disease will translate into useable tools and strategies for improved disease surveillance, diagnosis, prevention, and control in broiler chicken production. Knowledge will be extended to commercial poultry and allied industries.
12	Animal Genomics: increased understanding of gene function and expression and targeting of candidate genes affecting economically important traits in broiler chicken growth and production, disease resistance and immunity. Improvements in classical poultry breeding programs by use of marker assisted selection (MAS) and technology transfer.
13	Animal Nutrition: research will lead to improved understanding of nutritional requirements for poultry and ruminants and adoption of recommended dietary strategies by practicing nutritionists and producers. Specifically, results of poultry directed research aim to minimize nutrient contamination of the environment from manure. Results from ruminant based research will lead to improved management of forages to maximize nutritional value, safe use, and minimize spoilage during storage. Nutritional effects on dairy cattle health and immune function including factors impacting white blood cell gene expression will be studied. Research will also lead to improved understanding of the molecular and cellular mechanisms associated with bovine lameness and early detection of the disease

14	Environmental Compatibility of Animal Agriculture: In addition to addressing nutrient related problems, research and extension programs will develop long-term strategies and management practices for other environmental issues related to animal agriculture such as the fate and transport of trace elements; concerns about air quality with ammonia, hydrogen sulfide, volatile organic compounds, and fine particulates originating from poultry houses; environmental and human health impacts of endocrine disruptors (estrogen, testosterone) found in manures; fate and transport of viruses and other pathogens during disease outbreaks and subsequent disposal of poultry mortality, and potential environmental and human health effects of antibiotics.
15	Plant Biology and Crop Production: basic research will lead to improved understanding of plant molecular biology and allow genetic manipulation of physiological processes important to increasing crop yields and quality and crop resistance to biotic and abiotic stresses. Applied research and extension programs on cultural practices, crop varieties, fertilizer and manure use, precision agriculture, and integrated pest management will increase crop yields, minimize costs, and protect environmental quality. Extension programs will guide management practices for horticultural plants for the "Green Industry" and for homeowners, important because of the rapid conversion of farmland to urban and suburban uses.
16	New Markets: advances in plant molecular biology and genomics will provide new markets for farmers and commercial-scale horticulture, such as plants for bioenergy, pharmaceutical and nutriceutical uses. New and creative marketing programs will stimulate diversification and growth in the production of value-added and niche market crops, such as culinary herbs, spices, essential oil plants, and specialty vegetables for urban and suburban markets.
17	Land Use Change: research will identify strategies needed to manage land use change in a state where preserving farmland is a major goal, but economic and social forces are resulting in steady conversion of agricultural lands to suburban and urban uses. The economic, social, and cultural impacts of land fragmentation, suburban sprawl, and the "critical mass" of land and businesses needed to sustain agriculture in the long-term will be determined. Research knowledge and extension programs will guide long-term land use planning in cooperation with state and local agencies and governments, community groups, and other stakeholders
18	International Economics and Trade: research will provide strategies to foster international trade and economic growth in developed and developing countries, with an emphasis on policy issues related to agricultural and energy markets and climate change, particularly those related to poultry production and bioenergy crops. Extension programs will educate agricultural producers on international marketing strategies for traditional agricultural products (e.g., poultry, grain crops) as well as new cropping systems, such as organic agriculture and genetically modified crops.
19	Educational programs for K-12 teachers and youth on: (i) advances in animal and plant molecular biology and applications of the basic animal and plant sciences to the production of animals and of plants used for food, fiber, landscaping, timber, bioenergy, and pharmaceutical and nutriceutical purposes; (ii) value of soils as a critical natural resource vital to civilization, including the many functions of soils in agricultural and natural ecosystems, the importance of soil management to environmental quality, and the role of soils in sustaining aesthetically pleasing managed landscapes in suburban and urban settings; and (iii) the relationship between land use and major societal issues, such as economic development, community and family adaptation to changing social and political conditions, and the value of sustaining ecosystems and protecting environmental quality.
20	Soils and Environment: basic research will increase understanding of physical, chemical, and biological factors influencing the fate and transport of nutrients, metals, organics, and pathogens in soils. Applied research will lead to development of nutrient management strategies and recommendations that minimize nonpoint nutrient pollution from all land uses. Remediation practices for soils contaminated by metals, organics, and nutrients will use innovative, research-based measures to prioritize risk to the environment and human health based on the speciation, mobility, and bioavailability of contaminants in soils. Mitigation approaches for polluted soils will combine soil chemistry, physics, and soil/plant molecular biology to enhance removal or in-situ degradation or stabilization of pollutants in soils.

Outcome # 1

1. Outcome Target

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

2. Outcome Type : Change in Action Outcome Measure

3. Associated Knowledge Area(s)

- 307 - Animal Management Systems
- 311 - Animal Diseases

4. Associated Institute Type(s)

- 1862 Extension
- 1890 Extension

Outcome # 2

1. Outcome Target

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

2. Outcome Type : Change in Action Outcome Measure

3. Associated Knowledge Area(s)

- 307 - Animal Management Systems
- 601 - Economics of Agricultural Production and Farm Management

4. Associated Institute Type(s)

- 1862 Extension
- 1890 Extension

Outcome # 3

1. Outcome Target

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

2. Outcome Type : Change in Knowledge Outcome Measure

3. Associated Knowledge Area(s)

- 102 - Soil, Plant, Water, Nutrient Relationships
- 112 - Watershed Protection and Management
- 307 - Animal Management Systems
- 605 - Natural Resource and Environmental Economics
- 903 - Communication, Education, and Information Delivery

4. Associated Institute Type(s)

- 1862 Extension
- 1890 Extension

Outcome # 4

1. Outcome Target

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

2. Outcome Type : Change in Action Outcome Measure

3. Associated Knowledge Area(s)

- 112 - Watershed Protection and Management
- 307 - Animal Management Systems
- 605 - Natural Resource and Environmental Economics
- 903 - Communication, Education, and Information Delivery

4. Associated Institute Type(s)

- 1862 Extension
- 1890 Extension

Outcome # 5

1. Outcome Target

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

2. Outcome Type : Change in Action Outcome Measure

3. Associated Knowledge Area(s)

- 307 - Animal Management Systems
- 601 - Economics of Agricultural Production and Farm Management
- 903 - Communication, Education, and Information Delivery

4. Associated Institute Type(s)

- 1862 Extension
- 1890 Extension

Outcome # 6

1. Outcome Target

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

2. Outcome Type : Change in Action Outcome Measure

3. Associated Knowledge Area(s)

- 205 - Plant Management Systems
- 601 - Economics of Agricultural Production and Farm Management
- 903 - Communication, Education, and Information Delivery

4. Associated Institute Type(s)

- 1862 Extension
- 1890 Extension

Outcome # 7

1. Outcome Target

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

2. 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
- 601 - Economics of Agricultural Production and Farm Management
- 903 - Communication, Education, and Information Delivery

4. Associated Institute Type(s)

- 1862 Extension
- 1890 Extension

Outcome # 8

1. Outcome Target

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

2. 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
- 605 - Natural Resource and Environmental Economics
- 903 - Communication, Education, and Information Delivery

4. Associated Institute Type(s)

- 1862 Extension
- 1890 Extension

Outcome # 9

1. Outcome Target

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

2. Outcome Type : Change in Action Outcome Measure

3. Associated Knowledge Area(s)

- 601 - Economics of Agricultural Production and Farm Management
- 605 - Natural Resource and Environmental Economics
- 903 - Communication, Education, and Information Delivery

4. Associated Institute Type(s)

- 1862 Extension
- 1890 Extension

Outcome # 10

1. Outcome Target

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

2. Outcome Type : Change in Action Outcome Measure

3. Associated Knowledge Area(s)

- 112 - Watershed Protection and Management
- 601 - Economics of Agricultural Production and Farm Management
- 605 - Natural Resource and Environmental Economics
- 903 - Communication, Education, and Information Delivery

4. Associated Institute Type(s)

- 1862 Extension
- 1890 Extension

Outcome # 11

1. Outcome Target

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

2. Outcome Type : Change in Condition Outcome Measure

3. Associated Knowledge Area(s)

- 305 - Animal Physiological Processes
- 307 - Animal Management Systems
- 311 - Animal Diseases
- 903 - Communication, Education, and Information Delivery

4. Associated Institute Type(s)

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

Outcome # 12

1. Outcome Target

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

2. Outcome Type : Change in Condition Outcome Measure

3. Associated Knowledge Area(s)

- 304 - Animal Genome
- 305 - Animal Physiological Processes
- 307 - Animal Management Systems
- 311 - Animal Diseases

4. Associated Institute Type(s)

- 1862 Research
- 1890 Research

Outcome # 13

1. Outcome Target

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

disease

2. Outcome Type : Change in Condition Outcome Measure

3. Associated Knowledge Area(s)

- 112 - Watershed Protection and Management
- 305 - Animal Physiological Processes
- 307 - Animal Management Systems
- 605 - Natural Resource and Environmental Economics
- 903 - Communication, Education, and Information Delivery

4. Associated Institute Type(s)

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

Outcome # 14

1. Outcome Target

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

2. Outcome Type : Change in Condition Outcome Measure

3. Associated Knowledge Area(s)

- 102 - Soil, Plant, Water, Nutrient Relationships
- 112 - Watershed Protection and Management
- 205 - Plant Management Systems
- 305 - Animal Physiological Processes
- 307 - Animal Management Systems
- 601 - Economics of Agricultural Production and Farm Management
- 605 - Natural Resource and Environmental Economics
- 903 - Communication, Education, and Information Delivery

4. Associated Institute Type(s)

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

Outcome # 15

1. Outcome Target

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

2. Outcome Type : Change in Condition Outcome Measure

3. Associated Knowledge Area(s)

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

4. Associated Institute Type(s)

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

Outcome # 16

1. Outcome Target

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

vegetables for urban and suburban markets.

