2017 Rutgers Combined Research and Extension Annual Report of Accomplishments and Results

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I. Report Overview

1. Executive Summary

The New Jersey Annual Report of Accomplishments and Results is an integrated report reflecting Cooperative Research and Cooperative Extension programs. The report addresses all of the requirements regarding the use of Hatch Funds and Smith-Lever 3(b) and (c) funds. The report reflects the work of the New Jersey Agricultural Experiment Station (NJAES). The mission of NJAES is to enhance the vitality, health, sustainability, and overall quality of life in New Jersey by developing and delivering practical, effective solutions to current and emerging challenges relating to agriculture; fisheries; food; natural resources; the environment; public health; as well as economic, community, and youth development. Research at the NJAES and the Rutgers School of Environmental and Biological Sciences (SEBS) spans the biological spectrum, from molecules to ecosystems. Our skilled researchers strive to gain a deeper understanding of our physical world, identify the ways in which humans affect our planet, and develop multi-dimensional solutions to address real-world problems. NJAES has a vigorous program of applied research and outreach through its labs, farms, business incubators, and marine stations across the state. Research developments and technologies benefit the public through educational and training programs, technology transfer, policy recommendations, and innovative spin-off companies. Rutgers Cooperative Extension (RCE) helps the diverse population of New Jersey adapt to a rapidly changing society and improve their lives and communities through an educational process that uses science based knowledge. Through science-based educational programs, Rutgers Cooperative Extension truly enhances the quality of life for residents of New Jersey and brings the wealth of knowledge of the state university to local communities. Stakeholders continue to be active partners in identifying critical issues to be addressed. The NJAES values the contributions that stakeholders make to ensure that all research and extension projects and programs remain relevant and responsive to the needs of New Jersey residents. Cooperative Extension continues to increase our emphasis on our urban audience base and to deliver programs culturally appropriate to meet the diverse needs. The planned programmatic focus areas reported against include: Climate Change - Water Quality and Quantity; Childhood Obesity - Youth/Adult Obesity; 4-H Youth Development; Global Food Security and Hunger - Agricultural Viability; Climate Change - Home, Garden and Environment; Global Food Security and Hunger - Integrated Pest Management; Global Food Security and Hunger - Aquaculture; Food Safety; and Sustainable Energy. NJAES researchers and extension faculty and staff concentrate on these focus areas with relevant, innovative science-based educational programming and research solutions to address critical needs identified by New Jersey residents. NJAES has an organizational commitment to diversity which transcends the work of both Cooperative Research and Cooperative Extension. We strive to meet the needs of agricultural producers farming on the urban fringe, youth challenged by circumstances such as poverty and risks that impede their success, families faced with workforce employment issues and a growing number of families who are food insecure. We continue to implement RCE educational programs to meet the needs of underserved and underrepresented audiences and reduce any real or perceived barriers to participation.

Our programmatic and research efforts are highlighted below:

The NJAES programmatic efforts continue to span the scope of Youth Development, from life skills to

urban gardening and environmental issues, with attention provided to youth from urban communities with lower graduation rates, higher rates of poverty and unemployment, all of which contribute to educational deficiencies. Through 4-H and other youth development programs, participants are provided with leadership and life skill development opportunities, for example the Youth Financial Education program, gardening activities such as Horticulture Therapy and the Montclair Community Farms 4-H Association, and the New Jersey 4-H Dairy Program. In addition, 4-H continues to design and implement programs that highlight science at Rutgers University in hopes of inspiring and educating young people of New Jersey about STEM careers (i.e. 4-H Rutgerscience Saturdays).

NJAES researchers and agents continue to conduct research and provide outreach in water quality, water conservation, water pollution prevention, and management of water runoff. Some of the research and outreach programs in this area include the evaluation of the impact of multiple pesticides entering into surface and groundwater and the effects the levels have on aquatic species inhabiting the rivers and lakes, storm water education for sustainable residential landscapes in New Jersey, a technical assistance Program for Combined Sewer Overflow Communities, and Water Management and Quality for Ornamental Crop Production and Health. In addition the Polar Interdisciplinary Coordinated Education program embarked upon an effort to define the "big ideas" that the general public should know about the Polar Regions. In addition, NJAES researchers are using colonial nesting birds as bioindicators of coastal and bay ecosystem health, as indicators of the effects of severe storms and tidal floods/surges, and of sea level rise. Research has also been conducted to understand how patterns of population connectivity can help us to understand the dynamics in fishery productivity and the capacity of these populations to respond to stressors like fisheries and climate change.

Youth and adults in New Jersey, and nationally, continue to be at risk for developing diabetes, high blood pressure, heart disease, and other chronic illnesses. NJAES/RCE faculty and researchers address these issues through many programs, but some highlighted in the report include a program tailored for the South Asian Health Awareness population regarding stroke awareness, this population of people are burdened with significant morbidity and mortality related to chronic disease; research on vitamin D and Calcium metabolism in obesity; The importance of community based diabetes support groups; research on oral metabolic sensing of sugars by humans; an employee wellness program,Get Moving Get Healthy NJ Workforce; and a Junior Chef's Cooking Camp, providing middle-school children with hands-on food preparation experience to raise awareness and promote healthy eating.
NJAES researchers continue their work on new and specialty crops, as well as ethnic products, for example, research on the Yacon, a potential new crop for New Jersey growers; a breeding project to produce better tasting strawberries that are disease resistant and better adapted to the challenges of Northeast growing conditions; identifying malting barley varieties that will be successful in the Northeast and providing information to producers interested in producing commodities for farm based beverages, and new processing tomato varieties for growers in the Mid-Atlantic U.S. NJAES researchers are also studying the customer base and the market intermediaries who market processed ethnic foods to understand the barriers to help determine opportunities for processors, U.S. farmers, and other suppliers of ethnic food ingredients needed for processing ethnic food. In addition, NJAES researchers have assessed the changing coordination and supply chain management strategies being implemented in the fruit and vegetable sector and identified strategic organizational and marketing implications. Furthermore, NJAES researchers continue to investigate the determinants and effects of the adoption of new agricultural technologies, particulary biotechnologies and bioenergy systems.

Quality turf beautifies and enhances the environment, conserves soil, reduces pollution and provides a site for recreation. NJAES researchers are creating and managing plots used for studying microbial community dynamics within turfgrass to shed light on drought tolerance or drought susceptibility. NJAES researchers continue to research cost-effective reduced risk insect pest management practices. New tools have been developed and implemented for monitoring insect pest populations in blueberries and cranberries. Studies were conducted on the use and integration of biorational materials for the

management of peach rusty spot, and management strategies were developed for use against brown marmorated stink bugs in vegetables and tree fruit.

NJAES researchers studied viable and control technologies and practices to ensure food safety and the adoption of safe food handling and food supply. Research includes salmonella contamination of eggs, investigating how measurements of luminescence emission from molecules found in food can be used to monitor properties related to overall quality; and survival strategies of foodborne pathogen and commodity contamination in production fields and retail outlets.

Base funding from the State of New Jersey and from USDA - NIFA formula funds provides NJAES with a foundation for program development, implementation, and delivery, while competitive grants, contracts, and gifts increase the scope and impact of research and education programs. "Other" funding includes restricted and unrestricted gifts, income from sales and service activities, and patent and plant licensing income. County appropriations included salaries paid by counties to Rutgers Cooperative Extension (RCE) faculty and staff, research and extension programs. Grant income is the primary source of support for our nutritional assistance programs, national pesticide testing and pest management services and continuing professional educational programs for New Jersey's farmers, businesses, and residents. Grant income in FY17 also supported important research and extension initiatives in horticulture and plant pathology, climate change, water quality, and other environmental research as well as basic research into metabolic and other influences on human and animal health and wellbeing.

Total Actual Amount of professional FTEs/SYs for this State

Year: 2017	Extension		Research	
	1862	1890	1862	1890
Plan	130.0	0.0	60.0	0.0
Actual	115.0	0.0	41.2	0.0

II. Merit Review Process

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

- Combined External and Internal University External Non-University Panel
- Expert Peer Review

2. Brief Explanation

Merit review is performed by internal peer-review committees at departmental, school and University levels. External peer-review was performed for faculty under consideration for promotion and/or tenure evaluation. Review of scientific merit is also reviewed externally by granting agencies panels, journal editorial boards, and external university panels.

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 of traditional stakeholder individuals
- Survey of the general public
- Survey specifically with non-traditional groups
- Survey specifically with non-traditional individuals
- Survey of selected individuals from the general public
- Other (focus group sessions)

Brief explanation.

Five times a year, the NJAES leadership meet with the external advisory NJAES Board of Managers. Discussions and listening sessions focus on staffing, program development, and budgetary decisions. The Board of Managers is comprised of one representative from each county board of agriculture in NJ as well as state-wide members representing Biotechnology, Community Resources, Environment, Food Science, Marine Science, and Public Policy. Also, NJAES leadership participate in monthly meetings of the NJ State Board of Agriculture. Annually, NJAES leadership participate in the annual State Agricultural Convention and the NJ Farm Bureau convention.

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 Internal Focus Groups
- Use External Focus Groups
- Open Listening Sessions
- Needs Assessments
- Use Surveys

Brief explanation.

At the county and state levels faculty and staff engage partners and potential clientele in a variety of processes to collect input. Individual who participate in these processes are those who serve on advisory boards, special research and extension committees, leaders of commodity groups, partners who participate on government and service related boards, and individuals who participate in programs. Opportunities to participate in the process of gathering input are widely publicized through newsletters, websites, mass and social media and word of mouth. Engagement of input from groups and individuals who are underrepresented is proacively done to ensure that extension programs and research initiatives are relevant, responsive and address the diverse needs of our many publics.

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
- Survey of traditional Stakeholder groups
- Meeting with traditional Stakeholder individuals
- Survey of traditional Stakeholder individuals
- Meeting with the general public (open meeting advertised to all)
- Survey of the general public
- Meeting specifically with non-traditional groups
- Survey specifically with non-traditional groups
- Meeting specifically with non-traditional individuals
- Survey specifically with non-traditional individuals
- Meeting with invited selected individuals from the general public
- Survey of selected individuals from the general public

Brief explanation.

NJAES personnel participate in open forums in which current issues and concerns that impact the county are identified. Stakeholders are active participants in strategic planning processes conducted to identify priority needs that guide research and extension programming. Local assessment of program needs are routinely performed by county agents and educators. Diverse audiences are also targeted to gather appropriate needs data. Extension Specialists engage stakeholders, collaborators, commodity groups, public, private and government officials to identify research needs both applied and basic. Participation by field agents with county boards of agriculture and other local interest groups result in the identification of priority needs on the local and state levels that could benefit from Cooperative Extension programs and/or Cooperative Research solutions. Our partners in the educational process are key to helping faculty and staff identify effective methods for providing the research-based information which is the core of the land grant mission of transformation education that impacts individuals, communities, the environment and the quality of life for all.

3. A statement of how the input will be considered

- In the Budget Process
- To Identify Emerging Issues
- Redirect Extension Programs
- Redirect Research Programs
- In the Staff Hiring Process
- In the Action Plans
- To Set Priorities

Brief explanation.

NJAES welcomes and values the input of our stakeholders. We continually strive to create welcoming environments where stakeholders feel comfortable and trust what is shared will be carefully considered as policies are set, programs are developed, research direction is set and

budget priorities are identified. Stakeholders are essential and critical partners, and their input is necessary to ensure that the work we engage in is relevant and responsive. The NJAES Board of Managers are stakeholders who are actively engaged in the process of providing input on an ongoing basis throughout the year. They attend regular meetings with Extension and Research Directors to share their knowledge of their local county or special interest areas they represent. They are true representatives of the diversity of research and extension that NJAES extends to the residents of NJ and beyond. Not only do they provide invaluable feedback on issues, but they also function in supportive roles as advocates for our research initiatives and extension educational outreach. Other important sources include: NJ State Board of Agriculture, NJ Farm Bureau, County Boards of Agriculture, county and state health departments, state Department of Environmental Protection, and other relevant public and private agencies and organizations.

Brief Explanation of what you learned from your Stakeholders

Stakeholders provide valuable information that contributes to the prioritization process for staffing decisions and program development.

IV. Expenditure Summary

1. Total Actual Formula dollars Allocated (prepopulated from C-REEMS)			
Extension		Research	
Smith-Lever 3b & 3c	1890 Extension	Hatch	Evans-Allen
{No Data Entered}	{No Data Entered}	{No Data Entered}	{No Data Entered}

2. Totaled Actual dollars from Planned Programs Inputs				
	Extension		Research	
	Smith-Lever 3b & 3c	1890 Extension	Hatch	Evans-Allen
Actual Formula	2305487	0	3236332	0
Actual Matching	15740401	0	14329138	0
Actual All Other	2703763	0	8568695	0
Total Actual Expended	20749651	0	26134165	0

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

V. Planned Program Table of Content

V(A). Planned Program (Summary)

Program # 1

1. Name of the Planned Program

Climate Change - Water Quality & Quantity

☑ 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%	
111	Conservation and Efficient Use of Water	20%		20%	
112	Watershed Protection and Management	40%		40%	
133	Pollution Prevention and Mitigation	20%		20%	
605	Natural Resource and Environmental Economics	10%		10%	
	Total	100%		100%	

V(C). Planned Program (Inputs)

1. Actual amount of FTE/SYs expended this Program

Year: 2017	Extension		Research	
	1862	1890	1862	1890
Plan	15.0	0.0	6.0	0.0
Actual Paid	1.2	0.0	2.7	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**
119823	0	178109	0
1862 Matching	**1890 Matching**	**1862 Matching**	**1890 Matching**
1195374	0	1032066	0
1862 All Other	**1890 All Other**	**1862 All Other**	**1890 All Other**
174779	0	593795	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

• Work with municipalities to help them meet their regulatory responsibilities on stormwater management and watershed restoration
• Perform experiments to investigate what the current nutrient loads are in NJ water
• Determine the best methodologies for developing Total Maximum Daily Load (TMDL) values for NJ waterways
• Examine the effectiveness of alternative onsite wastewater treatment systems
• Provide scientifically sound advice to state regulatory bodies on water quality issues
• Math modeling of contamination transport in surface and groundwaters
• Create a program comprising of faculty, staff, volunteers, industry partners and government officials

2. Brief description of the target audience

• Municipalities
• State Department of Environmental Protection
• Staff and students who gain valuable scientific experience
• Industry partners who learn ways to meet water quality standards
• Communities who learn watershed restoration methods
• NJAES Faculty and Staff involved in water research/outreach
• School age youth
• Residents

3. How was eXtension used?

Faculty answered the ask the expert questions and developed collaborative educational products.

V(E). Planned Program (Outputs)

1. Standard output measures

2017	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	6819	2736905	641	100945

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

Patent Applications Submitted

Year:	2017
Actual:	0

Patents listed

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2017	Extension	Research	Total
Actual	18	20	38

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- A variety of strategies will be implemented to reach target audiences. This will include and not be limited to workshops, field visits, classes, newsletters, media releases, electronic communications,and publications.In addition a trained volunteer teaching base will be developed. Quantitative reports of participation will be collected.

Year	Actual
2017	0

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O. No.	OUTCOME NAME
1	Short term - Knowledge of nutrient loads in various NJ waterways. Find the best methodologies for determining TDMLs
2	Medium term - To identify representative pollutants and aquifer systems in New Jersey. To develop equilibrium isotherms to quantify the adsorption/desorption kinetics for the pollutant/soil/water systems. To develop breakthrough and leaching data for the pollutant/soil/water systems.
3	Long Term - A safe and secure water supply for all communities and industries in the state. An effective and efficient nutrient-trading program that meets the needs of industry and meets the standards set by the state regulatory bodies.
4	Stormwater Education Program for Sustainable Residential Landscapes in New Jersey - Medium term - To identify representative pollutants and aquifer systems in New Jersey. To develop equilibrium isotherms to quantify the adsorption/desorption kinetics for the pollutant/soil/water systems. To develop breakthrough and leaching data for the pollutant/soil/water systems.
5	New Jersey Technical Assistance Program for Combined Sewer Overflow (CSO) - Long Term - A safe and secure water supply for all communities and industries in the state. An effective and efficient nutrient-trading program that meets the needs of industry and meets the standards set by the state regulatory bodies.
6	Polar Interdisciplinary Coordinated Education (ICE) - Long Term - A safe and secure water supply for all communities and industries in the state. An effective and efficient nutrient-trading program that meets the needs of industry and meets the standards set by the state regulatory bodies.
7	Water Management and Quality for Ornamental Crop Production and Health - Long Term - A safe and secure water supply for all communities and industries in the state. An effective and efficient nutrient-trading program that meets the needs of industry and meets the standards set by the state regulatory bodies.
8	Onsite Wastewater Treatment Systems: Assessing the Impact of Climate Variability and Climate Change - Long-Term - A safe and secure water supply for all communities and industries in the state. An effective and efficient nutrient-trading program that meets the needs of industry and meets the standards set by the state regulatory bodies.

Outcome #1

1. Outcome Measures

Short term - Knowledge of nutrient loads in various NJ waterways. Find the best methodologies for determining TDMLs

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Agrochemical Impacts on Human and Environmental Health: Mechanisms and Mitigation - The evaluation of impact of multiple pesticides entering into surface and groundwater and the effects that these levels have on aquatic species inhabiting these rivers and lakes. Pesticides are designed to inhibit or block pathways that are involved in neurotransmission, and other hormonal related targets that can alter normal development even at low level exposure because of impacts on developing organisms. Recent studies by the USGS have illustrated that a number of commonly used pesticides are present as mixtures in streams and lakes in agricultural, rural and urban environments. Some of these are what are referred to as legacy pesticides or their metabolites that have been not used for many years but are still present and likely impacting aquatic life. Research has shown that in lower vertebrates (finfish, reptiles) and higher vertebrates (rodents, mammals) the embryonic and early development stages are much more sensitive to a large number of toxic compounds than adults. This is in part due to the disruption of normal development at the cellular and subcellular levels that results in embryonic death, structural damage or effects which may not be manifested until sexual maturity or adulthood. These studies will address the additive or non-additive effects of these pesticides on the embryo, juvenile and adult zebrafish model system. The ultimate goal is to use existing computer software to calculate levels that would be protective based on statistical values. Based on these values, policy decisions can be made as to what if any remedial activities might be needed to protect aquatic species. If highly conserved pathways are involved then this could be applicable to humans utilizing this water for drinking water or recreational fishing and hunting.

What has been done

During this time period NJAES researchers continued to develop new biomarkers to be used to determine chemical effects on developing organisms. They also characterized specific biochemical receptors which were associated with specific developmental abnormalities. Several

of the biomarkers developed in the laboratory were moved into field exposed populations.

A second study also began to test the effects of microplastics and PFASs (perflourinated compounds) on both humans from drinking water exposure and environmental exposure to developing embryonic fish. The risk assessment studies in drinking water were directed at the citizens of the state of New Jersey and other interested states with similar contaminated drinking water supplies.

Results
Based on the results both from the lab and field studies on the biomarkers it could be determined that there would be alterations at the population level within impacted ecosystems. Regarding the effects of microplastics and PFASs, this work is assessing the magnitude of the problem in freshwater and estuarine surface waters. This information has been presented at both regional and national meetings in the form of poster and platform presentations, published in appropriate research journals and presentations were given to researchers at the New Jersey Department of Environmental Protection (NJDEP) and at National Oceanographic and Atmospheric Administration seminars and webinars.

4. Associated Knowledge Areas

KA Code	Knowledge Area
102	Soil, Plant, Water, Nutrient Relationships
133	Pollution Prevention and Mitigation
605	Natural Resource and Environmental Economics

Outcome #2

1. Outcome Measures

Medium term - To identify representative pollutants and aquifer systems in New Jersey. To develop equilibrium isotherms to quantify the adsorption/desorption kinetics for the pollutant/soil/water systems. To develop breakthrough and leaching data for the pollutant/soil/water systems.

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Education, Research, and Organizational Capacity Building benefitting the Cohansey River in Cumberland County-The Cohansey River is one of three principle rivers in Salem and Cumberland Counties, and suffers water quality impacts that impair its use for swimming and recreational activities. Due to its importance for recreation, including swimming, fishing and boating, as well as its aesthetic and wildlife value, there has been sustained interest in the local community for improving its water quality.

What has been done
NJAES faculty continued research concerning the water quality of Sunset Lake, which is of local importance for its hosting a public swimming beach when water quality permits. This program focused on educating organizations and individuals engaged in improving water quality of the river, as well as conducting research to better advise these entities in decision-making. Specific parameters of interest were fecal bacteria and dissolved oxygen, as well as turbidity, nitrogen, and phosphorus. Results of this research were presented to the Cohansey Area Watershed Association with regular updates, as well with city officials and County Health Department Personnel. In 2016-2017, workshops were delivered to nonprofit organizations, municipal representatives, residents, and students in the watershed. These workshops addressed topics including local environmental water quality, water supply and use, and visual and chemical stream assessment by community volunteers.

Results
Program participants learned about local environmental water quality, local water supply and use, and visual and chemical stream assessment. They indicated an intention to educate others about what they learned and to change behaviors in their professional or personal lives. These outcomes are expected to continue to build capacity of decision makers in the watershed to assess potential solutions to ongoing water quality concerns. For participants in two workshops on local water supply and use (n = 20), survey respondents indicated a statistically significant increase in knowledge ($p < 0.05$) about local water sources, water use, policy, and water conservation. (Overall knowledge 3.22 out of 5.00 before, and 4.34 out of 5.00 after.) They indicated an intention to share what they learned with others (8.8 out of 10.0) and to make changes in their professional or personal life based on what they had learned (8.8 out of 10.0).

