2015 University of Delaware and Delaware State University Combined Research and Extension Annual Report of Accomplishments and Results

Status: Accepted

Date Accepted: 06/13/2016

I. Report Overview

1. Executive Summary

Delaware agriculture increasingly operates in a global economy and we face ongoing challenges in our efforts to help ensure food security for a growing population, develop innovative means to improve profitability and productivity, and protect the environment. Emerging issues must also be addressed, including avian influenza, climate change, farmland loss to development, food safety, and social issues for families and youth such as addressing preventive health and nutrition issues across the food system. Agriculture in Delaware remains strong today, with the Delmarva broiler industry the biggest agriculture commodity. The state has 490,000 acres of cropland (45% irrigated) that provide the grain crops needed for a thriving poultry industry, an innovative and profitable vegetable production industry, and a "green industry" that supports horticultural and natural resource interests of its citizens. A 2010 report led by the University of Delaware College of Agriculture & Natural Resources ("The Impact of Agriculture on Delaware's Economy") found that the total economic contribution of all categories of agriculture in Delaware was $7.95 billion in industry output and that the agricultural industry contributed $2.5 billion in value added activity, and $1.6 billion in labor income, supporting 30,000 jobs.

Our plan of work has been designed to help Delaware agriculture remain competitive, to meet its environmental challenges, sustain the state's natural resources and support our rural and urban youth, families, and communities. We focus on the following four programs intended to provide research-based solutions to the complex, global challenges facing Delaware today. It is important to note that divisions between these programmatic efforts are artificial. Our research and extension efforts are most commonly conducted by multi-disciplinary teams working across programs, in collaboration with colleagues in other disciplines. We also regularly plan and work with stakeholders in other University departments, other governmental agencies, foundations, community groups, universities, and political or policy-making positions. Delaware is also uniquely situated geographically to share across states in the mid-Atlantic region and positions and programs are utilized across state lines.

1. Sustainable Production Systems for Agricultural and Urban Landscapes

Delaware agriculture is fully integrated into the global economy and driven by the need to produce a safe and secure food supply for a growing world population. Longstanding components of agriculture in Delaware are animal production, grain, vegetables, aquaculture, soil management and watershed protection, and agricultural and natural resource economics. Vegetable crops, specifically lima beans, and specialty crops continue to diversify the vegetable production component.

Animal-based agriculture is one of the largest and most profitable enterprises in Delaware with poultry production and processing activities accounting for over $3.2 billion dollars in industry output, 13,437 jobs, and $911.6 million in value added, according to the 2010 report. Other livestock industries ($32M farm sales from dairy, beef cattle, swine) compose a smaller but locally important part of the agricultural economy. Aquaculture has emerged as a new sector, in freshwaters and coastal areas with shellfish. For poultry, diagnosis and control of infectious avian diseases is a high research priority, while for all of animal agriculture, research and extension programs focus on key issues such nutrient management and water 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 is highlighted by The Center for Behavioral and Experimental Agri-Environmental Research CBEAR. The mission of the center is applying behavioral insights and experimental designs to improve programs related to agriculture and the environment.
The University of Delaware, in conjunction with the state and private industry, has devoted 25 years to developing research capacity and expertise in basic and applied biotechnology. Areas of existing strength are avian virology, physiology, and genomics and plant molecular biology and plant breeding. In our avian programs, biotechnology is used at the basic level to improve poultry health and immune competence and to understand fundamental mechanisms of avian diseases. At the applied level, biotechnology efforts focus on improving diagnostic testing methods, developing vaccines and other disease control methodologies, surveying for emerging avian disease causing agents, and developing disease resistant breeds of chickens. For plants, basic biotechnology efforts include understanding gene regulation in plants, particularly those associated with RNA turnover or small RNA-mediated gene regulation. Other efforts include understanding disease resistance and signal transduction pathways in plants, understanding nitrogen fixation via the application of molecular and proteomics approaches, and understanding, at the molecular and atomic levels, plant-soil interfacial relations important to nutrient and heavy metal uptake.

2. A Safe and Secure Food Supply for Human Nutrition and Health
The American food system provides consumers with an abundant supply of convenient, economical, high-quality, nutritious, and safe food products. However, foodborne illnesses still occur in the U.S. Outbreaks of foodborne illness due to microbial contamination continue to be a major but preventable public health problem. While advances in understanding and controlling foodborne pathogens have been significant, new pathogens, new food products, increases in imported foods, and increasing anti-microbial resistance present new challenges to the nation's food safety programs. Our research programs focus on understanding foodborne pathogens and reducing the occurrence of these microbes during pre- and post-harvest by intervention strategies (e.g., high pressure, ultraviolet light, antimicrobial packaging). Extension activities center on food safety education of food producers, food handlers and consumers; emerging food safety and nutrition issues; and public education about how to respond to outbreaks of foodborne diseases. Recent legislation related to food safety in food service establishments has doubled the need for food safety training for this audience. Extension successfully boasts a 90% success rate of those trained in successfully receiving food safety certification.
Extension programming aimed at addressing health issues such as obesity and diabetes involves the development of healthy eating and physical activity patterns. These programs are delivered by family and consumer science educators, youth agents, paraprofessionals, master food educators and in the last few years a corps of youth health ambassadors. Special emphasis is placed on minority, low-income and educationally disadvantaged individuals since nationwide data indicate these individuals have disproportionate health rankings. Grant funded programs further enhance the efforts in these program areas. 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 increase fruit and vegetable intake, select beverage intake and increasing physical activity.
3. Volunteer, Family and Youth Development
The rapid economic and social changes occurring in Delaware today place high demands on families and communities. These problems occur in both rural and urban areas. Strong families are the basic building unit for our future citizens, yet those charged with this important responsibility often do not have the time, money, or skills to carry out their family roles in a positive, productive manner. Preparing citizens to take

prominent roles in shaping their future and the future of their communities and community policy is the fundamental goal of this planned program. Cooperative Extension activities are the major component of this program area.
Volunteer and Leadership development programming involves Master Gardener, Master Food Educators, Master Composters, youth health ambassadors and 4-H youth volunteers make up a volunteer corps of over 3000 volunteers. Advisory committees in each program area serve as additional volunteers. LEADelawares is an intensive 18 month leadership program for emerging agriculture leaders.
The 4-H youth development program focuses on mission mandate areas in STEM education, citizenship and nutrition and health. The goals of 4-H STEM are to increase awareness, understanding, and appreciation in the areas of science, technology, engineering, and mathematics.Through hands on learning experiences youth develop knowledge, skills, and abilities in science, technology, engineering, and mathematics that are both career and life skills. Reaching almost 46% of the youth 8-18 in Delaware, 4-H in multiple delivery formats is assisting Delaware youth to develop the leadership and life skills needed to become productive, independent, contributors to our society.
Farm, small business and family resource management remains critical to the economic stability of the state. Partnerships with FSA on risk management training as well as MD Ag Law program on farm transfer and succession planning are critical components of maintaining agriculture and it's infrastructure in DE. Likewise, with major changes in health care, education on smart choices of health care is another risk management program for both farm and families alike. Recent changes in DuPont ownership by DOW pose opportunities for enhanced work with encouraging agricultural entrepreneurship to maintain jobs in Delaware.

4. Environmental Stewardship in a changing climate

This program focuses on maintaining and restoring renewable natural resources and the vital services provided by healthy ecosystems in Delaware after 400 years of urbanization and agriculture. The impact of past and current land use changes, such as agricultural/forestry practices and encroachment of urban/suburban populations on native landscapes, is not fully understood but is thought to be contributing to the loss of many plant and animal species. Perturbation of ecosystems, such as by fragmentation of wildlife habitat, and nutrient enrichment of aquatic resources are key areas in need of more research and extension programming. New technologies in agricultural production that include control of insects, weeds, filamentous algae, and plant pathogens are needed to ensure sustainability of agriculture in Delaware while restoring and maintaining biodiversity and natural ecosystems located on farms. Finding ways to replace and sustain biodiversity in suburban landscapes, which today comprise 54% of Delaware, is another priority and is vital to future efforts to sustain natural resources in the face of increasingly rapid land use change.
Climate change will create major challenges for Delaware's agriculture and natural resource areas, due to a transition to a warmer climate, characterized by hotter summers and warmer winters and more extreme weather events. Sea level rise will lead to problems with salt water intrusion into ground waters used for irrigation, inundation of wetlands and other low-lying natural areas, and intensified flooding, particularly problematic for cropland near the coast that is only productive because of an extensive network of drainage ditches. Research and extension foci in his planned program are (i) improving fundamental understanding of why and how a changing climate affects animal and plant physiological processes related to health and productivity, the transformations of carbon, nutrients, organic chemicals, and toxins in soils, and biodiversity of plants and wildlife in natural ecosystems; (ii)developing cost-effective management strategies to help animal and crop producers and natural resource managers respond to weather extremes, greater pressures from insects and diseases, and sea level rise; and (iii)contributing to the development of climate change policies (e.g., carbon trading) that provide farmers and others with resources needed to adopt practices to mitigate climate change problems.

Total Actual Amount of professional FTEs/SYs for this State

Year: 2015	Extension		Research	
	1862	1890	1862	1890
Plan	42.9	16.5	80.5	8.3
Actual	32.4	18.1	118.0	17.3

II. Merit Review Process

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

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

2. Brief Explanation

Scientific Peer Review of Research Programs

We adopt by reference the National Standards for Peer Review.

Merit Review of Extension Programs

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

III. Stakeholder Input

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

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

Brief explanation.

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

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

1. Method to identify individuals and groups

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

Brief explanation.

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

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

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

1. Methods for collecting Stakeholder Input

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

Brief explanation.

We hold a variety of regular meetings across the state, which include a diverse mix of clientele, users, and stakeholders. These meetings include such things as: Agriculture Visiting Committee, State Chamber of Commerce, Kids County Advisory Council, Delaware Public Policy Institute Task Force, Council of Farm Organizations, USDA Food and Agricultural Council, State Agriculture Technical Committee, and user groups like 4-H parents and leader advisory groups 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 or extension is needed, we use their input to strengthen our requests for research support from funding agencies and to identify partners that can collaborate in research projects.

Brief Explanation of what you learned from your Stakeholders

Current and Future Unique strengths of the College
Current Strengths
Future Strengths
4-H & Youth development
Climate Science-mitigation and adaptation in agriculture, ecosystems and environment
Avian Biosciences and disease
Quantitative sciences: data analytics, predictive modeling, statistics related to large data sets
Ecosystem sciences and biodiversity
Legal and regulatory policy
Experimental economics
Sustainable landscapes and ecosystems
Food Safety
Urban agriculture
Genetics and Genomics
Integration of plant, animal and ecosystem health expertise with human health-a "one health" initiative
Integrated pest management
Natural resource economics and policy
Public horticulture
Soil and water quality, nutrient management, irrigation
Pre-vet medicine and animal biology
Current and future partnerships needed to leverage resources and achieve selective excellence in the college programs have been identified.
Current and future resources for the College are identified. Future resources needed to support unique strengths include new research lab facilities to replace those in Worrilow Hall that have exceeded their useful lifetime.
Several attributes make the college unique among colleges at UD or compared to other colleges of agriculture and related sciences in the region including:
expertise in biological, physical, and social sciences that can address the human dimensions of problems as well as the underpinning science
Extension engages the College with stakeholders, deliberately aligns CANR with the core values of UD, and provides strong sense of relevance and value to Delawareans
CANR provides a small college feel within the context of a larger research university.
World-class faculty in many disciplines are approachable and accessible to students, stakeholders, industry and communities.
CANR is located in the heart of the east coast megalopolis and its 350 acre Newark farm is largely

within the city limits. It provides excellent opportunities for urban agriculture interface studies as well as natural resource issues in a human dominated landscape

CANR enjoys unusually strong relationships with state and federal legislators and regional agencies in part due to the small size of Delaware relative to other states, but largely through our relevance to key sectors of the state's economy.