2. Outcome Type : Change in Condition Outcome Measure

3. Associated Knowledge Area(s)

- 201 - Plant Genome, Genetics, and Genetic Mechanisms
- 203 - Plant Biological Efficiency and Abiotic Stresses Affecting Plants
- 205 - Plant Management Systems
- 601 - Economics of Agricultural Production and Farm Management
- 605 - Natural Resource and Environmental Economics

4. Associated Institute Type(s)

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

Outcome # 17

1. Outcome Target

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

2. Outcome Type : Change in Condition Outcome Measure

3. Associated Knowledge Area(s)

- 112 - Watershed Protection and Management
- 605 - Natural Resource and Environmental Economics
- 903 - Communication, Education, and Information Delivery

4. Associated Institute Type(s)

- 1862 Extension
- 1862 Research
- 1890 Extension

- 1890 Research

Outcome # 18

1. Outcome Target

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

2. Outcome Type : Change in Condition Outcome Measure

3. Associated Knowledge Area(s)

- 601 - Economics of Agricultural Production and Farm Management
- 605 - Natural Resource and Environmental Economics
- 903 - Communication, Education, and Information Delivery

4. Associated Institute Type(s)

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

Outcome # 19

1. Outcome Target

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

2. Outcome Type : Change in Condition Outcome Measure

3. Associated Knowledge Area(s)

- 102 - Soil, Plant, Water, Nutrient Relationships
- 112 - Watershed Protection and Management
- 201 - Plant Genome, Genetics, and Genetic Mechanisms
- 203 - Plant Biological Efficiency and Abiotic Stresses Affecting Plants

- 205 - Plant Management Systems
- 304 - Animal Genome
- 305 - Animal Physiological Processes
- 307 - Animal Management Systems
- 311 - Animal Diseases
- 601 - Economics of Agricultural Production and Farm Management
- 605 - Natural Resource and Environmental Economics
- 903 - Communication, Education, and Information Delivery

4. Associated Institute Type(s)

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

Outcome # 20

1. Outcome Target

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

2. Outcome Type : Change in Condition Outcome Measure

3. Associated Knowledge Area(s)

- 102 - Soil, Plant, Water, Nutrient Relationships
- 112 - Watershed Protection and Management
- 203 - Plant Biological Efficiency and Abiotic Stresses Affecting Plants
- 205 - Plant Management Systems
- 605 - Natural Resource and Environmental Economics
- 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 similar evaluation studies for all planned programs developed for the Plan of Work. During this 5-year period we will conduct 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 2013 Plan of Work.

V(A). Planned Program (Summary)

Program # 2

1. Name of the Planned Program

Biotechnology and Biotechnology-based Agribusiness

2. Brief summary about Planned Program

Delaware has considerable expertise in basic biotechnology dating back about twenty years. Areas of existing strength are avian virology, physiology, and genomics and in basic plant biology and plant breeding. With regard to avian programs, biotechnology is being applied at the basic level to improve poultry health and immune competence and to understand basic disease mechanisms including those affected by microRNAs. At the applied level, efforts are directed toward improving diagnostic testing methods, developing vaccines and other disease control methods, surveying for emerging avian disease causing agents, and developing disease resistant breeds of chickens. In the plant biology arena, basic biotechnology efforts include understanding basic methods of 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 interfacial relations at the molecular and atomic levels in plants used for agriculture and environmental remediation. We anticipate that plant diagnostic methodology will increasingly be biotechnology based. We are interested in applying the biotechnology expertise existing at the University of Delaware to develop alternate energy sources that make economic sense for the Delmarva Peninsula. The use of genetically engineered plants to produce pharmaceuticals, vaccines, and other important products of biotechnology is being investigated in collaboration with a variety of industries. The evaluation of the marketability and consumer acceptance of biotechnology based products is a high priority.

3. Program existence : Intermediate (One to 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
201	Plant Genome, Genetics, and Genetic Mechanisms	25%	25%	25%	25%
304	Animal Genome	25%	25%	25%	25%
601	Economics of Agricultural Production and Farm Management	10%	10%	10%	10%
602	Business Management, Finance, and Taxation	10%	10%	10%	10%
603	Market Economics	10%	10%	10%	10%
604	Marketing and Distribution Practices	10%	10%	10%	10%
903	Communication, Education, and Information Delivery	10%	10%	10%	10%
	Total	100%	100%	100%	100%

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

1. Situation and priorities

The University of Delaware has existing strengths in avian biotechnology and basic plant biotechnology. We have seven faculty members in the avian group and seven faculty members in the plant group who are principally engaged in biotechnology- based research. Our infrastructure for carrying out biotechnology-based research is good and includes the Charles C. Allen Biotechnology Laboratory, the Delaware Biotechnology Institute, and a new Plant Growth Chamber Facility. Our major priorities are to conduct basic research, much of which is defined by the funding successes of individual faculty members and to apply biotechnology-based discoveries to field and industry situations wherever possible.

2. Scope of the Program

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

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

1. Assumptions made for the Program

For this program, we are assuming that individual faculty members will be successful at obtaining competitive grants from federal and state funding agencies and from foundations and that liaisons with industry will be not only maintained but strengthened as much as possible in the future. Federal formula funding provides some infrastructure assistance but is inadequate to provide the required resources for these sophisticated programs. Our challenge is to make good decisions about where to focus basic research and what will ultimately pay off in terms of the creation of industries capable of producing

biotechnology-based products of value to agriculture, environmental preservation, and human health.

2. Ultimate goal(s) of this Program

The ultimate goals of this program are to advance basic knowledge in the areas of avian and plant molecular biology. We also seek to apply those discoveries to the improvement of plant and animal agriculture through the development of agribusinesses that produce and market the plants and animal products generated from basic and applied biotechnology research. We focus on Delmarva agriculture but recognize that most of what we do is applicable to the global agricultural economy and to worldwide environmental and human health issues.

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
2014	0.5	0.0	21.3	0.1
2015	0.5	0.5	22.0	0.1
2016	0.5	0.5	22.0	0.5
2017	0.5	0.5	23.0	0.5
2018	1.0	1.0	24.0	0.5

V(F). Planned Program (Activity)

1. Activity for the Program

Research and Extension programs will target avian and plant biotechnology. In the avian arena, these projects will be aimed at understanding basic mechanisms, including those affected by microRNAs, disease etiology and control and emergence of new disease causing agents. Research will continue and expand on annotating the chicken genome, as well as the genome of many poultry pathogens, to help provide the tools needed to advance our understanding of poultry growth, health and disease. We plan to apply these tools to diagnosis and treatment of disease and screening for desirable production traits. We also seek to develop genome based diagnostic methods, and study the molecular basis of disease resistance and susceptibility. Some specific avian biotechnology research areas planned include: identification of genomic factors influencing pathogenesis of avian herpes viruses and mycoplasmas; evolution of virulence of Marek's Disease virus; interaction of MDV proteins with host cells; regulation of the immune response to avian pathogens; and gene expression profiles in growth-selected chickens. With respect to production-oriented research, a new integrated, multi-disciplinary approach, including collaboration with an international team of scientists, is now underway to help identify genes that explain the differences on fatness between two lines of chickens, the French Fat and Lean chicken lines. This research extends to the implementation of genomics technologies in commercial chicken breeding programs to be done in close collaboration with poultry industry researchers. With regard to plant biotechnology, projects will focus on understanding basic mechanisms of gene control in plants, disease resistance, nitrogen fixation, and plant/environment interactions. Areas of particular interest for basic plant biotechnology research include: RNA turnover or small RNA-mediated gene regulation; understanding disease resistance and signal transduction pathways in plants; understanding and enhancing symbiotic

nitrogen fixation via the application of molecular and proteomics approaches; developing biotechnology-based diagnostic methods for major plant diseases; and understanding processes controlling plant/soil interfacial relations at the molecular and atomic levels to enhance crop utilization of nutrients and the effectiveness of plants at remediation of soils contaminated with metals and organics. For both avian and plant biotechnology, findings will be applied as much as possible to existing issues in agriculture with the goal of integrating biotechnology research into new agribusinesses such as those producing plants better adapted to environmental and biological stress, plants used for the production of pharmaceuticals and nutriceuticals, and plant with bioenergy uses.

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

Extension

Direct Methods	Indirect Methods
● Education Class ● Workshop ● Group Discussion	● Newsletters ● TV Media Programs ● Web sites other than eXtension ● Other 1 (Newspapers)

3. Description of targeted audience

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

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

- Number of Competitive Grants Submitted
- Number of Competitive Grants Awarded
- Number of Research Projects Completed
- Number of Undergraduate Researchers
- Number of M.S. Graduate Students
- Number of Ph.D. Graduate Students
- Number of Post-doctoral Research Associates
- Number of Refereed Journal Articles
- Number of Books and Book Chapters
- Number of Technical Reports
- Number of Extension Bulletins and Factsheets
- Number of Invited Presentations
- Number of Volunteered Presentations
- Number of Workshops Conducted

☑ 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	Increased awareness by all components of the poultry industry of the opportunities to use biotechnology to prevent, diagnose, and control avian infectious diseases.
2	Increased number of farmers and members of the horticultural industry aware of the opportunities to use advances in plant biotechnology to develop new businesses.
3	Educational programs for K-12 youth and teachers on basic principles and applications of biotechnology to the plant, animal, and environmental sciences.
4	Commercial evaluation in agronomic and horticultural settings of genetically modified plants developed using biotechnology research.
5	Integration of plant and animal biotechnology educational materials developed cooperatively by research and extension staff into K-12 curricula in Delaware schools.
6	Stronger, more formal links between scientists conducting biotechnology research, extension specialists familiar with biotechnology applications, and state and regional economic development agencies and private industry.
7	Avian Biotechnology: basic research will provide an improved understanding of the fundamental causes and modes of action of avian diseases and the factors that influence their potential to spread to other animal species and humans; applied research will provide innovations in surveillance and diagnostic tools that help prevent or contain disease outbreaks and vaccines that prevent or control infectious diseases.
8	Plant Biotechnology: basic research will lead to an improved understanding of the processes by which plants grow, resist or adapt to diseases and other stresses; can be used to produce bio-based products useful for human health and nutrition, and regulate the uptake of plant nutrients in agricultural soils and contaminants (e.g., heavy metals) in polluted soils; applied research will lead to plants that can produce increased yields with lower inputs, resist pest and climatic stresses, and remediate or stabilize polluted soils.
9	Biotechnology-Based Agribusinesses: research and extension programs will link results of biotechnology research to industries interested and capable of marketing advances in animal and plant biotechnology; biotechnology, financial planning, marketing, and risk management will be combined to establish agribusinesses specializing in the diagnosis and control of avian infectious diseases, production of crop varieties that have lower fertilizer requirements and that are more tolerant of climatic stress; utilization of hyper-accumulating plants that can remediate contaminated soils, and the production of high-value plant products useful for human health and nutrition.