4. Associated Knowledge Areas

KA Code	Knowledge Area
133	Pollution Prevention and Mitigation
605	Natural Resource and Environmental Economics

Outcome #3

1. Outcome Measures

Long Term - A safe and secure water supply for all communities and industries in the state. An effective and efficient nutrient-trading program that meets the needs of industry and meets the standards set by the state regulatory bodies.

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Bringing Water to Urban Community Gardens - NJAES faculty/staff were requested to implement green infrastructure practices in two urban cities in New Jersey to reduce combined sewer overflows (CSOs). The water supply problem associated with these community gardens and urban farms is an issue that needed to be addressed. To reduce the occurrence of CSOs, the volume of stormwater entering the combined sewer system has to be reduced. Infiltrating stormwater runoff into the ground is usually the key process, but harvesting rainwater for reuse is a viable option, specifically in engaging residents and community groups who manage community gardens and urban farms. Community gardeners often had no access to city water on site and often relied on the approval of neighbors to access water, or they would rely on the Fire Department to fill 55 gallon barrels. Open barrels risk mosquito breeding, making the community garden or urban farmless desirable to the community. Rainwater harvesting reduces the volume of stormwater entering the combined sewer system, provides a health benefit to the community, and has been found to be the sole source of water for urban agriculture in most areas.

What has been done
NJAES/RCE personnel developed collaborative partnerships in these two cities. Camden SMART (Stormwater Management and Resources Training) and Newark DIG(Doing Infrastructure Green) were established to prioritize green infrastructure initiatives in their respective cities, with the NJAES/RCE personnel providing technical expertise. Through the collaborative partnerships, local community gardens and farms were identified and were contacted by a member of the collaborative. It is through the grassroots relationships with a member of the collaborative that made it possible to begin a dialogue of what rainwater harvesting would look like on the individual sites.

Results
Over a five-year span, the RCE Water Resources Program successfully installed ten (10) cisterns in Newark and five (5) cisterns in Camden. With these cisterns, a total of 167,274 gallons of stormwater runoff can be removed from the combined sewer system annually and reused by community gardeners. Based on an average cost of $5.93 per 1,000 gallons of potable water use (NJ American Water, 2015), our community partners are saving a total of $992.73 per year. In addition, over 300 rain barrels were distributed to Newark and Camden residents. A total of 350 residents participated in workshops to learn about the benefits and maintenance needs of rainwater harvesting systems. Based on NJ American Water's 2015 potable water use rates, each time a 50-gallon rain barrel fills, it saves a resident $0.30 from their water bill. Local community

groups were also trained on rainwater harvesting installations and have led their own installations with some support from NJAES/RCE personnel. The rainwater harvesting initiative provided participants with the knowledge to access non-potable water as a primary water source in urban agriculture. Each of the 15 lead gardeners are responsible for continuously maintaining their rainwater harvesting system. Each gardener and resident that participated in a rainwater harvesting workshop indicated that they are now aware that harvesting rainwater also provides additional benefits such as the reduction of stormwater runoff and flooding in their communities. Some participants of rain barrel workshops indicated that their interest in rainwater harvesting stemmed from their interactions with a gardener that had a larger cistern on site. These initial efforts have also lead the City of Newark to begin developing their own rain barrel program which is aimed to launch in 2018. In the City of Camden, the Camden County Utilities Authority has trained several of their staff to also lead their own rain barrel programs for the City of Camden. Water conservation allows Extension professionals to begin connecting with residents and bring awareness to the issues of stormwater runoff and combined sewer overflows.

4. Associated Knowledge Areas

KA Code	Knowledge Area
102	Soil, Plant, Water, Nutrient Relationships
111	Conservation and Efficient Use of Water
112	Watershed Protection and Management
133	Pollution Prevention and Mitigation
605	Natural Resource and Environmental Economics

Outcome #4

1. Outcome Measures

Stormwater Education Program for Sustainable Residential Landscapes in New Jersey - Medium term - To identify representative pollutants and aquifer systems in New Jersey. To develop equilibrium isotherms to quantify the adsorption/desorption kinetics for the pollutant/soil/water systems. To develop breakthrough and leaching data for the pollutant/soil/water systems.

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Stormwater Education Program for Sustainable Residential Landscapes in New Jersey - New Jersey is the most densely populated state in the country. Addressing environmental challenges in the state requires informing and motivating leaders, organizations, and residents from New Jersey's diverse populations and environments. Many lakes and streams in the state have been designated as impacted by state regulators. In most cases, the pollution is considered non-point source pollution that comes from home lawns, farms, parking lots, and a variety of other sources. Addressing these concerns necessitates the education of clientele groups not traditionally possessing a high degree of expertise in land management such as homeowners, as well as professionals such as municipal employees and landscapers. Educating paraprofessionals such as Rutgers Environmental Stewards and Rutgers Master Gardeners who then educate others multiplies the educational effect. Education programs that include examples of stormwater management practices such as rain gardens and rain barrels conserve potable water and reduce water pollution while engaging the audience with tangible and accessible projects that can be implemented at homes, businesses, and public areas. Conserving potable water and preventing water pollution are essential to preserving water resources for drinking water, business use, recreation, wildlife, and agriculture.

What has been done

NJAES faculty and staff conducted educational workshops addressing stormwater management, water conservation, and water pollution prevention. These included events in which participants built rain barrels to install at home and work sessions where participants installed a rain garden in a public area. Educational workshops were conducted, addressing 744 attendees, over a total of 90 hours. As a result of these programs, 178 rain barrels were constructed by participants and 10 rain gardens were installed.

Results

This programming successfully resulted in educating participants about the environmental benefits of water conservation and water pollution prevention. The 178 rain barrels built at these workshops are expected to save 250,000 gallons of potable water per year when installed and used at participants' homes. The 10 rain gardens installed by program participants mitigate the runoff from 7000 square feet of impervious surfaces and will treat and clean 180,000 gallons of stormwater runoff per year and prevent 22 lbs. of sediment, 0.2 lbs. of phosphorus, and 2.6 pounds of nitrogen from entering local waterways per year. These workshops also resulted in the restoration of 600 feet of the Manalapan Lake shoreline with native plants. For participants in three workshops (n = 50), survey respondents indicated a statistically significant increase in knowledge ($p < 0.05$) about their watershed, stormwater management, impervious cover, and nonpoint source water pollution in urban environments. (Overall knowledge 2.37 out of 5.00 before, and 4.61 out of 5.00 after.) They indicated an intention to redirect downspouts to a pervious area such as the lawn or garden (70%), use native plants for landscaping (66%), use soil testing to guide lawn fertilization (62%), and install a rain barrel or cistern (54%).

4. Associated Knowledge Areas

KA Code	Knowledge Area
102	Soil, Plant, Water, Nutrient Relationships
111	Conservation and Efficient Use of Water
112	Watershed Protection and Management
133	Pollution Prevention and Mitigation
605	Natural Resource and Environmental Economics

Outcome #5

1. Outcome Measures

New Jersey Technical Assistance Program for Combined Sewer Overflow (CSO) - Long Term - A safe and secure water supply for all communities and industries in the state. An effective and efficient nutrient-trading program that meets the needs of industry and meets the standards set by the state regulatory bodies.

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
New Jersey Technical Assistance Program for Combined Sewer Overflow (CSO) Communities - This program helps residents and local leaders understand the benefits of green infrastructure technologies and financing options to construct green infrastructure projects that reduce the occurrence of CSOs. CSOs continue to be a water resources and human health issue in New Jersey. They are a significant source of pollution that is directly discharged into a local water body that affects hundreds of thousands of New Jersey residents. According to the New Jersey Department of Environmental Protection, an average of 23 billion gallons of stormwater and wastewater discharge from the 210 CSO outfalls in 21 of New Jersey's urban communities annually. Through the use of green infrastructure, stormwater runoff from impervious surfaces can be cost effectively and sustainably managed to minimize flooding, improve water quality, and reduce the occurrence of CSOs.

What has been done
This program provides guidance, technical assistance, and resources to effectively implement and expand green infrastructure practices across New Jersey. Resources are dedicated to establish municipal action teams and develop green infrastructure feasibility plans across the 21 CSO communities in New Jersey. Municipal action teams bring together local governments, utility authorities, residents, and community organizations to serve as advocates for green infrastructure in their respective cities. As facilitators, the NJAES/RCE faculty and staff coordinate meetings with individual partners that have a vested interest in the environment, water resources, or neighborhood beautification. Individuals are invited to attend a larger meeting to establish a municipal action team. Together, the NJEAS/RCE faculty and staff and partners develop an agenda for a community-based green infrastructure initiative that fosters collaboration and

collective action for the municipality. As municipal action teams are established, the NJAES/RCE personnel assist in preparing green infrastructure feasibility plans. To develop the plan, the NJAES/RCE personnel work with local partners to identify flooding issues, vacant lots, and private and public properties that have a high probability to manage stormwater. The green infrastructure feasibility plan is developed in collaboration with municipal action team partners and provides a platform to train representatives on identifying potential green infrastructure opportunities. The program has successfully established eight (8) municipal action teams. The technical assistance program also includes support from NJEAS/RCE to provide expertise for policy and municipal ordinances that promote the use of green infrastructure as a stormwater best management practice while complying with stormwater regulations. Through the municipal action teams, NJAES/RCE has been able to increase awareness of the benefits of green infrastructure, assist in identifying funding opportunities for the implementation or green infrastructure project and programs, secure funding for the implementation of green infrastructure projects, and reduce stormwater runoff from entering into CSOs.

Results

From 2013-2017, the Green Infrastructure Guidance Manual was published for New Jersey. The NJAES/RCE personnel assisted in the design of 15 large-scale green infrastructure projects totaling 5.9 million dollars, completed the development of 14 municipal-wide green infrastructure plans. Eight municipal action teams were also established, and the NJAES/RCE personnel provided technical assistance with designing and implementing over 25 small-scale community-based green infrastructure projects and assisted partners in submitting 8.2 million dollars in grant proposals to further support outreach and implementation of green infrastructure projects. Participants that have engaged in the New Jersey Technical Assistance Program for CSO Communities have increased their knowledge and awareness about the benefits of green infrastructure practices. Through the program, green infrastructure feasibility plans, the green infrastructure guidance manual, and online learning tools provide municipal action teams with the ability to advocate for green infrastructure implementation in CSO communities. Although the program focuses on providing technical support for CSO communities which are typically in the urban core, municipal action teams are applicable to other communities that wish to establish a green infrastructure initiative. Extension professionals lead efforts to provide the technical support for the municipal action team which requires building trust, building grassroots organizational capacity, and completing small successes that the team can rally around.

4. Associated Knowledge Areas

KA Code	Knowledge Area
102	Soil, Plant, Water, Nutrient Relationships
111	Conservation and Efficient Use of Water
112	Watershed Protection and Management
133	Pollution Prevention and Mitigation
605	Natural Resource and Environmental Economics

Outcome #6

1. Outcome Measures

Polar Interdisciplinary Coordinated Education (ICE) - Long Term - A safe and secure water supply for all communities and industries in the state. An effective and efficient nutrient-trading program that meets the needs of industry and meets the standards set by the state regulatory bodies.

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Polar Interdisciplinary Coordinated Education (ICE)- The program aims to: build capacity of polar scientists in communicating and engaging with diverse audiences; create scalable, in-person and virtual opportunities for educators and students to engage with polar scientists and their research through data visualizations, data activities, educator workshops, webinars, and student research symposia; and evaluate the outcomes of Polar ICE and contribute to our broader understanding of science education practices. Scientists participating in Polar ICE programs learn strategies to communicate more effectively to diverse audiences by incorporating research-based communication strategies, including storytelling techniques and decoding interdisciplinary scientific knowledge, into their practices; develop and engage in strong scientist-educator partnerships and professional networks through the science communication professional development workshops and educator workshops; practice communication skills through interactive website features/social media, presentations at education conferences and webinars, or interactions with underserved and underrepresented students at symposia of the student research. Educators participating in Polar ICE programs gain access to polar data, data activities, and lesson plans, as well as, short videos explaining science practices using polar examples; develop skills in how to use real world scientific data in their classrooms and with their students; utilize online data software tools to help students learn how to orient to data as well as interpret and synthesize data observations; engage in scientist-educator partnerships and networks through the scientist professional development workshops and educator workshops. Students (grades 6-16) participating in Polar ICE programs will: conduct polar-related science investigations to enhance their comfort with using and analyzing data as well as presenting their results to broad audiences; engage in authentic experiences of the process of science that lead to positive identities in STEM, and ultimately contribute to the life-long trajectory of identity development as scientists.

What has been done

Polar Ice embarked upon an effort to define the big ideas that the general public should know about the Polar Regions. With the help of approximately 35 polar scientists from across the country, the Polar ICE team spent 4 months developing a set of 7 principles and fundamental concepts, comparable to the successful Ocean Literacy principles established by COSEE in 2002. This initiative strives to define for polar scientists, the importance concepts to think about when constructing broader impact statements for their research, and guidance for K-12 educators on significant concepts to teach in their classrooms, through the framework of the Next Generation Science Standards (NGSS); Data Stories/webinars: Polar-ICE Data Stories seek to demonstrate interesting events or comparisons using polar data. The first story focuses on the science research of the NSF funded CONVERGE project and how scientists are using physical oceanographic data to understand what drives patterns in the ocean. Two additional stories were completed this year including: "What are the whales doing?" and "How and why are glaciers changing over time?". Three webinars were conducted for 80 educators and an additional 3 planned for this spring. Polar-ICE worked with Palmer LTER scientists to offer six video teleconference calls (VTCs) to virtually connect students and their teachers to Palmer Station, Antarctica. Teachers completed an application process and agreed to teach 2-3 lessons prior to their call, with hands-on activities that would help prepare the students for the experiences. The Sci-I Project 2017 is a yearlong teacher training initiative starting with a 4-day workshop at the Byrd Center at Ohio State University. The intention of the workshop was to unpack the nuances and realities of the process of science while enabling the teachers to experience first-hand participating in an open-ended polar science investigation. The workshop was grounded in investigating various aspects of the Palmer LTER project as the data are easily available online, allow for interesting time series analyses, and are interdisciplinary in nature. Through hands on activities, group discussions, scientists' panels, and field trips the teachers explored the daily themes such as: developing truly testable questions, finding and making sense of data, and communicating results. EARTH Workshop were delivered. Since 2005 the Monterey Bay Aquarium Research Institute's Education and Research: Testing Hypotheses (EARTH) program has provided educators with means for accessing real-time data and integrating it with existing educational standards and tested curriculum through interactive and engaging activities. Polar ICE along with the C-DEBI program hosted a polar-focused EARTH-educator professional development workshop to engage educator leaders as developers (producers) of classroom appropriate polar-data focused activities. The EARTH workshop was 5-days long and brought together 20 educators from throughout the U.S. that work in school districts of predominately underserved and underrepresented students. Video Teleconference Calls (VTCs) virtually engaged students, educators and scientists in discussions about current Antarctic research. Because most students and educators will never visit Antarctica, it is important to engage them through video with active research and exploration going on in the 2017 field season at Palmer Station.

Results

Polar ICE to date has engaged 11 of the cohort of 2016 scientists (20) in K-12 professional development workshops or has engaged them in the creation of data stories. In addition to workshops and data stories, NJAES/RCE faculty continue to provide opportunities for scientists engagement in Polar ICE like our Ask a Scientist program and K-12 professional development webinars. While it is clear that factors beyond the influence of Polar ICE have some impact on students' self-efficacy around science, some of the findings do have implications. For example, Polar ICE seeks to train scientists to communicate their science in classrooms and non-formal education environments, so it follows that students, who benefit from exposure to these scientists, at least according to the findings noted above, should improve in self-efficacy with regard to learning science. In addition, programs such as Polar ICE will benefit students who live in rural

areas, who may not have access to such programs through their schools.

4. Associated Knowledge Areas

KA Code	Knowledge Area
102	Soil, Plant, Water, Nutrient Relationships
111	Conservation and Efficient Use of Water
133	Pollution Prevention and Mitigation
605	Natural Resource and Environmental Economics

Outcome #7

1. Outcome Measures

Water Management and Quality for Ornamental Crop Production and Health - Long Term - A safe and secure water supply for all communities and industries in the state. An effective and efficient nutrient-trading program that meets the needs of industry and meets the standards set by the state regulatory bodies.

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Water Management and Quality for Ornamental Crop Production and Health -Consideration and use of non-traditional irrigation sources has become critical to the green industries (nursery, greenhouse landscape), as their dependence on high-quality water sources is increasingly threatened by climate change, competition and allocation to other priority uses. NJAES researchers continue evaluating short- and long-term effects of alternative water sources like reclaimed water and graywater on ornamental plants/crops, contrasting them to traditional good-quality water sources. Ongoing results imply that periodical tracking of water quality parameters, and adjustments to irrigation management practices could allow for satisfactory use of these alternative water sources.

What has been done

The long-term effects of non-traditional irrigation water sources on the chemical, physical and biological properties of soils are currently being assessed. NJAES researchers are also evaluating the use of integrated nutrient diagnostic techniques to optimize fertilizer use efficiency and productivity in intensively managed greenhouse-grown cut flower crops. The researchers have started another run of experiments with laundry graywater to irrigate container-grown nursery plants and evaluate the short-term effects on plant performance. These studies incorporate laundry graywater effluents derived from both conventional and alternative (biodegradable, environmentally-friendly) detergents, softeners and bleaching agents.

Results
Preliminarily results indicate that graywater generated from conventional detergents and softeners produces plant growth and aesthetic qualities fairly similar to plants irrigated with good quality well-water. The addition of conventional bleaching agents to graywater, however, rapidly and significantly affects negatively plant growth and quality, due to high and phytotoxic concentrations of free and total chlorine. Short-term irrigation with graywater produced from alternative biodegradable detergents and softeners does produce plants with similar growth and quality as control plants. Addition of a peroxide bleaching agent to this graywater, however, leads to stunted growth and unsightly leaf tissue coloration and wilting after 8 weeks from the start of treatments, and eventually culminating on marginal-followed by complete- leaf necrosis. Pending results of mineral analyses of leaf tissues, it is suspected that the relatively high alkalinity and sodium content found in the peroxide-based bleaching agent leads to the observed results. The alternative irrigation water sources project and activities have allowed the engagement of employees from municipal and county wastewater treatment plants and golf course and parks/grounds keeping personal handling, using and managing reclaimed water sources for outdoor irrigation activities. Research protocols (sample collection, processing and chemical/biological analyses have been shared with them.

4. Associated Knowledge Areas

KA Code	Knowledge Area
102	Soil, Plant, Water, Nutrient Relationships
111	Conservation and Efficient Use of Water
112	Watershed Protection and Management
133	Pollution Prevention and Mitigation
605	Natural Resource and Environmental Economics

Outcome #8

1. Outcome Measures

Onsite Wastewater Treatment Systems: Assessing the Impact of Climate Variability and Climate Change - Long-Term - A safe and secure water supply for all communities and industries in the state. An effective and efficient nutrient-trading program that meets the needs of industry and meets the standards set by the state regulatory bodies.

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Onsite Wastewater Treatment Systems: Assessing the Impact of Climate Variability and Climate Change- Pharmaceuticals and personal care products are chemicals that are commonly used in many American households and contribute to the municipal waste stream. Some of these chemicals may be metabolized by the human body, but a large fraction is released directly into the waste stream. Pharmaceuticals and personal care products may have pharmacological activity, whereas others may interfere with hormonal systems by mimicking estrogen. These chemicals must be degraded by the microorganisms in wastewater treatment systems, otherwise they may be released into the environment. This has an ecological impact on any animals that may be living in water that receives treated effluent, and also could contaminate drinking water.

What has been done
NJAES researcher examined the biodegradation of household chemicals that include pharmaceuticals and personal care products. These chemicals are either washed down the drain or flushed down the toilet and end up as components in waste water. These chemicals must be degraded by the microorganisms in wastewater treatment systems, otherwise they may be released into the environment. NJAES researchers continue to monitor our enrichment cultures for pharmaceutical biodegradation activity. Cultures will be periodically transferred to fresh media to maintain activity and further enrich for biodegrading populations. They genetically characterize these enriched microbial communities to gain a better understanding of the types of processes these microorganisms may be involved in. Over this year, they have transferred the cultures to maintain biodegradation activity, simplified microbial communities able to degrade diphenhydramine or naproxen have been obtained, microplastic beads were used as a device to deliver naproxen to wastewater enrichment cultures, and cultures were transferred several times with microplastic as the substrate carrier.

Results
NJAES researchers showed differences between the composition of microbes in the bulk liquid and those that have colonized the microplastic. This has not been shown before in the context of pharmaceutical biodegradation. Additionally, two naproxen-degrading consortia were tested to identify their substrate range. The consortia were found to transform both natural compounds, pharmaceuticals, and personal care products that all contained similar structural characteristics. Some of these products are novel microbial transformation products. These findings are in preparation for submission to a scientific journal. Findings have been incorporated into the curriculum for a course Environmental and Pollution Microbiology.

4. Associated Knowledge Areas

KA Code	Knowledge Area
102	Soil, Plant, Water, Nutrient Relationships
111	Conservation and Efficient Use of Water
112	Watershed Protection and Management
133	Pollution Prevention and Mitigation
605	Natural Resource and Environmental Economics

V(H). Planned Program (External Factors)

External factors which affected outcomes

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

Brief Explanation

External Factors did not affect outcomes.