IV. Expenditure Summary

1. Total Actual Formula dollars Allocated (prepopulated from C-REEMS)			
Extension		Research	
Smith-Lever 3b & 3c	1890 Extension	Hatch	Evans-Allen
1342032	1179123	1636582	1242633

2. Totaled Actual dollars from Planned Programs Inputs				
	Extension		Research	
	Smith-Lever 3b & 3c	1890 Extension	Hatch	Evans-Allen
Actual Formula	1130666	1179123	1571960	1244128
Actual Matching	1496608	1179123	2269805	1244128
Actual All Other	4455172	221133	16733392	2550479
Total Actual Expended	7082446	2579379	20575157	5038735

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

V. Planned Program Table of Content

V(A). Planned Program (Summary)

Program # 1

1. Name of the Planned Program

SUSTAINABLE PRODUCTION SYSTEMS FOR AGRICULTURAL AND URBAN LANDSCAPES

☑ Reporting on this Program

V(B). Program Knowledge Area(s)

1. Program Knowledge Areas and Percentage

KA Code	Knowledge Area	%1862 Extension	%1890 Extension	%1862 Research	%1890 Research
102	Soil, Plant, Water, Nutrient Relationships	10%	10%	10%	10%
112	Watershed Protection and Management	5%	5%	5%	5%
201	Plant Genome, Genetics, and Genetic Mechanisms	10%	10%	10%	10%
203	Plant Biological Efficiency and Abiotic Stresses Affecting Plants	5%	5%	5%	5%
205	Plant Management Systems	10%	10%	10%	10%
212	Pathogens and Nematodes Affecting Plants	5%	5%	5%	5%
304	Animal Genome	10%	10%	10%	10%
305	Animal Physiological Processes	5%	5%	5%	5%
307	Animal Management Systems	5%	5%	5%	5%
311	Animal Diseases	15%	15%	15%	15%
405	Drainage and Irrigation Systems and Facilities	10%	10%	10%	10%
604	Marketing and Distribution Practices	5%	5%	5%	5%
903	Communication, Education, and Information Delivery	5%	5%	5%	5%
	Total	100%	100%	100%	100%

V(C). Planned Program (Inputs)

1. Actual amount of FTE/SYs expended this Program

Year: 2015	Extension		Research	
	1862	1890	1862	1890
Plan	16.8	5.1	34.1	2.0
Actual Paid	11.5	5.4	65.5	1.2
Actual Volunteer	0.0	0.0	0.0	0.0

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

Extension		Research	
Smith-Lever 3b & 3c	**1890 Extension**	**Hatch**	**Evans-Allen**
205375	156934	1246158	146668
1862 Matching	**1890 Matching**	**1862 Matching**	**1890 Matching**
297383	156934	2059078	146668
1862 All Other	**1890 All Other**	**1862 All Other**	**1890 All Other**
1305112	191289	8619731	107520

V(D). Planned Program (Activity)

1. Brief description of the Activity

Research and extension programs fall into the following target areas:

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

A. Animal Agriculture: For animal agriculture, research and extension programs will target: (1)Poultry Health and Disease Prevention and Control - mechanisms of disease induction, host genetic resistance and immune responses in poultry with a focus on diagnostic surveillance methodology, vaccination and biocontainment; (2) Poultry Growth and Development - basic molecular and cellular mechanisms regulating poultry growth, development and meat yield;(3) Avian Genomics - development and application of avian microarrays for: disease diagnosis, resistance, and control; growth and development; and optimization of desired production traits; (4) Alternative Production Systems - alternative production systems to reduce disease, mortality, and waste production, minimize antibiotic use, integrate alternative energy into production systems and foster compatibility between animal production, environmental quality, and urban populations; (5)Nutrient Utilization in Poultry and Ruminants - increased nutrient utilization and reduced nutrient excretion via improved understanding of animal biology; (6) Comparative Pathology Laboratory. This laboratory supports the efforts of poultry diagnostic laboratories in Delaware and Maryland and features collaborative research on histopathologic analysis for researchers engaged in studies related to animal disease and animal models of human disease, and consultation regarding tissue dissection, collection, trimming, fixation, image capture, and techniques in immune-histochemistry.

B. Plant Biology and Crop Production: Key activities are: (1) Agronomic, Vegetable and Horticultural Crops - improving varietal selection, disease and pest resistance, seed technology, cultural and marketing practices; (2) New Crops - financial and environmental impacts of new crops or new varieties of existing crops, emphasizing the growth of local food productions systems and sustainable landscape design practices for urban settings; (3) Integrated Pest Management - control of insect pests, weeds, and plant pathogens via biological and chemical methods; (4) Engineering Technologies - improvements in harvesting and guidance systems and expanded research and extension programs on irrigation management; implementing recent advances in remote sensing, tillage, and pesticide application; (5) Plant Breeding, Crop Genomics, Proteomics, and Bioinformatics - basic research on how plants adapt to their environments and soil/climate stress and the nature of soil microorganism-plant symbiotic relationships and plant/soil interfacial reactions affecting crop growth and quality; (6) Pasture and Forage Management - research on pasture-based animal production systems and forage research on improving biological control systems for alfalfa. (7) Nutrient Management for Water and Quality - fertilizer and waste management programs to ensure economic and environmental sustainability while considering crop needs, nutrient reactions in soils, alternative fertilizer sources, and government policies.

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

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

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

2. Brief description of the target audience

For animal agriculture, the target audience is primarily poultry integrators, growers, breeders, trade groups and allied industries; dairy and beef producers; livestock commodity groups; forage producers, equine owners, producers and interest groups; state and federal agencies; federal research laboratories; scientists in the U.S. and international colleagues, K-12 teachers, and environmental and community groups. For crop and soils related research and extension programs, the audience includes existing and prospective grain crop producers, vegetable and horticultural crop producers, mixed (animal and crop production, e.g., dairy, horse) farms, crop commodity and trade, the "green industry", certified crop advisors, private agricultural consultants, state and federal agencies, agrichemical and agricultural equipment companies, processors, marketers of plants of flavor, fragrance, and medicine, peer scientists in the U.S. and other countries, K-12 educators, and policy-makers. For urban agriculture the audience includes farmers, landowners, state agencies and federal agencies, land use organizations, environmental groups, business and community leaders, families, students, and the general public.

3. How was eXtension used?

In 2015 the eXtension Institutional Team comprised of faculty and staff from across all planned program areas continue to provide the leadership for this work. This past year the team has focused on the following:

- Continuation of Social media plan and Ask an Expert
- On-line course development with Continuing and Professional Development
- Became a premier member of new eXtension structure-one specialist selected as I-corp member in climate change initiative.

Our Ag Week in early January 2015 was part of our social media campaign and targeted production practices.

The largest percentage of our Ask an Expert aspect of eXtension is focused on consumer horticulture and landscape. We average about 319 questions through this format on a yearly basis we answered 11% more questions than we did in 2014. Our Delaware State Fair exhibit once again featured the Ask an Expert aspect of our Extension program and we spoke to over 2000 individuals regarding this aspect of Extension program delivery.
We are currently in development of two online courses related to this goal area: Nutrient Management Certification and Beginning Farmer program.

V(E). Planned Program (Outputs)

1. Standard output measures

2015	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	44546	40949	721	0

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

Patent Applications Submitted

Year:	2015
Actual:	1

Patents listed
experimental avian infectious bronchitis virus vaccine, HT 1639

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2015	Extension	Research	Total
Actual	16	1	17

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Competitive Grants Awarded

Year	Actual
2015	63

Output #2

Output Measure

- Undergraduate Researchers

Year	Actual
2015	55

Output #3

Output Measure

- M.S.and Ph.D. Students

Year	Actual
2015	60

Output #4

Output Measure

- Post-doctoral Research Associates

Year	Actual
2015	17

Output #5

Output Measure

- Refereed Journal Articles

Year	Actual
2015	84

Output #6

Output Measure

- Books and Book Chapters

Year	Actual
2015	4

Output #7

Output Measure

- Extension Bulletins and Factsheets

Year	Actual
2015	49

Output #8

Output Measure

- Webpage views/downloads

Year	Actual
2015	53451

Output #9

Output Measure

- Workshops at State, National or International Level

Year	Actual
2015	40

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

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

Outcome #1

1. Outcome Measures

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

2. Associated Institution Types

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

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2015	333

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Blueberry Variety Selection Research and Education

Blueberries are a potentially profitable crop for Delaware growers, especially those who direct market. People interested in planting blueberries or with existing plantings have consulted Extension for advice on variety selection. The expense of blueberry plants and the long life of a planting (50+ years), makes choosing the right variety important. While there are sizable blueberry plantings in neighboring states, there are few commercial plantings in Delaware and there is limited research and information available to guide growers in variety selection for blueberries in our soils and climate. Southern highbush varieties could be useful in Delaware because of their heat tolerance but their cold hardiness in Delaware is unknown.

What has been done

Blueberry variety trials which included some southern highbush varieties were installed at the University of Delaware?s research farm in Georgetown, Delaware (25 varieties) and at Bennett Orchards in Frankford, Delaware (10 varieties). Most of the varieties were installed in 2011 and yield data has been collected from these plantings for three years. Field day tours of the Georgetown planting were held in July of 2014 and 2015 to allow people interested in growing blueberries to see plants growing and taste fruit from the varieties being trialed. Yield results from the trials have been presented at the field days and during Delaware Ag Week.

Results

Several varieties with high yield, vigorous growth and good fruit quality have been identified and are being recommended to growers. Some of these are southern highbush varieties. All of the southern highbush varieties exhibit more vigorous growth under summer conditions, but some have exhibited cold injury to flower buds. Other southern highbush varieties have experienced no winter injury and may be useful for commercial production in Delaware.
Forty-seven people attended a field meeting which featured the blueberry research at the Georgetown research farm on July 10, 2014. Because of a thunderstorm, we used photographs of the plants taken that day for a ?virtual tour? of the planting. We had berry samples from 15 of the varieties in the variety trial for people to taste and evaluate. We also conducted a survey of the participants. All of the respondents indicated that the workshop was ?helpful? or ?very helpful? in educating them on the opportunities and challenges in growing blueberries. Sixty-eight percent of the respondents indicated that the meeting increased their knowledge of variety selection. Twenty-one percent of respondents indicated that the meeting increased the likelihood that they would choose to plant blueberries commercially.
Thirty people attended a small fruit twilight meeting which featured the blueberry research. Eighty-three percent of those who responded indicated that the meeting had increased their knowledge of variety selection.

4. Associated Knowledge Areas

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

Outcome #2

1. Outcome Measures

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

2. Associated Institution Types

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

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2015	337

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Urban growing/selling produce

There are a limited number of fruit and vegetable crops that are produced and/or marketed in the urban areas in Newcastle County, in the State of Delaware and neighboring states. This is occurring at a time when immigrant and traditional communities around the Delaware region are demanding an increase in the availability of fresh, locally grown fruits and vegetables. These needs are addressed in the Planned Program area of Global Food security under the knowledge area codes 102, 205, and 602.

What has been done
Our objective focused on providing risk management education in enterprise diversification, varietal selection and crops production and marketing. The goal was to increase acreage /volume of production as well as to increase sales of fresh produce in and around the State of Delaware. The target audience was small, limited resource, minority and underserved populations in the City of Wilmington and Newcastle County, Delaware.

Results
Participants in this program increased adoption of recommended practices for growing and selling fruits and vegetables locally and regionally. Participants have increased their knowledge in ethnic crops production, food safety practices, harvesting and post-harvest practices as well as season extension, planning the farm business and marketing. It is estimated an additional 1500 pounds of crops valued at $3,000 retail were produced and/or marketed by participants that benefitted from urban agriculture programs conducted by Delaware State University in 2015. Most of the producers were grown by minority producers included women owned farms and gardens. Producers grew over 35 varieties of crops in Northern Delaware in 2015. Crops include traditional vegetables, arugula, broccoli, cabbage, thyme, watermelon, sweet potato and other crops. This list is by no means exclusive. Crops were sold to restaurants, retail stores, direct market, and internets sites and at festivals, produce was also sold or shipped to states such as New York. And some of the produce was given to charities as well.