Outcome # 1

1. Outcome Target

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

2. Outcome Type : Change in Knowledge Outcome Measure

3. Associated Knowledge Area(s)

- 304 - Animal Genome
- 603 - Market Economics
- 903 - Communication, Education, and Information Delivery

4. Associated Institute Type(s)

- 1862 Extension
- 1862 Research
- 1890 Extension

Outcome # 2

1. Outcome Target

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

2. Outcome Type : Change in Knowledge Outcome Measure

3. Associated Knowledge Area(s)

- 201 - Plant Genome, Genetics, and Genetic Mechanisms
- 304 - Animal Genome
- 602 - Business Management, Finance, and Taxation
- 603 - Market Economics
- 903 - Communication, Education, and Information Delivery

4. Associated Institute Type(s)

- 1862 Extension
- 1862 Research
- 1890 Extension

Outcome # 3

1. Outcome Target

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

2. Outcome Type : Change in Knowledge Outcome Measure

3. Associated Knowledge Area(s)

- 201 - Plant Genome, Genetics, and Genetic Mechanisms
- 304 - Animal Genome
- 903 - Communication, Education, and Information Delivery

4. Associated Institute Type(s)

- 1862 Extension
- 1890 Extension

Outcome # 4

1. Outcome Target

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

2. Outcome Type : Change in Action Outcome Measure

3. Associated Knowledge Area(s)

- 201 - Plant Genome, Genetics, and Genetic Mechanisms
- 601 - Economics of Agricultural Production and Farm Management
- 603 - Market Economics

4. Associated Institute Type(s)

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

Outcome # 5

1. Outcome Target

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

2. Outcome Type : Change in Action Outcome Measure

3. Associated Knowledge Area(s)

- 201 - Plant Genome, Genetics, and Genetic Mechanisms

- 304 - Animal Genome
- 903 - Communication, Education, and Information Delivery

4. Associated Institute Type(s)

- 1862 Extension
- 1890 Extension

Outcome # 6

1. Outcome Target

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

2. Outcome Type : Change in Action Outcome Measure

3. Associated Knowledge Area(s)

- 201 - Plant Genome, Genetics, and Genetic Mechanisms
- 304 - Animal Genome
- 601 - Economics of Agricultural Production and Farm Management
- 603 - Market Economics
- 604 - Marketing and Distribution Practices
- 903 - Communication, Education, and Information Delivery

4. Associated Institute Type(s)

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

Outcome # 7

1. Outcome Target

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

2. Outcome Type : Change in Condition Outcome Measure

3. Associated Knowledge Area(s)

- 304 - Animal Genome

4. Associated Institute Type(s)

- 1862 Research

Outcome # 8

1. Outcome Target

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

2. Outcome Type : Change in Condition Outcome Measure

3. Associated Knowledge Area(s)

- 201 - Plant Genome, Genetics, and Genetic Mechanisms

4. Associated Institute Type(s)

- 1862 Research
- 1890 Research

Outcome # 9

1. Outcome Target

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

2. Outcome Type : Change in Condition Outcome Measure

3. Associated Knowledge Area(s)

- 201 - Plant Genome, Genetics, and Genetic Mechanisms
- 304 - Animal Genome

- 602 - Business Management, Finance, and Taxation
- 603 - Market Economics
- 903 - Communication, Education, and Information Delivery

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

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

Description

{NO DATA ENTERED}

V(K). Planned Program - Planned Evaluation Studies

Description of Planned Evaluation Studies

We will use similar evaluation studies for all planned programs developed for the Plan of Work. During this 5-year period we will conduct 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 2013 Plan of Work.

V(A). Planned Program (Summary)

Program # 3

1. Name of the Planned Program

Natural Systems, Biodiversity, and Wildlife Ecology

2. Brief summary about Planned Program

Maintaining and restoring renewable natural resources and the vital services provided by healthy ecosystems in Delaware after 400 years of urban and agricultural land use is our focus in this planned program. The impact of past and current land use changes, such as agricultural/forestry practices and encroachment of urban/suburban populations on native landscapes, is not fully understood but is thought to be contributing to the loss of many plant and animal species. Perturbation of ecosystems, such as by fragmentation of wildlife habitats due to development and nutrient enrichment of aquatic resources caused by greater runoff as impervious surface increases, are key areas where the interface between terrestrial and aquatic ecosystems is in need of more research and extension programming. New technologies in agricultural production that include control of insects, weeds, filamentous algae, and plant pathogens are needed to ensure sustainability of agriculture in Delaware while restoring and maintaining biodiversity and natural ecosystems located on farms. Finding ways to replace and sustain biodiversity in suburban landscapes, which today comprise 54% of Delaware, is another priority and is vital to future efforts to sustain natural resources in the face of increasingly rapid land use change from agriculture to more developed land uses.

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

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

1. Situation and priorities

Delaware's natural ecosystems are becoming increasingly fragmented as urbanization converts farmland into homes, businesses, roadways, and other suburban 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). Our priorities are research and extension programs that guide statewide efforts to: develop agricultural/forestry practices that ensure ecosystem integrity and enhance biodiversity; maximize the extent of biodiversity in the newly fragmented landscapes coming to dominate Delaware; work cooperatively with state and regional environmental and wildlife agencies to expand our current collaborations and use this to identify key fisheries, wildlife and environmental monitoring needs; encourage proven bioenergy technology using native plant material (biomass); prevent or reverse encroachment of invasive plants; and provide quality habitats that sustain wildlife.

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

The State of 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 farm size 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.

2. Ultimate goal(s) of this Program

The ultimate goals of Planned Program 3 are to redesign agricultural and forestry practices and suburban/urban landscaping paradigms in ways that sustain the competitiveness of Delaware's agricultural and forestry enterprises while enhancing biodiversity and the production of ecosystem services. We plan to promote the conservation and wise utilization of Delaware's aquatic and natural resources; gain a better understanding of issues related to habitat quality and natural resource protection; and educate stakeholders on the need for increased protection and conservation of aquatic and terrestrial habitats that will impact the future of Delaware's natural resources.

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
2014	1.6	1.6	3.4	1.8
2015	1.5	2.0	3.5	2.0
2016	1.5	2.0	3.5	2.5
2017	2.0	3.0	4.0	3.0
2018	2.0	3.0	4.0	3.0

V(F). Planned Program (Activity)

1. Activity for the Program

Research and extension programs will target: (1) Integrated Pest Management - developing and delivering integrated pest management (IPM) programs, a "systems" approach using chemical, cultural, mechanical, and biological control to increase profits to producers and protect the environment; (2) Sustainable Agriculture/Forestry - developing and promoting efficient and sustainable agricultural, forestry,

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

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 ● Web sites other than eXtension

3. Description of targeted audience

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

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

- Number of Competitive Grants Submitted
- Number of Competitive Grants Awarded
- Number of Research Projects Completed
- Number of Undergraduate Researchers
- Number of M.S. Graduate Students
- Number of Ph.D. Graduate Students
- Number of Post-doctoral Research Associates
- Number of Refereed Journal Articles
- Number of Books and Book Chapters
- Number of Technical Reports
- Number of Extension Bulletins and Factsheets
- Number of Invited Presentations
- Number of Volunteered Presentations
- Number of Workshops Conducted

☑ 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	Increased number of farmers and other producers aware of the principles of integrated pest management and familiar with the practices and technologies needed for a systems-based approach to prevent and control problems with insects, weeds, and plant pathogens.
2	Educational programs for K-12 youth and teachers on ecosystems and natural resources that emphasize the importance of sustaining biodiversity for natural and managed land uses.
3	Through the Center for Managed Ecosystems, conduct research and outreach programs on restoring and enhancing biodiversity and wildlife habitat in suburbanized landscapes.
4	Increased number of farmers and other land managers adopting integrated approaches to pest management for insects, weeds, alien invasive plants, and plant pathogens in agricultural and natural ecosystems.
5	Increased participation by all stakeholders in educational programs on responsible environmental management of natural resources, nutrients, and pesticides.
6	Increases in the amount of agricultural and suburban land where wildlife habitat has been restored or enhanced.
7	Integrated Pest Management: basic and applied research will increase the effectiveness of a systems-based approach to prevent or control pests (insects, weeds, plant pathogens) that threaten agricultural productivity and damage natural, urban, and suburban landscapes. Extension programs will promote adoption of IPM by farmers and other land managers.
8	Ecosystem restoration: fundamental research on ecosystem processes will provide evidence of the full range of ecological, water quality, and economic benefits associated with sustaining and enhancing natural ecosystems such as wetlands, forests, riparian corridors, and tidal marshes, and lead to greater restoration and expansion of areas important for wildlife habitat and biodiversity.
9	Wildlife habitat and management: research will assess the impacts of human activity on wildlife habitats and develop management practices that can protect threatened or endangered species and lead to policies that protect and enhance wildlife populations.
10	Protection of native species: research and extension programs will quantify the ecological and economic benefits of protecting indigenous plant species and restricting the spread of invasive plants and animals.

Outcome # 1

1. Outcome Target

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

2. Outcome Type : Change in Knowledge Outcome Measure

3. Associated Knowledge Area(s)

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

4. Associated Institute Type(s)

- 1862 Extension
- 1890 Extension

Outcome # 2

1. Outcome Target

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

2. Outcome Type : Change in Knowledge Outcome Measure

3. Associated Knowledge Area(s)

- 112 - Watershed Protection and Management
- 136 - Conservation of Biological Diversity
- 903 - Communication, Education, and Information Delivery

4. Associated Institute Type(s)

- 1862 Extension
- 1890 Extension

Outcome # 3

1. Outcome Target

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

2. Outcome Type : Change in Action Outcome Measure

3. Associated Knowledge Area(s)

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

4. Associated Institute Type(s)

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

Outcome # 4

1. Outcome Target

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

2. Outcome Type : Change in Action Outcome Measure

3. Associated Knowledge Area(s)

- 112 - Watershed Protection and Management
- 123 - Management and Sustainability of Forest Resources
- 216 - Integrated Pest Management Systems
- 903 - Communication, Education, and Information Delivery

4. Associated Institute Type(s)

- 1862 Extension
- 1890 Extension

Outcome # 5

1. Outcome Target

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

2. Outcome Type : Change in Action Outcome Measure

3. Associated Knowledge Area(s)

- 112 - Watershed Protection and Management
- 135 - Aquatic and Terrestrial Wildlife
- 136 - Conservation of Biological Diversity
- 903 - Communication, Education, and Information Delivery

4. Associated Institute Type(s)

- 1862 Extension
- 1890 Extension

Outcome # 6

1. Outcome Target

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

2. Outcome Type : Change in Action Outcome Measure

3. Associated Knowledge Area(s)

- 112 - Watershed Protection and Management
- 123 - Management and Sustainability of Forest Resources
- 135 - Aquatic and Terrestrial Wildlife
- 903 - Communication, Education, and Information Delivery

4. Associated Institute Type(s)

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

Outcome # 7

1. Outcome Target

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

2. Outcome Type : Change in Condition Outcome Measure

3. Associated Knowledge Area(s)

- 216 - Integrated Pest Management Systems
- 903 - Communication, Education, and Information Delivery

4. Associated Institute Type(s)

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

Outcome # 8

1. Outcome Target

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

2. Outcome Type : Change in Condition Outcome Measure

3. Associated Knowledge Area(s)

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

4. Associated Institute Type(s)

- 1862 Research
- 1890 Research

Outcome # 9

1. Outcome Target

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

2. Outcome Type : Change in Condition Outcome Measure

3. Associated Knowledge Area(s)

- 112 - Watershed Protection and Management
- 135 - Aquatic and Terrestrial Wildlife
- 903 - Communication, Education, and Information Delivery

4. Associated Institute Type(s)

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

Outcome # 10

1. Outcome Target

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

2. Outcome Type : Change in Condition Outcome Measure

3. Associated Knowledge Area(s)

- 136 - Conservation of Biological Diversity
- 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

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

- Competing Programmatic Challenges

Description

{NO DATA ENTERED}

V(K). Planned Program - Planned Evaluation Studies

Description of Planned Evaluation Studies

We will use similar evaluation studies for all planned programs developed for the Plan of Work. During this 5-year period we will conduct 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 2013 Plan of Work.