V(I). Planned Program (Evaluation Studies)

Evaluation Results

NJAES research and extension outcomes related to this planned program were evaluated utilizing a variety of evaluation methods appropriate for each initiative to determine the effectiveness on both a qualitative and quantitative level. For KASA and practice change we included the measurement of knowledge gained as measured by pre/post Likert-scale assessments. Surveys were used to measure increase in skills acquired, behavior change and practice adoption. For process evaluation we focused on program delivery, participation, relevance and timeliness. Data was collected at appropriate times for each initiative that supports this planned program. IRB approved evaluation instruments were used to collect research and extension data. Data analyses and comparisons relevant to basic and applied research and demonstration were collected and analyzed and reported utilizing a variety of data collection methods appropriate to each research question. The major goal of evaluating is the demonstration of social, economic, behavior and environmental changes in conditions that contribute to improved quality of life as a result of participation in programs and benefits of research solutions. See state defined outcomes for detailed results of each initiative.

Key Items of Evaluation

None to report.

V(A). Planned Program (Summary)

Program # 2

1. Name of the Planned Program

Childhood Obesity - Youth/Adult Obesity

☑ 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
701	Nutrient Composition of Food	5%		10%	
702	Requirements and Function of Nutrients and Other Food Components	10%		10%	
703	Nutrition Education and Behavior	25%		25%	
704	Nutrition and Hunger in the Population	15%		15%	
724	Healthy Lifestyle	40%		40%	
801	Individual and Family Resource Management	5%		0%	
	Total	100%		100%	

V(C). Planned Program (Inputs)

1. Actual amount of FTE/SYs expended this Program

Year: 2017	Extension		Research	
	1862	1890	1862	1890
Plan	10.0	0.0	5.0	0.0
Actual Paid	4.7	0.0	7.1	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**
348855	0	519304	0
1862 Matching	**1890 Matching**	**1862 Matching**	**1890 Matching**
1813591	0	2175474	0
1862 All Other	**1890 All Other**	**1862 All Other**	**1890 All Other**
278357	0	2908023	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

• To identify the factors that promote excessive weight gain as well as protect against childhood obesity
• Measure how children born small for age are different with respect to body composition and risk for diabetes prior to developing diabetes or obesity.
• Investigate how perilipin A works in adipocytes to control fat storage and fat breakdown.
• Collect and analyze data on obesity-related measures (i.e., BMI) in adults and children
• Examine how weight loss affects calcium absorption and bone mass
• Create a multidisciplinary program comprising of faculty, staff, the medical community, industry partners and government officials
• Conduct adult/youth education and deliver targeted messages on healthy food choices and increased physical activity education using the following strategies:

Direct Methods:
• Educate Youth
• Educate Parents
• Educate Volunteers
• Food and Fitness Ambassadors
• Educate Child Health Summit Professionals
• Educate Teachers/School Nurses
• Educate Communities

Indirect Methods:
• Website
• Social Marketing

2. Brief description of the target audience

• Clinicians, Physicians and Nurses
• Health Care Professionals
• Hospitals (including teaching hospitals)
• Staff and students who gain valuable scientific experience
• Industry partners that benefit from fundamental and applied research in obesity and related chronic diseases
• Communities that benefit from increased knowledge about the mechanisms involved in obesity
• Other faculty and staff working on similar research
• Health-related organizations and foundations interested in obesity/nutrition issues
• School Age Youth
• Teens
• Teachers
• After School Providers
• Parents
• Volunteers
• Extension Professionals
• State and County Agencies and Organizations
• Schools

3. How was eXtension used?

RCE faculty used the following CoPs: Family, Food and Fitness; Creating Healthy Communities; Community Nutrition Education, Diversity, Equity and Inclusion; Healthy Food Choices in Schools; and Military Families. Faculty answered ask the expert questions, developed collaborative educational products, conducted professional development sessions and provided leadership to CoPs.

V(E). Planned Program (Outputs)

1. Standard output measures

2017	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	31501	557207	17575	20085

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

Patent Applications Submitted

Year:	2017
Actual:	0

Patents listed

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2017	Extension	Research	Total
Actual	15	60	75

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- A variety of strategies will be implemented to reach target audiences. This will include and not be limited to workshops, field visits, classes, newsletters, media releases, electronic communications,publications. In addition a trained volunteer teaching base will be developed. Quantitative reports of participation will be collected

Year	Actual
2017	0

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O. No.	OUTCOME NAME
1	Short Term - Individuals gain awareness, knowledge, skills related to: Attitudes about healthy eating for adults/youth. Healthy food choices for adults/youth. Selection of healthy foods for adults/youth. Benefits of physical activity (reduced overweight and obesity, reduced risk of diabetes, heart disease and cancer.) Physical activity recommendations for health for adults/youth. Identify factors that promote excessive weight gain and protect against childhood obesity.
2	Medium Term - Individuals incorporate skills/change behaviors related to: Increased adoption of healthy food practices. Increased consumption of fruits, vegetables, whole grains and low-fat dairy. Increased participation in family meals. Increased participation in physical activity. Increased participation in family-related physical activity. Increased use of new 'campaign' website. Improved understanding of the relationship between early nutrition and later risk for chronic disease. Understanding the process by which perilipins at the surface of lipid droplets control how much energy is released from the adipocyte at times of need. Understanding how the intestines and body uptake and process dairy fat. Identify genes, their protein product and how the proteins influence the way the body processes fat.
3	Long Term - Individuals experience: Decreased overweight and obesity for youth/adults. Decreased risk factors for nutrition-related health problems and chronic diseases that are affected by diet and physical activity for youth/adults. A clear and comprehensive understanding of the genetic and physiological mechanisms of obesity and related chronic diseases. Pharmacological and/or medical treatments to alleviate the effects of obesity and related diseases.
4	Oral Metabolic Sensing of Sugars by Humans - Short Term - Individuals gain awareness, knowledge, skills related to: Attitudes about healthy eating for adults/youth. Healthy food choices for adults/youth. Selection of healthy foods for adults/youth. Benefits of physical activity (reduced overweight and obesity, reduced risk of diabetes, heart disease and cancer.) Physical activity recommendations for health for adults/youth. Identify factors that promote excessive weight gain and protect against childhood obesity.
5	Get Moving Get Healthy NJ Workforce - Long Term - Individuals experience: Decreased overweight and obesity for youth/adults. Decreased risk factors for nutrition-related health problems and chronic diseases that are affected by diet and physical activity for youth/adults. A clear and comprehensive understanding of the genetic and physiological mechanisms of obesity and related chronic diseases. Pharmacological and/or medical treatments to alleviate the effects of obesity and related diseases
6	Food Waste in Paterson Public Schools - Long Term -Individuals experience: Decreased overweight and obesity for youth/adults. Decreased risk factors for nutrition-related health problems and chronic diseases that are affected by diet and physical activity for youth/adults. A clear and comprehensive understanding of the genetic and physiological mechanisms of obesity and related chronic diseases. Pharmacological and/or medical treatments to alleviate the effects of obesity and related diseases.
7	Small Steps to Health and Wealth Military Webinars for Professionals -Long Term - Individuals experience: Decreased overweight and obesity for youth/adults. Decreased risk factors for nutrition-related health problems and chronic diseases that are affected by diet and physical activity for youth/adults. A clear and comprehensive understanding of the genetic and physiological mechanisms of obesity and related chronic diseases. Pharmacological and/or medical treatments to alleviate the effects of obesity and related diseases

8	Jr. Chef's Cooking Camp - LongTerm - Individuals experience: Decreased overweight and obesity for youth/adults. Decreased risk factors for nutrition-related health problems and chronic diseases that are affected by diet and physical activity for youth/adults. A clear and comprehensive understanding of the genetic and physiological mechanisms of obesity and related chronic diseases. Pharmacological and/or medical treatments to alleviate the effects of obesity and related diseases

Outcome #1

1. Outcome Measures

Short Term - Individuals gain awareness, knowledge, skills related to: Attitudes about healthy eating for adults/youth. Healthy food choices for adults/youth. Selection of healthy foods for adults/youth. Benefits of physical activity (reduced overweight and obesity, reduced risk of diabetes, heart disease and cancer.) Physical activity recommendations for health for adults/youth. Identify factors that promote excessive weight gain and protect against childhood obesity.

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
In 2011, the New Jersey Department of Health identified South Asians as being 42% of the foreign born Asians in New Jersey. South Asians are burdened with significant morbidity and mortality related to chronic diseases. Among SA's in US, they have a higher rate of obesity, report least amount of physical activity, develop stroke at much younger age. Stroke is the leading cause of serious long term disability. The cost of stroke treatment was estimated at $71.55 billion in 2012. Currently there exists a critical gap in the delivery of culturally tailored stroke prevention education programs for the South Asian immigrant community.

What has been done
The South Asian Health Awareness About Stroke (SAHAS) is a culturally and linguistically tailored program for South Asian community. This initiative was established at the Rutgers Medical School in 2007. The mission of SATHI is to improve health outcomes in South Asians living in the United States. This stroke awareness program was developed to educate this population on cardiovascular risk prevention and the importance of calling 911 when experiencing a stroke. Over 300,000 South Asians live in New Jersey. New Jersey's South Asian communities are primarily concentrated in three counties. The program is designed in consultation with the

Northwestern School of Medicine. The curriculum is developed using resources from the American Heart Association, Academy of Nutrition and Dietetics and American Stroke Association. Program materials have been translated into regional languages. The targeted audience are small group (15-20) adult participants of South Asian descent between the ages of 30-80 years. The delivery consists of two sessions conducted 1-2 weeks apart. The sessions are conducted by a Stroke Nurse and a NJAES/RCE Registered Dietitian. Pre and post data are collected from all participants.

Results
The SAHAS program has held 22 sessions, a total of 417 participants have attended, 336 of these have attended both session 1 and 2 and
completed pre and post questionnaire. This program has been effective in improving stroke knowledge (p-value: 0.0001). Younger participants tended to improve more than their older counterparts (p-value:0.0005) Participants knowledge of calling 911 when experiencing stroke reached 100% on the post test evaluation. With this program the cost of stroke related disability and treatment for the State of New Jersey will be reduced. This estimation will be calculated in Fall 2018 after completion of this program for 5 years.

4. Associated Knowledge Areas

KA Code	Knowledge Area
701	Nutrient Composition of Food
703	Nutrition Education and Behavior
704	Nutrition and Hunger in the Population
724	Healthy Lifestyle

Outcome #2

1. Outcome Measures

Medium Term - Individuals incorporate skills/change behaviors related to: Increased adoption of healthy food practices. Increased consumption of fruits, vegetables, whole grains and low-fat dairy. Increased participation in family meals. Increased participation in physical activity. Increased participation in family-related physical activity. Increased use of new 'campaign' website. Improved understanding of the relationship between early nutrition and later risk for chronic disease. Understanding the process by which perilipins at the surface of lipid droplets control how much energy is released from the adipocyte at times of need. Understanding how the intestines and body uptake and process dairy fat. Identify genes, their protein product and how the proteins influence the way the body processes fat.

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Vitamin D and Calcium Metabolism in Obesity - The vitamin D field is in a state of uncertainty, with clinicians recommending high doses with the belief that it will prevent a wide range of diseases, but these recommendations are almost entirely based on observational studies. Patients with obesity are often vitamin D deficient, and lose bone with weight reduction, but almost no studies have addressed whether vitamin D supplementation may benefit this population and attenuate non-skeletal outcomes during caloric restriction. There are a large number of ongoing trials, but none focus on obesity or weight loss. Obesity reduces serum levels of 25 hydroxy-vitamin D (25OHD) and increases parathyroid hormone (PTH) and markers of chronic low inflammation, which can contribute to poor bone quality, insulin resistance, and poor cognition. Evidence shows that both weight reduction and vitamin D supplementation will positively influence outcomes related to insulin resistance and cognitive abilities. The interaction between dietary vitamin D and its endocrine actions on non-skeletal effects (including cognition and diabetes) will also affect bone quality and risk of falling and ultimately affect fracture risk. In another project, researchers are examining how dietary fat affects calcium and bone metabolism in a mature murine model. While very high intakes of dietary fat during growth reduce calcium absorption and bone mineral density, little is known about how dietary fat affects calcium absorption and bone during normal caloric intake. It is hypothesized here that adequate dietary fat is important for absorption and bone health under certain conditions. It is expected that this research will provide insight into important mechanisms regulating the inter-relationship between adipose tissue and vitamin D metabolism, and dietary fat that can influence and improve nutritional recommendations during dieting.

What has been done

NJAES researchers examined whether 3 levels of dietary vitamin D intake affect osteocalcin levels and markers of insulin resistance in postmenopausal women during caloric restriction. In addition, they examined body composition and vitamin D receptor polymorphisms to determine if they can help explain the variability in the serum 25-hydroxyvitamin D response to supplementation, and to examine cognitive outcomes. The research team also assessed whether a high fat diet at two levels of energy intake affect calcium absorption, transporters and bone mineral density (BMD) and quality in older mice. Fifty-eight obese/overweight women were randomly assigned to one of 3 doses of Vitamin D. Serum was analyzed for bone regulating, glucose and insulin. An oral glucose tolerance test was performed at 12 months. Homeostasis Model Assessment (HOMA) and quantitative insulin sensitivity check index (QUICKI) were calculated. In another project during this period, NJAES researchers examined how the herb, Salacia, affects body weight and glycemic indices. Briefly, animal studies indicate Salacia reduces body weight, possibly due to its alpha-glucosidase inhibitor (alpha-GI) properties, but this has not been examined previously. In this study, a randomized, placebo-controlled, 3-way cross-over design was used to evaluate whether Salacia Chinensis (SC) reduces appetite in healthy overweight/obese adults. Forty-eight participants were fasted overnight and consumed a dose of SC or placebo with a fixed breakfast meal at each visit. Appetite sensations, glycemic indices and gastrointestinal peptides were measured.

Results
On the vitamin D study, at 1 year, serum 25OHD levels increased and differed between groups 600, 2000 and 4000 IU, respectively ($p<0.05$). Weight change was similar across groups. There was an interaction between Vitamin D group and time on glucose and QUICKI. The decline in serum glucose and the increase in QUICKI was greater in the 2000 IU compared to the 600 IU group and did not differ significantly compared to the 4000 IU group. Insulin decreased to a similar extent between groups over time ($p<0.05$). There were no significant correlations between changes in total, free or bioavailable 25OHD and glycemic markers or OC measures. Overall, dietary vitamin D intake modestly affects glycemic markers in healthy overweight/obese older women.

Results indicated that SC had no effect on postprandial appetite. However, in women, hunger was reduced by SC compared to placebo at multiple time points, but not in men. It was ultimately determined that Salacia Chinensis lowered glycemic indices in response to a meal supporting its role as an alpha-GI. There was no overall effect of SC on appetite measures, but there was an effect on gut peptides, and hunger was attenuated in the females. Overall, Salacia affects certain gastrointestinal peptides suggesting it may be an appetite modulator.

4. Associated Knowledge Areas

KA Code	Knowledge Area
701	Nutrient Composition of Food
702	Requirements and Function of Nutrients and Other Food Components
703	Nutrition Education and Behavior
704	Nutrition and Hunger in the Population
724	Healthy Lifestyle

Outcome #3

1. Outcome Measures

Long Term - Individuals experience: Decreased overweight and obesity for youth/adults. Decreased risk factors for nutrition-related health problems and chronic diseases that are affected by diet and physical activity for youth/adults. A clear and comprehensive understanding of the genetic and physiological mechanisms of obesity and related chronic diseases. Pharmacological and/or medical treatments to alleviate the effects of obesity and related diseases.

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Community Based Diabetes Support Groups in Hunterdon County: As of 2015 data from the Centers for Disease Control and Prevention surveillance systems, about 30.3 million people in the United States have diabetes. This represents 9.4% of the population. Additionally, another 84 million people have pre-diabetes, and are at risk of developing type 2 diabetes. If uncontrolled, diabetes has great potential to contribute to serious health complications, including heart disease, stroke, kidney disease, and blindness. The total economic costs of treating diabetes and pre-diabetes has been estimated to be $322 billion. The burden to an individual with diabetes can involve healthcare costs 2.3 times greater than for someone without this disease, and can include increased visits to the Emergency Department, more frequent and longer hospital stays, loss of work, and decreased quality of life. Health experts employ various education strategies to improve health outcomes for people affected by diabetes/pre-diabetes. These have included clinically based education programs such as American Diabetes Association Accredited Diabetes Self-Management Education (DSME) which is usually delivered in a hospital or clinic setting. More recently the National Standards for Diabetes Self-Management Education and Support (DSME/S) have evolved to more fully recognize the importance of ongoing patient support after DSME, particularly for implementing and sustaining positive lifestyle behaviors. Connecting patients to community-based partners (who may offer convenient locations and daily opportunities for patients to apply knowledge gained in DSME) can be an effective strategy to help them better implement self-management behaviors. One format for offering ongoing support for people with diabetes/pre-diabetes is through the concept of a "community-based diabetes support group". This is an ongoing group that meets on a regular basis in a familiar and convenient location, and which provides a forum where adults can discuss issues and share solutions for the many factors which may impact their ability to effectively manage their diabetes. Support groups are typically led by a skilled facilitator who guides the group discussions and also serves as a link to other community partners who might provide valuable resources to the group. Target audiences include individuals diagnosed with diabetes, pre-diabetes, or those otherwise at risk, and their spouses and caregivers.

What has been done

Despite having an excellent and long standing clinical DSME program, Hunterdon County did not have an existing diabetes support group available to the public. As a result of discussions arising from a county-wide Community Diabetes Coalition, NJAES/RCE faculty took the lead in developing and providing the first community-based Diabetes Self-Management Support Group in Flemington. The first group was established with help from Hunterdon County Senior Services and draws primarily older, retired adults as well as referrals from Hunterdon Healthcare's Center for Nutrition and Diabetes Management and other local community partners. In mid-2016 a second evening group was launched in partnership with Clinton Shoprite, to serve working as well as older adults. The two groups meet monthly and besides interactive group discussions, include special events such as supermarket tours, healthy cooking demonstrations, dining out events, guest speakers.

Results

On average about 15-20 individuals attend the groups regularly between the 2 locations. Those who attend regularly have shared that the group helps them stay focused on self-managing their diabetes and is a great complement to the more formal training they have received, which is often limited in frequency and duration. Several have reported positive individual health outcomes including weight loss, weight maintenance, and lower glycosylated blood hemoglobin (HgA1C), which is a measure of long-term diabetes control. One individual has gone on to provide leadership to his worksite by serving as the coordinator of a workplace diabetes support group. Additional participant feedback includes: "I was in denial about my diabetes. I forgot what I read. Repetition when necessary helps me remember and practice what's important." "Lot's of reinforcement-new ideas, helpful information, and encouragement," "Learning what other people do to better their life," "Talking with others-they have great ideas and are knowledgeable," "I would tell people with diabetes to go to a support group. I knew about calories but I was overwhelmed when I had to learn about carbs," "I learned portion control and the importance of eating a wide variety of foods: fruits, vegetables lots of rainbows of fruits and vegetables," "I learned how to stick to a diet and exercise," "Take ownership of your diabetes!" "You are not alone! Take control of your life, it's your responsibility. Support is available!" "I have found that meeting each month (is helpful) with others who have diabetes, who can understand the ups and downs. They can provide helpful advice based on their coping with the disease."

4. Associated Knowledge Areas

KA Code	Knowledge Area
701	Nutrient Composition of Food
702	Requirements and Function of Nutrients and Other Food Components
703	Nutrition Education and Behavior
704	Nutrition and Hunger in the Population
724	Healthy Lifestyle

Outcome #4

1. Outcome Measures

Oral Metabolic Sensing of Sugars by Humans - Short Term - Individuals gain awareness, knowledge, skills related to: Attitudes about healthy eating for adults/youth. Healthy food choices for adults/youth. Selection of healthy foods for adults/youth. Benefits of physical activity (reduced overweight and obesity, reduced risk of diabetes, heart disease and cancer.) Physical activity recommendations for health for adults/youth. Identify factors that promote excessive weight gain and protect against childhood obesity.

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Oral Metabolic Sensing of Sugars by Humans - According to the Centers for Disease Control and Prevention (CDC), 36% of American adults are obese and 17% are overweight. Furthermore, the CDC reports that from 1990 to 2010 obesity increased dramatically among US adults. Along with the increasing girth there has been an increase in obesity-related diseases: diabetes, metabolic syndrome, and heart disease. Although the proximate cause(s) for the increased incidence of obesity during the past few decades is unknown, arguments have been made for overconsumption of calorie-rich foods and/or of starch and sugar-sweetened insulinogenic beverages, decreased physical activity, and decreased breast-feeding. Regardless of which factors contribute most to obesity, an energy imbalance with higher consumption vs. expenditure of calories is key, and the stimulation of insulin is necessary. Preferential consumption of sugary sodas and fruit juices over lower-calorie beverages and potential differences in satiation from calories in liquid vs. solid form are known contributors. Replacing sugars in beverages with non-caloric sweeteners or otherwise diminishing consumption of sugar-rich beverages may aid weight loss or dampen weight gain. Diet sodas, however, are often not as effective as water consumption at reducing weight, and consumers overwhelmingly prefer calorie-containing sodas to no-calorie sodas.

The functional imaging studies and psychophysical taste experiments proposed in this research will determine if sugar transporters and metabolic sensors are present and active in human taste cells and if they are likely to contribute to sugar perception in humans. Improving our understanding of the roles of glucose signaling in taste may help prevent and control obesity, diabetes, and metabolic syndrome, which now afflict greater than 25% of Americans.