4. Associated Knowledge Areas

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

V(H). Planned Program (External Factors)

External factors which affected outcomes

- Appropriations changes

Brief Explanation

Reduced IPM Funds

V(I). Planned Program (Evaluation Studies)

Evaluation Results

Onion Crops Alternative Issue: There has been commercial interest expressed in growing significant acreage of bulb onions as fresh market sweet onions, onions grown for fresh cut processing, and onions for frozen processing in Delaware. Currently, bulb onions are only grown on a very small scale in Delaware (less than 10 acres). Most of the currently supplies come from other areas of the country. Centers of production include New York and Michigan (storage onions), and Oregon, Washington, Texas, and Georgia (sweet types). Some sweet onion production occurs in neighboring Mid-Atlantic states (PA and NJ) to the north where a fresh market industry has been developed using hand set plants grown in plastic mulch. However, this system has significant growing and labor costs.
While there have been inquiries on a yearly basis for sourcing onions from Delaware, actual market potentials need to be explored. Therefore, potential markets for bulb onions will be measured by surveying processing companies, including frozen food and fresh cut firms, and wholesale produce buyers for supply needs and pricing.
What has been done: In this project, applied research focused on using information from previous small plot research to develop larger scale field trials including overwintering direct seeded, overwintering transplanted, early spring transplanted, and later spring transplanted production in conventional and plasticulture systems. This work addressed variety selection, plant production, stand establishment, planting date, spacing, weed control, insect management, disease management, fertilization, and harvest and curing procedures for Delaware conditions. The goal was not only to have successful production but also extended production.
Results: Research and economic evaluation activities completed included two years of large plot trials with bulb onions on production timing using promising varieties, two years of yield optimization studies with promising bulb onion varieties, three years of trials comparing conventional and plasticulture production systems for bulb onions on cooperating farms, two years of trials comparing direct seeded and transplanted production systems, and an evaluation of the economics of greenhouse transplant production vs. obtaining southern grown plants.
The overall goal of this project was to develop recommendations for growers on bulb onion production and marketing on a commercial scale in Delaware.

- This project showed that direct seeded bareground onions will not be economical, and therefore large scale processing onion production for freezing will not be recommended in Delaware.
- This project showed that bareground transplanted onion production is also not economical because of low yields and is not recommended.

- This project showed that plasticulture transplanted onion production is potentially economical for fresh processing and fresh market sweet onions and developed the following recommendations:
  - March plantings are needed. April plantings reduced the potential for producing large onions.
  - 120 lbs of N split into 2 applications with drip irrigation produced the best growth. This is 20 lbs/a more N than currently recommended.
  - Irrigation management is critical because of the small root systems and beds must be kept moist.
  - Prompt harvest once most onions reach 3" diameter is necessary to minimize bulb rots.
  - Thrips management will be critical for production in Delaware.
  - Small cell local greenhouse grown transplants produced good yields and may be an economic substitute for southern bareroot transplants.
  - A number of varieties were identified for use in Delaware, several with similar yields and better storage characteristics to Candy, the standard variety grown in the region.
  - This project showed that overwintering onions have some promise, and the Bridger variety was very versatile; however, there is still too much risk to growing overwintering onions in Delaware and overwintering onions cannot be recommended except as a trial currently in Delaware.

Results from this work has been presented in 2015 and will be presented again to growers in 2016 at the Fruit and Vegetable Growers Association of Delaware annual meeting at Delaware Agriculture Week reaching over 200 growers. Information on growing onions in Delaware has also been provided by distribution of extension publications through the University of Delaware. Two onion workshops/field days were held in 2014 and 2015 with 50 in attendance. In addition, websites were utilized as a vehicle to disseminate information to interested parties in Delaware and the region through the weekly crop update reaching an additional 200-300 growers. Findings from this work will be sent to seed companies, processing company personnel and wholesale buyers by the end of December 2015 to aid in decision making and interactions with growers. In addition to grower and processing company outreach, information from this study was presented to the Mid-Atlantic Vegetable Workers Conference in January 2015 and at the Southern Maryland vegetable meetings in February 2015 reaching an additional 250 growers. These all are measures of the short-term success of this project.

Long-term success of the project will be measured by an increase in bulb onion production in Delaware. Research has shown the promise of plasticulture production; however labor needs for plasticulture onions will probably limit production from previous estimates. While the original long term goal was to have at least 200 acres of onions being produced in Delaware after 5 years, a modified goal is to have 50-75 acres of onions in Delaware.

Potential growers and industry representatives interested in buying onions were the main beneficiaries of this project. Information on onion research was presented to over 200 potential Delaware growers at meetings and field days. Information published in the weekly crop update has reached an additional 200-300 growers in the region. Findings from this work will be sent to nine seed companies, two frozen vegetable processing companies, four wholesale buyers and two fresh cut processors. Information presented at the Mid-Atlantic Vegetable Conference in January 2015 and at the Southern Maryland vegetable meetings in February 2015 reached an additional 250 growers.

Exploring epigenomes in common bean (Phaseolus vulgaris) under pathogen and drought stress pressure

Common bean is an important food legume consumed primarily for its protein and dietary fiber and is also a rich source of micro and macronutrients. A large portion of the global

population depends on common bean and other legumes for dietary protein. Demands for legumes are increasing globally and as production increases so also are the production challenges. About 62% of biotic and 37-67% of abiotic stress factors affect the yield and quality of common bean. Dr. Kalavacharla and his team of postdoctoral fellows, graduate and undergraduate students at the Molecular Genetics and Epigenomics laboratory have developed integrative approaches to understand common bean epigenome as affected by bean rust fungus (Uromyces appendiculatus) and drought. Using Chip-seq analysis to identify DNA-protein interactions across the genome, and RNA seq analysis to understand gene expressions at global level they have observed DNA methylations across the genome as well as for selected genes. By isolating cloneing and amplifying, and certain methyl transferases and histone acetylases and deacetylases, researchers now have a better understanding of the important roles they play in epigenome modifications and epigenetic gene regulations.

Issue: Fusarium Head Blight - Wheat is the third most valuable field crop in Delaware, with a production estimate of $27,000,000 in 2014/15. Fusarium head blight (FHB) is considered by the USDA to be the most damaging and important disease of small grains since the rust outbreaks of the 1950's. This disease has resulted in significant reductions in yield, grain quality, and grower profitability in Delaware as recently as 2013. Initial discussions with growers at that time indicated a need for education and applied research to improve management of this disease in Delaware and the mid-Atlantic region.

Response: To address these deficiencies, an applied research and educational program was developed to improve awareness and management of FHB in wheat grown in the mid-Atlantic. Applied research included USDA-ARS funded projects examining potential integrated management practices for managing FHB as well as large scale grower demonstrations to assess management practices on FHB and grain quality. Demonstrations were conducted with growers and consultants representing roughly 13,195, or 20%, of the 2015 wheat crop in Delaware.

Results: Results of the 2015 demonstrations showed the efficacy and utility of incorporating moderately resistant varieties and properly times and labeled fungicides for scab management as well and the role of irrigation in FHB development and mycotoxin accumulation in grain. All participants indicated that they learned something that would benefit their future operation including proper irrigation (40%), proper fungicide application and effectiveness (20%) and variety selection (20%).

In addition, the extension plant pathologist worked with the Delaware state climatologist to integrate DEOS weather monitoring systems into the Fusarium head blight prediction center interface (www.wheatscab.psu.edu). This collaboration resulted in the addition of over 50 weather systems into the interface, enabling growers and industry access to more accurate weather and disease forecasting data, and resulting in Delaware having the highest FHB prediction resolution in the United States.

Educational programs that addressed FHB management included five face to face industry and grower talks presented to 467 growers and agriculture professionals in Delaware and Maryland. Six articles were published in regional newsletters and an additional four articles were posted online at the Field Crop Disease Management Blog, which averages between 750-1400 views per month. An invited online session was delivered to 35 Industry agronomists and CCA's in 23 states, representing over 1850 growers producing more than 95,500 acres of wheat. Of the 11 survey respondents, 100% indicated that they learned a new management strategy. All respondents indicated that they will use something learned in the talk, such as suggesting their growers integrate management practices to suppress FHB. Four respondents placed the value of the information at between $10-25 /A, five respondents indicated the value of the information was between $25-50 /A, and two

placed the value at over $100/A. Taken collectively, the value of the information could result in over $4.9 million in production value across wheat growing regions of the central and Eastern United States.

Research:
Collaborative research is being conducted examining aspects of the ecology of soil microorganisms as related to plant (soybean) productivity. This work will eventually be useful in enhancing soybean production in an environmentally friendly manner. To date, this work has focused on certain bacteria (rhizobia) that supply the soybean plant with nitrogen in the absence of commercial fertilizers. In particular, it has examined the role of soil viruses in ecology and effectiveness of these bacteria. Two peer-reviewed journal articles have been published and two more are in preparation on these general topics. The research is on-going.

Developed experimental avian infectious bronchitis virus vaccine, HT 1639. Signed a MTA/Research Agreement with Amick Farms to field test the vaccine in Delmarva broilers chickens under USDA 9CFR Part 107. Amick has used the vaccine in 100% broilers produced since early January 2016. If vaccine improves broiler performance, will consider developing a UD invention disclosure. Will also seek to license vaccine to commercial vaccine company.

USDA NIFA funded research is determining the bacterial and viral composition of the avian respiratory tract. This avian respiratory microbiome can be used to evaluate and study avian respiratory diseases in the context of the interactions between various bacterial, viral, and host components.
Lighting is a major concern for the poultry industry because birds are raised in controlled conditions. Incandescent lamps have been the major lighting source for many years, but newer technologies such as LED lamps offer potential benefit. Our group has systematically analyzed over 315 lamps and lamp controllers (dimmers) combinations and made the results available for growers.

"Potential Farmer Adoption of High / Available Phosphorus Corn over a Three-year Period" was in the publication process during this time period. High Available Phosphorus corn is an option for reducing phosphate use and runoff and so farmer acceptance is critical. The results show that farmer acceptance is possible but yield drag and technology fees have impact and premiums may well be needed.

High Tunnel Production Issue: Use of High Tunnels in production of vegetable crops and small fruits is growing in Delaware. The mild winter temperatures have allowed for all year production with more cool temperature vegetables being produced using season extension techniques.
A USDA sponsored capacity building grant has enabled Cooperative Extension to strengthen the Smyrna Outreach Research Center (SORC) as a hub for high tunnel production demonstration in a bid to increase horticultural activities among growers. For the last three years, two high tunnel based workshops have been carried out at SORC with a remarkable average attendance of 48 growers. A total of 79 site visits were paid to grower high tunnels and up to 40 visits to the high tunnels were reported during the period. The **Environmental Quality Incentive Program (EQIP)** has enabled growers install high tunnels by providing financial support.
Results:
-Up to 20 high tunnels have been put up by growers, mostly with the help from

Delaware EQIP- program.
-75% of the attendees have learned skills that help in managing their high tunnels.
-55% of the attendees have incorporated Integrated Pest Management (IPM) Techniques in their management programs from aspects learned during the workshops.
-10% of the attendees are looking into putting up season extension structures to extend their production period.

Eastern Oyster Aquaculture Grow-out Gear Comparison in Lewes, DE, Determining the Remote Set Efficiency in Delaware's Oyster Gardening Program, and Oyster Spat Surveys to Assess the Distribution of Oyster Spat Settlement in the Delaware Inland Bays.
Dr. Ozbay and her team assess different gear types used to grow hatchery raised Eastern oysters in the Broadkill River, near Lewes, DE. Efficiency was assessed by measuring the oyster spat set at various remote set containment gears and by monitoring growth rates and water quality. This was compared with the distribution of naturally occurring oyster spat throughout the Delaware Inland Bays.
These projects targeted the community in order to increased awareness among the citizens and potential commercial aquaculture growers in DelMarVa region on coastal habitat conservation, regulators of water quality. The information generated will help the enhancement of diverse marine communities, and protection of natural shorelines trough oyster research activities and oyster rehabilitation as a healthy food source.
The research partners for this program include University of Delaware Sea Grant Program, Oyster Gardening Program Volunteers, Center for the Inland Bays, DE DNREC DNERR, Rider University, Morgan State University, DuPont Clear into the Future Program Staff, CIBER, UD and other collaborators.
The research compared oyster growth-out methods and measured water quality parameters including temperature, dissolved oxygen, salinity, conductivity, pH, turbidity, total suspended solids, and hardness at the area and in the water column where the oysters were grown. The findings provided a better understanding of the potential impacts of various aquaculture methods on the biodiversity and ecosystem services provided by oysters and aquaculture structures. This activity will be extended to multiple locations and extended for a longer growing period. The information will provide baseline information to the potential shellfish farming business.