V(A). Planned Program (Summary)

Program # 4

1. Name of the Planned Program

Family and Youth Development

2. Brief summary about Planned Program

Rapid economic and social changes challenge the capacity of families to function well, placing extremely high demands and workloads on those charged with raising children and caring for dependent elderly. 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 has been a signature trait of Cooperative Extension. While many challenges face society today, perhaps none is more critical than helping youth develop the leadership and life skills necessary to survive in the 21st century. When environments include sustained opportunities for young people to gain a sense of belonging, independence, mastery and generosity, youth can master skills to make positive life choices, effectively contribute to decision-making and act responsibly; and positively influence their communities and beyond. On-going and caring relationships are essential to positive development. The need for science, engineering and technology (SET) education is essential for today's young people. Financial security is one of the most pressing concerns for Delawareans. Studies show the importance of financial well being to overall well being of families. As of data from 2007, on average, the median household income has ***declined*** from the inflation-adjusted values in 2000. The income level has ***decreased*** to $52,499, representing a 5.3 percent ***decline***. Delaware ranks 28 of 46 states in terms of the ***decline*** in median income in the US. In addition, the poverty rate in Delaware has increased by 1.2 percent since the 2000 rates, moving from 9.2 percent to 10.4 percent. Our planned program focuses on Extension efforts to address these growing problems by aiding families, individual adults and youth, and communities to improve their quality of life and financial status while working to ensure opportunities for all youth to participate in long-term, sustainable relationships under the direction of caring adults in community-based settings.

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
801	Individual and Family Resource Management	25%	25%	0%	0%
802	Human Development and Family Well-Being	25%	25%	0%	0%
806	Youth Development	40%	40%	0%	0%
903	Communication, Education, and Information Delivery	10%	10%	0%	0%
	Total	100%	100%	0%	0%

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

1. Situation and priorities

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 pressures on our youth and puts them at greater risk. Parents struggle to sustain families financially and to provide guidance and economic support to their children and also to elderly relatives. 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.

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. 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.

2. Ultimate goal(s) of this Program

The ultimate goals of Planned Program 4 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
2014	6.6	3.3	0.0	0.3
2015	7.0	3.5	0.5	0.5
2016	7.0	4.0	0.5	0.5
2017	8.0	4.0	0.5	1.0
2018	8.0	5.0	1.0	1.0

V(F). Planned Program (Activity)

1. Activity for the Program

Research and extension programs will target: (1) Volunteer Leadership Development programs will be delivered on public policy education; volunteer leadership development (e.g., 4-H adult and teen volunteers and camp counselors, master gardeners, master food educators; T.R.Y. (Teens reaching youth), middle management volunteers (volunteers managing volunteers); extension advisory committees; and Family and Community Educators. Special attention will be paid to training volunteers in risk management and emergency preparedness issues. (2) Family Well-Being Across the Lifespan Educational Programming, including Just in Time Parenting (Great Beginnings and the Brown Bag program for parents of young children) and Families Matter! (for parents of school-age children), interactive web sites, newsletter series, workshops, worksite seminars and classes focusing on positive parenting and care giving, family stress management, child development, healthy relationships and marriage education, savvy decision-making, anger management and conflict resolution, healthy communication, intergenerational well-being, teamwork, leadership, and community involvement skills; 3) Safe Communities - programs will include drug and alcohol prevention education, bicycle safety education, pedestrian safety education, farm safety, and car seat safety; youth tobacco prevention will also be an area where significant resources are targeted; (4) Family Economic Well-Being and Consumer Decision Making educational programs will be developed and delivered focusing on strategies for effective consumer decision making, financial planning, financial management counselor training, basic budgeting, credit management, and retirement planning; (5) 4-H Youth Development programs will focus on life skills development, positive life choices, leadership development, citizenship and community involvement, and career exploration with emphasis on science, engineering and technology knowledge. Rural communities in southern Delaware will be targeted. The goal is to provide expanded youth opportunities for out-of-school time, develop human and community capital and develop and strengthen youth-adult partnerships. Also, using technology as a tool, significant mentoring to reduce inappropriate behaviors that lead to poor choices by youth will be implemented. Appropriate settings including clubs, camps, school enrichment and after school will use the latest technology to deliver the sustained opportunities.

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	● Public Service Announcement ● Billboards ● Newsletters ● TV Media Programs ● Web sites other than eXtension ● Other 1 (Newspapers)

3. Description of targeted audience

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

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

- Number of Competitive Grants Submitted
- Number of Competitive Grants Awarded
- Number of Research Projects Completed
- Number of Undergraduate Researchers
- Number of Refereed Journal Articles
- Number of Technical Reports
- Number of Extension Bulletins and Factsheets
- Number of Invited Presentations
- Number of Volunteered Presentations
- Number of Workshops Conducted

☑ 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	Leadership development programs for volunteers interested in improving the quality of life for youth, families and communities.
2	Greater knowledge by Delaware youth of the importance of academic performance, social skills, and job preparedness to their future careers.
3	Educational programming for adults and youth emphasizing the development of positive life skills related to parenting, family financial planning, and safe communities.
4	Number of youth adopting behaviors that reduce their risk of using alcohol, tobacco and related substances, and that result in improved academic, social, and job preparedness skills.
5	Number of parents/families participating in extension programming who demonstrate positive parenting skills.
6	Number of youth and adults adopting increased leadership, communication, conflict management and decision-making skills
7	Number of program participants adopting skills for balancing work and family and stress management that promote healthy, well-functioning individuals and families
8	Number of families who adopt best practices in financial management, retirement planning and consumer decision-making.
9	Number of adults adopting best practices in child development, business development, educational program development in child care settings.
10	Number of youth who have increased science, engineering, and technology skills.
11	Number of youth with greater involvement in citizenship and community service programs.
12	An enhanced capacity for families and youth to improve their quality of life because of increased skills in parenting and family relationships, academic preparedness, career development, family financial planning, leadership and volunteerism, and citizenship and community involvement

Outcome # 1

1. Outcome Target

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

2. Outcome Type : Change in Knowledge Outcome Measure

3. Associated Knowledge Area(s)

- 801 - Individual and Family Resource Management
- 806 - Youth Development
- 903 - Communication, Education, and Information Delivery

4. Associated Institute Type(s)

- 1862 Extension
- 1890 Extension

Outcome # 2

1. Outcome Target

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

2. Outcome Type : Change in Knowledge Outcome Measure

3. Associated Knowledge Area(s)

- 806 - Youth Development
- 903 - Communication, Education, and Information Delivery

4. Associated Institute Type(s)

- 1862 Extension
- 1890 Extension

Outcome # 3

1. Outcome Target

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

2. Outcome Type : Change in Knowledge Outcome Measure

3. Associated Knowledge Area(s)

- 801 - Individual and Family Resource Management
- 802 - Human Development and Family Well-Being
- 903 - Communication, Education, and Information Delivery

4. Associated Institute Type(s)

- 1862 Extension
- 1890 Extension

Outcome # 4

1. Outcome Target

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

2. Outcome Type : Change in Action Outcome Measure

3. Associated Knowledge Area(s)

- 806 - Youth Development
- 903 - Communication, Education, and Information Delivery

4. Associated Institute Type(s)

- 1862 Extension
- 1890 Extension

Outcome # 5

1. Outcome Target

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

2. Outcome Type : Change in Action Outcome Measure

3. Associated Knowledge Area(s)

- 801 - Individual and Family Resource Management
- 806 - Youth Development

4. Associated Institute Type(s)

- 1862 Extension
- 1890 Extension

Outcome # 6

1. Outcome Target

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

2. Outcome Type : Change in Action Outcome Measure

3. Associated Knowledge Area(s)

- 801 - Individual and Family Resource Management
- 806 - Youth Development
- 903 - Communication, Education, and Information Delivery

4. Associated Institute Type(s)

- 1862 Extension
- 1890 Extension

Outcome # 7

1. Outcome Target

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

2. Outcome Type : Change in Action Outcome Measure

3. Associated Knowledge Area(s)

- 801 - Individual and Family Resource Management
- 802 - Human Development and Family Well-Being
- 903 - Communication, Education, and Information Delivery

4. Associated Institute Type(s)

- 1862 Extension
- 1890 Extension

Outcome # 8

1. Outcome Target

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

2. Outcome Type : Change in Action Outcome Measure

3. Associated Knowledge Area(s)

- 801 - Individual and Family Resource Management
- 802 - Human Development and Family Well-Being
- 903 - Communication, Education, and Information Delivery

4. Associated Institute Type(s)

- 1862 Extension
- 1890 Extension

Outcome # 9

1. Outcome Target

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

2. Outcome Type : Change in Action Outcome Measure

3. Associated Knowledge Area(s)

- 801 - Individual and Family Resource Management
- 802 - Human Development and Family Well-Being

4. Associated Institute Type(s)

- 1862 Extension
- 1890 Extension

Outcome # 10

1. Outcome Target

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

2. Outcome Type : Change in Action Outcome Measure

3. Associated Knowledge Area(s)

- 806 - Youth Development
- 903 - Communication, Education, and Information Delivery

4. Associated Institute Type(s)

- 1862 Extension
- 1890 Extension

Outcome # 11

1. Outcome Target

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

2. Outcome Type : Change in Action Outcome Measure

3. Associated Knowledge Area(s)

- 801 - Individual and Family Resource Management
- 806 - Youth Development

4. Associated Institute Type(s)

- 1862 Extension
- 1890 Extension

Outcome # 12

1. Outcome Target

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

2. Outcome Type : Change in Condition Outcome Measure

3. Associated Knowledge Area(s)

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

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 similar evaluation studies for all planned programs developed for the Plan of Work. During this 5-year period we will conduct 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 2013 Plan of Work.

V(A). Planned Program (Summary)

Program # 5

1. Name of the Planned Program

Food Safety

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. However, foodborne illness still occurs 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 the public education about how to respond to outbreaks of foodborne diseases.