What has been done

This study hypothesizes that entry of glucose along with sodium via sodium-glucose transport proteins (SGLT1) leads to depolarization of sweet-responsive taste cells in humans as it does in rodents. It hypothesizes further that metabolism of glucose transported into taste cells, leads to elevated intracellular enzymes (ATP) that closes the sweet taste cell channel, depolarizing the cell. The main goals of this project are to provide initial tests of these hypotheses by anatomical and functional studies with human taste cells and psychophysical taste tests of human subjects. Our objective is to use a psycho-pharmacological approach to understand and to help identify the oral taste receptors for macronutrients including carbohydrates and amino acid receptors.

Results

The majority of subjects found that when sucrose cannot be cleaved by oral saccharidases that sucrose is a less effective sweetener. This appears to be due to the fact that sucrose cannot signal metabolically as a disaccharide, as only monosaccharides are transported across mammalian cell membranes. NJAES researchers believe these data not only support a role for metabolic signaling in sugar taste, but also indicate that oral saccharidases are necessary for this to occur and that high fructose corn syrup will differ from sucrose in the metabolic signal generated. This may explain differences observed in perception between sucrose sweetened beverages and high fructose corn sweetener.

4. Associated Knowledge Areas

KA Code	Knowledge Area
701	Nutrient Composition of Food
702	Requirements and Function of Nutrients and Other Food Components
703	Nutrition Education and Behavior
704	Nutrition and Hunger in the Population
724	Healthy Lifestyle

Outcome #5

1. Outcome Measures

Get Moving Get Healthy NJ Workforce - Long Term - Individuals experience: Decreased overweight and obesity for youth/adults. Decreased risk factors for nutrition-related health problems and chronic diseases that are affected by diet and physical activity for youth/adults. A clear and comprehensive understanding of the genetic and physiological mechanisms of obesity and related chronic diseases. Pharmacological and/or medical treatments to alleviate the effects of obesity and related diseases

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Get Moving Get Healthy NJ Workforce: Adults in our nation are at increased risk for developing diabetes, high blood pressure, heart disease, and other chronic illness. New Jersey residents are also challenged with the same health issues as well as continually increasing health care benefits. Employers are having difficulty managing health care costs for their employees. Workplace wellness programs have shown to increase the wellness knowledge and behavior of employees and encourage them to adopt a healthier lifestyle.

What has been done
NJAES/RCE faculty and staff have responded to this need by creating and providing Get Moving Get Healthy NJ Workforce as a means of engaging employees in a walking program that takes existing knowledge of healthy lifestyle and physical activity and improves the retention of learning

after the program. Employees are encouraged to wear a pedometer to track daily activity and walking steps that are entered into Walk NJ Point-to-Point online. The 52-week online program is provided for employees who volunteer to participate in a project that will raise awareness of the positive impact on their healthy lifestyle. The goal is for employees to live longer, healthier lives by: - Increasing the awareness of the importance of sustaining good health with proper nutrition and physical activity. - Increasing awareness of the importance of physical activity as a component of healthy lifestyle. - Increasing awareness of the effect of healthy eating habits, physical activity, and stress reduction.

Results

Follow-up survey taken by 479 employees (Survey Monkey used to aggregate the data). Result to date are as follows: Question #1 - Made progress in the following areas: 47% improved physical condition, 50% lost some body weight, 32% lost some inches around the body, 33% improved physical appearance, 43% fit better in clothing, 34% improved level of energy, 35% improved sleep, 51% improved diet, 61% increased consumption of fruit, 61% increased consumption of vegetables, 56% decreased consumption of sugar, 34% decreased consumption of fats, 27% decreased level of stress, 40% increased level of exercise, 21% used strategies to prevent disease, 32% increased their personal savings, 38% decreased their debt, 89% quit smoking. Question #2 - Rate your level of physical condition before workplace wellness program: 11% Poor, 25% Fair, 47% Good, 15%, Very Good, 2% Excellent. After the workplace wellness program 1% Poor, 14% Fair, 52% Good, 29% Very Good, 4% Excellent. Population demographics 84% female, 16% male. Age Range: 8% between 20-30, 16% between 31-40, 24% between 41-50, 36% between 51-60, 16% over 60.

4. Associated Knowledge Areas

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

Outcome #6

1. Outcome Measures

Food Waste in Paterson Public Schools - Long Term -Individuals experience: Decreased overweight and obesity for youth/adults. Decreased risk factors for nutrition-related health problems and chronic diseases that are affected by diet and physical activity for youth/adults. A clear and comprehensive understanding of the genetic and physiological mechanisms of obesity and related chronic diseases. Pharmacological and/or medical treatments to alleviate the effects of obesity and related diseases.

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Food Waste in Paterson Public Schools: Today food waste is one of the largest environmental issues of our time. In the United States we throw out about 40% of the food we grow. Approximately 31% of that food loss is lost at the retail and consumer level. That is approximately 133 billion pounds and $161 billion of food wasted annually. That is why the Environmental Protection Agency (EPA) and the United States Department of Agriculture teamed up on September 16, 2015, to create the first-ever national food loss and waste goal in the United States which called for a 50-percent reduction in food waste by 2030. Decreasing food waste will not only save the land, water, labor, and energy used to produce the food, it will also save the national resources put in to dispose of it. In 2010, the economic cost of disposing of food into landfills was more than $2 billion. This is because food is the single largest component of municipal solid waste going to landfills, accounting for over 20% by weight. Additionally food waste is contributing to the global warming concern on our planet. Food waste creates a greenhouse gas methane, which is 21 times more potent than carbon dioxide. That is why the EPA and USDA created a U. S. Food Waste Challenge, with focus on high waste producers such as K-12 schools and consumers.

What has been done
Data collection occurred one month prior to the intervention training. Afterwards a training session was conducted for the food service workers followed by a training session for the lunchroom monitors. NJAES/RCE faculty conducted hands on training for the 15 schools that were selected for measurement to see if they met their self-set goals. Post intervention food waste was measured.

Results
A total of 9,140 trays were measured for food waste, 4,637 for the pre-intervention and 4,503 trays for the post-intervention. Of the food and beverages served during our 60 visits to schools 2,473 pounds were wasted before the intervention and 2,123 were wasted after the intervention. This indicates that the amount of food waste prior to the intervention per school that accounted for 84 pounds of food per school day, which for the 180 days of school amounts to 14,838 pounds of food and district wide that is 623,196 pounds of food wasted per year. There was a 98-pound decrease in milk, 150 pound decrease in fruit, 80 pound decrease in vegetable and 22 pounds of grain and protein. Overall, 350 pounds of food was saved which was a 14 % reduction in food waste due to this intervention. Additionally, a total of 7,129 pounds of food was donated from January 2017 until August 2017 to the local food pantry CUMAC.

4. Associated Knowledge Areas

KA Code	Knowledge Area

703	Nutrition Education and Behavior
704	Nutrition and Hunger in the Population
724	Healthy Lifestyle

Outcome #7

1. Outcome Measures

Small Steps to Health and Wealth Military Webinars for Professionals -Long Term - Individuals experience: Decreased overweight and obesity for youth/adults. Decreased risk factors for nutrition-related health problems and chronic diseases that are affected by diet and physical activity for youth/adults. A clear and comprehensive understanding of the genetic and physiological mechanisms of obesity and related chronic diseases. Pharmacological and/or medical treatments to alleviate the effects of obesity and related diseases

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Small Steps to Health and Wealth Military Webinar for Professionals: Military families need to improve their finances by increasing saving and decreasing debt. Military families also need to improve their diet, food choices, and physical activity and keep their weight in a normal range.

What has been done
A webinar was designed by NJAES faculty and co-taught to cover financial and health goals. A power point program was developed with handouts and the webinar was facilitated through the University of Illinois as part of a webinar series for military families. 129 military personnel participated in the 2-hour webinar.

Results
Evaluations conducted by the Military families showed an 85% knowledge gained overall. Learning in both financial and health behaviors lead to behavior changes 6 months after the webinar. Reduced debt and increased consumption of fresh produce were two of the comments made by participants.

4. Associated Knowledge Areas

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

Outcome #8

1. Outcome Measures

Jr. Chef's Cooking Camp - LongTerm - Individuals experience: Decreased overweight and obesity for youth/adults. Decreased risk factors for nutrition-related health problems and chronic diseases that are affected by diet and physical activity for youth/adults. A clear and comprehensive understanding of the genetic and physiological mechanisms of obesity and related chronic diseases. Pharmacological and/or medical treatments to alleviate the effects of obesity and related diseases

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Improving the diet of young children with a Jr. Chef's Cooking Camp: Overweight and obesity are serious problems in the United States. During the past 20 years, there has been a dramatic increase in obesity in the United States and rates remain high. More than one-third of U.S. adults (35.7%) and approximately 17% (or 12.5 million) of children and adolescents aged 2-19 years are obese. Obesity increases the risk of serious health conditions like diabetes, heart disease, stroke, high blood pressure and some cancers. According to the U.S. Centers for Disease Control and Prevention (CDC), in 2010, no state had a prevalence of obesity less than 20%. In 2013, New Jersey had an obesity rate of 24.6% and Cape May County had a rate of 24.5% in 2008. No state met the nation's Healthy People 2010 goal to lower obesity prevalence to 15%. Rather, in 2010, there were 12 states with an obesity prevalence of 30%. In 2000, no state had an obesity prevalence of 30% or more. These are serious health problems that must be addressed through a multifaceted approach. Many of today's health problems--obesity, heart disease, diabetes, and cancer--can be reduced through good nutrition and a healthy life style. Cooking programs and classes for children seem to positively influence children's food preferences and behaviors, according to research. Getting kids involved in the kitchen, through cooking classes may make

them more likely to choose healthy foods. More than one-,third of adolescents in the United States were obese in 2012, according to the CDC. This trend has been caused, at least in part, by a significant decrease in the amount of meals that people consume at home since the 1980s. Today's parents lack time and may not have learned to cook healthy meals. Families eat more convenience foods and are more likely to eat at fast food restaurants, where meals are more calorie-dense and less nutritious.

What has been done

A two-session pilot cooking program was developed and implemented in the fall of 2012. The pilot plan was created NJAES/RCE faculty to provide middle schoolers hands-on food preparation experience, raise their nutritional awareness and promote healthful eating. The goal was to test the program and follow with a cooking camp in the summer. In the summer of 2013, a 5-day Jr. Chefs' Cooking Camp was held using the same format as the pilot class. In the Jr. Chefs' Cooking Camp kids learned to prepare simple and healthy foods for themselves and the family. Other lessons included Choose My Plate, food safety, kitchen safety, table manners and table setting. In the final class the students prepared a full meal together. A physical activity was included each day of the camps. The Jr. Chefs' Cooking Camp (JCCC) was expanded and JCCC II was added. In the Jr. Chefs' Cooking Camp I (JCCC- I) kids learned to prepare simple and healthy foods for themselves and the family. In Jr. Chefs' Cooking Camp II the children used more advanced recipes and equipment including the preparation of a healthy meal using USDA My Plate as a guide. The cooking camp was repeated in 2015, 2016, and 2017. At the close of each day, students received a cooking tool that they had used in the day's lesson (i.e. measuring cups, spatula) to take home. To date 90 students have completed the program. Jr. Chefs' Cooking Camp aimed to teach new healthy foods and how to prepare them; encourage healthy food choices that last a lifetime; stress the importance of eating from My Plate especially fruits and vegetables; increase consumption of fruits and vegetables; and increase daily physical activity. The targeted audience included 6-8 graders and they were recruited children through announcements on their school websites and news releases and those who had attended the camp the previous summer. Most of the students were sad when the program ended and asked if we could extend the program or offer again next summer. Judging by the phone calls from parents and face-to face conversations, the JCCC sessions were well received by youth and their parents. Nine (9) sessions of the Jr. Chefs' Cooking Camp has been held over the course of 5 summers.

Results

At the end of the 2017 Jr. Chefs' Cooking Camps, students (n=22) indicated the following: After this nutrition/cooking series I have Prepared at least one of the recipes at home = 86%. After this nutrition/cooking series I plan to Eat more fruits and vegetables = 73%. Choose low-fat non-fat dairy products = 54%. Read the nutrition labels on food packaging = 77%. Eat more whole grains = 63%. Prepare breakfast using one of the recipes from class = 86%. Would be interested in a Jr. Chefs' Cooking Camp II = 100%. Participants were provided with the opportunity to try need foods, feel a sense of accomplishment, sit down to a 'family meal' that they helped prepare, know where the food came from and how it was prepared. Longer term outcomes included: learning skills they can use for the rest of their lives, learning to eat well and may be more likely to eat healthfully as adults, gaining self-confidence through positive cooking experiences, increasing communication.

4. Associated Knowledge Areas

KA Code	Knowledge Area
701	Nutrient Composition of Food

702	Requirements and Function of Nutrients and Other Food Components
703	Nutrition Education and Behavior
704	Nutrition and Hunger in the Population
724	Healthy Lifestyle

V(H). Planned Program (External Factors)

External factors which affected outcomes

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

Brief Explanation

None to report.

V(I). Planned Program (Evaluation Studies)

Evaluation Results

NJAES research and extension outcomes related to this planned program were evaluated utilizing a variety of evaluation methods appropriate for each initiative to determine effectiveness on both a qualitative and quantitative level. For KASA and practice change we included the measurement of knowledge gained as measured by pre/post Likert-scale assessments. Surveys were used to measure increase in skills acquired, behavior change and practice adoption. For process evaluation we focused on program delivery, participation, relevance and timeliness. Data was collected at appropriate times for each initiative that supports this planned program. IRB approved evaluation instruments were used to collect research and extension data. Data analyses and comparisons relevant to basic and applied research and demonstration were collected and analyzed and reported utilizing a variety of data collection methods appropriate to each research question. The major goal of evaluating is the demonstration of social, economic, behavior and environmental changes in conditions that contribute to improved quality of life as a result of participation in programs and benefits of research solutions. See state defined outcomes for detailed results of each initiative.

Key Items of Evaluation

None to report.

V(A). Planned Program (Summary)

Program # 3

1. Name of the Planned Program

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
806	Youth Development	100%		0%	
	Total	100%		0%	

V(C). Planned Program (Inputs)

1. Actual amount of FTE/SYs expended this Program

Year: 2017	Extension		Research	
	1862	1890	1862	1890
Plan	30.0	0.0	0.0	0.0
Actual Paid	6.3	0.0	0.0	0.0
Actual Volunteer	2735.0	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**
413630	0	0	0
1862 Matching	**1890 Matching**	**1862 Matching**	**1890 Matching**
2257456	0	0	0
1862 All Other	**1890 All Other**	**1862 All Other**	**1890 All Other**
94291	0	0	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

Positive Youth Development:

• Employ Essential Elements (belonging, independence, mastery and generosity) as the basis for life skill development and related workforce development skills.

- Utilize Experiential Education Model (Experience, Share, Process, Generalize, Apply).

Provide opportunities for youth to:
- Feel and believe that they are cared about by others (Attachment, Belonging, Connection)
- Feel and believe they are capable and successful (Achievement, Mastery, Competence)
- Know they are able to influence people and events (Autonomy, Power, Confidence)
- Practice helping others through youth's own generosity (Altruism, Purpose, Contribution)

Subject matter:
(USDA/NIFA Mission Mandates)
Science, Engineering, Technology (includes:science literacy, animal science, plant science, environmental science, life sciences, etc) Citizenship (includes youth engagement, community youth development, community service, character development, civic engagement, etc) Healthy Lifestyles (includes chemical health, mental and emotional health, foods & nutrition, physical health and safety, etc).

2. Brief description of the target audience

- School Age Youth (K - 13, one year out of high school) and their Parents
- 4-H Volunteers (adult and youth)
- Teachers/Educators/other Youth Development Educators
- School Age Child Care Providers
- College Students (interns, collegiate 4-H)
- Other Extension Professionals and University Partners
- Communities: Stakeholders and Non-Profit, Social Service, Government Agencies
- Under-served and Under-represented Audiences

Delivery modes:
- 4-H Clubs and Related Activities
- 4-H Afterschool (clubs and short-term programs)
- School Enrichment
- Special Interest
- 4-H Camping (day camps and overnight camping)
- Mentoring and Individual Study

3. How was eXtension used?

Faculty used the following CoPs: Program Evaluation, Personal Finance, Community, Local and Regional Food Systems, Volunteer Administration. Faculty answered "Ask an Expert"
questions, developed collaborative educational products, and conducted professional development sessions.

V(E). Planned Program (Outputs)

1. Standard output measures

2017	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	69654	1792560	38781	401888

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

Patent Applications Submitted

Year:	2017
Actual:	0

Patents listed

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2017	Extension	Research	Total
Actual	46	0	46

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- A variety of strategies will be implemented to reach target audiences. This will include and not be limited to workshops, field visits, classes, newsletters, media releases, electronic communications,and publications.In addition a trained volunteer teaching base will be developed. Quantitative reports of participation will be collected.

Year	Actual
2017	0

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O. No.	OUTCOME NAME
1	Short Term - Youth increase awareness, knowledge, attitudes, and skills related to essential elements, workforce development, life skill development, and relevant subject matter. Volunteers increase knowledge and awareness of practices fostering positive youth development, including youth/adult partnerships. Youth development professionals and stakeholders increase awareness and knowledge of problems and solutions supporting positive youth development, including: policies that need to be addressed,community resources and support.
2	Medium Term - Youth apply knowledge, attitudes, skills, and behaviors needed to become competent, caring and contributing citizens by: taking on leadership roles in their youth organizations and schools, and working in partnership with adults in a variety of settings. Youth and adults demonstrate effective partnerships through increased youth participation on advisory committees and other governing bodies. Volunteers and youth development professionals apply practices fostering positive youth development.
3	Long Term - Youth demonstrate mastery and competencies needed to become engaged by assuming leadership positions in communities; developing and implementing action plans to address community needs, and becoming productive members of the workforce. 4-H youth are engaged partners in decision making regarding RCE programming including but not limited to 4-H youth development programming. 4-H alumni and volunteers become engaged citizens by assuming leadership positions in communities. Youth development professionals and stakeholders influence decision makers in policy development related to youth development needs and issues.
4	Horticulture - Short Term - Youth increase awareness, knowledge, attitudes, and skills related to essential elements, workforce development, life skill development, and relevant subject matter. Volunteers increase knowledge and awareness of practices fostering positive youth development, including youth/adult partnerships. Youth development professionals and stakeholders increase awareness and knowledge of problems and solutions supporting positive youth development, including: policies that need to be addressed,community resources and support.
5	New Jersey 4-H Dairy Program - Short Term -Youth increase awareness, knowledge, attitudes, and skills related to essential elements, workforce development, life skill development, and relevant subject matter. Volunteers increase knowledge and awareness of practices fostering positive youth development, including youth/adult partnerships. Youth development professionals and stakeholders increase awareness and knowledge of problems and solutions supporting positive youth development, including: policies that need to be addressed,community resources and support.
6	4-H Butterfly Pavilion - Short Term - Youth increase awareness, knowledge, attitudes, and skills related to essential elements, workforce development, life skill development, and relevant subject matter. Volunteers increase knowledge and awareness of practices fostering positive youth development, including youth/adult partnerships. Youth development professionals and stakeholders increase awareness and knowledge of problems and solutions supporting positive youth development, including: policies that need to be addressed,community resources and support.
7	Horticulture Therapy with Incarcerated Youth - Medium Term - Youth apply knowledge, attitudes, skills, and behaviors needed to become competent, caring and contributing citizens by: taking on leadership roles in their youth organizations and schools, and working in partnership with adults in a variety of settings. Youth and adults demonstrate effective

	partnerships through increased youth participation on advisory committees and other governing bodies. Volunteers and youth development professionals apply practices fostering positive youth development.
8	4-H Young Scientist - Medium Term -Youth apply knowledge, attitudes, skills, and behaviors needed to become competent, caring and contributing citizens by: taking on leadership roles in their youth organizations and schools, and working in partnership with adults in a variety of settings. Youth and adults demonstrate effective partnerships through increased youth participation on advisory committees and other governing bodies. Volunteers and youth development professionals apply practices fostering positive youth development.
9	Montclair Community Farms 4-H Association-Medium Term-Youth apply knowledge, attitudes, skills, and behaviors needed to become competent, caring and contributing citizens by: taking on leadership roles in their youth organizations and schools, and working in partnership with adults in a variety settings. Youth and adults demonstrate effective partnerships through increased youth participation on advisory committees and other governing bodies. Volunteers and youth development professionals apply practices fostering positive youth development.

Outcome #1

1. Outcome Measures

Short Term - Youth increase awareness, knowledge, attitudes, and skills related to essential elements, workforce development, life skill development, and relevant subject matter. Volunteers increase knowledge and awareness of practices fostering positive youth development, including youth/adult partnerships. Youth development professionals and stakeholders increase awareness and knowledge of problems and solutions supporting positive youth development, including: policies that need to be addressed,community resources and support.

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
REAL LIFE Academy - Teens will soon be making the transition from living with their parents to living on their own. But are they prepared with the skills they need to make this transition? For instance, a study completed by the Organization for Economic Co-operation and Development indicated that "more than one in six students in the United States does not reach the baseline level of proficiency in financial literacy. At best, these students can recognize the difference between needs and wants, can make simple decisions on everyday spending, and can recognize

the purpose of everyday financial documents such as an invoice." In the past, schools provided basic cooking, sewing, and financial management skills through Home Economics programs. These types of programs are rarely offered in schools today. Where are teens learning these skills now? While many skills can be learned in the home, parents can use some help.