Key Items of Evaluation

Continued capacity funding for IPM programming is critical.

V(A). Planned Program (Summary)

Program # 2

1. Name of the Planned Program

SAFE AND SECURE FOOD SUPPLY FOR HUMAN NUTRITION AND HEALTH

☑ Reporting on this Program

V(B). Program Knowledge Area(s)

1. Program Knowledge Areas and Percentage

KA Code	Knowledge Area	%1862 Extension	%1890 Extension	%1862 Research	%1890 Research
501	New and Improved Food Processing Technologies	5%	5%	5%	5%
703	Nutrition Education and Behavior	25%	25%	25%	25%
704	Nutrition and Hunger in the Population	10%	10%	10%	10%
712	Protect Food from Contamination by Pathogenic Microorganisms, Parasites, and Naturally Occurring Toxins	20%	20%	20%	20%
723	Hazards to Human Health and Safety	5%	5%	5%	5%
724	Healthy Lifestyle	10%	10%	10%	10%
806	Youth Development	25%	25%	25%	25%
	Total	100%	100%	100%	100%

V(C). Planned Program (Inputs)

1. Actual amount of FTE/SYs expended this Program

Year: 2015	Extension		Research	
	1862	1890	1862	1890
Plan	8.5	6.6	14.8	1.2
Actual Paid	4.7	6.0	12.6	2.4
Actual Volunteer	0.0	0.0	0.0	0.0

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

Extension		Research	
Smith-Lever 3b & 3c	**1890 Extension**	**Hatch**	**Evans-Allen**
205375	481240	5319	396867
1862 Matching	**1890 Matching**	**1862 Matching**	**1890 Matching**
262014	481240	46244	396867
1862 All Other	**1890 All Other**	**1862 All Other**	**1890 All Other**
559181	0	1831967	1598780

V(D). Planned Program (Activity)

1. Brief description of the Activity

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

II. Food Safety
Research efforts involve high pressure processing to reduce bacteria, viruses, protozoan oocysts, and bacterial endospores; inactivation of pathogenic bacterial species with high pressure and mild heat; using various antimicrobial films to control bacteria, such as Listeria monocytogenes; physiological and genetic analysis of pressure-resistant Listeria monocytogenes; testing of activity of antimicrobial films against native and inoculated bacteria on foods and surfaces; effects and mechanisms of non-thermal processes (ozone, UV, oxidative chemicals, iron, and/or high pressure processing) on protozoa, human pathogenic viruses, and bacteriophage, and increase understanding of basic biochemistry of these microorganisms.

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

2. Brief description of the target audience

Adults, youth, particularly low income adults and youth, 4-H adult and teen volunteers, as well as Master Food Educators are the primary target audiences for the Extension programs. Community groups and

health organizations will be another audience but also partners in outreach efforts.

3. How was eXtension used?

In 2015 the eXtension Institutional Team comprised of faculty and staff from across all planned program areas continue to provide the leadership for this work. This past year the team has focused on the following:

- Continuation of Social media plan and Ask an Expert
- On-line course development with Continuing and Professional Development
- Became a premier member of new eXtension structure-one specialist selected as I-corp member in climate change initiative.

The social media strategy particularly focused on safe and secure food supply issues during targeted holiday seasons as well as during food preservation time.

V(E). Planned Program (Outputs)

1. Standard output measures

2015	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	11829	30577	34338	2921

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

Patent Applications Submitted

Year:	2015
Actual:	0

Patents listed

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2015	Extension	Research	Total
Actual	0	5	5

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Competitive Grants Awarded

Year	Actual
2015	27

Output #2

Output Measure

- Undergraduate Researchersw

Year	Actual
2015	4

Output #3

Output Measure

- M.S. and Ph.D Students

Year	Actual
2015	10

Output #4

Output Measure

- Post-doctoral Research Associates

Year	Actual
2015	1

Output #5

Output Measure

- Refereed Journal Articles

Year	Actual
2015	5

Output #6

Output Measure

- Books and Book Chapters

Year	Actual
2015	0

Output #7

Output Measure

- Extension Bulletins and Fact Sheets

Year	Actual
2015	19

Output #8

Output Measure

- Webpage views/downloads

Year	Actual
2015	19048

Output #9

Output Measure

- Workshops at State, National, and International Level

Year	Actual
2015	1270

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O. No.	OUTCOME NAME
1	Nutrition and Health: Increases in the knowledge, skills and plans to adopt and/or adoption of healthful diet practices and/or physical activity
2	Food Safety: Increases in the knowledge, skills and plans to adopt better food safety/food handling practices. The number of people certified in safe food handling practices. Basic and applied research will lead to enhanced safety and wholesomeness of foods as a result of improved understanding of the mechanisms whereby food pathogens exist, enter, survive, propagate and actuate disease syndromes in individuals who consume contaminated products. Gene-based methods to rapidly and accurately identify food-borne pathogens will increase the safety of food products.
3	Healthy Living: Increases in the knowledge, skills and plans to adopt and/or adoption of health literacy and chronic disease management and prevention skills. Increases in the knowledge, skills and plans to adopt and/or adoption of practices to prevent accidents and injuries. Increases in the knowledge, skills and plans to adopt and/or adoption of practices to prevent bullying and suicides. Increases in the knowledge, skills and plans to adopt and/or adoption of positive behaviors regarding health and legal risks of using tobacco, drugs, and alcohol.

Outcome #1

1. Outcome Measures

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

2. Associated Institution Types

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

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2015	14518

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
4-H Food Smart Families 2015
Skills learned as children are important as those children become adults. Based on consumption studies, we know that Americans are not consuming the recommended amounts of vegetables, fruits, whole grains, and low-fat dairy products. Additionally, many adults do not have food preparation skills to prepare simple meals thereby relying on eating out or convenience foods.

What has been done
EFNEP staff and individuals trained by UD Cooperative Extension staff presented lessons to youths on each of the food groups. Fun activities emphasized the importance of each of the groups, information on purchasing, and preparing a dish safely. Each day the youth participated in some type of physical activity that they could do at home.
A major part of the curriculum dealt with developing food preparation skills. Children prepared individual salads in a bag, which included kale that they massaged to improve the flavor and texture, and another salad green. From two or three choices, they selected one vegetable, a fruit, an item to add crunch and color, and a protein. They added cheese, croutons, and salad dressing containing no oil. The bag was closed and shaken to mix the salad. Additional recipes included Mexicali Eggs, Corn and Spinach Sauté, One Pan Pasta, and homemade ice cream prepared with whole and evaporated milk to reduce the fat. Children also measured out ingredients for homemade whole wheat bread in the bag.
Each child received a bag with ingredients to finish the bread and to prepare the one pan pasta at home for their family. In addition to the food, each child received a bag containing measuring spoons, measuring cups, a cutting board and a copy of the recipes used that week.

Results

Between June 2015 and the end of December 2015, approximately 2,459 youth participated in the Food Smart Families...Kids in the Kitchen program. Seventy-nine percent improved one or more skills or knowledge needed to meet dietary guidelines. Specifically, 32, 25, and 22 percent improved their response to eat healthy snacks, eat vegetables, and eat fruits, respectively. In response to questions about asking someone to buy fruits and vegetables, 21 percent indicated they would do so while 30 percent said they would ask someone to buy low-fat milk.
Comments from children and others:
?"This salad is so good. Can I have the recipe?"
?Many never tried kale, water chestnuts, corn, peas, or fruit in salads.
?One 23-year old councilor at a site had never eaten salad; he had to text a picture to his mom with him and the salad he created.
?"This spaghetti is 'jumpin'." (Slang for very good.)
?Several campers said they made One Pot Pasta on the night they received their bag.
?"This spinach is sooo good."
?"I don?t want to drink water because I don?t want the spaghetti taste to go away!?
?"You are the best cook." (Spinach and Corn Sauté)
?"Keep making this. I could eat this three meals a day". (Spinach and Corn Sauté).
?"We should try this (Spinach and Corn Sauté) with kale."
?Comments on the bread in a bag measuring ? "This is fun!"
?"Can we have more bread? It is so good." (Instructors brought a loaf of bread in the bag so children could taste it.)
?"This is the best ice cream I have ever had!"
?"Will you be back on Monday?"

4. Associated Knowledge Areas

KA Code	Knowledge Area
703	Nutrition Education and Behavior
704	Nutrition and Hunger in the Population
724	Healthy Lifestyle
806	Youth Development

Outcome #2

1. Outcome Measures

Food Safety: Increases in the knowledge, skills and plans to adopt better food safety/food handling practices. The number of people certified in safe food handling practices. Basic and applied research will lead to enhanced safety and wholesomeness of foods as a result of improved understanding of the mechanisms whereby food pathogens exist, enter, survive, propagate and actuate disease syndromes in individuals who consume contaminated products. Gene-based methods to rapidly and accurately identify food-borne pathogens will increase the safety of food products.

2. Associated Institution Types

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

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2015	3994

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Servsafe® and Dine Safe Food Safety Education for Quantity Food Handlers

The Centers for Disease Control estimates that each year roughly 1 in 6 Americans (or 48 million people) get sick, 128,000 are hospitalized, and 3,000 die of foodborne diseases. In addition, about two to three percent develop some type of long-term health problem such as Guillain-Barré syndrome, reactive arthritis, and renal disease. The Centers for Disease Control suggests that 70 percent of the foodborne outbreaks in the U.S. can be traced to some handling mistake in a quantity foodservice establishment. Therefore, food handlers in these operations must be aware that their food handling practices can reduce the risk of developing a foodborne illness.

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

Results
During the last year (2015), University of Delaware Cooperative Extension has reached 587 quantity foodservice workers in the ServSafe® program (a 34% increase from 2014) and 199 participants in the Dine Safe program. As a result of participating in the trainings, attendees will personally or have their staff do the following:
?93% will wash hands more frequently.
?82% will calibrate thermometers on a regular basis.
?76% will keep hot foods at or above 135°F.
?86% will use sanitizers correctly, including checking concentration.
?86% will thoroughly wash and sanitize all food surfaces before preparing a different food item.

4. Associated Knowledge Areas

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

Outcome #3

1. Outcome Measures

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

2. Associated Institution Types

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

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2015	8933

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Dining with Diabetes

In Delaware, as is evident throughout the United States, there is a need for more diabetes education as only 51 percent of those diagnosed with diabetes have taken a class about managing their diabetes, according to the 2012 BRFS. Diabetes is the seventh leading cause of death in the United States, however, Delaware?s overall age-adjusted mortality rates have been decreasing for persons with diabetes over the past 20 years. The long-term health consequences of untreated or high blood sugar levels are staggering and results in such problems as blindness,

heart disease, amputation of limbs, and renal failure. As of 2014, about 11 percent of the Delaware population reported having been diagnosed with diabetes, and this number has been steadily increasing, keeping pace with the increasing rate of pre-diabetes and diabetes in the country.

What has been done

Dining with Diabetes consists of three classes that provide diabetes education, cooking demonstrations and tasting of healthy foods. The first class focuses on desserts, the second class focuses on main dishes, and the last class focuses on side dishes. After each lesson, the participants take home recipes and diabetes resources, as well as knowledge on how they can manage their diabetes on a daily basis. This program teaches its participants about reducing sugar, salt and fat without giving up on taste.