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	15%	15%	40%	40%
502	New and Improved Food Products	10%	10%	15%	15%
712	Protect Food from Contamination by Pathogenic Microorganisms, Parasites, and Naturally Occurring Toxins	60%	60%	40%	40%
903	Communication, Education, and Information Delivery	15%	15%	5%	5%
	Total	100%	100%	100%	100%

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

1. Situation and priorities

A major health concern worldwide, even in developed countries such as the U.S., is foodborne illness, which causes an estimated 13 million cases each year in the U.S. Of these individuals, 2 to 3 percent develop long-term health problems, such as reactive arthritis, paralysis, liver damage, or kidney failure. Approximately 4,500 to 6,000 individuals die annually. The Centers for Disease Control estimates

that 77 percent of all foodborne outbreaks can be traced to foodservice operations, 20 percent to home food preparation practices, and 3 percent to mistakes in the food processing industry. Research priorities include understanding the basic microbiology and chemistry of foodborne diseases in agricultural settings and at food processing facilities, developing new strategies to process food safely and securely, assessing bioactivities of nutraceuticals and functional foods using antimicrobial tests, cell cultures, and antioxidant assays, and the effects of processing methods on efficacy and safety of functional foods and minimally processed foods. Extension priorities are focused on educational programs that communicate the basic principles of safe food handling for families, institutions (e.g., childcare centers, schools), and the community at large.

2. Scope of the Program

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

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

1. Assumptions made for the Program

Many individuals are increasingly concerned about the safety of their food supply. Much of this concern can be traced to a lack of understanding of the issues related to foodborne illnesses. The media play to these concerns, providing limited or incomplete information on which to make informed choices. Examples of recent concerns include food allergens and bird flu. Interest groups often distort sound scientific facts to further their causes. Foodservice workers, producers, and food entrepreneurs lack the knowledge and skills to handle food safely to prevent foodborne illness. Although the incidence of foodborne illness has decreased for a wide variety of reasons, such as requiring HACCP and food safety education certification, continual food safety training is needed. Through training, food handlers develop skills and motivation to produce safe food. Because many youth are responsible for part or all food preparation in the home, it is critical that we teach children safe food handling techniques to reduce the incidence of foodborne illnesses. They get little or no training in school or by their parents, often don't have a parent available to observe preparing food in the home and if they do, the parent often lacks safe food handling skills. Research is continually finding new ways to reduce pathogens on food products while maintaining sensory quality. New techniques such as ultraviolet light and antimicrobial packaging can protect the food supply thereby decreasing foodborne illness. Interdisciplinary and inter-institutional research and extension programming will continue to be the guiding goal.

2. Ultimate goal(s) of this Program

In research, the ultimate goals of Planned Program 5 are increasing the understanding of foodborne pathogens and reduction of these pathogens during pre- and post-harvest processing by using intervention strategies such as high pressure, ultraviolet light, and antimicrobial packaging. Extension goals are to reduce the incidence of foodborne illness and increase the understanding of the scientific facts surrounding emerging issues in nutrition, food safety, and health so that informed choices can be made.

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
2014	0.9	2.4	4.9	0.5
2015	1.5	2.5	5.0	0.5
2016	1.5	3.0	5.0	0.5
2017	2.0	3.5	6.0	1.0
2018	2.0	4.0	6.0	1.0

V(F). Planned Program (Activity)

1. Activity for the Program

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

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

Extension

Direct Methods	Indirect Methods
● Workshop ● One-on-One Intervention ● Other 1 (Train the trainer) ● Other 2 (4-H programs)	● Newsletters ● Web sites other than eXtension ● Other 1 (News releases)

3. Description of targeted audience

Restaurant workers, volunteer food handlers, delicatessen workers, day care providers, institutional foodservice workers, school foodservice personnel, caterers/private chefs, food entrepreneurs, retail food

owners/managers, food producers, youth ages 5 to 18, parents and caregivers of children from birth to 18, limited-resource individuals and families, 4-H leaders and clubs, Boys and Girls clubs, teachers and other school personnel, youth in low-income schools, policy makers, and media.

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

- Number of Competitive Grants Submitted
- Number of Competitive Grants Awarded
- Number of Research Projects Completed
- Number of Undergraduate Researchers
- Number of M.S. Graduate Students
- Number of Post-doctoral Research Associates
- Number of Refereed Journal Articles
- Number of Books and Book Chapters
- Number of Technical Reports
- Number of Extension Bulletins and Factsheets
- Number of Invited Presentations
- Number of Volunteered Presentations
- Number of Workshops Conducted
- Number of Ph.D. Graduate Students

☑ 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	Increased number of farmers, processors, food handlers, and families who are aware of food safety and nutrition issues that can lead to illness and long-term health problems and of the practices and technologies needed to ensure a safe and healthy food supply.
2	Educational programs for K-12 youth and teachers on food safety that will help reduce the likelihood of food-borne illness.
3	Increased number of farmers and food processors adopting research-based advances in food science technology that will prevent the incidence and spread of foodborne illnesses.
4	Safe, new food products that are preserved using innovative technologies designed to maintain food quality and nutrient content.
5	Increased number of program participants improving in one or more safe handling practices.
6	Increased number of participating youth increasing understanding of safe food handling procedures.
7	Food science and technology: basic and applied research will lead to optimization of intervention strategies incorporating high hydrostatic pressure processing, ultraviolet light, ozone treatment, active packaging and low-temperature storage to eliminate or significantly reduce the source of foodborne disease in food products. Applied food science research and extension programs in these areas will increase awareness to food producers and consumers of the most effective strategies for food product safety.
8	Food safety: research and extension programs will lead to enhanced safety and wholesomeness of foods as a result of improved understanding of the mechanisms whereby food pathogens exist, enter, survive, propagate and actuate disease syndromes in individuals who consume contaminated products. Gene-based methods to rapidly and accurately identify food-borne pathogens will increase the safety of food products.

Outcome # 1

1. Outcome Target

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

2. 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
- 903 - Communication, Education, and Information Delivery

4. Associated Institute Type(s)

- 1862 Extension
- 1890 Extension

Outcome # 2

1. Outcome Target

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

2. Outcome Type : Change in Knowledge Outcome Measure

3. Associated Knowledge Area(s)

- 712 - Protect Food from Contamination by Pathogenic Microorganisms, Parasites, and Naturally Occurring Toxins
- 903 - Communication, Education, and Information Delivery

4. Associated Institute Type(s)

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

Outcome # 3

1. Outcome Target

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

2. Outcome Type : Change in Action 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
- 903 - Communication, Education, and Information Delivery

4. Associated Institute Type(s)

- 1862 Extension
- 1890 Extension

Outcome # 4

1. Outcome Target

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

2. Outcome Type : Change in Action Outcome Measure

3. Associated Knowledge Area(s)

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

4. Associated Institute Type(s)

- 1862 Research
- 1890 Research

Outcome # 5

1. Outcome Target

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

2. Outcome Type : Change in Action 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
- 903 - Communication, Education, and Information Delivery

4. Associated Institute Type(s)

- 1862 Extension
- 1890 Extension

Outcome # 6

1. Outcome Target

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

2. Outcome Type : Change in Action 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
- 903 - Communication, Education, and Information Delivery

4. Associated Institute Type(s)

- 1862 Extension
- 1890 Extension

Outcome # 7

1. Outcome Target

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

2. Outcome Type : Change in Condition Outcome Measure

3. Associated Knowledge Area(s)

- 501 - New and Improved Food Processing Technologies
- 502 - New and Improved Food Products

- 712 - Protect Food from Contamination by Pathogenic Microorganisms, Parasites, and Naturally Occurring Toxins

4. Associated Institute Type(s)

- 1862 Research
- 1890 Research

Outcome # 8

1. Outcome Target

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

2. Outcome Type : Change in Condition Outcome Measure

3. Associated Knowledge Area(s)

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

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

- 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 similar evaluation studies for all planned programs developed for the Plan of Work. During this 5-year period we will conduct 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 2013 Plan of Work.

V(A). Planned Program (Summary)

Program # 6

1. Name of the Planned Program

Childhood Obesity

2. Brief summary about Planned Program

The planned program in the area of Childhood Obesity revolves around development of healthy eating and physical activity patterns. These programs will be delivered by family and consumer science educators, youth agents, paraprofessionals, and trained volunteers. Special emphasis will be placed on minority, low-income and educationally disadvantaged individuals since nationwide data indicate these individuals have a disproportionate share of diet-related diseases, including being overweight. Although many diseases occur more frequently with advancing age, dietary practices in young people significantly affect the occurrence and onset of these diseases. Extension activities center on selecting foods from My Pyramid, meal planning, and food preparation to lose or maintain weight and increasing physical activity. These Extension-led efforts should contribute to reducing obesity in Delaware by modifying individual, family, and community behavior to promote healthy lifestyles, regular physical activity, consume healthy foods in appropriate quantities, and increase the frequency and quality of family meals.

3. Program existence : Intermediate (One to 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
702	Requirements and Function of Nutrients and Other Food Components	10%	10%	10%	10%
703	Nutrition Education and Behavior	20%	20%	20%	20%
724	Healthy Lifestyle	60%	60%	60%	60%
903	Communication, Education, and Information Delivery	10%	10%	10%	10%
	Total	100%	100%	100%	100%

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

1. Situation and priorities

Obesity is a major concern in the U.S. and is now considered a national epidemic. A stroll through any public setting in Delaware makes it evident that this national epidemic also is occurring in the First State. In 2008, prevalence data reported by the National Center for Chronic Disease Prevention & Health

Promotion **Behavioral Risk Factor Surveillance System indicated that 64 percent of adults in Delaware are either obese or overweight, as compared to about 54 percent 10 years earlier. Moreover, Delawareans classified as obese rose from almost 19 percent in 1997 to 28 percent in 2008.** Thirty-four percent of low-income Delawareans are obese compared to 27 percent of higher income residents. Obesity rates among youth are higher in Delaware than the national average. Fourteen percent of Delaware students in grades 9-12 are overweight and another 15 percent are at risk of becoming overweight. Surveys of Delaware youth found that males and females ages 12-14 have higher BMI values than high school students. Results suggest adolescents in grades 6-8 are at highest risk for obesity. Although obesity among children in this country has risen threefold since 1960, recent findings found no significant changes in BMIs occurring between 2003 and 2006. More than 50 percent of Delawareans indicated that they were trying to lose weight in 2005, with only 16 percent reporting that they received medical advice to lose weight. Twenty-one percent said they were eating fewer calories and 13 percent were consuming less fat, while 48 percent were watching both calorie and fat intake. Seventy-one percent noted they were using physical activity to lose or maintain weight. Although information obtained in the 2008 Behavioral Risk Factor Surveillance System (BRFSS) suggests that 24 percent of adult Delawareans did not participate in any physical activity during the past month, the level of inactivity was higher for low-income individuals (39 and 42 percent for those with incomes below $15,000 and between $15,000 and 24,999, respectively) compared 16 percent for individuals making more than $50,000 per year. Many factors contribute to obesity. These factors can be divided into genetic, behavioral, and environmental conditions. From an individual perspective, behavioral factors related to diet and physical activity are more practical to address than environmental issues. Dietary behaviors related to obesity include eating away from home; large portion sizes; availability of a vast array of high fat, high sugar foods; increased consumption of soft drinks; and reduced frequency of family meals. Studies show that adolescents who eat with adults at home on a regular basis consume more fruits and vegetables, eat more dairy products, and are less likely to have weight problems than those who do not.