What has been done
The REAL LIFE Academy was designed to reach this need for teaching teen basic life skills. The format for the program was a one week long day camp for teens who had just completed grades 7, 8, and 9.
The goal of the REAL LIFE Academy is to introduce teens to skills they will need for life on their own including the following: financial management; cooking skills and meal planning (including shopping); consumerism skills; home care and laundry; automotive skills (change a tire, auto care basics); consumerism skills (grocery store field trip); basic nutrition; basic first aid; clothing care (sew on a button, iron a shirt, remove a stain); Basic etiquette -and more! The week included cooking everyday with a culinary arts teacher from the Salem County Vo-Tech to learn basic culinary skills. Another instructor from the Salem County Vo-Tech taught basic automotive information like fluids used in a car and how to change a tire. He also taught the teens to frame a wall.Financial management was taught each day with guest speakers and by using "My Financial Future" which is National 4-H curriculum. True Colors was used as one of the activities. Additional curriculum regarding etiquette and consumerism decision making came from Florida, Georgia, and Oklahoma 4-H. NJAES/FCHS personnel taught nutrition lessons each day and also conducted a session on the importance of physical activity and led a field trip
to a local grocery store where teens learned about unit pricing. An educator from the County Health Department provided a basic first aid session. A representative from the USDA, taught a session on resume writing. A REAL LIFE Simulation where teens were assigned a career, marital status, number of children, and their credit status. They determined their net monthly income for the month and then needed to visit a dozen stations where they need to make choices for things like transportation, housing, insurance, groceries, child care, and amenities. The materials for the simulation were adapted from Florida 4-H curriculum. A 4-H volunteer and members of the Salem County Chamber of Commerce helped with the planning of the program.

Results
A retrospective pre-post survey indicated increases in:
-skills learned
-knowledge gained
-Greatest increases were seen in:
-changing a tire
-building a wall frame
-knife skills
-keeping a check register

When asked on thing they learned, teens indicated the following:
-Learned how credit works
-How to cook
-How to build a wall
-My love for herbs
-How to change a tire
-How to spend money wisely
-How to write a check
-Car liquids

4. Associated Knowledge Areas

KA Code	Knowledge Area
806	Youth Development

Outcome #2

1. Outcome Measures

Medium Term - Youth apply knowledge, attitudes, skills, and behaviors needed to become competent, caring and contributing citizens by: taking on leadership roles in their youth organizations and schools, and working in partnership with adults in a variety of settings. Youth and adults demonstrate effective partnerships through increased youth participation on advisory committees and other governing bodies. Volunteers and youth development professionals apply practices fostering positive youth development.

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Youth Financial Education: Financial education for youth became a high priority in New Jersey following passage of a 2010 requirement for a semester of personal finance instruction prior to high school graduation. The mandate became effective starting with graduating high school seniors in 2014. As a result, demand is strong from teachers and school administrators statewide for training (both in financial subject matter topics and creative/interactive teaching methods) to build local capacity for delivering financial education. Most school districts have reassigned existing teachers to teach personal finance rather than hire new ones and they need professional development. A national study released in 2009 found that many teachers lack subject matter content knowledge and confidence to teach personal finance and need training to become successful. NJAES/RCE faculty and staff have been instrumental in state financial education capacity-building efforts. Responding to a Request for Information (RFI) from the NJ Department of Education in 2012, RCE was selected by the NJ Department of Education to receive funds from credit unions to use for professional development for financial education teachers. Funding in 2017 supported two full-day teacher conferences, two after-school teacher workshops, three webinars, and the creation of seven new lesson plans as part of the development of a 'model curriculum' tied to New Jersey financial education core curriculum content standards.

What has been done

NJAES faculty worked closely with the NJ Coalition for Financial Education, the NJ Council for Economic Education, and the NJ Department of Education to deliver seven financial education teacher training events (two full-day workshops called Financial Education Boot Camp, two afterschool teacher workshops called Financial Education Teacher Exchange, and three one-hour webinars) during 2017 that collectively reached about 200 teachers. An NJAES faculty member also worked closely with the NJ Department of Education to develop seven new comprehensive personal finance lesson plans, shown below. Each lesson plan includes background content for the instructor, five interactive learning activities, learning extensions, a glossary, reference materials, and assessments. The new lesson plans, plus 11 others developed previously, are housed online. The seven new lesson plans developed in 2017 are listed below. The lesson plans have been viewed more than 1,000 times and shared via conferences and social media and include: Investing for Your Future; Credit Counseling: Where, When, and Why; The Purpose and Importance of Wills; The Costs and Benefits of Renter's and Homeowner's Insurance; Income Tax Exemptions and Deductions; Saving and Investing Strategies and Influences; Credit Report Basics: Analyzing and Disputing Information. Another youth education deliverable an NJAES faculty member's curation of financial education resources such as lists of created useful videos, online calculators, online quizzes, infographics, lesson plans, and more. A Next Gen Personal Finance blog post about the lists was widely distributed via social media and at conferences, thereby providing financial educators with resources to present personal finance content in creative and interactive ways.

Results

The teacher training programs, described above, had post-class evaluations that indicated that participants gained new knowledge, found the training sessions valuable, and planned to incorporate class material into their classroom lessons. Follow-up evaluations were conducted by the NJ Department of Education.

4. Associated Knowledge Areas

KA Code	Knowledge Area
806	Youth Development

Outcome #3

1. Outcome Measures

Long Term - Youth demonstrate mastery and competencies needed to become engaged by assuming leadership positions in communities; developing and implementing action plans to address community needs, and becoming productive members of the workforce. 4-H youth are engaged partners in decision making regarding RCE programming including but not limited to 4-H youth development programming. 4-H alumni and volunteers become engaged citizens by assuming leadership positions in communities. Youth development professionals and stakeholders influence decision makers in policy development related to youth development needs and issues.

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
4-H Rutgerscience Saturdays: The NJAES researchers designing this program strive to promote career interest in STEM fields through exposure to and interaction with the information, tools, and people in science. By interacting with scientist role models researchers and programming staff are motivating youth camp participants to feel like they can perform skills necessary to be a scientist.

What has been done
4-H Rutgerscience Saturdays is a Science Technology Engineering and Mathematics (STEM) program designed to connect middle school age young people to Rutgers University faculty and inspire them to become scientists and engineers. The program is designed to enrich young people's interest and competency in science, technology, and communications by having direct interaction with Rutgers University faculty, graduate and undergraduate students. The program offers middle school aged young people, the opportunity to engage in hands on activities and demonstrations that highlight a wide variety of STEM disciplines through Rutgers University. 4-H Rutgerscience Saturdays are offered in the fall and spring semesters predominantly on the Cook Campus of the School of Environmental and Biological Sciences. The program is a combination of demonstrations, tours, field experiences, and hands on activities around a different STEM theme. The focus is on creating opportunities for young people to experience skills and techniques used in a specific STEM discipline, with the assistance and guidance of a practicing Rutgers scientist. The program has offered programs in topics such as geology, entomology, oceanography, food sciences, and environmental sciences. A typical 4-H Rutgerscience Saturday involved 3-6 scientists interacting with approximately 40 young people.

Results
Youth attending 4-H Rutgerscience Saturdays report they enjoy meeting other science interested youth creating a sense of belonging. This year, two alumni of Science Saturdays were admitted as freshmen at Rutgers. An NJAES faculty member regularly meet with alumni for lunch and continue to offer support and advice. Although gains in content knowledge are no longer measured, K-12 educators share with NJAES faculty that students bring their experiences back to the formal classroom in the form of reports and posters.

4. Associated Knowledge Areas

KA Code	Knowledge Area
806	Youth Development

Outcome #4

1. Outcome Measures

Horticulture - Short Term - Youth increase awareness, knowledge, attitudes, and skills related to essential elements, workforce development, life skill development, and relevant subject matter. Volunteers increase knowledge and awareness of practices fostering positive youth development, including youth/adult partnerships. Youth development professionals and stakeholders increase awareness and knowledge of problems and solutions supporting positive youth development, including: policies that need to be addressed,community resources and support.

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Horticulture: Teachers as well as military youth program staff are now expected to offer gardening activities to children in most school districts and all military installations in New Jersey. These requirements have been instituted in all geographic areas in the county as an effort to encourage healthier lifestyles through improved eating habits and also to demonstrate a more economical method for parents to provide fresh fruits and vegetables for their children.

What has been done
Teachers and staff members serving the Joint Base military youth program attended formal horticulture classes and participated in hands-on gardening activities over a period of three months. Following the initial training, participants worked with youth participants throughout the program. Objectives and goals included the following: Conduct soil testing and then amend the soil as indicated by the test results; Grow seedlings and transplant them; Map spacing of plants within the dimensions of the garden space available; Complete the lesson activities on plant pest and disease identification; Keep written record to document progress and challenges throughout the season; Implement hands-on activities for youth to learn the horticulture science and grow vegetables in their garden. Curriculum was the 4-H Garden Project which includes the Helpers Guide distributed to participants.

Results
100% of participants reported knowledge gained in three areas: How to plan a garden to scale; Implement using lesson activities from the curriculum and helpers guide; Lead youth in a team effort to plan, grow, and harvest fresh vegetables. Observations by the Program Coordinator were

reported as follows: Staff participants demonstrated increasing skill over time; effectively engaged youth in the hands on experience; youth were proud to display samples of their garden harvest at the county fair; the summer garden experience encouraged youth not only to work hard but also to be patient until they could finally harvest their "crop".

4. Associated Knowledge Areas

KA Code	Knowledge Area
806	Youth Development

Outcome #5

1. Outcome Measures

New Jersey 4-H Dairy Program - Short Term -Youth increase awareness, knowledge, attitudes, and skills related to essential elements, workforce development, life skill development, and relevant subject matter. Volunteers increase knowledge and awareness of practices fostering positive youth development, including youth/adult partnerships. Youth development professionals and stakeholders increase awareness and knowledge of problems and solutions supporting positive youth development, including: policies that need to be addressed,community resources and support.

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
New Jersey 4-H Dairy Program: Animal Science projects continue to be one of the largest areas of involvement in the New Jersey 4-H Program. In the 2016- 2017 4-H year there were 152 4-H Dairy Project members in the state and 33 adult volunteers working with them.

What has been done
Numerous educational events and competitions are provided on the county and state level to assess skills achieved including, subject matter knowledge and life skills. Events include: Dairy Quiz Bowls, Dairy Management Contest, Dairy Skill-a-thon stations, Dairy Judging contest, as well as county and the state 4-H Dairy Shows.

Results

Preparing for participation in these state events, youth apply what they've learned and increase their development of life skills. While each event/competition has unique objectives, there are several similarities in the events such as: demonstrating best practices in fitting and showmanship for species/breeds; demonstrating best practices in selecting project animals; applying learned skills in animal selection through judging events; practicing oral and written skills in placing animals in judging events; demonstrating and applying skills learned through hands-on activities of skill-athon stations; applying ethics and good sportsmanship State.

4-H Dairy Quiz Bowl- Twenty Five (25) participants from four counties competed in a Quiz Bowl contest to test their knowledge of the dairy industry. Youth competed in a Jeopardy type competition and a formal speech competition for the New Jersey Holstein Association, and a poster display. From this competition one four- member Quiz Bowl team competed in the National Holstein Convention competition in Washington State. One New Jersey 4-H member also youth gave a speech at the National Holstein contests. In the dairy judging contest youth learn the life skills of observation and evaluation techniques, public speaking and decision making. In 2016, Eighteen (18) youth from three counties participated in the event. Of that group, 4 youth participated in the National 4-H Dairy Judging contest in Wisconsin. At the State 4-H Dairy Show, 36 4-H members from five New Jersey Counties were in the show this year with 75 animals. Youth learned how to select, fit and show an animal to the best of their ability. They also learn sportsmanship and cooperative learning techniques as many of the members work together to help clip and wash their animals prior to the show. Older 4-H members mentor and assist younger members in teaching their animals to walk on the halter. For the National 4-H Dairy Conference, one teen member was selected to attend the National 4-H Dairy Conference. Those youth participated in hands on workshops, heard world class speakers on topics such as dairy careers, and visited several dairy related agribusinesses. State 4-H Dairy Clip- off Competition - This competition allow for 4-H youth to practice and display the skills they have learned in their club for preparing a young dairy heifer for show. Youth work in teams and are randomly assigned an animal from the College Dairy Herd. Given one hour to clip, brush and trim the animals, they are then critiqued by a 4-H alum judge. In 2017, 35 youth from 3 counties participated in this competition.

4. Associated Knowledge Areas

KA Code	Knowledge Area
806	Youth Development

Outcome #6

1. Outcome Measures

4-H Butterfly Pavilion - Short Term - Youth increase awareness, knowledge, attitudes, and skills related to essential elements, workforce development, life skill development, and relevant subject matter. Volunteers increase knowledge and awareness of practices fostering positive youth development, including youth/adult partnerships. Youth development professionals and stakeholders increase awareness and knowledge of problems and solutions supporting positive youth development, including: policies that need to be addressed,community resources and support.

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
4-H Butterfly Pavilion: According to OH State, Monarch Butterflies face a number of serious threats to their survival, several of which homeowners can help eradicate. The loss of native milkweed stands associated with habitat destruction and increased agricultural herbicide use means less food for larval (caterpillar) monarch butterflies. Loss of late-summer nectar sources means less food to fuel the adults, including fourth-generation adults on their migration journey. Insecticide use on host or nectar plants can harm or kill monarch caterpillars or adults.

What has been done
4-H of Warren County New Jersey built a butterfly pavilion in their 4-H building on their fairgrounds to be opened to the public during their eight day fair. The public enter the enclosed antechamber where they are instructed about safety while in the pavilion, learn how to identify the species of butterflies within the pavilion, and with 1-2 interesting facts about each species. They are then invited to enter the pavilion, following a small winding path filled with flowers, water elements, and live butterflies. They can feed the butterflies using Q-tips and delicious, sugary Gatorade made available. Upon exiting the pavilion, guests check for winged hitch-hikers in the enclosed exit room and learn how important butterflies are as pollinators and how to combat the decline of their habitat by attracting them in their gardens at home. The pavilion is the key element in recruiting new members especially for a newly formed bee and butterfly club in the county to further the work of building butterfly habitats.

Results
Participants who went through the butterfly pavilion became aware of the indigenous pollinators and their behaviors and needs to flourish. Of particular focus was the threat to Monarch butterflies, which only lay eggs on milkweed. Habitat shrinkage due to herbicides and urban sprawl are of great concern as well. Over 2000 fair goers raised $750 by going through the pavilion in 2017.

4. Associated Knowledge Areas

KA Code	Knowledge Area
806	Youth Development

Outcome #7

1. Outcome Measures

Horticulture Therapy with Incarcerated Youth - Medium Term - Youth apply knowledge, attitudes, skills, and behaviors needed to become competent, caring and contributing citizens by: taking on leadership roles in their youth organizations and schools, and working in partnership with adults in a variety of settings. Youth and adults demonstrate effective partnerships through increased youth participation on advisory committees and other governing bodies. Volunteers and youth development professionals apply practices fostering positive youth development.

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Horticulture Therapy with Incarcerated Youth: The Union County Juvenile Detention Center houses youth awaiting judicial proceeding and or more permanent placement in the state corrections system. The majority of the youth have lead impoverished lives. Regardless of their background this time of incarceration is a stressful period for these adolescents. Alleviating their anxiety and helping them develop skills for their release is of critical importance. Also, a part of stress/anxiety relief is exercise and good nutrition. The horticulture therapy provides both.

What has been done
4-H has created a horticulture therapy program for the youth. Youth are introduced therapeutic elements of horticulture and the goal is to instill in them life skills of persistence and perseverance. On a regular basis the NJAES/RCE faculty and staff in Union County met with the youth to plan, plant and maintain a horticulture therapy area. In the area ornamentals are grown and then given as gifts to their visitors. Additionally, produce is grown in the garden and used as the focal point of nutrition lessons.

Results
The program is well supported by the administration of the Union County Human Services Department. Approximately 35 youth participated in the program in 2017. In 2017 they grew crops of sweet corn, tomatoes, sunflower seeds, watermelons, cantaloupes, peppers, tomatoes, cucumbers, sweet potatoes, carrots and strawberries. All of the food harvested is consumed by the residents. Greatly contributing to good nutrition and anxiety relief.

4. Associated Knowledge Areas

KA Code	Knowledge Area
806	Youth Development

Outcome #8

1. Outcome Measures

4-H Young Scientist - Medium Term -Youth apply knowledge, attitudes, skills, and behaviors needed to become competent, caring and contributing citizens by: taking on leadership roles in their youth organizations and schools, and working in partnership with adults in a variety of settings. Youth and adults demonstrate effective partnerships through increased youth participation on advisory committees and other governing bodies. Volunteers and youth development professionals apply practices fostering positive youth development.

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

4-H Young Scientist: In urban public schools, many students and their families are living with a severe economic disadvantage. Unlike suburban and rural school districts, urban school districts operate in densely populated areas serving significantly more students. Typically there is low student achievement in these areas, a lack of instructional coherence. Urban schools are often bombarded with many, sometimes contradictory, instructional initiatives and approaches and can easily become fragmented. Moreover, the professional development used to launch these initiatives that support teachers' continued learning is too frequently ineffective. Given the great needs of the students served by them, urban school systems are often under-resourced. They are defined both by their geography and their demographics, with urban schools overall having higher than average rates of poverty, immigrant students, English language learners, and students of color. Effective science and technology education is critical for the success of urban youth. Disadvantaged urban schools face a host of challenges, including lack of resources, limited school leadership, and ineffective curricula, all of which impact negatively on science teaching and learning.

What has been done

The Young Scientist program is an informal, hands-on science series that utilizes curriculum from

The Young Scientists Club, 365 Awesome Science Experiments, Design It! , and Explore It! It provides youth an opportunity to perform experiments and reinforces science concepts that are appropriate for in-school enrichment and the out-of-school time setting. This is a one to three-month long science program, delivered once a week to youth enrolled in various afterschool programs, camps, and during school enrichment scheduled activities. The Young Scientist program has reached over 400 students in the past year. It encompasses a buffet of science topics, each week a new topic is accompanied by an exciting activity. Educational, yet fun activities are used to explore science principles found in disciplines like food science, kitchen science, animal science, bubble science, rainbow science, engineering, and much more.

Results

According to the teachers, the Young Scientist program excites and engages the students with projects that include hands-on science experiments. With these activities they learn and discover more. The combination of hands-on experiments and inquiry-based learning is especially effective with students that may otherwise be difficult to reach academically. This curriculum grabs the student who otherwise may not be interested in science, even the student that may not be interested in school. They love that there is a product produced by the end of each class, which makes them proud that they have accomplished the task. To measure the impact of the Young Scientist curriculum on student learning, there was a post-program evaluation completed by the students. On the evaluation, students indicated that they learned a lot about how to complete an experiment, science concepts, and teamwork. The evaluations also indicated most students acquired scientific-inquiry skills and analytical skills. They would utilize this info to: share with their siblings, help with career exploration, inspire them to pick a career in science, find out how things work, increase their grades in science during school, spark creativity, develop science fair projects, and become smarter.

4. Associated Knowledge Areas

KA Code	Knowledge Area
806	Youth Development

Outcome #9

1. Outcome Measures

Montclair Community Farms 4-H Association-Medium Term-Youth apply knowledge, attitudes, skills, and behaviors needed to become competent, caring and contributing citizens by: taking on leadership roles in their youth organizations and schools, and working in partnership with adults in a variety settings. Youth and adults demonstrate effective partnerships through increased youth participation on advisory committees and other governing bodies. Volunteers and youth development professionals apply practices fostering positive youth development.

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Montclair Community Farms 4-H Association: The Montclair Community Farms 4-H Association serves as hands-on resources that engages the community in urban farming, sustainable agriculture, affordable food access, and healthy food and lifestyle choices. The main anticipated outcome was to serve the senior population to increase their consumption of healthy locally grown produce. Other anticipated outcomes included; increased participation in our Urban Youth Farming Program, increased participation in our Farm Camp, a greater number of volunteers to support growing efforts, and expansion of community partner connections to create synergistic health and wellness outcomes.

What has been done

The Montclair Community Farms 4-H Association (MCF) supports community garden sites, community partnerships and programs that educate the community and youth farmers in urban farming, sustainable agriculture, and healthy food and lifestyle choices. Association members include staff and faculty representatives from HOMECorp, Montclair Department of Health and Human Services, Montclair History Center, Montclair State University, NJAES/RCE 4-H faculty/staff, Master Gardeners, and Montclair DIGS, and youth advisory members. Together, the association supports staff and volunteers to offer a seasonal mobile farm stand, a seasonal community garden including chickens and bees, and year-round educational programs and volunteer opportunities. MCF has been active in the community since 2012 and is growing stronger each year. Each year, impact is evaluated, community needs are reassessed, and an action plant is creating for the coming growing season. The main focus in preparing for the 2017-growing season was to increase access to and quantity of locally grown food made available to community members, specifically seniors. MCF's mobile farm stand has expanded into the community during the 2017 season. The farm doubled its outreach with continued weekly visits to three Montclair senior sites. The team is looking to expand community garden opportunities for local residents. Now on its third mobile farm stand season, MCF has developed relationships with community sites and serves as a dependable resource for fresh, organic, affordably-priced food serving those in the community with lower and/or fixed incomes. MCF is now able to accept USDA SNAP Food Stamps, enabling patrons to use their SNAP funds to purchase fresh produce directly. MCF will be able to market this service at the beginning of the 2018 season to initiate its familiarly at the start to patrons. MCF continued to offer bi-monthly volunteer opportunities at farm sites to the public totaling over 1050 volunteer hours at service days. Staff also continued to work in partnership with the 4- H youth farmer club program for mobile stand success totaling over 250 youth volunteer hours. The youth farm camp also expanded this year by offering 3 half day camp week options and adding a fourth week full day option focusing on farm to table, top chef style. All camp weeks were a success and brought in additional funds to support an assistant farmer position for the next growing season and maintenance costs.