Results

In 2015, a total of 29 individuals enrolled in the Dining with Diabetes workshop series held once in the winter and once in summer in New Castle County and once in the fall in Kent County. As a result, attendees reported eating more vegetables (69 percent), eating more fruits (53 percent), reading Nutrition Facts labels (61 percent), reading ingredient labels (66 percent), being more physically active (44 percent), more likely to eat on a regular basis (70 percent), and more likely to eat breakfast (65 percent). Furthermore, planning healthier meals, using different artificial sweeteners, and using better portion control were noted as additional ways to manage their diabetes by 66, 44, and 84 percent of participants, respectively.

4. Associated Knowledge Areas

KA Code	Knowledge Area
724	Healthy Lifestyle
806	Youth Development

V(H). Planned Program (External Factors)

External factors which affected outcomes

- Public Policy changes
- Government Regulations

Brief Explanation

Food Safety Legislation regarding public eating facilities increased both the demand for programming and the competition to others providing the mandated education.

V(I). Planned Program (Evaluation Studies)

Evaluation Results

Community Gardens

Issue: In New Castle County, the number of community gardens has increased dramatically in the last few years. Many of these gardens serve low-income communities. Often managers and participants have little experience in growing and handling produce. Because of the importance of good agricultural practices that apply to individuals associated with community gardens, educational programs for these individuals are crucial.

Response: For the last two years, New Castle County Extension staff addressed these concerns by training garden managers and participants on how to safely grow fruits and vegetables. The program is modeled after the Good Agriculture Practices/Good Handling Practices (GAP/GHP) training for commercial fruit and vegetable growers. Emphasis is placed on soil amendments, water quality, personal hygiene, and sanitation of equipment.
Results: Survey results in 2015 revealed that 95 percent of the participants had a better understanding of the need to protect individuals from unsafe produce, their role in producing safe produce, how water and fecal material can contaminate produce, and the importance in good personal hygiene. All respondents indicated that they had a better understanding that microorganisms can contaminate produce. In terms of the actual practices in growing produce as a result of the training, 77 percent reported they would wash and sanitize harvesting tools and equipment while 88 percent said they would monitor chlorine levels in wash water, eliminate contamination in the garden from wildlife/pets, compost wastes to eliminate harmful microorganisms, and store composted material to reduce cross contamination, respectively.

Research projects to use dietary strategy for cancer prevention, including a research project on molecular targets of soy food intake on prevention of prostate cancer in 2015 Experimental Biology Annual meeting.

Evaluating the toxicity and safety of BPA biobased replacement; in order to address high rate of negative attitudes toward traditionally synthesized antimicrobials by consumers, the group is also working with USDA ARS Eastern Regional Research Center under a research agreement to study novel antimicrobial compounds. To enhance food quality and safety for public, the group is working with collaborators to develop novel application of pulse light food processing to extend food shelf-life and reduce microbial contamination.

Protecting the food supply from dangerous bacterial pathogens is of great importance to our food production systems. As we strive to ensure the safety of our food supply, we must consider the possible role that communities of harmless microorganisms play in preventing the contamination of food by pathogenic bacteria and viruses. We have leveraged state-of-the-art DNA sequencing technologies for examining communities of microorganisms associated with the hide and gut of cattle. We have found that the composition and diversity of these communities changes with the presence of pathogenic E. coli. The absence of E. coli corresponded with a more diverse bacterial community consisting of bacterial species typically found in soils. This work was recently published in the open-acess journal entitled: Microbiome. This work lays a groundwork for understanding how natural bacterial communities might have a beneficial effect on improving food safety.

The focus was on investigating effects of surface properties on microbial contamination of fresh produce. We systematically examined the effects of surface roughness, topography, and hydrophobicity on colloid (used as surrogates for bacteria) retention number, aggregation, and ease of removal. We found that water distribution, which is affected by surface properties, is the best predictor on colloid retention and removal. Such findings are useful for developing effective cleaning methods.

Botvin Life Skills Program Middle School and Elementary School Impact:
Issue:
The Botvin Life Skills Training, a research-validated effective substance abuse prevention program, is implemented to prevent the onset of cigarette and tobacco use among

Delaware youth. Preventing the use of cigarettes among Delaware youth as a gateway drug will help prevent the onset of our youth from using alcohol, marijuana, and other illicit drugs.
Even though youth and adult tobacco use has been decreasing over the years, each year, a new group of students has more access to tobacco ads and faces a greater amount of peer pressure. With more youth receiving education about drug abuse, there is a decline in tobacco and alcohol use.
Response: The Botvin Life Skills Program was taught in private schools, afterschool programs, public schools, and community programs across Delaware to middle and elementary school students. The Botvin Life Skills Program helps to increase the knowledge of the consequences of tobacco and other substance use/abuse. The Botvins program also helps to prevent and/or decrease the use of tobacco and other substance use and abuse.
Results: The middle and elementary school students that participate in the Botvin Life Skills Program take a pre and post questionnaire. The questionnaire summaries are prepared by National Health Promotion Associates, Inc. The summaries will show the students' anti-drug knowledge, relaxation knowledge, social skills knowledge, advertising knowledge, communication knowledge, smoking attitudes, drinking attitudes, drug refusal skills, and life skills use.
Botvin Accomplishment report
Middle School Outcome Evaluation
Drug Refusal Skills post test (n=73) indicated that:
7% increase (97%) post test score of students said that they would say "no" when someone tries to get them to smoke a cigarette
7% increase (96%) post test score of student that would say "no" when someone tries to get them to drink beer, wine, or liquor
Life Skills posttest (n=73) indicated that:
11% increase (70%) students indicated that they would say "no" to someone who asked to borrow money from them
Anti-Drug Knowledge post test (n=74) indicated that:
19% increase (42%) students indicated they learned that Marijuana smoking decreases your eyesight
24% increase (65%) students learned that a stimulant is a chemical that speeds up the body

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Elementary School Outcomes Evaluation
Life Skills post test (n 152) indicated that:
13% increase (59%) indicated they would tell someone to move if they cut ahead of them in line
11% increase (57%) indicated when they feel nervous or stressed out, they should take deep breaths to relax
Anti-Smoking post test (n=155) indicated that:
25% increase (98%) indicated they learned smoking cigarettes causes mouth cancer
18% increase (82%) indicated they learned cigarette smoking causes your heart to beat faster
Life Skills Knowledge post test (n=155)
16% increase (78%) indicated they learned stress can cause you to get sick
14% increase (91%) indicated they learned that a good way to refuse to do something is to be assertive
Health Rocks Impact Statement
Issue:
According to the Government study "Monitoring the Future" funded by the National Institute

of Health, tobacco use continues to fall among grades 8, 10 and 12 but there is an increase of "other tobacco products - electronic cigarettes and cigars that are sold in an array of sweet, kid-friendly flavors - (and) may be undermining these gains and luring kids into nicotine addiction" as stated by Tobacco Free Kids.org in response to this study.

From 2011 to 2014, past 30-day use of e-cigarettes increased nine-fold for high school students (1.5% to 13.4%) and more than six-fold for middle school students (0.6% to 3.9%). In June of 2014, Delaware passed a law that the sale of e-cigarettes to minors is illegal. Since the data on e-cigarettes is still new and seemingly from federal studies, it is important to continue the educational outreach to middle school and high school youth on the dangers of not just tobacco, but all tobacco related products.

Also in the studies and news are the statistics on the growing use of opiates (prescription drugs), and heroin in Delaware as reported by the News Journal and nationally as reported by the Center for Disease Control.

Response:

In 2015, Delaware 4-H reached 5,962 youth at 109 locations statewide with over 10 hours of Tobacco, Drug, and Alcohol Prevention Life Skills through the Health Rocks Curriculum. (23 of the sites were new sites including a new school district...Colonial). Delaware 4-H facilitates 10 lessons of Health Rocks, has participants complete homework, posters, and community projects while teachers facilitate additional hours both prior and after our delivery of the curriculum. (The Delaware Department of Education requires students in grades 5-12 to complete 15 hours of Tobacco, Drug and Alcohol prevention based on Health Education Standards each year so teachers are increasingly excited to partner with us).

This year Delaware Health Rocks staff updated curriculum to include information about the dangers of e-cigarettes which students had perceived to be lower risks. We also expanded the content on Marijuana which students were perceiving as a lower risks prior to our teaching.

Results: A questionnaire with retrospective measures, developed and analyzed by a team from the University of Nebraska, assessed participants' self-reported increase in knowledge, skills and potential for positive behaviors after participating in the program.

Youth understanding of the addictive nature of cigarette use increased across all demographic by 14% to 86.3%.

95.9% of youth understood after the training that substance use could ruin their relationships with friends and family members, an 8% increase.

Youth also learned skills in how to say no to risky behavior (an 8% increase).

Key Items of Evaluation

V(A). Planned Program (Summary)

Program # 3

1. Name of the Planned Program

FAMILY AND YOUTH DEVELOPMENT

☑ Reporting on this Program

V(B). Program Knowledge Area(s)

1. Program Knowledge Areas and Percentage

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

V(C). Planned Program (Inputs)

1. Actual amount of FTE/SYs expended this Program

Year: 2015	Extension		Research	
	1862	1890	1862	1890
Plan	9.8	2.9	0.9	0.3
Actual Paid	7.7	6.0	0.0	0.0
Actual Volunteer	0.0	0.0	0.0	0.0

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

Extension		Research	
Smith-Lever 3b & 3c	**1890 Extension**	**Hatch**	**Evans-Allen**
211784	429134	0	0
1862 Matching	**1890 Matching**	**1862 Matching**	**1890 Matching**
360206	429134	0	0
1862 All Other	**1890 All Other**	**1862 All Other**	**1890 All Other**
2436932	29844	0	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

Extension programs will target: (1) Science, Technology, Engineering, and Math (STEM) for youth development, (2) Volunteer and Leadership Development, and (3) Farm, Small Business and Family Resource Management.
Science, Technology, Engineering, and Math (STEM) will be a key component of 4-H Youth Development programs. Incorporating a youth assets approach, 4-H programs will focus on life skills development, positive life choices, leadership development, citizenship/community involvement, and career exploration with emphasis on science, engineering and technology knowledge. Appropriate settings including clubs, camps, school enrichment and after school will use the latest technology to deliver the sustained opportunities. All programming will encompass the latest research on positive youth development and will incorporate the components of positive and sustained adult-youth relationships; life skills-building activities for youth; and opportunities for youth participation in and leadership of valued community activities.

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

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

2. Brief description of the target audience

The target audience includes:Youth ages 5-19, 4-H members, 4-H volunteers, new 4-H volunteers, Master Gardeners, Master Food Educators, Community Leaders, at-risk youth and families, court appointed and incarcerated youth and adults, parents of children (from birth through school-age), youth agency professionals, key decision-makers, human service professionals, child care/after school providers, family day home providers, social clubs, church groups, private and public school youth and teachers, after school 4-H clubs and school age child care programs, farm owners and farm families.

3. How was eXtension used?

In 2015 the eXtension Institutional Team comprised of faculty and staff from across all planned program areas continue to provide the leadership for this work. This past year the team has focused on the following:

- Continuation of Social media plan and Ask an Expert
- On-line course development with Continuing and Professional Development
- Became a premier member of new eXtension structure-one specialist selected as I-corp member in climate change initiative.

The social media strategy is particularly effective with our youth development program. 4-H has specific pages and posts as well as a focus on alumni gathering through social media efforts.
We are in early stages of developing on line training in key competency areas for volunteer development.