2. Scope of the Program

- In-State Extension
- In-State Research
- Multistate Extension

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

1. Assumptions made for the Program

Many individuals lack the understanding and skills to plan and prepare nutritious meals. Individuals who are overweight have increased risk of developing various health problems. It is often assumed that people who maintain what is accepted as a healthy weight are well-nourished; however, poor food choices may mean they are undernourished even though their weight is within a normal range. An assumption is that one of the most effective ways to improve our health, including decreasing obesity and the risk and effect of chronic diseases, is through behavior modification that changes our actions. The modification must focus on positive goals, small steps, and behaviors encouraging healthy food choices and physical activity each day that can be maintained over a lifetime. Because prevention is important in maintaining health, effective programs must concentrate on improving dietary patterns and increasing physical activity. A variety of reasons are thought to hinder individuals from adopting a healthy lifestyle. Some of these reasons include lack of time, resources, understanding what needs altering, and motivation to change. Likewise, marketing of food products and our culture influences our behavior. It is also presumed that certain segments of the population, such as youth and limited resource individuals, lack the knowledge

and/or ability to choose a healthy diet. For these individuals, improving skills associated with meal planning and purchasing and preparing foods are critical. One factor that has been linked to weight of youth is the frequency of family meals. By increasing family meals it is assumed that a reduction in obesity rates for youth will occur.

2. Ultimate goal(s) of this Program

The ultimate goals for Planned Program 6 are for adults and youth to their improve health by becoming physically active on a regular basis and consuming healthy foods in appropriate quantities, and increasing family meals. -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
2014	17.2	2.2	0.0	0.1
2015	17.5	2.5	0.5	0.5
2016	18.0	3.0	0.5	1.0
2017	18.0	4.0	1.0	1.5
2018	18.0	4.0	1.0	2.0

V(F). Planned Program (Activity)

1. Activity for the Program

Extension efforts include, but are not limited to, conducting Healthy Habits, Healthy Start - a 6 hour program on healthy eating and physical activity for child care workers, Family Meals Workshops - a series of three, three-hour programs for families with young children, FoodSkills - an eight part workshop for low-income adults without children; Expanded Food and Nutrition Education Program - a series of eight lessons for low-income adults with children; Expanded Food and Nutrition Education Program for low-income youth; training volunteers including Master Food Educators, 4-H leaders, agency personnel, and teachers; providing Just In Time parenting newsletters; incorporating physical activity and healthy foods/snacks in all 4-H camps and after-school programs; providing special educational programs at the 4-H Military Program; and conducting favorite foods contests and CATCH programs for youth. In addition, using videography and other tools, youth will document both the healthy and unhealthy aspects of their communities. This includes those areas involving food, food choices, food safety, food security and other healthy/unhealthy lifestyle aspects of their communities.

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

Extension

Direct Methods	Indirect Methods

● Education Class	● Public Service Announcement
● Workshop	● Billboards
● Group Discussion	● Newsletters
● One-on-One Intervention	● TV Media Programs
● Demonstrations	● Web sites other than eXtension
● Other 1 (Train the Trainer)	

3. Description of targeted audience

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

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

- Number of Competitive Grants Submitted
- Number of Competitive Grants Awarded
- Number of Extension Bulletins and Factsheets
- Number of Invited Presentations
- Number of Volunteered Presentations
- Number of Workshops Conducted
- Number of Research Projects Completed
- Number of Undergraduate Researchers
- Number of M.S. Graduate Students
- Number of Refereed Journal Articles

☑ 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	Statewide educational programs for K-12 youth and teachers focused on nutrition, healthy diets and obesity causing factors that will help reduce the likelihood of food-borne illness, develop good nutritional and dietary habits, avoid obesity, and prevent chronic illnesses related to poor nutrition.
2	Targeted educational programs on understanding the causes of obesity and the means to reduce obesity for low-income communities, youth through after-school programs and childcare workers.
3	Increased number of program participants improving one or more nutrition practices.
4	Increased number of program participants who improve the frequency and quality of family meals.
5	Increased number of program participants engaged in greater levels of physical activity
6	Reducing obesity in Delaware by extension programs that modify individual, family, and community behavior in a manner that promotes healthy lifestyles, physical activity on a regular basis, the consumption of healthy foods in appropriate quantities, and increasing family meals.
7	Greater understanding, particularly in low-income communities and by youth, of the health risks associated with obesity and the options available to prevent or correct obesity problems.

Outcome # 1

1. Outcome Target

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

2. Outcome Type : Change in Knowledge Outcome Measure

3. Associated Knowledge Area(s)

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

4. Associated Institute Type(s)

- 1862 Extension
- 1890 Extension

Outcome # 2

1. Outcome Target

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

2. Outcome Type : Change in Knowledge Outcome Measure

3. Associated Knowledge Area(s)

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

4. Associated Institute Type(s)

- 1862 Extension
- 1890 Extension

Outcome # 3

1. Outcome Target

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

2. Outcome Type : Change in Action Outcome Measure

3. Associated Knowledge Area(s)

- 702 - Requirements and Function of Nutrients and Other Food Components
- 703 - Nutrition Education and Behavior
- 903 - Communication, Education, and Information Delivery

4. Associated Institute Type(s)

- 1862 Extension
- 1890 Extension

Outcome # 4

1. Outcome Target

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

2. Outcome Type : Change in Action Outcome Measure

3. Associated Knowledge Area(s)

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

4. Associated Institute Type(s)

- 1862 Extension
- 1890 Extension

Outcome # 5

1. Outcome Target

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

2. Outcome Type : Change in Knowledge Outcome Measure

3. Associated Knowledge Area(s)

- 724 - Healthy Lifestyle
- 903 - Communication, Education, and Information Delivery

4. Associated Institute Type(s)

- 1862 Extension
- 1890 Extension

Outcome # 6

1. Outcome Target

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

2. Outcome Type : Change in Condition Outcome Measure

3. Associated Knowledge Area(s)

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

4. Associated Institute Type(s)

- 1862 Extension
- 1890 Extension

Outcome # 7

1. Outcome Target

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

2. Outcome Type : Change in Condition Outcome Measure

3. Associated Knowledge Area(s)

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

4. Associated Institute Type(s)

- 1862 Extension
- 1890 Extension

V(J). Planned Program (External Factors)

1. External Factors which may affect Outcomes

- 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 similar evaluation studies for all planned programs developed for the Plan of Work. During this 5-year period we will conduct 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 2013 Plan of Work.

V(A). Planned Program (Summary)

Program # 7

1. Name of the Planned Program

Climate Change

2. Brief summary about Planned Program

Climate change is expected to create significant challenges for Delaware's agriculture and natural resource areas, primarily due to a transition to a warmer climate, characterized by hotter summers and warmer winters, greater annual rainfall, and more extreme weather events. Major problems predicted include prolonged droughts, disruptions of key farming operations such as planting and harvesting due to heavy spring and fall rains, higher incidences and more diversity in the type of animal and plant pests (insects, diseases), greater potential for water quality degradation as nutrients move more rapidly and more often to waters via leaching and runoff, and losses of biodiversity in forests, wetlands, and other areas as plants now native to Delaware become stressed and more susceptible to invasions by alien plants and gradually replaced by those more suited to a warmer climate. Sea level rise is anticipated, leading 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 now only productive because of an extensive network of agricultural drainage ditches. The focus of research and extension activities in this planned program will be: (i) improving our 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.

3. Program existence : Intermediate (One to 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	15%	15%	15%	15%
111	Conservation and Efficient Use of Water	10%	10%	10%	10%
132	Weather and Climate	10%	10%	10%	10%
136	Conservation of Biological Diversity	10%	10%	10%	10%
203	Plant Biological Efficiency and Abiotic Stresses Affecting Plants	5%	5%	5%	5%
205	Plant Management Systems	10%	10%	10%	10%
305	Animal Physiological Processes	5%	5%	5%	5%
307	Animal Management Systems	10%	10%	10%	10%
311	Animal Diseases	10%	10%	10%	10%
601	Economics of Agricultural Production and Farm Management	5%	5%	5%	5%
605	Natural Resource and Environmental Economics	5%	5%	5%	5%
903	Communication, Education, and Information Delivery	5%	5%	5%	5%
	Total	100%	100%	100%	100%

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

1. Situation and priorities

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, groundwaters 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 increased crop yields, many negative impacts are also expected. In particular, because most cropland is located in the sandy, coastal plain, greater and more severe droughts are expected, accompanied by more severe heat stress for crops, and higher and longer pressure from already difficult to manage 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 cool 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, for dairy, studies show decreases in birth rates and lower milk yields 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. Priorities for our research and extension programs on climate change are: improving our basic understanding of agricultural and ecological impacts of a new climate; developing agricultural and natural resource management practices for challenges related to water and nutrient use, increased pest pressure and the possible need for new crops better suited to warmer, wetter conditions; and improving our ability to mitigate effects of climate change by greater use of practices that sequester carbon in soils and natural resource areas.

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, wetter, 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 7 are: (1) greater basic 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; (2) development of management practices, systems, and technologies to mitigate the effects of climate change, particularly those related to 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; (3) 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 (4) providing science-based educational programs on the factors causing climate change and cost-effective options to address the challenges created by a changing climate for K-12 teachers, policy-makers, and the public.

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
2014	7.3	1.7	20.8	0.9
2015	7.5	2.0	21.0	1.5
2016	8.0	2.0	21.0	1.5
2017	8.0	2.5	22.0	2.0
2018	9.0	2.5	22.0	2.0

V(F). Planned Program (Activity)

1. Activity for the Program

Research and extensions programs will focus on: (1) Animal agriculture: understanding impacts of climate change on animal physiological processes, health, and disease, particularly for poultry and dairy; developing management practices to rapidly diagnose, prevent, and mitigate (e.g., new vaccines) effects of avian diseases on poultry health and productivity, including current disease problems and new ones that may appear and proliferate under new climatic conditions; developing new systems and technologies to reduce effects of environmental stress on animal health and productivity; 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. (2) Agronomic crops: basic research on how environmental stresses associated with climate change (e.g., heat, moisture stress) affect crop physiology and productivity; plant genetics and breeding studies to develop cultivars of major crops better adapted to a changing climate, in terms of water use efficiency and resistance to insects and disease; applied research and extension programs on irrigation management and water use efficiency for periods of prolonged drought and restricted water use and for groundwaters that may become more saline from salt water intrusion; integrated pest management to diagnose and control insects, weeds, and diseases (current and newly emerging) during longer growing seasons and under warmer and wetter growing conditions; nutrient cycling and management, particularly for manures and other byproducts where decomposition and nutrient release rates and timings are affected by warmer, wetter climates; basic and applied research on factors

controlling C sequestration and new agronomic management practices that help mitigate greenhouse gas emissions by sequestering C in soils; 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. (3) Natural Ecosystems: characterizing effects of climate change on biodiversity of plants and wildlife exposed to greater pressure from droughts, insects, disease, and invasive species; studying how climate change affects natural ecosystems and insects critical to crop production (e.g., pollination, honeybees); investigate value of marshes, wetlands, and forests to sequester C; increase C storage by encouraging tree planting and sustainable forestry management; 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, as climate change occurs, is an important area of ecological research today. Two new projects will collectively map important stopover areas for birds during their migrations along the entire US Atlantic coast using the national network of weather radars; (4) Resource economics: develop creative new economic policies to profitably link agriculture and forestry with those sectors generating significant quantities of greenhouse gases (e.g., energy, transportation) in cooperative efforts to mitigate greenhouse gas emissions; improve understanding of the relationship of climate change to agricultural and environmental policy development, including farmland preservation, conservation reserve programs; study impacts of climate change on groundwater aquifers, integrate climate change into the Chesapeake Bay water quality model; contribute to policies and educational programs on recycling, develop environmentally-friendly bio-based fuels from local feed stocks, and assist in analysis of Delaware's greenhouse gas inventories from energy use (mobile sources, utilities, residential, industrial, transportation, commercial, natural gas distribution, waste management, agriculture, land use, etc.).