Results

513 volunteers totaling over 1,000 hours; 602 Seniors and community members served with the mobile farmstand. 4-H Youth Farmers (weekly from July - October, 5-13 youth varied by week; 4-H Chicken Club (monthly beginning in September, 5-7 kids each month); 4- H Farm Camp (4

camp weeks, ranging from 25-35 kids each week); Farm Camp Youth Survey Data Week 3 of camp (RCE Youth evaluation for grades K-3); n=28; 50% of youth indicated they learned a lot and 43% indicated they learned some about where their food comes from. 61% of youth indicated they learned a lot and 25% indicated they learned some about growing food. 68% of youth indicated they can teach someone in their family about what they learned; 92 % of youth indicated they want to learn more Farm Camp Youth Survey Data Week 4 of camp (RCE Youth evaluation for grades 4-12) n=17; 71%want to learn more about gardening/food; 59% plan to share what they learned; 82% indicated that they learned about community food needs; 83% indicated that the info presented was useful Farm Camp - Parent Survey Data- Parent surveys were sent out at the end of each week of farm camp to understand family perceptions of farm camp and opportunities for program improvement. n=36 (surveys were sent to 79 families); 96% of families indicated that they felt adequate measures where in place to ensure your child's safety. 96% of respondents indicated that their child shared a positive experience from farm camp. 100% of parents indicated being satisfied with the daily lessons and learning goals. Comments include: "Joseph loves farm camp. It was his third year. We wish it were longer!!! Maybe starting earlier???? Thank you. Perhaps more exposure to animals. My daughter loved her week at farm camp so I am very happy with everything that she was exposed to but more animals would have been great. Senior Survey Data - In partnership with Montclair State University, surveys were administered at 4 of the senior sites that the MCF mobile farm stand serves to better understand our impact and opportunities for program improvement. n=33 - 36% of farm stand customers tried New Vegetable; 75% shared vegetables with family or friends; 82% indicating eating more fresh vegetables as a result of the farm stand; 58% Shopped at MCF Weekly; 100% indicated they would shop at the farm stand the following year; 5.3 of 6 Satisfaction rating for Convenience; 5.9 of 6. Satisfaction rating for Offerings - 2.9 of 3 for Quality better than regular grocer. 4.3 of 5. Satisfaction rating for Price Produce Grown/Supplemented Orange Road/Miller Street: about 550 pounds recorded. Supplemented: about 1,050 pounds recorded. Eggs: 547 recorded; Over 1000 pounds of food was purchased by community members raising $1,500.

4. Associated Knowledge Areas

KA Code	Knowledge Area
806	Youth Development

V(H). Planned Program (External Factors)

External factors which affected outcomes

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

Brief Explanation

None to report.

V(I). Planned Program (Evaluation Studies)

Evaluation Results

NJAES research and extension outcomes related to this planned program were evaluated utilizing a variety of evaluation methods appropriate for each initiative to determine effectiveness on both a qualitative and quantitative level. For KASA and practice change we included the measurement of knowledge gained as measured by pre/post Likert-scale assessments. Surveys were used to measure increase in skills acquired, behavior change and practice adoption. For process evaluation we focused on program delivery, participation, relevance and timeliness. Data was collected at appropriate times for each initiative that supports this planned program. IRB approved evaluation instruments were used to collect research and extension data. Data analyses and comparisons relevant to basic and applied research and demonstration were collected and analyzed and reported utilizing a variety of data collection methods appropriate to each research question. The major goal of evaluating is the demonstration of social, economic, behavior and environmental changes in conditions that contribute to improved quality of life as a result of participation in programs and benefits of research solutions. See state defined outcomes for detailed results of each initiative.

Key Items of Evaluation

None to report.

V(A). Planned Program (Summary)

Program # 4

1. Name of the Planned Program

Global Food Security and Hunger - Agricultural Viability

☑ 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
205	Plant Management Systems	20%		20%	
211	Insects, Mites, and Other Arthropods Affecting Plants	20%		20%	
215	Biological Control of Pests Affecting Plants	20%		20%	
601	Economics of Agricultural Production and Farm Management	20%		20%	
604	Marketing and Distribution Practices	20%		20%	
	Total	100%		100%	

V(C). Planned Program (Inputs)

1. Actual amount of FTE/SYs expended this Program

Year: 2017	Extension		Research	
	1862	1890	1862	1890
Plan	65.0	0.0	36.0	0.0
Actual Paid	6.1	0.0	13.1	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**
663725	0	904460	0
1862 Matching	**1890 Matching**	**1862 Matching**	**1890 Matching**
4539034	0	4410113	0
1862 All Other	**1890 All Other**	**1862 All Other**	**1890 All Other**
442704	0	1987478	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

Identify critical programmatic foci/needs based on Extension and stakeholder assessment. These can be broadly defined under three areas:

- Production BMPs (nutrient, pest, waste/by-products management, water quality and quantity, energy)
- Financial BMPs (marketing, labor, risk management, policy e.g. farmland preservation)
- Ag Systems (sustainable ag, organic ag, new crops and use/alternative)

Develop an inventory of local (county based), regional and statewide programs designed to meet these needs; identify team members and their roles.

Create a multi-task effort to generate and share research-based information with clientele through demonstrations, educational meetings and workshops, certification programs, trainings, development of recommendation and decision making guides, etc.

2. Brief description of the target audience

Stakeholders (broadly defined to include producers, processors, marketers, end-users, policymakers, legislators).

Commercial agriculture producers and end-users (such as marketers, processors, consumers, etc.).

Municipalities and other governmental and non-governmental agencies, etc.

3. How was eXtension used?

Faculty participated in answering "ask the expert" questions, participation in Horse Quest, Wildlife Damage Management, Agricultural Waste Management, Specialty Vegetables, Blueberries, Organic Agriculture, Grapes, Agritourism CoPs, learn professional sessions and the development of collaborative educational products.

V(E). Planned Program (Outputs)

1. Standard output measures

2017	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	64446	2370125	6162	26400

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

Patent Applications Submitted

Year:	2017
Actual:	14

Patents listed
15/530644 - Ilex x designated CR195-115 (Issued)
14/756233 - CORNUS KOUSA TREE DESIGNATED "RUTPINK" (Issued)
15812968 - Downy Mildew Resistant/Tolerant Sweet Basil Varieties (applied)
62/431,218 - Catnip Cultivar CR3 (applied)
15338014 - Catnip Cultivar CR9 (applied)
US PP27,657 - Cranberry variety named CNJ99-9-96 (Issued)
US PP27,709 - Cranberry variety named CNJ99-52-15 (Issued)
62/541,395 - Compositions and Methods Comprising Endophytic Bacterium for Application to Target Plants to Increase Plant Growth, and Increase Resistance to Abiotic and Biotic Stressors (Applied)
15/530,547 - NECTARINE TREE NAMED NJN103 (applied)
15/530,542 - NECTARINE TREE NAMED NJN102 (applied)
15/530,545 -PEACH TREE NAMED NJ357 (applied)
15/530,543 - PEACH TREE NAMED NJ358 (applied)
15/530,541 - PEACH TREE NAMED NJ359 (applied)
15/530,785 - NECTARINE TREE NAMED NJF20 (applied)

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2017	Extension	Research	Total
Actual	40	83	123

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- A variety of strategies will be implemented to reach target audiences. This will include and not be limited to workshops, field visits, classes, newsletters, media releases, electronic communications,and publications.In addition a trained volunteer teaching base will be developed. Quantitative reports of participation will be collected.

Year	Actual
2017	0

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O. No.	OUTCOME NAME
1	Short Term - Increases in knowledge and skills of agricultural and horticultural industry professionals will occur relating to: Nutrient management Pest management Waste/by-products management and utilization Improving water quality and conserving water Conserving energy Marketing skills Labor management Risk management Policy e.g. farmland preservation Sustainable ag and organic ag production methods New crops and use/alternative crops
2	Medium Term - Productive agricultural land is stabilized to meet the needs of the agricultural industry and the needs of people of NJ. Agriculture remains a relevant and viable economic sector as profits increase (through reduced costs and/or increased or new sales or revenue streams). Measurable reductions in environmental impact (clear and adequate sources of water, reduced waste, reduced soil losses, reductions in non-point source pollution, etc.) will occur through the adoption of improved and sound management practices. Overall state environmental quality will be enhanced by agriculture, such as through the utilization and recycling of biowastes generated by the non-ag sector or the enhancement of air quality. The products of NJ agriculture will add to the nutritional quality of New Jerseyans food supply.
3	Long Term - New Jersey's agriculture will remain a viable and important industry. New Jersey residents will recognize the importance of agriculture's contributions to societal well being (open space, quality of life) and will support the agricultural industry socially, politically and economically.
4	Controlled Environment Engineering - Short Term - Increases in knowledge and skills of agricultural and horticultural industry professionals will occur relating to: Nutrient management Pest management Waste/by-products management and utilization Improving water quality and conserving water Conserving energy Marketing skills Labor management Risk management Policy e.g. farmland preservation Sustainable ag and organic ag production methods New crops and use/alternative crops.
5	New Processing Tomato Varieties for Growers in the Mid-Atlantic U.S. - Medium Term - Productive agricultural land is stabilized to meet the needs of the agricultural industry and the needs of people of NJ. Agriculture remains a relevant and viable economic sector as profits increase (through reduced costs and/or increased or new sales or revenue streams). Measurable reductions in environmental impact (clear and adequate sources of water, reduced waste, reduced soil losses, reductions in non-point source pollution, etc.) will occur through the adoption of improved and sound management practices. Overall state environmental quality will be enhanced by agriculture, such as through the utilization and recycling of biowastes generated by the non-ag sector or the enhancement of air quality. The products of NJ agriculture will add to the nutritional quality of New Jerseyans food supply.
6	Yacon a Potential New Crop for New Jersey Growers - Medium Term- Productive agricultural land is stabilized to meet the needs of the agricultural industry and the needs of people of NJ. Agriculture remains a relevant and viable economic sector as profits increase (through reduced costs and/or increased or new sales or revenue streams). Measurable reductions in environmental impact (clear and adequate sources of water, reduced waste, reduced soil losses, reductions in non-point source pollution, etc.) will occur through the adoption of improved and sound management practices. Overall state environmental quality will be enhanced by agriculture, such as through the utilization and recycling of biowaste generated by the non-ag sector or the enhancement of air quality. The products of NJ agriculture will add to the nutritional quality of New Jerseyans food supply.

7	RU Brew: Specialty Malting Grains - Medium Term -Productive agricultural land is stabilized to meet the needs of the agricultural industry and the needs of people of NJ. Agriculture remains a relevant and viable economic sector as profits increase (through reduced costs and/or increased or new sales or revenue streams). Measurable reductions in environmental impact (clear and adequate sources of water, reduced waste, reduced soil losses, reductions in non-point source pollution, etc.) will occur through the adoption of improved and sound management practices. Overall state environmental quality will be enhanced by agriculture, such as through the utilization and recycling of biowastes generated by the non-ag sector or the enhancement of air quality. The products of NJ agriculture will add to the nutritional quality of New Jerseyans food supply.
8	Strawberry Project - Long Term - New Jersey's agriculture will remain a viable and important industry. New Jersey residents will recognize the importance of agriculture's contributions to societal well being (open space, quality of life) and will support the agricultural industry socially, politically and economically
9	Organic Sustainable Horticulture - Long Term - New Jersey's agriculture will remain a viable and important industry. New Jersey residents will recognize the importance of agriculture's contributions to societal well being (open space, quality of life) and will support the agricultural industry socially, politically and economically
10	Soil Fertility - Long Term - New Jersey's agriculture will remain a viable and important industry. New Jersey residents will recognize the importance of agriculture's contributions to societal well being (open space, quality of life) and will support the agricultural industry socially, politically and economically
11	Breeding and germplasm Enhancement for New Jersey Cranberry and Blueberry Industries - Long Term- New Jersey's agriculture will remain a viable and important industry. New Jersey residents will recognize the importance of agriculture's contributions to societal well being (open space, quality of life) and will support the agricultural industry socially, politically and economically
12	Farm Management - Long Term - New Jersey's agriculture will remain a viable and important industry. New Jersey residents will recognize the importance of agriculture's contributions to societal well being (open space, quality of life) and will support the agricultural industry socially, politically and economically

Outcome #1

1. Outcome Measures

Short Term - Increases in knowledge and skills of agricultural and horticultural industry professionals will occur relating to: Nutrient management Pest management Waste/by-products management and utilization Improving water quality and conserving water Conserving energy Marketing skills Labor management Risk management Policy e.g. farmland preservation Sustainable ag and organic ag production methods New crops and use/alternative crops

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
An Examination of the Demand for Domestically Produced and Processed Ethnic Food in the United States: The American food basket reflects a growing share of more ethnic food, tropical products, and imported, consumer-ready, value-added (processed) food products as Americans become wealthier, more health conscious, and more ethnically diverse. This growth presents an opportunity for producers and marketers of ethnic food products to tap into a section of the U.S. food market that is rapidly growing and has high potential. Research has shown that the import of consumer-ready, value-added processed products from developing countries has been rising over the years. At the same time, there is considerable rise in the refusal of imported food by the US Food and Drug Administration (FDA). Therefore, food safety is a major concern in over imported food in the United States. The increased refusal begs the question: would market intermediaries of processed ethnic food, including processors, be interested in sourcing their products, including raw materials domestically from the U.S.? Additionally, does such interest and willingness translate into an increased demand for raw materials produced by the upstream domestic farmers?

What has been done
NJAES researchers are studying the customer base, i.e., consumers of processed ethnic food in the U.S., and the market intermediaries who market processed ethic food. Projected research outcomes include identifying factors and barriers faced by domestic food processors when attempting to source their ingredients domestically. Understanding such barriers will help to determine opportunities for such processors as well as for U.S. farmers and other suppliers of ethnic food ingredients needed for processing of ethnic food. So far, work has been undertaken to determine factors driving consumer decisions regarding purchasing of domestically processed ethnic food.

Results
Based on the research carried out so far, NJAES researchers have learned that consumers in Central Jersey spend over 39% of their monthly grocery bill on ethnic food, and the top 5 products demanded are: spices, flour/rice, snacks, sauces, and sweets. In terms of their store selection, consumers select stores based on product availability, prices, distance to the store, location of the store, and store familiarity. Consumers believe that processed ethnic foods made in the USA are safer and healthier compared to what is currently available (which is mostly imported). Consumers are willing to purchase or willingness to buy (WTB) Made in USA processed ethnic food IF such food is authentic, organic, tastier, similarly priced, and identical to what is currently available. The likelihood of consumers purchasing "Made in USA" processed food increases when consumers believe that such food are tastier than the imports, have familiar brand names, and when their HH size is larger. The bottom line is consumers do have positive attitudes toward "Made in USA" processed ethnic food, and are likely to buy if local (domestic) entrepreneurs are able to compete with the currently available goods in terms of taste (flavor), authenticity, and quality (brand familiarity).

4. Associated Knowledge Areas

KA Code	Knowledge Area
205	Plant Management Systems
211	Insects, Mites, and Other Arthropods Affecting Plants
215	Biological Control of Pests Affecting Plants
601	Economics of Agricultural Production and Farm Management
604	Marketing and Distribution Practices

Outcome #2

1. Outcome Measures

Medium Term - Productive agricultural land is stabilized to meet the needs of the agricultural industry and the needs of people of NJ. Agriculture remains a relevant and viable economic sector as profits increase (through reduced costs and/or increased or new sales or revenue streams). Measurable reductions in environmental impact (clear and adequate sources of water, reduced waste, reduced soil losses, reductions in non-point source pollution, etc.) will occur through the adoption of improved and sound management practices. Overall state environmental quality will be enhanced by agriculture, such as through the utilization and recycling of biowastes generated by the non-ag sector or the enhancement of air quality. The products of NJ agriculture will add to the nutritional quality of New Jerseyans food supply.

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Sustainable Practices, Economic Contributions, Consumer Behavior, and Labor Management in the U.S. Environmental Horticulture Industry: With the decline in the economy and housing construction, environmental horticulture industry (sometimes referred to as the "green industry") growers are faced with financial uncertainty, rising input costs, but flat prices, consumer economic fears, an increasingly global and complex market, growing public concern about chemicals and water pollution, slow housing starts, and a maturing market. One may argue that the impact of the mass marketing of nursery and floricultural crops has been to reduce the number of growers while increasing the overall size and mechanization of individual operations. The capital requirements, increased input costs, reduced margins, increased demands from buyers, and the market power

associated with fewer numbers of buyers have all created intense market pressures and heightened competitive rivalry among producers. The industry's profit margins are typically low, leaving little room for growers to absorb significant increases in costs or decreases in revenues. Unlike farmers who produce field crops, nursery and greenhouse firms bear the entire price, market, and production risks because these crops have had no government support programs. Thus, many growers are challenged to produce an aesthetically pleasing, profitable, and socially responsible crop while decreasing costs and increasing efficiency of production practices. In this extremely competitive industry, producers must make production, management, and marketing decisions based on accurate and timely information. This research will address way producers can hone their marketing and management skills to continue to survive and respond to current trends. A growth area that has not been economically analyzed is urban/rooftop greenhouses. The New Jersey Greenhouse Cost Accounting Program will be used to evaluate investment alternatives used in urban greenhouses, and modifications will be made as needed to look at additional parameters that will be identified in the research.

What has been done

Budgets have been produced for ultra-niche sustainable crops that can be profitable in the Northeast. The best production practices were identified for each crop, along with an economic analysis including a full cost analysis of the negative costs to the environment. Economic analyses is conducted on the use of various sustainable containers. Extension outreach materials were developed and training sessions offered. NJAES researchers have prepared a report for the nursery industry in NJ as well as the development brochures, and fact sheets available on the Rutgers Farm Management Website. The effect of selected nursery mechanization/automation practices and labor management practices on labor productivity and efficiency are being determined through surveys.

Results

NJAES researchers produced a series of 10 on-line interactive budgets as well as a series of factsheets explaining the budget and how it can vary from grower to grower. Five classes have been offered since last reporting period. Budgets are in the review process for those crops. To develop some background knowledge in the area of urban farming, researchers identified and contacted several producers in the NJ/NYC area and conducted background research to look at the economic and social costs and returns of successful urban greenhouses. The results of these assessments were published in professional and trade journals and presented at professional meetings to provide existing and new urban greenhouses with guidelines that can help provide food security for urban residents.

4. Associated Knowledge Areas

KA Code	Knowledge Area
205	Plant Management Systems
211	Insects, Mites, and Other Arthropods Affecting Plants
215	Biological Control of Pests Affecting Plants
601	Economics of Agricultural Production and Farm Management
604	Marketing and Distribution Practices

Outcome #3

1. Outcome Measures

Long Term - New Jersey's agriculture will remain a viable and important industry. New Jersey residents will recognize the importance of agriculture's contributions to societal well being (open space, quality of life) and will support the agricultural industry socially, politically and economically.

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Specialty Crops and Food Systems: Exploring Markets, Supply Chains and Policy Dimensions - Organic Produce once a fad, has now flourished into a multi-billion dollar industry, reaching $35.1 billion in sales in 2013. This upward trend in organic food will continue to grow as consumers become acutely aware of social sustainability, sense of community, and their willingness to promote opportunities for small farmers to maintain their farming life style. In addition, frequent food recalls and the proliferation of genetically modified organisms (GMOs) accentuated the perception of risk associated with the conventional food system and the consumers are looking for safe and naturally grown alternatives in organic food. However, lack of information relating to production and marketing is likely to limit the potential growth of organic agriculture in the U S. Furthermore, we perceive significant potential for an increase in profit margins for organic farmers, but more information needs to be discovered on consumer perceptions and behaviors in the Mid-Atlantic region in order to enable our growers to fully take advantage of the organic market.

What has been done
Farmers across the world utilize various methods to combat the effects of pests on crops to enhance yield, productivity, and to reduce the cost of cultivation. The widespread incidence of poverty and malnutrition, especially in the developing countries, motivated the extensive and intensive use of pesticides. However, increased agricultural productivity did not come about without adverse bearings on the human health and environment. To gauge the preference for pesticide-free produce, an internet survey of 1100 Mid Atlantic consumers in five states was conducted during 2016.

Research was also conducted to assess the changing coordination and supply chain management strategies being implemented in the fruit and vegetable sector and identify strategic

organizational and marketing implications for a set of firms that are diverse in terms of commodity, marketing approach and size of operation (including small and mid-size farms).

Results
NJAES researchers developed a logic model to predict the characteristics of those who willing to buy (WTB) a pesticides free fruits and vegetables in the Mid-Atlantic region of US. The Logic model results indicate that respondents are those who: Consciously look for healthy food; Think food advertisements always help the consumers to decide which agricultural food items to purchase; Regularly check the food label; Preferred organically grown but not local produce; Think organic food does not contain GMO's; Provide support for local farmers and agriculture; Preferred to buy organic Chutney/Pickles; Preferred to buy organic Juice, preferred to buy organic wine; Are more like to buy pesticide-free produce. Whereas those with an education of four years' college degree and high amount spent on each visit for fruits and vegetables are less likely to be concerned with pesticide-free produce compared to others. The assessment of perception of consumers' willingness to buy pesticide-free produce will help the producers, wholesalers, and retailers to target ultimate consumers to sell their produce.