V(E). Planned Program (Outputs)

1. Standard output measures

2015	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	10631	4724	11033	618

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

Patent Applications Submitted

Year:	2015
Actual:	0

Patents listed

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2015	Extension	Research	Total
Actual	0	0	0

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Competitive Grants Awarded

Year	Actual

2015	24

Output #2

Output Measure

- Undergraduate Researchers

Year	Actual
2015	1

Output #3

Output Measure

- M.S. and Ph.D Students

Year	Actual
2015	0

Output #4

Output Measure

- Post-doctoral Researchers

Year	Actual
2015	0

Output #5

Output Measure

- Refereed Journal Articles

Year	Actual
2015	0

Output #6

Output Measure

- Books and Book Chapters

Year	Actual
2015	0

Output #7

Output Measure

- Extension Bulletins and Fact Sheets

Year	Actual
2015	21

Output #8

Output Measure

- Webpage views/downloads

Year	Actual
2015	113694

Output #9

Output Measure

- Workshops and regional, national, and international levels

Year	Actual
2015	12

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

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

Outcome #1

1. Outcome Measures

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

2. Associated Institution Types

- 1862 Extension
- 1890 Extension

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2015	174

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Summer Evening of STEM
According to the 2014 Leaders and Laggers report on K-12 STEM Education, commissioned by the U.S. Chamber of Commerce, Delaware earned low grades in technology education, and overall, a low return on its educational investment. Delaware received average grades in progress from a similar report issued in 2007. As part of the $10,000 grant awarded to Delaware 4-H by HughesNet and National 4-H Council, the ?4-H Summer Evening of STEM? event aimed to reinvigorate interest in STEM education and spur awareness in the diverse careers made available to Delaware students who are motivated to select science, technology, engineering and math as central to their course work.

What has been done
Delaware 4-H is a leader in STEM education and the organization is committed to exposing all youth in Delaware to as many STEM opportunities as possible through special events, day and overnight camping and afterschool programming. 4-H?s model of experiential learning is one of proven excellence. The goal of ?4-H Summer Evening of STEM? seeks to expose more Delaware children to this model.
While many youths are putting learning on the backburner during the summer, approximately 100 Delaware youth used their free time to raise awareness of STEM curriculum and began the process to elevate Delaware?s current middle-level ranking of STEM education to a that of a leading STEM educator in the nation ?The First State of STEM. In response, Delaware youth participated in the ?Innovation Incubator? science activity made possible by a $10,000 grant from HughesNet®, the nation?s #1 satellite Internet service from Hughes Network Systems, LLC (Hughes). For the activity, youth actively engaged in several STEM stations which included STEM careers, rocket construction, environmental science, robotics, and learning the properties of

healthy soils.

Results

As a result of this program, where Strongly Agree = 4, Agree = 3, Disagree = 2, Strongly Disagree = 1

I liked learning about this subject. 3.13 I learned how to use a new technology today.

I learned more about a new technology today. 3.17 I can name one way science, technology, or engineering can be used to help my neighborhood.

I can see myself using this technology in my career. 3.23 I want to learn more about science, technology, or engineering.

I understand how science, technology, or engineering can solve problems.3.31 I would like to use this technology again.

I want to learn more about this subject. 3.28 I am more aware of careers in science, technology, or engineering.

3.18 I would like to learn how to use other technologies.

4. Associated Knowledge Areas

KA Code	Knowledge Area
803	Sociological and Technological Change Affecting Individuals, Families, and Communities
806	Youth Development
901	Program and Project Design, and Statistics

Outcome #2

1. Outcome Measures

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

2. Associated Institution Types

- 1862 Extension
- 1890 Extension

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2015	201

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Master Food Educators

Expanding Cooperative Extension?s Reach into Communities through Volunteer Development

There is a trend toward marketing and selling fresh produce by the agricultural community at farmer?s markets and supermarkets with the message of buying local and fresh. The consumer challenge is that many individuals do not know how to prepare foods in a healthy manner or how to keep food safe.

These figures show a great need for the nutrition programs that UD Cooperative Extension has to offer. But with few full-time staff to address the nutrition and wellness concerns of clientele, Cooperative Extension needed to increase its capacity to reach citizens of Delaware.

What has been done

Master Food Educator Volunteer Program

This year?s Master Food Educator Program focused on skill development and workshop design for the 22 active volunteers. Advanced trainings scheduled bi-monthly in New Castle and Kent counties helped volunteers increase knowledge and confidence about nutrition, food science, wellness, food preparation, and food safety. In addition, requesting volunteers to provide presentations and conduct food demonstrations for their peers at workshop committee meetings and advanced training's strengthened presentation skills and instilled confidence in volunteers to provide information to the public.

Cooperative Extension recruits, screens and trains community volunteers. The organization links volunteers to volunteer opportunities and provides the research-based resources used during these events or presentations. Ongoing ?advanced? training and business meetings continue the volunteers? professional development and guide volunteers to new opportunities for outreach. The Extension educators coordinate the efforts and link volunteers with the outreach opportunities ensuring that the materials and resources are ready and the volunteers are trained to support the initiative in which they are involved.

In addition, community nutrition students and dietetic interns who volunteer with UD Cooperative Extension often assist in the development of resources to support this group by conducting literature reviews or developing workshop sessions.

Results

During the 2015 program year 22 Master Food Educators (MFE?s) volunteered to support 32 workshops, 36 public events and assisted in judging 3 events giving just over 775 hours to Cooperative Extension?s outreach efforts. This has an approximate economic value of $17,879 (based on $23.07/hour 2015 values from Independent Sector.org).

?Staffing Displays at 36 Public Events

?Making 32 presentations or conducting workshops
?Assisting Extension with over 19 programs
?Interacting with families and individuals during National Public Health Week
MFE?s reached 2,390 individuals through their workshops and public event efforts.
The summary of the evaluation survey conducted as a part of the Eating Heart Smart workshops conducted by volunteer Karen Sommers at the Glasgow/Bear YMCA
?What ideas or practices do you plan to try as a result of this workshop?? respondents indicated:
?Research the Dietary Approaches to Stop Hypertension (DASH) diet;
?Check out Choosemyplate.gov;
?Be more aware of food labels and try recipe substitutions;
?Eat more fruits and less salty meats;
?And a number indicated they would ?Use the information presented now or in the future?

4. Associated Knowledge Areas

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

Outcome #3

1. Outcome Measures

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

2. Associated Institution Types

- 1862 Extension
- 1890 Extension

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2015	2883

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Farm Bill Education in Delaware

The 2014 Farm Bill brought many program changes that farmers in Delaware and throughout the country would need to understand in order to make informed decisions to manage the financial risk associated with milk and crop production.

The authorized programs, Ag Risk Coverage and Price Loss Coverage, were designed to guarantee farmers some level of revenue protection and/or price protection for specific commodities. In addition, the 2014 farm bill allowed farmers to update yield averages and ?base? acre allocation, which hadn?t been permitted for several years. So, in essence, in a poor year, farmers may have been compensated based on a lower planted acres average and yield average than actual.

What has been done

Extension staff who were trained with a national curriculum, worked with the Farm Service Agency to deliver educational meetings and demonstrations on the use of the decision tools that were developed specifically for the new farm bill program. In Delaware, there were over 150 participants, all who were involved in agriculture and the majority who were producers and landowners.

Results

In Delaware, over 28,000 ?base? acres were reallocated to corn acres on 495 farms. The significance here is that these growers took advantage of a one-time opportunity to allocate their production acres on paper (and for payment) to better match their actual production and thus have the ability to more efficiently manage their finances in a given year. This followed the national trend, where grain producers across the country increased their corn base? acres.

4. Associated Knowledge Areas

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

V(H). Planned Program (External Factors)

External factors which affected outcomes

- Public Policy changes
- Government Regulations

Brief Explanation

V(I). Planned Program (Evaluation Studies)

Evaluation Results

CIBER Education and Outreach Programs at Delaware State University

According to the Unites States Department of Education, among the students interested in STEM (science, technology, engineering and mathematics) fields, nearly 57% of high school students lose interest in these fields by the time they graduate and only 16% want to pursue STEM related careers. Through CIBER scholars program we have provided summer and regular academic year research opportunities to 40 students from Delaware higher educational institutions. Additionally, for the past three years the program has been facilitating training to eight bioenergy scholars every year through NEWBio. The NEWBio scholars were from higher educational institutions around the country. Through the outreach activities, such as teacher training workshops and exhibition booth at educational fair; the program creates awareness of the research areas we are focucing to the k-12 community.
For more details about this program please visit ://www.newbio.psu.edu/education/Posters.asp
Please visit ciber.desu.edu.

Tech Wizards Mentoring Program

Issue: There is a need for highly engaging STEM programming at the 4-H afterschool program sites to support the development of math and reading skills and the use of various technology. In particular, low-income and minority students have limited opportunities in out-of-school time to participate in informal learning in math and science. More opportunities to explore various types of technology with adult mentors to encourage and support application of math and science process skills is needed to enhance academic achievement and encourage continued study in science, technology, engineering and math (STEM) toward future goals in science related careers.
Response: By adding the STEM mentoring component at each site, the youth are strengthening outcomes which include: improved academic performance in school, improved decision making and life skills, improved attachment to school, reduction in juvenile delinquency and an improved attitude toward post-secondary education. The addition of training in STEM activities and mentoring skills encourages hesitant mentors to routinely plan and implement science, technology, engineering and math in activity lesson plans throughout the afterschool and summer program.
Progress on these goals is measured through tracking student perceptions with pre/post surveys that measure life skills, decision making and perceptions of support from caring adults. Additional results include report cards and parent survey feedback.
Survey results for 180 statewide participants in grades 5-8th using 4-H Common Core indicators for life skills, decision making and perceptions of support from caring adults in the Tech Wizard Mentoring program indicate:
As a result of my experience in 4-H
Strongly Agree/Agree
Disagree
Strongly Disagree
I am comfortable in making my own decisions
99%
1%
0%
I have a plan for reaching my goals
93%
4%
3%
I know how to deal with stress in a positive way
87%
11%

2%
I can stand up for things that are important to me
97%
2%
1%
I can use technology to help me express my ideas
93%
5%
2%
I have adults in my life who care about me and are interested in my success
96%
4%
0%
I have talents I can offer to others
90%
8%
2%
I learned things that helped me to make a difference in my community
88%
97%
3%
I like to work with others to solve problems
92%
7%
1%

Parent Survey Feedback:
"4-H Afterschool has helped to build my children's confidence and has given them an outlet to productively express theirselves. My daughter enjoys the workshops and even participated in a public speaking event. This was an enouromous accomplishment that was cultivated from her participation in 4-H. She is fully equipped to speak with her peers and others."
"My child has tried new things and learned that she likes them and has made a connection with the adults in the program who have all been encouraging and made connections with her. She looks forward to going to the program and always shares the fun she has had when I pick her up. I love this program!"

Kent County 4-H Outreach Makes a Difference with the Embryology Program
Issue: Within the tight rigors of the educational schedule, the embryology program brings a great tool into the Kent County elementary schools for students to enjoy while meeting many of their curriculum requirements. Teachers use this program to reinforce math skills, reading skills, writing skills and science concepts. Experiencing this program helps the

students develop life lessons such as responsibility, caring and empathy, and excitement. Embryology provides priceless teaching opportunities where children are able to think and feel. With budget cuts in mainstream classrooms, the embryology program fits the needs of many classrooms and students.

Response: In order to meet the needs of the classrooms and students, Kent County 4-H offers the embryology outreach program in the spring each year. Supplies are dropped off at the school's main office the week prior to the beginning of the program. This includes both education materials along with the incubator, brooder (container, feed and water dishes, heat lamp) feed and wood shavings. On the Monday morning of the program, eggs are picked up from the University of Delaware Farm incubating room and delivered to the schools. On Tuesday afternoon, they begin hatching. On Friday of the same week, materials and supplies are picked up. The chicks typically go to 4-Hers in the county who are enrolled in poultry projects, and there is a waiting list.

Results: During the program year of 2015, 96 classrooms participated in this outreach effort including 2,328 students and 121 teachers. In order to know the effect of the program, 20 random teachers from different site locations were surveyed on very specific questions. 100% of the teachers surveyed strongly agreed or agreed on the following statements:

- Students maintained a positive attitude and stayed focused or improved focus during the embryology classroom instruction time.
- Students' math skills and communication skills were reinforced through the Embryology program, by activities such as graphing, reading thermometers, and journaling.
- The program helped children develop an understanding of biology concepts through this program, including basic needs, life cycles and habitats.
- The program reinforced skills such as observing, listening and predicting.
- Students gained practice in responsibility and compassion for animals and developed a greater appreciation for living things.
- Students gained development in personal skills including citizenship, leadership, teamwork, patience, cooperation and sharing.