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

Extension

Direct Methods	Indirect Methods
● Education Class	● Public Service Announcement
● Workshop	● Newsletters
● Group Discussion	● TV Media Programs
● One-on-One Intervention	● Web sites other than eXtension
● Demonstrations	● Other 1 (Newspapers)

3. Description of targeted audience

For animal agriculture, primarily poultry integrators, growers, breeders, trade groups and allied industries; dairy and beef producers; livestock commodity groups; forage producers, equine owners, producers and interest groups; for crop and soils related research and extension programs, the audience includes existing and prospective grain crop producers, mixed (animal and crop production, e.g., dairy, horse) farms, crop commodity groups and trade associations, the "green industry" (e.g., horticulture, nurseries, landscapers), and certified crop advisors; for natural resource and ecology programs, private and not-for-profit organizations managing forests, wetlands, marshes, and other natural resource areas; state and federal agencies responsible for wildlife, forestry management, and coastal ecosystems; for our resource economic programs the audience includes farmers, landowners, policy-makers and state and federal agencies directly related to climate change policy (Delaware Development Office; Land Use Planning and Preservation; Department of Agriculture; Department of Health and Human Services; Department of Natural Resources & Environmental Control; Department of Transportation; Economic Development Office, USDA, NRCS, USEPA). For all programs, Delaware State Government and local

legislators, homeowner associations, educators, community leaders, utility managers, retail stores distributing Energy Star products, fleet managers, building industry, Delaware Clean State Program members, Delaware Farm Bureau leaders, federal-state-local agriculture businesses, state and federal agencies; federal research laboratories; peer scientists in the U.S. and international colleagues, K-12 teachers, and environmental and community groups.

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

- Number of Competitive Grants Submitted
- Number of Competitive Grants Awarded
- Number of Research Projects Completed
- Number of Undergraduate Researchers
- Number of M.S. Graduate Students
- Number of Ph.D. Graduate Students
- Number of Post-doctoral Research Associates
- Number of Refereed Journal Articles
- Number of Books and Book Chapters
- Number of Technical Reports
- Number of Extension Bulletins and Factsheets
- Number of Invited Presentations
- Number of Volunteered Presentations
- Number of Workshops Conducted

☑ 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	Educational programs for the poultry, livestock and equine industries on likely effects of climate change on animal health, productivity, the incidence of disease, greater energy costs due to warmer temperatures, and their management options to prevent new problems.
2	Greater awareness by farmers, the "Green Industry", other producers, and land managers of the types and possible magnitude of climate change impacts on crop production, with an emphasis on drought and irrigation management, increased incidences and diversity of pest pressures from insects, disease, and weeds, and nutrient cycling and transport for different crop rotations and tillage systems.
3	Outreach programs and demonstration projects on underlying principles and soil management programs now available to enhance carbon sequestration by agriculture, forestry, and other natural ecosystems (e.g., marshes, wetlands).
4	Educational programs for K-12 teachers, policy-makers, and the public on climate change and its potential effects on agriculture, natural ecosystems, and current and proposed approaches and new policies that could mitigate problems associated with climate change.
5	Increased number of poultry and livestock producers adopting management practices specifically designed to mitigate disease and animal health problems associated with climate change, particularly those related to year-round warmer conditions and weather extremes.
6	Increased number of crop producers adopting management practices specifically designed to mitigate plant growth problems associated with climate change, particularly those related to drought, pest pressures, and nutrient use.
7	Development of systematic strategies and plans to address climate change impacts on natural resource areas, particularly those related to plant species change, loss of biodiversity, wildlife ecology, and invasive plants.
8	Increased number of farmers, natural resource managers, and others aware of and participating in programs related to mitigating greenhouse gas emissions through programs such as carbon credits and carbon trading.
9	Greater scientific understanding of the fundamental mechanisms by which climate change affects plant and animal physiological processes, soil biological and chemical processes, and ecosystem health, with particular emphasis on challenges due to plant and animal diseases, water use efficiency, and biodiversity
10	Successful adoption of research-based management practices and economic policies that sustain animal agriculture, ensure crop productivity, protect or restore natural resource areas negatively impacted by climate change, and reduce greenhouse gas emissions.

Outcome # 1

1. Outcome Target

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

2. Outcome Type : Change in Knowledge Outcome Measure

3. Associated Knowledge Area(s)

- 305 - Animal Physiological Processes
- 307 - Animal Management Systems
- 311 - Animal Diseases
- 903 - Communication, Education, and Information Delivery

4. Associated Institute Type(s)

- 1862 Extension
- 1890 Extension

Outcome # 2

1. Outcome Target

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

2. Outcome Type : Change in Knowledge Outcome Measure

3. Associated Knowledge Area(s)

- 102 - Soil, Plant, Water, Nutrient Relationships
- 111 - Conservation and Efficient Use of Water
- 132 - Weather and Climate
- 205 - Plant Management Systems
- 601 - Economics of Agricultural Production and Farm Management
- 903 - Communication, Education, and Information Delivery

4. Associated Institute Type(s)

- 1862 Extension
- 1890 Extension

Outcome # 3

1. Outcome Target

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

2. Outcome Type : Change in Knowledge Outcome Measure

3. Associated Knowledge Area(s)

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

4. Associated Institute Type(s)

- 1862 Extension
- 1890 Extension

Outcome # 4

1. Outcome Target

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

2. Outcome Type : Change in Knowledge Outcome Measure

3. Associated Knowledge Area(s)

- 132 - Weather and Climate
- 205 - Plant Management Systems
- 307 - Animal Management Systems
- 601 - Economics of Agricultural Production and Farm Management
- 605 - Natural Resource and Environmental Economics
- 903 - Communication, Education, and Information Delivery

4. Associated Institute Type(s)

- 1862 Extension
- 1890 Extension

Outcome # 5

1. Outcome Target

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

2. Outcome Type : Change in Action Outcome Measure

3. Associated Knowledge Area(s)

- 305 - Animal Physiological Processes
- 307 - Animal Management Systems
- 311 - Animal Diseases
- 903 - Communication, Education, and Information Delivery

4. Associated Institute Type(s)

- 1862 Extension
- 1890 Extension

Outcome # 6

1. Outcome Target

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

2. Outcome Type : Change in Action Outcome Measure

3. Associated Knowledge Area(s)

- 102 - Soil, Plant, Water, Nutrient Relationships
- 111 - Conservation and Efficient Use of Water
- 132 - Weather and Climate
- 203 - Plant Biological Efficiency and Abiotic Stresses Affecting Plants
- 205 - Plant Management Systems
- 601 - Economics of Agricultural Production and Farm Management
- 605 - Natural Resource and Environmental Economics
- 903 - Communication, Education, and Information Delivery

4. Associated Institute Type(s)

- 1862 Extension
- 1890 Extension

Outcome # 7

1. Outcome Target

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

2. Outcome Type : Change in Action Outcome Measure

3. Associated Knowledge Area(s)

- 132 - Weather and Climate
- 136 - Conservation of Biological Diversity
- 605 - Natural Resource and Environmental Economics
- 903 - Communication, Education, and Information Delivery

4. Associated Institute Type(s)

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

Outcome # 8

1. Outcome Target

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

2. Outcome Type : Change in Action Outcome Measure

3. Associated Knowledge Area(s)

- 132 - Weather and Climate
- 601 - Economics of Agricultural Production and Farm Management
- 605 - Natural Resource and Environmental Economics
- 903 - Communication, Education, and Information Delivery

4. Associated Institute Type(s)

- 1862 Extension
- 1890 Extension

Outcome # 9

1. Outcome Target

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

2. Outcome Type : Change in Condition Outcome Measure

3. Associated Knowledge Area(s)

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

4. Associated Institute Type(s)

- 1862 Research
- 1890 Research

Outcome # 10

1. Outcome Target

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

2. Outcome Type : Change in Condition Outcome Measure

3. Associated Knowledge Area(s)

- 102 - Soil, Plant, Water, Nutrient Relationships
- 111 - Conservation and Efficient Use of Water
- 132 - Weather and Climate
- 136 - Conservation of Biological Diversity
- 203 - Plant Biological Efficiency and Abiotic Stresses Affecting Plants
- 205 - Plant Management Systems

- 305 - Animal Physiological Processes
- 307 - Animal Management Systems
- 311 - Animal Diseases
- 601 - Economics of Agricultural Production and Farm Management
- 605 - Natural Resource and Environmental Economics
- 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 similar evaluation studies for all planned programs developed for the Plan of Work. During this 5-year period we will conduct 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 2013 Plan of Work.

V(A). Planned Program (Summary)

Program # 8

1. Name of the Planned Program

Sustainable Energy

2. Brief summary about Planned Program

Energy remains a primary concern of all stakeholders involved in agriculture and natural resources management. Research and extension programs related to bioenergy will include those focused on (i) Biomass crops: genetics and basic plant biology studies, plant-microbe interactions that enhance growth and water use efficiency of biomass crops; production and agronomic management practices for current (corn, soy) and innovative new cropping systems (e.g., sweet sorghum, switchgrass, poplars); equipment changes and needs for new biomass crops, especially related to planting and harvesting; improving nutrient management BMPs mitigating potential environmental impacts of biomass energy crops and assessing their impacts on water quality relative to current cropping systems; and addressing economic, social and cultural issues related to changing from long-standing to new cropping systems; (ii) Bioenergy production systems and re-use of byproducts: evaluation of farm-scale anaerobic digestion for bioenergy production, using animal manures, cover crops (e.g., forage radishes), and other by-products; evaluation of gasification/pyrolysis technologies, especially those using poultry litter. Finding beneficial agricultural uses for the by-products of energy production such as distillers' grains; (iii)Water supply: managing regional water supplies to produce biomass energy crops, including better understanding of the impacts of climatic extremes, improving drought tolerance, increasing irrigation use efficiency, use of wastewaters, and developing cropping systems that foster efficient water use by crops; and (iv) Education and outreach: development of bioenergy and climate change curricula for youth (e.g., K-12, 4-H programs, Master Gardeners).