4. Associated Knowledge Areas

KA Code	Knowledge Area
205	Plant Management Systems
211	Insects, Mites, and Other Arthropods Affecting Plants
215	Biological Control of Pests Affecting Plants
601	Economics of Agricultural Production and Farm Management
604	Marketing and Distribution Practices

Outcome #4

1. Outcome Measures

Controlled Environment Engineering - Short Term - Increases in knowledge and skills of agricultural and horticultural industry professionals will occur relating to: Nutrient management Pest management Waste/by-products management and utilization Improving water quality and conserving water Conserving energy Marketing skills Labor management Risk management Policy e.g. farmland preservation Sustainable ag and organic ag production methods New crops and use/alternative crops.

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual

2017	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Controlled Environment Engineering: The national greenhouse industry, including the rapidly expanding indoor agriculture industry, is always looking for ways to improve production efficiency and reduce inputs. This industry is an important part of U.S. agriculture, with a 2012 farm gate value of ~$6.5 billion (USDA-NASS, 2014). Challenges include the relatively high demand for energy (especially for heating & cooling, supplemental lighting, pumping), as well as the operation and efficiency of equipment that consumes this energy. Reductions in energy consumption and improvements in equipment efficiencies will have an immediate and in some cases substantial impact on the financial viability of an operation. This program is focuses on helping greenhouse operators to make informed decisions about energy use, its conversion efficiency and the management strategies that can be implemented to improve production output and therefore the bottom line.

What has been done

Nationwide, commercial greenhouse growers and Extension personnel have been exposed to research and outreach efforts through various presentations and publications. A proposed product label was published that encourages the horticultural lighting industry to adopt an information label that growers can use to compare the performance of fixtures made by different manufacturers.

Results

It is estimated that this information has led to proper designs of controlled environment plant production facilities and updated operational strategies that saved an average sized (1-acre) business a total of $20,000 in operating and maintenance costs annually. Greenhouse energy conservation presentations and written materials have been prepared and delivered to local and regional audiences. Greenhouse growers who implemented the information resulting from our research and outreach materials have been able to realize energy savings between 5 and 30%. The proposed product label for fixtures used for horticultural applications is being considered for adoption by several lighting manufacturers and will help growers considering a lighting installation at their operation.

4. Associated Knowledge Areas

KA Code	Knowledge Area
205	Plant Management Systems
211	Insects, Mites, and Other Arthropods Affecting Plants
215	Biological Control of Pests Affecting Plants
601	Economics of Agricultural Production and Farm Management
604	Marketing and Distribution Practices

Outcome #5

1. Outcome Measures

New Processing Tomato Varieties for Growers in the Mid-Atlantic U.S. - Medium Term - Productive agricultural land is stabilized to meet the needs of the agricultural industry and the needs of people of NJ. Agriculture remains a relevant and viable economic sector as profits increase (through reduced costs and/or increased or new sales or revenue streams). Measurable reductions in environmental impact (clear and adequate sources of water, reduced waste, reduced soil losses, reductions in non-point source pollution, etc.) will occur through the adoption of improved and sound management practices. Overall state environmental quality will be enhanced by agriculture, such as through the utilization and recycling of biowastes generated by the non-ag sector or the enhancement of air quality. The products of NJ agriculture will add to the nutritional quality of New Jerseyans food supply.

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
New processing tomato varieties for growers in the Mid-Atlantic U.S.: The Mid-Atlantic U.S. food processing industry has declined steadily since the mid-20th century, but remains a significant component of the overall agricultural economy. As the industry has relocated geographically, agricultural support services such as seed companies have curtailed activities, creating a need for new, competitive processing tomato varieties that are adapted to unique environmental conditions.

What has been done
A traditional plant breeding and field performance trials program was established to address this need. Germplasm was acquired from multiple sources worldwide and evaluated in successive field trials. Top-performing populations were selected and hybridized to combine the key varietal characteristics that define overall performance, a combination of field (yield, disease resistance) and factory (fruit quality) parameters. The results of field and lab experiments were conveyed to clientele via verbal and written presentations in an annual meeting. Seeds of selected new varieties were produced and made available to clientele for trial and production through the grower-contractor.

Results
Seeds of new, adapted processing tomato varieties were sold to 15 contracted growers who reported an economic benefit of 10% (combined lower seed cost and higher varietal performance) on acreage and tonnage attributable to the new varieties.

4. Associated Knowledge Areas

KA Code	Knowledge Area
205	Plant Management Systems
211	Insects, Mites, and Other Arthropods Affecting Plants
215	Biological Control of Pests Affecting Plants
601	Economics of Agricultural Production and Farm Management
604	Marketing and Distribution Practices

Outcome #6

1. Outcome Measures

Yacon a Potential New Crop for New Jersey Growers - Medium Term- Productive agricultural land is stabilized to meet the needs of the agricultural industry and the needs of people of NJ. Agriculture remains a relevant and viable economic sector as profits increase (through reduced costs and/or increased or new sales or revenue streams). Measurable reductions in environmental impact (clear and adequate sources of water, reduced waste, reduced soil losses, reductions in non-point source pollution, etc.) will occur through the adoption of improved and sound management practices. Overall state environmental quality will be enhanced by agriculture, such as through the utilization and recycling of biowaste generated by the non-ag sector or the enhancement of air quality. The products of NJ agriculture will add to the nutritional quality of New Jerseyans food supply.

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Yacon a Potential New Crop for New Jersey Growers: Yacon (Smallanthus sonchifolius) is crop

grown in South America for its sweet tasting edible tuber. There is recent interest in yacon in the United States due to it's unique sweet flavors as well as the potential health benefits from its consumption. Yacon tubers contain fructooligosaccharides (FOS) which creates a sweet taste but are also indigestible. FOS have been shown to potentially enhance digestive health. Farmers have expressed interest in growing and marketing yacon as a specialty crop in New Jersey but there very little information on its cultural requirements, yield and market potential. Since yacon is harvested in the fall and can be stored, it has the potential to be a valuable specialty crop for local growers who have expanded their marketing season through community supported agriculture and winter farmers markets.

What has been done
Field trials were conducted to determine if yacon can be successfully grown in New Jersey. Six cultivars of yacon were planted in a field trial and production components such as yield, tuber quality, tuber and rhizome storage examined. The marketing potential of yacon tubers was evaluated in cooperation with a local farmer.

Results
Field trials showed that yacon can be grown and harvested in New Jersey. The successful overwintering of yacon rhizomes as a means of propagation and multiplication was also demonstrated. Short term storage of yacon tubers was shown to be practical for local growers although long term storage needs more study. Yacon tuber yield, quality, and flavor varied greatly by cultivar. The results of the field trials were presented to 57 local farmers at a winter educational meeting and several farmers expressed interest in growing yacon. The local grower cooperating in test marketing yacon said the tubers sold well at local farmers markets especially to health conscious consumers.

4. Associated Knowledge Areas

KA Code	Knowledge Area
205	Plant Management Systems
211	Insects, Mites, and Other Arthropods Affecting Plants
215	Biological Control of Pests Affecting Plants
601	Economics of Agricultural Production and Farm Management
604	Marketing and Distribution Practices

Outcome #7

1. Outcome Measures

RU Brew: Specialty Malting Grains - Medium Term -Productive agricultural land is stabilized to meet the needs of the agricultural industry and the needs of people of NJ. Agriculture remains a relevant and viable economic sector as profits increase (through reduced costs and/or increased or new sales or revenue streams). Measurable reductions in environmental impact (clear and adequate sources of water, reduced waste, reduced soil losses, reductions in non-point source pollution, etc.) will occur through the adoption of improved and sound management practices. Overall state environmental quality will be enhanced by agriculture, such as through the utilization and recycling of biowastes generated by the non-ag sector or the enhancement of air quality. The products of NJ agriculture will add to the nutritional quality of New Jerseyans food supply.

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

RU Brew - Specialty Malting Grains: The idea of producing specialty and niche market crops is a fairly unfamiliar concept to traditional grain farmers in the northeast region. Grain farmers are typically geared to producing for the commodities market where price is largely determined by CBOT pricing. The typical measure of success is measured solely in terms of yield. Many opportunities for specialty or niche market crops presented to farmers at extension and industry meetings are vegetable or fruit crops. Grain producers tend to shy away from such ventures as it often would require investing in additional equipment for production, packaging etc. Such opportunities require the grain farmer to learn about producing a commodity they have no experience with. These opportunities often require the grain farmer to operate outside of their comfort level. However, recently opportunities for producing specialty and niche grains have become increasingly more available. This is particularly attractive to existing grain farmers as they have the knowledge and understanding to produce grain crops. In addition, there are generally minimal capital and infrastructure changes which must be made to produce these crops. An emphasis on higher quality products over traditional commodity grade is one of the usual defining characteristics the specialty markets are seeking. Organically produced and GMO free may also be additional considerations. Alterations to crop production and management are generally the predominate changes that must be made. The transition to producing such crops is generally easier for an existing grain farmer. The most readily apparent market for grain farmers is the craft brewing and distillery markets. The National Association of Brewers reports that 75% of 21+ year olds live within 10 miles of a local brewery. The resurgence of local brewing in America is certainly evidenced by the more than 4,000 active American breweries contained in the National Association of Brewers database. In fact, the US is currently approaching the historical high of 4,131 breweries reported in 1871. New Jersey currently has 82 craft breweries producing in excess of 110,000 barrels of craft beer annually. The NJ breweries source very limited amounts of grain locally. The result is a potential new market for NJ grain producers. Craft beer is in many ways a reflection and driver of the local food movement. In an age of massive corporate brands, people are thirsty for experiences like riding a bike or hiking to the local brewpub and having a beer produced with local ingredients. Very similar to the consumer's desire to source and purchase locally produced fruits and vegetables. Unlike a chef in a local restaurant, craft brewers can find it to be difficult to source locally-grown hops, barley and other ingredients in the U.S. That's starting to change as brewers seek out more local ingredients. The rise of the local food

and drink movement has led to a surge in beer made with items like local honey, fresh fruit or local "wet" (green) hops.

What has been done
Historically NJ farmers once produced limited amounts of malting barley, as evidenced by Rutgers Extension bulletins from the 1960s. In the early 1900s one time NJ was home to a very large Brewery and Malt House. Rutgers Extension also conducted research in 1996 to determine if malting barley could feasibly be produced to support the fledgling craft brewing industry. With the booming growth of the craft brewing industry in the United States and New Jersey, and the fact that approximately 10% of the US population lives within a 100 mile radius of Princeton, NJ; farmers were again questioning whether malt barley could be a feasible crop for NJ grain Growers. In response NJAES/RCE faculty and staff started the RU Brew Group to provide information to producers interested in producing commodities for farm based beverages. The group has conducted both spring and winter malting barley trials as part of the Eastern Spring Barley Nursery (ESBN) multistate variety screening in cooperation with North Dakota State University. The purpose of the ESBN is to identify malting barley varieties that will be successful in the northeast states. In addition to conducting the trials, grower field days, and meetings have been conducted, both in state and out of state. A social media page was also established to exchange information with growers was established. A working relationship with both a regional and in state craft maltsters has been established to provide technical assistance.

Results
Over 90% of participants have indicated that they have gained knowledge or information that will be useful in making the decision as to whether or not to produce malting barley. Over 90% of participants indicated that the program was beneficial to them. Individuals reached via social media posts to date have been over 2,200.

4. Associated Knowledge Areas

KA Code	Knowledge Area
205	Plant Management Systems
211	Insects, Mites, and Other Arthropods Affecting Plants
215	Biological Control of Pests Affecting Plants
601	Economics of Agricultural Production and Farm Management
604	Marketing and Distribution Practices

Outcome #8

1. Outcome Measures

Strawberry Project - Long Term - New Jersey's agriculture will remain a viable and important industry. New Jersey residents will recognize the importance of agriculture's contributions to societal well being (open space, quality of life) and will support the agricultural industry socially, politically and economically

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Rutgers NJAES Strawberry Project: Strawberries are an important crop for many New Jersey farmers that sell directly to consumers through retail operations. A New Jersey Agricultural Experiment Station (NJAES) 2015 survey of 75 of an estimated 130 small fruit growers in NJ revealed that 19% of small fruit growers attributed 25% or more of their income to strawberries. The most important attributes reported by growers when considering selection of strawberry varieties were flavor (93.8%), disease resistance (76.4%); yield (73.3%) and fruit size (72.2%). Growers reported an average retail price of $3.31 per pound and an average wholesale price of $2.20 per pound. Growers produced over 15,000 pounds of strawberries per acre. The goals for the NJAES breeding program were to produce better tasting strawberries that were disease resistant and better adapted to the challenges of Northeast growing conditions.

What has been done
Utilizing traditional plant breeding the Rutgers NJAES has developed strawberry selections which have the potential to help farmers enhance local production and marketing. The new strawberry selections were tested in field research trials at five Universities and on twenty local farms using both organic and conventional production systems. Rutgers NJAES developed partnerships with two commercial strawberry nurseries to test the plant material for potential release to the industry. Farmers and industry professionals were educated on this research and local strawberry production techniques through twelve presentations, on-farm meetings and Extension conferences. Consumers learned about the project through Extension training sessions, newspaper and journal articles and television segments.

Results
The results of the University field research and on-farms trials resulted in plant patents applications for three of the Rutgers NJAES strawberry selections. One of the selections was released for commercial production and named "Rutgers Scarlet" TM. Two licensed nurseries sold over 298,280 "Rutgers Scarlet" strawberry plants to 532 growers from 43 states and four Canadian provinces. Three hundred and twenty farmers were able to observe and learn about the selections firsthand at educational meetings. An additional 1,200 farmers were made aware of the strawberry selections and their potential through grower newsletters and other media outlets. Consumer awareness about local strawberry production, the project and the new selections was raised through tours, TV and radio segments, newspaper articles, educational videos, taste panels and web based press releases that went out to over 500,000 people. Eighty-five researchers and Extension workers gained knowledge about the project and the new strawberry

selections through presentations at meetings and conferences. This interaction helped create a stronger research and Extension network to help advance regional strawberry production and variety development and release. Thirty-eight students and one hundred and fifty Master Gardener volunteers were made aware of the project and the new strawberry selections and increased their knowledge of local sustainable strawberry production and agricultural research and extension and are now able to outreach this information to a large audience. In 2016, 218,625 Rutgers Scarlet strawberry plants were sold and distributed to 92 growers in 22 states with an estimated wholesale production value of $480,975. In 2017, 298,288 "Rutgers Scarlet" TM strawberry plants were sold and distributed to 532 growers in 43 states and four Canadian provinces for an estimated wholesale production value of $656,233. The increased demand among growers in New Jersey and throughout the USA and Canada to produce and market the new "Rutgers Scarlet" TM strawberry demonstrates a change in behavior and adoption of a new variety to enhance profits for growers.

4. Associated Knowledge Areas

KA Code	Knowledge Area
205	Plant Management Systems
211	Insects, Mites, and Other Arthropods Affecting Plants
215	Biological Control of Pests Affecting Plants
601	Economics of Agricultural Production and Farm Management
604	Marketing and Distribution Practices

Outcome #9

1. Outcome Measures

Organic Sustainable Horticulture - Long Term - New Jersey's agriculture will remain a viable and important industry. New Jersey residents will recognize the importance of agriculture's contributions to societal well being (open space, quality of life) and will support the agricultural industry socially, politically and economically

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Organic Sustainable Horticulture: With a continued growth rate about 20% during the last two decades even in recessionary years, organic agriculture has emerged as a mainstream activity. Commercial organic sales in the U.S. reached 40 billion dollars in 2015 with vegetables and fruits as the leading category. The number of organic growers continue to grow thereby creating the need to train organic farmers, extension agents, advisors, consultants and consumers. General goals were established for a holistic organic growing system. The general goals of this seven-year program were to fill the primary production gaps in organic blueberry production with science based research, to reduce risk and help develop an integrated crop management system for organic growers not only in New Jersey where the trials were conducted but to use applicable parts and conceptual approaches in any production area. The specific objectives were to investigate viable solutions for organic weed, insect and disease management; to compile, compare and to incorporate proven horticultural practices into a sustainable production system for highbush blueberry. In 2016-7, the NJAES researcher summarized the goals of a 6-year program in soil health where a new method of microbial population in ag soils to add to physical and chemical measurements in a diversity of farms was developed.

What has been done

The general goals of this seven-year program were to fill the primary production gaps in organic blueberry production with science based research, to reduce risk and help develop an integrated crop management system for organic growers not only in New Jersey where the trials were conducted but to use applicable parts and conceptual approached in any production area. An NJAES researcher investigated viable solutions for organic weed, insect and disease management and compiled, compared and to incorporated proven horticultural practices into a sustainable production system for high bush blueberry. In 2016-7, the research was summarized in soil health to develop a new method of microbial population in ag soils to add to physical and chemical measurements in a diversity of farms system.

Results

There has been an increase in organic blueberry acres of 55 acres for a total of 275 and growing - highest state on the East Coast - worth 2,500,000. There was an increase in organic vegetables, fruit and grains of about 20 acres.

4. Associated Knowledge Areas

KA Code	Knowledge Area
205	Plant Management Systems
211	Insects, Mites, and Other Arthropods Affecting Plants
215	Biological Control of Pests Affecting Plants
601	Economics of Agricultural Production and Farm Management
604	Marketing and Distribution Practices

Outcome #10

1. Outcome Measures

Soil Fertility - Long Term - New Jersey's agriculture will remain a viable and important industry. New Jersey residents will recognize the importance of agriculture's contributions to societal well being (open space, quality of life) and will support the agricultural industry socially, politically and economically

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Soil Fertility: Soil fertility is of fundamental importance to achieving food security. Both organic and conventional farmers use soil testing and plant tissue analysis to monitor crop nutrient status and predict when fertilizer amendments are needed. Judicious use of soil fertility amendments ensures the economic viability of farming systems and protects water quality from excessive nutrient runoff and leaching.

What has been done
NJAES researchers conducting soil testing and plant tissue analysis for essential mineral elements and examined them in relation to yield, health, and quality of several economically important crops. Findings from this soil fertility research program was shared with organic and conventional farmers at grower meetings. Fact sheets were published to provide guidelines on soil fertility management. The most recent fact sheet published entitled "Silicon needs of Soils and Crops" helps growers reduce to need to use pesticides for crop protection.

Results
Implementation of the methods described in the fact sheet Silicon Needs of Soils and Crops has allowed pumpkin growers to reduce the use certain types of pesticides by 50% or more.

4. Associated Knowledge Areas

KA Code	Knowledge Area
205	Plant Management Systems

211	Insects, Mites, and Other Arthropods Affecting Plants
215	Biological Control of Pests Affecting Plants
601	Economics of Agricultural Production and Farm Management
604	Marketing and Distribution Practices

Outcome #11

1. Outcome Measures

Breeding and germplasm Enhancement for New Jersey Cranberry and Blueberry Industries - Long Term- New Jersey's agriculture will remain a viable and important industry. New Jersey residents will recognize the importance of agriculture's contributions to societal well being (open space, quality of life) and will support the agricultural industry socially, politically and economically

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Breeding and germplasm enhancement for New Jersey cranberry and blueberry industries: New Jersey is a major producer of both cranberries and blueberries with a current total industry crop value of over $111 million per annum. Since 2010, there are approximately 7,900 acres of blueberry and 3,200 acres of cranberry production in the state. Both crops can suffer major yield losses due to insects, disease, and adverse climatic conditions. Critical pesticides currently employed by the blueberry and cranberry industries may be restricted or have loss of label in the near future, making alternative approaches essential for the sustainability of these two industries. Development of disease-resistant cultivars would aid in reducing dependence on pesticides without increasing risk of crop loss, as well as providing a higher quality commodity. For New Jersey blueberry growers, traditional breeding objectives such as reliable productivity, winter-hardiness, frost-tolerance, and insect and disease resistance are still relevant. Furthermore, due to market competition from other blueberry production areas and labor issues, two desirable traits have emerged as primary: varieties with an earlier ripening season (7-10 days earlier than current varieties), and machine harvestability for fresh market.

For New Jersey cranberry growers, the main emphasis needs to be directed towards increasing production efficiency due to the fluctuation of cranberry prices in recent years, and developing cultivars with increased resistance to the fruit rot disease complex. Classical plant breeding

procedures, breeding and selections cycles, will be followed for both blueberry and cranberry, involving identification of prepotent parents, crosses for trait complementation and enhancement, and selection for adaptation, productivity, fruit quality, etc. The major impact of this program will be the development of cranberry and blueberry cultivars better adapted to a warmer climate thereby enhancing reliable production and economic sustainability, environmental compatibility, and 'value-added' nutrition. The breeding and genetics objectives outlined in this proposal will also provide a better understanding of the inheritance of characteristics in these species, and offer genetic tools to design more efficient blueberry and cranberry breeding programs.

What has been done

Farming of native berry crops, e.g., cranberry and blueberry, provides a significant contribution to NJ and US economies. Thus it is critical to provide blueberry and cranberry growers with varieties that are better suited to current and emerging challenges, both socioeconomic and environmental, enabling the economic sustainability of these crops. NJAES research is focused on developing these improved varieties. In the past year, progress has been made in numerous areas, including: Blueberry breeding - A number of advanced selections were mechanically harvested for the first time in July 2017, and promising selections were identified which show improved machine-harvest ability traits. Machine harvest of blueberries is increasingly important due to labor shortages and high cost of hand labor. Cranberry breeding - Advanced selections with resistance to fruit rot disease have been established in three diverse growing areas, NJ, WI and BC trials. The performance of these selections under minimal fungicide inputs will allow us to evaluate them for potential release.