Transfer the Farm

Issue: The average age of the primary farm operator is 56. Ideally, at some point, the primary operator (and family) will begin the process of transferring the farm to the next generation. This is not a task that is completed overnight, but rather over time, with a lot of communication, understanding, trust and patience among the family members. But knowing where to begin is a major obstacle for farm families - just getting the conversation begun can be the most difficult part.

Response: On November 3rd, The University of Delaware Cooperative Extension and University of Maryland Extension Ag Law Initiative held an educational session on the topic of transferring the farm to the next generation. The intention was to offer farmers some fundamentals as a place to begin, while also gathering baseline data of how comfortable the audience was with the topics presented and what type of specific educational programs on the topic would be useful and beneficial.

Results: Fifteen farm families attended the session. As indicated by pre and post class surveys, the participants reported having increased their knowledge on all the information presented. The topics included: prenuptial agreements, trusts, wills, operating agreements, communication styles, fair vs. equitable, business entity usage, goal setting and transition planning.

As a result of the information presented, four families indicated they planned to initiate the

"transfer the farm" and three of those would include the next generation and four individuals indicated they would begin the process of writing a Will.
Topics for future workshops were requested on the topic of farm insurance, business planning and developing a mission statement, and health insurance.

Making Smart Decisions about Health Insurance
Issue:
Research shows almost all consumers are confused about how to purchase and use health insurance. Only 12 percent of English-speaking American adults have proficient health literacy skills, according to the Department of Education's National Assessment of Health Literacy, which used 2003 data - the latest comprehensive information on health literacy. Adults ages 25 to 39, those who are white and Asian-Pacific, people with higher levels of education, and those with higher incomes are more health literate than adults ages 65 and older, most minority groups, people with less education and people with low incomes.
Many of the eligible consumers are challenged with making a health insurance decision and do not know how to choose coverage based on risks, needs and personal financial situations. About half (51 percent) of Americans do not understand the basic health insurance terms premium, deductible and copay. When people need to do math to figure out out-of-pocket costs, the lack of understanding grows. Only 16 percent of respondents in a Nov. 2014 Kaiser Family Foundation survey could calculate the cost of an out-of-network lab test, for example.
Response: During the 2015 calendar year, the team of University of Maryland Extension faculty and professionals and a Delaware extension educator continued to refine the Smart Choice health insurance literacy program. This year's focus has been to increase the number of certified educators, report on national activities and refine the evaluation tool to reduce the number of questions. Presentations were made at the Health Insurance Preconference of the National Health Conference and the American Association for Family and Consumer Sciences.
Results: Certified Smart Choice Extension Educators taught 61 workshops in seven states between September 2014 and March 2015 reaching 399 consumers. Impact of the workshops was measured by valid and reliable questions developed and tested by the American Institutes of Research (AIR) using a reduced number of items from the first pilot. When asked "As of right now, how confident are you in making a health insurance decision" the results from pre/post surveys showed that on a scale of 1 to 4, with 1 being not at all confident and 4 being very confident, consumers showed an increase in confidence, moving from 2.37 before the workshop to 3.19 at the end of the workshop.
During 2015, additional Extension Educators from Minnesota, Arkansas, Illinois, Minnesota and New York were trained. In total, the Health Insurance Literacy Initiative (HILI) team has taught 189 Extension Educators from 31 states.
On October 1, the HILI team offered an update webinar for 46 Certified Extension Educators. Participants were introduced to the results of the 2014-15 pilot test. They learned about new products being introduced in 2015-16. Some Certified Educators from participating states shared stories of their programming.
In Delaware, Smart Choice was offered three times; once for a farm audience reaching nine participants and twice for consumer audiences reaching 14. All participants showed an increase in confidence with both understanding health insurance terms as well as making a health insurance decision.

Key Items of Evaluation

V(A). Planned Program (Summary)

Program # 4

1. Name of the Planned Program

ENVIRONMENTAL STEWARDSHIP IN A CHANGING CLIMATE

☑ Reporting on this Program

V(B). Program Knowledge Area(s)

1. Program Knowledge Areas and Percentage

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

V(C). Planned Program (Inputs)

1. Actual amount of FTE/SYs expended this Program

Year: 2015	Extension		Research	
	1862	1890	1862	1890
Plan	7.8	1.9	30.7	4.8
Actual Paid	7.0	0.7	40.0	5.0
Actual Volunteer	0.0	0.0	0.0	0.0

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

Extension		Research	
Smith-Lever 3b & 3c	**1890 Extension**	**Hatch**	**Evans-Allen**
508132	111815	320483	700593
1862 Matching	**1890 Matching**	**1862 Matching**	**1890 Matching**
577005	111815	164483	700593
1862 All Other	**1890 All Other**	**1862 All Other**	**1890 All Other**
153947	0	6281694	844179

V(D). Planned Program (Activity)

1. Brief description of the Activity

I. Increased knowledge of and best management practices to mitigate the effects of climate change
a. Animal agriculture: understanding impacts of climate change on animal physiological processes, health, and disease, particularly for poultry and dairy; developing management practices to rapidly diagnose, prevent, and mitigate (e.g., new vaccines) effects of avian diseases on poultry health and productivity, including current disease problems and new ones that may appear and proliferate under new climatic conditions; developing new systems and technologies to reduce effects of environmental stress on animal health and productivity. The latest research projects are focusing on animal care, management and environmental design to ensure animal well-being and raise awareness of environmental protection, law and legislation. These studies are on four fronts, including monitoring technologies for animal physiological and behavioral response, assessment of animal-environment interactions, quantitation of air quality and emissions from animal feeding operations, and assessment and development of best management practices aiming at mitigating air emissions based on their character, amount, and dispersion.
b. Agronomic crops: basic research on how environmental stresses associated with climate change (e.g., heat, moisture stress) affect crop physiology and productivity; plant genetics and breeding studies to develop cultivars of major crops better adapted to a changing climate, in terms of water use efficiency and resistance to insects and disease; applied research and extension programs on irrigation management and water use efficiency for periods of prolonged drought and restricted water use and for groundwater that may become more saline from salt water intrusion; integrated pest management to diagnose and control insects, weeds, and diseases (current and newly emerging) during longer growing seasons and under warmer and wetter growing conditions; nutrient cycling and management, particularly for manures and other byproducts where decomposition and nutrient release rates and timings are affected by warmer, wetter climates; basic and applied research on factors controlling C sequestration and new agronomic management practices that help mitigate greenhouse gas emissions by sequestering C in soils; and new studies now underway on how changing temperature and rainfall patterns will affect phosphorous management and water quality impacts, using isotope geochemistry to identify how and why the phosphorous has been released from cropland to surface and ground waters. Integrated Pest Management - developing and delivering integrated pest management (IPM) programs, a "systems" approach using chemical, cultural, mechanical, and biological control to increase profits to producers and protect the environment;
c. Natural Ecosystems: characterizing effects of climate change on biodiversity of plants and wildlife exposed to greater pressure from droughts, insects, disease, and invasive species; studying how climate change affects natural ecosystems and insects critical to crop production (e.g., pollination, honeybees); investigate value of marshes, wetlands, and forests to sequester C; increase C storage by encouraging

tree planting and sustainable forestry management; and new studies using weather radar to quantify bird distributions and to track migratory birds. Understanding stopover ecology of migratory birds, including how they select the habitats where they stop and how that impacts their behavior and the success of their migrations is an important area of ecological research today. Sustainable Agriculture/Forestry - developing and promoting efficient and sustainable agricultural, forestry, and other resource conservation practices and policies that ensure sustained ecosystem function and provide food and habitat for biodiversity, including crop diversification, agroforestry, native windbreaks, cover crops, living mulches, field border systems, and conservation buffers; Wildlife, Woodlands, and Aquatic Resources - understanding and mitigating the impact of agricultural practices and urbanization on biodiversity, woodlands, and aquatic resources. Focus will be on human impacts on the fundamental processes that create and maintain biodiversity, such as atmospheric nitrification of ecosystems, minimal habitat requirements, speciation, predator-prey interactions, community and ecosystem structure, and extinction processes. Approaches to develop and sustain biodiversity in agriculture, suburban landscapes, and natural habitats, will be studied. Nonpoint source nutrient pollution models will assess impacts of land use/cover change from agriculture to urban on water quality and quantity on local ponds and creeks; Wetlands Ecosystems - improve understanding of wetlands restoration, protection, and preservation. Emphasis will be on seasonally saturated and non-seasonally saturated wetlands, the wildlife species that inhabit them, and the importance of sedges in wetland habitats; Protection of Delaware's Native Species - research on non-indigenous invasive species, a leading cause of plant and animal extinction in Delaware, will focus on impacts of invasive species on ecosystem function and on methods of restoration after their removal. Wildlife Management - effects of human activity on migratory shore birds, box turtles in suburban habitat fragments, neotropical bird migrants in Delaware, Bobwhite quail in warm season grasslands, horseshoe crab ecology in the Delaware Bay, insect biomass production in suburban habitats, habitat restoration for bats and White-tailed deer populations and lead to recommendations for improved habitat management; new research focuses on the ecology and conservation of wild felids, the evaluation of wildlife behavioral response to human recreation, the development of new technologies in wildlife research, the application of hierarchical models, and monitoring bird and bat flight activity near wind turbines; Fisheries - population status, spawning areas, and management of Atlantic sturgeon in the Delaware River.

d. Resource economics: develop creative new economic policies to profitably link agriculture and forestry with those sectors generating significant quantities of greenhouse gases (e.g., energy, transportation) in cooperative efforts to mitigate greenhouse gas emissions; improve understanding of the relationship of climate change to agricultural and environmental policy development, including farmland preservation, conservation reserve programs; study impacts of climate change on groundwater aquifers, integrate climate change into the Chesapeake Bay water quality model; contribute to policies and educational programs on recycling, develop environmentally-friendly bio-based fuels from local feed stocks, and assist in analysis of Delaware's greenhouse gas inventories from energy use (mobile sources, utilities, residential, industrial, transportation, commercial, natural gas distribution, waste management, agriculture, land use, etc.).

2. Brief description of the target audience

For animal agriculture, target audiences are primarily poultry integrators, growers, breeders, trade groups and allied industries; dairy and beef producers; livestock commodity groups; forage producers, equine owners, producers and interest groups. For crop and soils related research and extension programs, the audience includes existing and prospective grain crop producers, mixed (animal and crop production, e.g., dairy, horse) farms, crop commodity groups and trade associations, the "green industry" (e.g., horticulture, nurseries, landscapers), and certified crop advisors. For natural resource and ecology programs, private and not-for-profit organizations managing forests, wetlands, marshes, and other natural resource areas; state and federal agencies responsible for wildlife, forestry management, and coastal ecosystems. For our

resource economic programs the audience includes farmers, landowners, policy-makers and state and federal agencies directly related to climate change policy (Delaware Development Office; Land Use Planning and Preservation; Department of Agriculture; Department of Health and Human Services; Department of Natural Resources & Environmental Control; Department of Transportation; Economic Development Office, USDA, NRCS, USEPA).

For all programs, audiences include farm owners and operators, aquaculture producers, recreational fisheries, seafood consumers, water quality managers, agribusiness and private consultants, horticultural professionals, city land use planners and other policy-makers, home gardeners, childcare providers, environmental educators, Delaware State Government and local legislators, homeowner associations, educators, community leaders, utility managers, retail stores distributing Energy Star products, fleet managers, building industry, Delaware Clean State Program members, Delaware Farm Bureau leaders, federal-state-local agriculture businesses, state and federal agencies; federal research laboratories; peer scientists in the U.S. and international colleagues, K-12 teachers, and environmental and community groups. Train the trainer programs will develop volunteers in Master Gardeners and Forest Stewards to augment program outreach.

3. How was eXtension used?

In 2015 the eXtension Institutional Team comprised of faculty and staff from across all planned program areas continue to provide the leadership for this work. This past year the team has focused on the following:

- Continuation of Social media plan and Ask an Expert
- On-line course development with Continuing and Professional Development
- Became a premier member of new eXtension structure-one specialist selected as I-corp member in climate change initiative.