3. Program existence : Intermediate (One to 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	15%	15%	15%	15%
201	Plant Genome, Genetics, and Genetic Mechanisms	25%	25%	25%	25%
205	Plant Management Systems	25%	25%	25%	25%
403	Waste Disposal, Recycling, and Reuse	10%	10%	10%	10%
601	Economics of Agricultural Production and Farm Management	15%	15%	15%	15%
605	Natural Resource and Environmental Economics	5%	5%	5%	5%
903	Communication, Education, and Information Delivery	5%	5%	5%	5%
	Total	100%	100%	100%	100%

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

1. Situation and priorities

Delaware agriculture has a range of serious issues facing it today that are directly related to the consumption of energy. At the same time there is growing interest in the use of agricultural by-products, such as poultry litters, as alternative energy sources, particularly for heating and energy generation. To date, however, the use of Delaware cropland for large scale production of bioenergy crops has not received as much attention, largely because of the high demand of the regional poultry industry for feed grains. Priorities of this Planned Program will include: (1) investigations into the feasibility of using poultry litters, or other agricultural by-products, as an energy source, in conjunction with local industries and utility companies; (2) Related to this, assessing the value of energy by-products, such as the biochars produced by pryolysis of poultry litters, as soil amendments that can improve soil quality and reduce nutrient losses to air and water; (3) Plant molecular biology and genomic studies of new crops that have the potential for use as energy sources, such as through processes that utilize cellulosic ethanols, as opposed to ethanol from grain; and (4) Energy conservation strategies for all agricultural and natural resource areas that can lead to cost-savings and extend the long-term life of fossil fuel energy sources critical to food production today.

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 energy costs for food production will increase in importance and complexity and will become a major economic and environmental issue for agriculture for decades to come. Consequently, research and extension programs on energy conservation, use of agricultural and other by-products as renewable energy sources, and advanced plant biology and agronomic studies on development and production of new bioenergy crops will be a high priority for 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 8 are: (1) an energy efficient agriculture that uses a economically sustainable mix of fossil fuels, renewable energy sources, and energy conservation to meet the growing global demand for food; (2) development of management practices, systems, and technologies that are energy efficient and incorporate renewable energy sources; (3) investigating and proposing new economic policies that foster adoption of renewable energy sources by agriculture; and (4) providing science-based educational programs on the factors causing energy concerns and the options to provide sustainable energy supplies for food production and natural resource conservation for K-12 teachers, policy-makers, and the public.

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
2014	1.3	0.1	1.6	0.5
2015	1.5	0.3	1.6	0.5
2016	1.5	0.3	2.0	1.0
2017	2.0	0.5	2.5	1.5
2018	2.0	0.5	3.0	2.0

V(F). Planned Program (Activity)

1. Activity for the Program

Research and extension programs will focus on: (1) Plant molecular biology studies with bioenergy crops. Research is now underway to identify small RNAs (short stretches of ribonucleic acid) related to

stresses such as drought, temperature and nutrient deprivation and then correlate them to the emerging genetic code of Brachypodium distachyon, thus enhancing the plant's value as a functional genomic model for energy crops and temperate grasses. Brachypodium has many advantages for carrying out functional studies in the laboratory compared to energy crops such as switchgrass and Miscanthus, and temperate grasses that are important sources of food like wheat. (2) Plant and soil management systems for existing (e.g., corn) and newly emerging bioenergy crops (e.g., barley, sweet sorghum).While just beginning, we expect this research to address many aspects of biomass/bioenergy crop production including genetics and basic plant biology studies, especially of plant-microbe interactions that enhance growth and water use efficiency of biomass crops; production and agronomic management practices for current (barley) and innovative new cropping systems (e.g., sweet sorghum, switchgrass, poplars); equipment changes and needs for new biomass crops, especially related to planting and harvesting; improving nutrient management BMPs (reduces energy consumption for fertilizer production); mitigating potential environmental impacts of biomass energy crops and assessing their impacts on water quality relative to current cropping systems; and addressing economic, social and cultural issues related to changing from long-standing to new cropping systems. (3) Bioenergy production systems and re-use of byproducts: evaluation of farm-scale anaerobic digestion for bioenergy production, using animal manures, cover crops (e.g., forage radishes), and other by-products; evaluation of gasification/pyrolysis technologies, especially those using poultry litter. Related studies will focus on finding beneficial agricultural uses for the by-products of energy production such as biochar from litters and distillers' grains.

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

Extension

Direct Methods	Indirect Methods
● Education Class ● Workshop ● One-on-One Intervention ● Demonstrations	● Newsletters ● TV Media Programs ● Web sites other than eXtension

3. Description of targeted audience

For animal agriculture, the targeted audience is broad, given the impacts of energy costs on all aspects of animal production and includes poultry integrators, growers, breeders, trade groups and allied industries; dairy and beef producers; livestock commodity groups; forage producers, equine owners, producers and interest groups; for crop and soils related research and extension programs, the audience includes existing and prospective grain crop producers, mixed (animal and crop production, e.g., dairy, horse) farms, crop commodity groups and trade associations, the "green industry" (e.g., horticulture, nurseries, landscapers), and certified crop advisors; for natural resource and ecology programs, private and not-for-profit organizations managing forests, wetlands, marshes, and other natural resource areas; state and federal agencies responsible for wildlife, forestry management, and coastal ecosystems; for our resource economic programs the audience includes farmers, landowners, policy-makers and state and federal agencies directly related to climate change policy (Delaware Development Office; Land Use Planning and Preservation; Department of Agriculture; Department of Health and Human Services; Department of Natural Resources & Environmental Control; Department of Transportation; Economic Development Office, USDA, NRCS, USEPA). For all programs, Delaware State Government and local legislators, homeowner associations, educators, community leaders, utility managers, retail stores distributing Energy Star products, fleet managers, building industry, Delaware Clean State Program members, Delaware Farm Bureau leaders, federal-state-local agriculture businesses, state and federal

agencies; federal research laboratories; peer scientists in the U.S. and international colleagues, K-12 teachers, and environmental and community groups.

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

- Number of Competitive Grants Submitted
- Number of Competitive Grants Awarded
- Number of Research Projects Completed
- Number of Undergraduate Researchers
- Number of M.S. Graduate Students
- Number of Ph.D. Graduate Students
- Number of Post-doctoral Research Associates
- Number of Refereed Journal Articles
- Number of Books and Book Chapters
- Number of Technical Reports
- Number of Extension Bulletins and Factsheets
- Number of Invited Presentations
- Number of Volunteered Presentations
- Number of Workshops Conducted

☑ 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	Increased knowledge base on the part of the Delaware agricultural and natural resource community of the options to increase energy use efficiency and develop alternative energy sources that are more sustainable.
2	Greater adoption of solar energy and biomass energy technologies by animal agriculture to help reduce the operating costs of poultry and dairy production in particular.
3	Widespread use of energy conservation practices by Delaware farmers engaged in production of agronomic and vegetable crops, as a result of extension education programming.
4	A more energy-efficient poultry industry that is able to utilize alternative sources of energy cost-effectively, particularly solar energy, energy derived from by-products of poultry production, and wind energy.
5	Incorporation of sustainable energy technologies into other major agricultural technology systems, such as irrigation and major equipment used for production, harvesting, and processing of agronomic and vegetable crops.

Outcome # 1

1. Outcome Target

Increased knowledge base on the part of the Delaware agricultural and natural resource community of the options to increase energy use efficiency and develop alternative energy sources that are more sustainable.

2. Outcome Type : Change in Knowledge Outcome Measure

3. Associated Knowledge Area(s)

- 205 - Plant Management Systems
- 403 - Waste Disposal, Recycling, and Reuse
- 601 - Economics of Agricultural Production and Farm Management
- 605 - Natural Resource and Environmental Economics
- 903 - Communication, Education, and Information Delivery

4. Associated Institute Type(s)

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

Outcome # 2

1. Outcome Target

Greater adoption of solar energy and biomass energy technologies by animal agriculture to help reduce the operating costs of poultry and dairy production in particular.

2. Outcome Type : Change in Action Outcome Measure

3. Associated Knowledge Area(s)

- 403 - Waste Disposal, Recycling, and Reuse
- 601 - Economics of Agricultural Production and Farm Management
- 605 - Natural Resource and Environmental Economics
- 903 - Communication, Education, and Information Delivery

4. Associated Institute Type(s)

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

Outcome # 3

1. Outcome Target

Widespread use of energy conservation practices by Delaware farmers engaged in production of agronomic and vegetable crops, as a result of extension education programming.

2. Outcome Type : Change in Action Outcome Measure

3. Associated Knowledge Area(s)

- 102 - Soil, Plant, Water, Nutrient Relationships
- 201 - Plant Genome, Genetics, and Genetic Mechanisms
- 205 - Plant Management Systems
- 601 - Economics of Agricultural Production and Farm Management
- 605 - Natural Resource and Environmental Economics
- 903 - Communication, Education, and Information Delivery

4. Associated Institute Type(s)

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

Outcome # 4

1. Outcome Target

A more energy-efficient poultry industry that is able to utilize alternative sources of energy cost-effectively, particularly solar energy, energy derived from by-products of poultry production, and wind energy.

2. Outcome Type : Change in Condition Outcome Measure

3. Associated Knowledge Area(s)

- 403 - Waste Disposal, Recycling, and Reuse
- 601 - Economics of Agricultural Production and Farm Management
- 605 - Natural Resource and Environmental Economics
- 903 - Communication, Education, and Information Delivery

4. Associated Institute Type(s)

- 1862 Extension
- 1862 Research
- 1890 Extension

- 1890 Research

Outcome # 5

1. Outcome Target

Incorporation of sustainable energy technologies into other major agricultural technology systems, such as irrigation and major equipment used for production, harvesting, and processing of agronomic and vegetable crops.

2. Outcome Type : Change in Condition Outcome Measure

3. Associated Knowledge Area(s)

- 102 - Soil, Plant, Water, Nutrient Relationships
- 201 - Plant Genome, Genetics, and Genetic Mechanisms
- 205 - Plant Management Systems
- 601 - Economics of Agricultural Production and Farm Management
- 605 - Natural Resource and Environmental Economics
- 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

Description

{NO DATA ENTERED}

V(K). Planned Program - Planned Evaluation Studies

Description of Planned Evaluation Studies

We will use similar evaluation studies for all planned programs developed for the Plan of Work. During this 5-year period we will conduct 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 2013 Plan of Work.