Extension specialist, Jenn Volk has been selected as an i-Three Issue Corps project by eXtension. Her project is entitled "Virtual Demonstration Network of Agricultural Climate Change Adaptation and Mitigation Strategies in the Northeast". Working with the USDA NE Climate Hub University Partners Network, Jennifer will develop a network of field demonstration sites to showcase agricultural climate change adaptation and mitigation strategies currently in place across the NE region. This network will be displayed using a web based story mapping tool that will include background information and multimedia content on practices and systems. This tool will virtually demonstrate effective climate change adaptation and mitigation strategies to Extension colleagues throughout the northeast and the agriculture and forestland clientele.

V(E). Planned Program (Outputs)

1. Standard output measures

2015	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	15770	145211	1135	151

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

Patent Applications Submitted

Year: 2015

Actual: 0

Patents listed

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2015	Extension	Research	Total
Actual	4	8	12

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Competitive Grants Awarded

Year	Actual
2015	52

Output #2

Output Measure

- Undergraduate Researchers

Year	Actual
2015	62

Output #3

Output Measure

- M.S. and Ph.D. Students

Year	Actual
2015	28

Output #4

Output Measure

- Post-doctoral Researchers

Year	Actual
2015	5

Output #5

Output Measure

- Refereed Journal Articles

Year	Actual
2015	15

Output #6

Output Measure

- Books and Book Chapters

Year	Actual
2015	5

Output #7

Output Measure

- Extension Bulletins and Fact Sheets

Year	Actual
2015	51

Output #8

Output Measure

- Webpage views/downloads

Year	Actual
2015	49002

Output #9

Output Measure

- Workshops at regional, national, and international levels

Year	Actual
2015	27

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

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

Outcome #1

1. Outcome Measures

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

2. Associated Institution Types

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

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2015	3977

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Pollen Library
Researchers, land managers, beekeepers and master gardeners need to know what pollinators forage on and also what plant species constitute a healthy pollinator diet. The national pollinator protection strategy was developed and signed into action during the spring of 2015. This strategy mandates that federal lands must increase plant pollinator forage and augment the landscape nationally with nutritious forage for pollinators. It is imperative that government officials and land managers plant species that provide floral resources for insect flower visitors.

What has been done
A pollen library has been developed representing over 350 species native to the mid-Atlantic. We have morphological and seasonal information and a digitized library that allows us to identify pollen collected by flower visitors. Using our pollen library, we have developed a free, user friendly pollen identification guide that is hosted by Discover Life. This provides beekeepers, landowners, gardeners and more with the ability to identify pollen to family and, in some cases, species. Using our library and guide we have been able to track pollen weekly from honey bee colonies and develop a seasonal pollen calendar for Northern Delaware and the surrounding counties in PA and MD.

Results

We have been invited to present work at national and regional conferences. We have been hired by other universities to identify pollen collected from various studies. We have hosted over five different students representing lab groups from leading universities in order to train them in pollen slide preparation and pollen identification. Constituents in Delaware, Pennsylvania and Maryland have been trained in pollen collection and have started tracking their honey bee colonies.

4. Associated Knowledge Areas

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

V(H). Planned Program (External Factors)

External factors which affected outcomes

- Public Policy changes
- Government Regulations

Brief Explanation

V(I). Planned Program (Evaluation Studies)

Evaluation Results

Investigation of Physiological Mechanisms Underlying Heat Stress Response in Lima Bean

Issue: Baby lima beans are an important processing vegetable crop for Delaware farmers and large seeded lima beans are a profitable fresh market crop. Heat stress causes delayed pod set, split sets and reduced yield in lima bean plantings that flower during high temperature conditions (usually in July and early August). Delaware lima bean growers and processors have identified heat stress as the major yield limiting factor for lima bean production.

Response: In 2013, 2014 and 2015 I carried out several field and greenhouse experiments to investigate the physiological effects of heat stress on lima bean, develop effective heat tolerance screening methods and identify heat tolerant lima bean germplasm to use in the breeding program. I have also made crosses with heat tolerant germplasm and developed populations from which new heat tolerant lima bean varieties can be selected.

Results: Results of the field and greenhouse experiments have shown that heat stress in lima bean is brought on by nighttime temperatures of 70°F and higher. High daytime temperatures have little or no effect. The effect of high night temperatures is reduced pollen production and/or release. Reduced pollen production results in fewer seeds and pods set and consequently, lower yield. The effect of heat stress seems to be localized to the flower/pod.
I have identified several lima bean lines that have the ability to set pods and produce seed under high night temperature conditions. None of these lines have commercial quality seed and so they have been crossed with commercially acceptable cultivars to produce populations that are now being screened to identify lines with heat tolerance and commercial quality seed.
We have developed methods by which we can screen germplasm for heat tolerance in the greenhouse. These methods are being used to develop new heat tolerant cultivars and identify additional, genetically diverse sources of heat tolerance.

Delaware Nutrient Management Certification 2015
Issue: Nutrient impairments are common in Delaware waters, resulting from non-point sources of nitrogen (N) and phosphorus (P) from agricultural and urban areas. Agricultural nutrient losses are linked to the use of manures and inorganic fertilizers to supply nutrients to growing crops. The 1999 Delaware Nutrient Management Act mandated that individuals who fertilize more than 10 acres of land, own/manage more than eight animal units (1 animal unit = 1000 pounds live animal weight), apply nutrients for a fee (commercial fertilizer handler), or consult in the business of nutrients must become nutrient certified.
Response: University of Delaware Cooperative Extension offers initial nutrient management certification training to individuals as required by law. State-wide training sessions are led by UD Cooperative Extension, with oversight by the Delaware Nutrient Management Commission and the Delaware Department of Agriculture. Since 2001, we certified more than 2,500 individuals at four certification levels (nutrient generator, private nutrient handler, commercial nutrient handler, and nutrient consultant). In 2015, the University of Delaware Cooperative Extension offered 13 initial certification sessions and three required examination sessions for an agricultural audience.
Results: In 2015, 90 individuals were newly certified. Based on pre- and post-test evaluations, we determined that 60 of 88 participants (68%) at the Delaware Nutrient Management Certification Sessions in 2015 increased their knowledge of Delaware's nutrient management issues and certification requirements; the average increase was 21% for those attending both sessions I and II. Evaluations were conducted after each session. Respondents indicated they were responsible for nutrient management decisions on more than 195,000 acres or managed more than 3,500 animal units. Respondents indicated they had gained skills as a result of the sessions. For example, 59 of 61 respondents (97%) indicated that they know better how to interpret a soil test report. Respondents also indicated their willingness to adopt new or change existing management practices after attending the certification session. For example, 41 of 51 respondents (80%) indicated they planned to change how they manage phosphorus, and 64 of 73 respondents (88%) indicated they would submit an annual report to the Delaware Department of Agriculture (required by Delaware state law for all land under a nutrient management plan).

Climate Variability and Change
Issue: Farmers are very adept at managing changes in weather (which is experienced instantaneously), and when asked, often dismiss concerns regarding changes in our climate (which are experienced over much longer periods of time). But Delaware is already experiencing gradual changes in our climate and we at Cooperative Extension can play a

role in helping to lead research on climate adaptation strategies and share our knowledge and tools with our clientele so that they can adapt to a changing climate as easily as they adapt to the changing weather.

Response: To begin a conversation about climate change with Delaware's agriculture community, a session titled, Weathering These Changing Times, was held at Delaware Ag Week in 2015. An introductory overview of climate science was shared and invited speakers presented on Delaware's Climate Change Impact Assessment Report and work that is being pursued on a salt tolerant crop. UD's Jennifer Volk shared information on potential impacts to Delaware's agriculture and water resources as a result of climate change and what Cooperative Extension is doing on this topic already.

Results: Approximately 25 participants attended the three-hour session. Based on a post session survey, approximately 88% of those polled indicated that they learned something new. Fewer respondents (38%), said they planned to implement a new practice or tool at this time. During the session, many participants freely joined in a discussion about their perspectives of climate change and raised questions that challenge the validity of climate change claims. It was an enlightening and respectful discussion that helped shed light on what others in the agricultural community may be thinking and will help focus future outreach efforts on the topic. It is clear that the conversation about climate change must continue, but the discussion can be framed differently to eliminate the debate over the science and focus more on the local research and tools that can be directly applied by our clientele.

Unraveling the molecular responses of bioenergy crop switchgrass under drought and heat stress

For sustainable bioenergy production, dedicated crops should have high biomass yields, wide adoptability in variable environmental conditions and require low agronomical inputs. Switchgrass (Panicum virgatum L.) is one such dedicated bioenergy crop, which has attracted significant amount of research worldwide. Epigenomic analysis of switchgrass in response to biotic and abiotic stresses is relatively new. The Delaware State University research team is focusing on epigenomic analysis of switchgrass and salt marsh grass.

By using global analysis two genotypes representing lowland and upland ecotypes were compared to find key differences in their epigenomic status. The Molecular Genetics and Epigenomics laboratory teams are applying multifaceted research approach to unravel structural changes in DNA, gene and DNA-Protein interaction levels when these ecotypes are under drought and heat stress.

Genome-wide leaf transcriptome profiling for two unstressed, yet contrasting tetraploid switchgrass genotypes, VS16 and AP13 have been established. Deep sequencing of six RNA-seq libraries yielded ~268 million-50nt Illumina reads that were uniformly distributed between two genotypes with ~133 million reads from AP13, and ~135 million reads from VS16. More than 90% of the RNA-seq reads mapped to the reference genome sequence, AP13, which is available at Phytozome.

Through this reference epigenome project, several significantly enriched genes including various classes of disease-resistance proteins, cell-wall associated kinases, chlorophyll binding family proteins, cellulose synthesis genes and enzymes involved in fatty acid biosynthesis have been identified.

Land Use Impacts on Marsh Ecosystems and Associated Fauna and Flora in Delaware Blackbird Creek, and Climate Change Education

A study was conducted on the interaction and impact of of Phragmites australis on Fish Habitat and Associated Fauna: Blue crab, Callinectes sapidus and Resident Fish Population, as well as the impacts of land use and land cover on aquatic health and marsh habitat in

Delaware Blackbird Creek.

The study focused on the difference in Proteobacteria, which are considered to be the predominant microbial communities in marsh ecosystems. The symbiotic microbes (Mycorrhizae) and critical microbial genes that help terrestrial plants to survive under abiotic stress conditions were also targeted. In addition, the water quality of the marsh ecosystem was monitored, using diatoms and the uptake of heavy metals by native and invasive marshes were also measured.

Several projects funded under this planned program target community outreach and increase awareness among the citizens in DelMarVa region on the impacts of land use and anthropogenic activities on the aquatic health including marsh grasses, aquatic fauna and flora, and water quality. Phragmites dominated sites inhabited by larger crabs while Spartina dominated sites inhabited by smaller crabs, and those in the pre-molt stage. Fish abundance appears to be correlated with crab abundance across our sites. We observed the association of (Vesicular Arbuscular Mycorrhiza) fungi within the roots of Spartina alterniflora.

Key Items of Evaluation

VI. National Outcomes and Indicators

1. NIFA Selected Outcomes and Indicators

Childhood Obesity (Outcome 1, Indicator 1.c)	
	Number of children and youth who reported eating more of healthy foods.
Climate Change (Outcome 1, Indicator 4)	
	Number of new crop varieties, animal breeds, and genotypes whit climate adaptive traits.
Global Food Security and Hunger (Outcome 1, Indicator 4.a)	
	Number of participants adopting best practices and technologies resulting in increased yield, reduced inputs, increased efficiency, increased economic return, and/or conservation of resources.
Global Food Security and Hunger (Outcome 2, Indicator 1)	
	Number of new or improved innovations developed for food enterprises.
Food Safety (Outcome 1, Indicator 1)	
	Number of viable technologies developed or modified for the detection and
Sustainable Energy (Outcome 3, Indicator 2)	
	Number of farmers who adopted a dedicated bioenergy crop
Sustainable Energy (Outcome 3, Indicator 4)	
	Tons of feedstocks delivered.