Results

Genetic resistance to fruit rot will allow for reduced and/or alternative fungicide applications, reducing costs for grower, environmental impacts, and human health concerns. The latest breeding crosses should result in varieties with enhanced disease resistance. A better understanding of genetic and environmental factors influencing phytochemicals, associated with human health, has provided guidance to our breeding program. Varieties with enhanced phytochemical levels will improve plant performance, and lead to berry products with improved nutritional aspects.

4. Associated Knowledge Areas

KA Code	Knowledge Area
205	Plant Management Systems
211	Insects, Mites, and Other Arthropods Affecting Plants
215	Biological Control of Pests Affecting Plants
601	Economics of Agricultural Production and Farm Management
604	Marketing and Distribution Practices

Outcome #12

1. Outcome Measures

Farm Management - Long Term - New Jersey's agriculture will remain a viable and important industry. New Jersey residents will recognize the importance of agriculture's contributions to societal well being (open space, quality of life) and will support the agricultural industry socially, politically and economically

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
According to the 2012 Census of Agriculture, 20% of New Jersey's 9,071 farms are managed by a woman. Women managing these farms could benefit from Annie's Project New Jersey: Risk Management for Beginner Farmers and the other business management and estate planning programming that focuses on business management training for female farmers. New and beginning farmers face two primary obstacles: high startup costs and a lack of viable land for purchase or rent (which is further intensified in the state of New Jersey). Because these farmers have limited resources, they must manage resources efficiently. According to the 2012 United States Department of Agriculture (USDA), farmers on their operations for less than five years had smaller farms than did established farmers. Additionally, the average size of farms in New Jersey is only 79 acres. Neither of these have large acreage so they are often unable to reap the benefits of economies of scale and therefore have a higher cost to benefit ratio of production. According to the latest Ag Census (2012) the cost of farmland in New Jersey averages $12,792 per acre, four times the national average. Unlike farmers who produce field crops, specialty crop producers bear the entire price, market, and production risks because these crops have had minimal government support programs. New Jersey has some of the highest per-acre farmland in the nation (USDA, FSA website, 2015 which presents a unique disadvantage for new farmers in the Garden State. For these new farmers on small acreage, earning high profits per acre is the only way their farm can be sustainable.

What has been done
NJAES faculty and staff have completed 7 years of Annie?s Project. Annie's Project New Jersey is tailored to New Jersey farmers and differs from Annie's Project in other states in five key areas: 1) the focus on creating a farm business plan throughout the training, 2) the use of social media

education and adoption for marketing and business development, 3) the use of social media tools to assist the participants in networking that is sustainable and interactive, long after the course is completed, 4) using a unique combination of in-person education and distance learning opportunities to expand the audience within the program, and 5) recording the distance learning sessions for asynchronous education of participants and additional women farmers following the completion of the "live" course. One-day courses were offered in different parts of the state to reach women who couldn't spare the time to spend 6-8 weeks taking the more detailed, traditional course. In 2011, this concept was taken abroad per Rutgers' mission, Jersey Roots, Global Reach. In Turkey it became Suzanne's Project. Suzanne's Project went to Guyana in 2012. Suzanne's Project was tailored to local conditions and included business management, technical topics and computer literacy. In 2013, an International Service Learning component called Empowering Turkish Women Farmers and took 5 students to live on farms in Boztepe Turkey to develop case studies for future Suzanne's Project classes. In 2014, Annie's Project for Greenhouses was offered. In 2015 an Estate Planning one-day workshop was offered in three locations in New Jersey. In 2016 a one day Empowering Women Farmers Through Agricultural Business Management course was offered to women that did not have a week or multiple evenings to attend. In 2016, funding was secured from the EU Erasmus+ Program to develop workbooks and an educational program to train the trainers to educate women farmers in Europe. In 2017, teachers' handbooks and workbooks were completed for women farmers as well as e-learning videos on an Empowering Women Farmers with Agricultural Business Management Training (EMWOFA). The program available is in English, Spanish, German, and Turkish. While there are several programs in New Jersey that aid beginner farmers including the Northeast Organic Farming Association's (NOFA) beginner farmer incubation program and Cornell's Northeast Beginning Farmers Project, none are teaching the production and business topics required to grow ultra-high value crops.

Results

Annie's Project New Jersey has resulted in scholarly deliverables as well as positive changes in the lives of program participants. A special page on the Rutgers Farm Management Website has been created to post resources developed for Annie's Project New Jersey http://farmmgmt.rutgers.edu/anniesproject.html. This website includes a video about Annie's Project New Jersey. Presentations from Annie's Project for greenhouses as well as earlier sessions are on the Rutgers Farm Management Website along with handouts and Power Point Presentations. In addition to serving as a resource for farmers in New Jersey, these resources are being used in other states. The project has been widely reported in the news media in New Jersey and in Turkey. Several of these presentations have been published. A new group that was added were U.S. veterans who are interested in started agricultural businesses. This program has been modified for local conditions. Through a program called Empowering Women Farmers with Agricultural Business Management Training, the program went to Turkey, Germany, Spain, and Guyana where it has received equally positive results, local support, and tremendous local press.

4. Associated Knowledge Areas

KA Code	Knowledge Area
205	Plant Management Systems
211	Insects, Mites, and Other Arthropods Affecting Plants
215	Biological Control of Pests Affecting Plants
601	Economics of Agricultural Production and Farm Management
604	Marketing and Distribution Practices

V(H). Planned Program (External Factors)

External factors which affected outcomes

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

Brief Explanation

None to report.

V(I). Planned Program (Evaluation Studies)

Evaluation Results

NJAES research and extension outcomes related to this planned program were evaluated utilizing a variety of evaluation methods appropriate for each initiative to determine the effectiveness on both a qualitative and quantitative level. For KASA and practice change we included the measurement of knowledge gained as measured by pre/post Likert-scale assessments. Surveys were used to measure increase in skills acquired, behavior change and practice adoption. For process evaluation we focused on program delivery, participation, relevance and timeliness. Data was collected at appropriate times for each initiative that supports this planned program. IRB approved evaluation instruments were used to collect research and extension data. Data analyses and comparisons relevant to basic and applied research and demonstration were collected and analyzed and reported utilizing a variety of data collection methods appropriate to each research question. The major goal of evaluating is the demonstration of social, economic, behavior and environmental changes in conditions that contribute to improved quality of life as a result of participation in programs and benefits of research solutions. See state defined outcomes for detailed results of each initiative.

Key Items of Evaluation

None to report.

V(A). Planned Program (Summary)

Program # 5

1. Name of the Planned Program

Climate Change - Home, Garden and Environment

☑ 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	20%		20%	
111	Conservation and Efficient Use of Water	20%		20%	
131	Alternative Uses of Land	20%		20%	
205	Plant Management Systems	20%		20%	
721	Insects and Other Pests Affecting Humans	20%		20%	
	Total	100%		100%	

V(C). Planned Program (Inputs)

1. Actual amount of FTE/SYs expended this Program

Year: 2017	Extension		Research	
	1862	1890	1862	1890
Plan	15.0	0.0	10.0	0.0
Actual Paid	3.1	0.0	7.5	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**
441908	0	517468	0
1862 Matching	**1890 Matching**	**1862 Matching**	**1890 Matching**
2133780	0	2396358	0
1862 All Other	**1890 All Other**	**1862 All Other**	**1890 All Other**
137891	0	1256343	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

Identify critical programmatic foci/needs based on Extension and stakeholder assessment broadly defined under two areas:

- Environmentally sound gardening/lawn care
- Home horticulture-lawn, garden and grounds management
- Commercial horticulture - professional management and maintenance
- Environmentally sound household, structural pest control
- Home pest control-termites, carpenter ants, etc.
- Human-heath related pest control-bed bugs, mosquitoes, ticks, etc.
- A school IPM program will be developed to train end-users sound management techniques,

Develop an inventory of local (county based) and regional and statewide programs designed to meet these needs. Identify team members and their roles. Create a multi-task effort to generate and share research-based information with clientele, including research, demonstrations, educational meetings and workshops, certification programs, trainings, etc. Research on plant cultivars that exhibit increased disease ans insect resistance, as well as reduced need for fertilizer and irrigation water, will lead to reduced dependence on chemical control of pests and disease, lessening the impact on the environment.

2. Brief description of the target audience

Stakeholders:

- Homeowners and residential clientele
- Commercial horticulture professionals (management and maintenance)
- Commercial pest control operators
- Public health officials
- Local environmental commissions or others that have interest in these areas
- Municipalities and other governmental and non-governmental agencies, including Parks Commission, Public Health, Mosquito Commission, schools, etc.
- Volunteers (trained via Master Gardener Program, Environmental Stewards Program), youth and others who can support and benefit from these efforts
- Underserved and underrepresented audiences

3. How was eXtension used?

Faculty participated in the development of collaborative educational products and answering "ask the expert" questions.

V(E). Planned Program (Outputs)

1. Standard output measures

2017	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	21658	161061	3284	591

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

Patent Applications Submitted

Year: 2017

Actual: 36

Patents listed
US 2017/0000101 - Collapsible stackable disposable inexpensive pesticide free traps for surveillance and control of Aedes container breeding mosquitoes and other container breeding insects. (Issued)
US 9,265,247 - Autodissemination of an insect-growth regulator for insect management (Issued)
US 17/50778 - Non-membrane feeding device and diet formulation for mosquito colony production (Applied)
201700188 - Chinook creeping bentgrass (applied)
201700083 - Piranha creeping bentgrass (applied)
201700040 - Monsieur Perennial ryegrass-applied
201700293 - Jetty Hard Fescue-applied
201600233 - Marvel Creeping red fescue-applied
201600246 - Rhambler 2SRP Tall fescue-applied
201600387 - Selkirk Tall fescue-applied
201700084 - Reflection Tall fescue-applied
201700278 - Leonardo Tall fescue-applied
201700279 - Rockwell Tall fescue-applied
201700280 - Michelangelo Tall fescue-applied
201700291 - Motif Tall fescue-applied
201700292 - Valkyrie LS Tall fescue-applied
201700013 - Bloodhound Tall fescue-applied
201400138 -Focus Creeping bentgrass-issued
201600145 - Xeric Creeping red fescue-issued
201500359 - Firecracker SLS Tall fescue-issued
201500362 - Hot Rod Tall fescue-issued
201500364 - Screamer LS Tall fescue-issued
201500365 - Titanium Tall fescue-issued
201500366 - Avenger II Tall fescue-issued
201500367 - Raptor III Tall fescue-issued
201500381 - Xtender Tall fescue-issued
201300041 - Rebounder Tall fescue-issued
201600066 - SuperSonic Tall fescue-issued
201600067 - Blacktail Tall fescue-issued
201600068 - Trinity Tall fescue-issued
201600042 - Fantasia Tall fescue-issued
201500206 - Diablo Tall fescue-issued
201500190 - Firebird II Tall fescue-issued
201500299 - Metolius Perennial ryegrass-issued
201500074 - Benchmark Perennial ryegrass-issued
201500035 - Waterworks Kentucky bluegrass-issued

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2017	Extension	Research	Total
Actual	19	39	58

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- A variety of strategies will be implemented to reach target audiences. This will include and not be limited to workshops, field visits, classes, newsletters, media releases, electronic communications,publications. In addition a trained volunteer teaching base will be developed.Quantitative reports of participation data will be collected.

Year	Actual
2017	0

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O. No.	OUTCOME NAME
1	Short Term - Increased knowledge and improved decision making skills of professionals and volunteers (Master Gardeners and Environmental Stewards) working in commercial horticulture professions (management and maintenance), commercial pest control operators, public health officials, municipalities and other governmental and non-governmental agencies. Increased number of trained youth and adult volunteers, and measurable impact of their assistance on clientele. Increased number of certified pest control operators. Increased number of youth and adult clientele utilizing Extension information and service to improve their own and others knowledge and decision making skills.
2	Medium Term - Educated youth and adult clientele, both professional and residential, utilize their newly gained knowledge and skills to implement and make changes such as: Efficient and effective pest control techniques. Proper utilization of fertilizers and other soil amendments as needed based on soil testing. Proper selection of plant materials to reduce need for chemical inputs. Reduction in the damage caused by structural pests. Reduction in health related incidents and costs association with human health vectors (ticks, mosquitoes). Protect health and safety of school children. Enhance or maintain environmental quality.
3	Long Term - New Jersey's residents will reside, work and play in a healthy, safe, and sound environment-in their homes, gardens, schools, parks and workplaces.
4	Long Term - New Jersey's residents will reside, work and play in a healthy, safe, and sound environment-in their homes, gardens, schools, parks and workplaces.
5	Long Term - New Jersey's residents will reside, work and play in a healthy, safe, and sound environment-in their homes, gardens, schools, parks and workplaces.
6	Long Term - New Jersey's residents will reside, work and play in a healthy, safe, and sound environment-in their homes, gardens, schools, parks and workplaces.
7	Long Term - New Jersey's residents will reside, work and play in a healthy, safe, and sound environment-in their homes, gardens, schools, parks and workplaces.

Outcome #1

1. Outcome Measures

Short Term - Increased knowledge and improved decision making skills of professionals and volunteers (Master Gardeners and Environmental Stewards) working in commercial horticulture professions (management and maintenance), commercial pest control operators, public health officials, municipalities and other governmental and non-governmental agencies. Increased number of trained youth and adult volunteers, and measurable impact of their assistance on clientele. Increased number of certified pest control operators. Increased number of youth and adult clientele utilizing Extension information and service to improve their own and others knowledge and decision making skills.

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Outdoor Recreation, Parks and Other Green Environments: Understanding Human and Community Benefits and Mechanisms - Citizen science programs pose excellent opportunities for the public to engage in authentic science learning. These programs fall under the umbrella of public participation in scientific research and have been shown to result in science content learning gains and development of scientific reasoning skills. In addition to these traditional STEM learning gains, citizen science projects promote positive community engagement, self-efficacy among volunteers with respect to environmental action, and increased motivation to engage in environmental learning. A number of claims have suggested, however, that simple engagement in outdoor activities and environmental recreation might equally contribute to these individual and community level literacy gains.

What has been done
NJAES researchers conducted surveys regarding environmental learning among individuals who are and who are not engaged in a citizen science projects. They targeted a land management citizen science project as well as individuals who engage in recreation on restored landscapes. First, to enable a comparison between citizen scientists and non-citizen scientists, the group took a subset of individuals associated with another citizen science program and created both an adult and school-aged curriculum focused on science and environmental literacy, as well as, on species invasion and land use. NJAES researchers created and validated a "Greenspaces"

instrument targeting adults who engage in citizen science programs and those who do not. The challenge was finding and validating a series of questions that would help to understand science and environmental literacy among the vastly different audiences. Additionally, the group developed questions about outdoor and park use, which can enable better design of future programs. The instrument was delivered to over 600 individuals with a roughly 30-50% response rate. Further, through analysis of evaluation instruments, researchers developed a statistical ordination approach to allow making predictions and associations between audiences but also providing insight into future program design.

Results

Based on a previous survey, the researchers found a strong correlation between education and financial status. Data suggests that Environmental Literacy is correlated with amount of education, visitation to regional or national parks, trust in local groups and print media. Environmentally-literate individuals were less likely to trust large scale institutions and, most of all, large corporations. Environmental literacy did not scale with science knowledge or personality features such as optimism. Environmentally-literate individuals were likely to own pets and prefer less urban/suburban environments. These individuals tended not to use local parks. Additionally, if an individual preferred an urban environment, they were more likely to trust government. By and large, respondents listed issues of health and society as being more important that environmental quality. Most of the respondents did not seem aware of phrases such as ecosystem services or security. In the final study year, the group conducted the largest survey of county residents in one particular county. They looked to expand the study to individual behavior and its possible correlates to environmental behavior. They found that among those who engage in the environmentally responsible behaviors, there seemed to be two groups. The first group tended to identify as environmentalists and to engage in behaviors which were explicitly recognizable are "green" or "environmentally friendly" behaviors; while the second group, who did not characterize themselves as environmentalists, tended to frame their actions as a result of thinking about the impact of their actions.

4. Associated Knowledge Areas

KA Code	Knowledge Area
102	Soil, Plant, Water, Nutrient Relationships
111	Conservation and Efficient Use of Water
131	Alternative Uses of Land
205	Plant Management Systems
721	Insects and Other Pests Affecting Humans

Outcome #2

1. Outcome Measures

Medium Term - Educated youth and adult clientele, both professional and residential, utilize their newly gained knowledge and skills to implement and make changes such as: Efficient and effective pest control techniques. Proper utilization of fertilizers and other soil amendments as needed based on soil testing. Proper selection of plant materials to reduce need for chemical inputs. Reduction in the damage caused by structural pests. Reduction in health related incidents and costs association with human health vectors (ticks, mosquitoes). Protect health and safety of school children. Enhance or maintain environmental quality.

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
The Chemical and Physical Nature of Particulate Matter Affecting Air, Water and Soil Quality: This project will characterize the physical, chemical, biological and/or morphological properties of aggregated or disaggregated particulate matter and their environmental and health impacts over a wide range of spatio-temporal scales, including their potential effects on air quality. The project focused on particulate matter derived from the production, use, and disposal of consumer products.

What has been done
NJAES researchers investigated the physical, chemical, and biological nature of particulate matter, including nanoparticles, derived from agricultural practices, processes, and operations and from the production, use, and disposal of consumer products, as they impact air, water, and soil quality and associated health, economic, and environmental impacts. As part of the investigation of risks associated with nanotechnology-enabled consumer products, NJAES researchers analyzed potential exposures to particles released during the use of nanotechnology-enabled sprays. Specifically, they investigated the fate of particles released from such products, namely their deposition on the floor and resulting resuspension due to walking. Two Silver(Ag)-containing and two Zinc(Zn)-containing spray products were selected which generate relatively high mass concentration when applied. The products were applied in a chamber with controlled background particle concentration. After spraying, the spray was allowed to settle, and experimenter walked on the floor and measured the resuspension rate and size distribution at different locations. The experiments were performed on the carpet and vinyl flooring, and the particles from the same spray were resuspended every 24 hours until the resuspended particle mass concentration reached the maximum value. Filter samples were also collected to analyze the morphology and chemical composition of the resuspended particles.

Results
The sprayed particle mass concentration ranged from 0.3 to 58.2 mg/m3. The resuspended particle concentration ranged from 5.2 to 61, depending on the product. Researchers found that the particle resuspension rate due to walking varied substantially product to product and for different floor types, and it reached the peak value 24 hours or 48 hours after spraying. As could be expected, the large particles representing agglomerates of sprayed nanoparticle and their agglomerates resuspended the easiest. The resuspension pattern from both the carpet and vinyl surface was the same, but the resuspension rate from the carpet was an order of magnitude

higher than that from the vinyl. The resuspended particles and their agglomerates showed the presence of various metals, including silver and zinc as was advertised in product composition.

The data shows that when nanotechnology-enabled consumer products are used in homes, the sprayed particles deposit on floors and can be resuspended thus becoming available for inhalation. The extent of the resuspension depends on the flooring type, the product, as well as the activity causing the resuspension.

4. Associated Knowledge Areas

KA Code	Knowledge Area
102	Soil, Plant, Water, Nutrient Relationships
111	Conservation and Efficient Use of Water
131	Alternative Uses of Land
205	Plant Management Systems
721	Insects and Other Pests Affecting Humans

Outcome #3

1. Outcome Measures

Long Term - New Jersey's residents will reside, work and play in a healthy, safe, and sound environment-in their homes, gardens, schools, parks and workplaces.

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Diagnosis and prediction of storms that can affect the Northeast: Currently, the tools that weather forecasters use to forecast thunderstorms do not account for the fact that the air outside a thunderstorm can mix with the air inside a thunderstorm as the storm develops and matures. In some cases, this mixing of air could prevent a storm from advancing beyond the stage of being a small cloud. As a result, thunderstorms are occasionally forecast that do not materialize. This can then lead to lost economic opportunities (e.g., a farmer decides not to plant because of the forecast for storms that don't actually happen). This research project is investigating the best way to incorporate the mixing process into thunderstorm forecasting techniques without it getting so

complicated as to be intractable. Software that is commonly used by weather forecasters will be modified to incorporate the mixing process, and particular forecasts will be reexamined with the new tools. Ultimately, forecasts of thunderstorms should improve as a result. In a similar vein, new techniques are also being researched in the realm of forecasting nor'easters. Again, software in common use is being tweaked and validated, with the overall goal being an improvement in weather forecasting.

What has been done
Two objectives of the research conducted by NJAES faculty included: new diagnostics of convection will allow for improved analyses and predictions of convection, and may lead to statistical analyses of environments favorable for convection that are more powerful in discriminating between those environments conducive for convection, and those environments that are not, both for current and future climates; to improve the understanding of the dynamics and thermodynamics of nor'easters.

Results
NJAES researchers developed new diagnostics for forecasting thunderstorms that take into account the cooling effect that evaporation of dry air into clouds can have on thunderstorm development. The findings show that, under certain conditions, the new diagnostics can clue forecasters into situations where thunderstorms will struggle to develop, and become less severe than standard diagnostics would suggest. Research into nor'easters has shown that model simulations of these winter storms is highly sensitive to the approximations that are used to account for cloud and precipitation processes in numerical models. These processes must be approximated because they take place on scales much smaller than the scales that regional or global-scale models can directly simulate. This implies that using a variety of these approximations can be an effective way to generate probabilistic forecasts (e.g., there is a 60% chance of getting at least 3 inches of snow). All severe weather events from 2015 and 2016 as reported to the Storm Prediction Center (SPC) were analyzed when the SPC had forecast at least a slight risk of severe weather. Reanalysis data was used to construct profiles of atmospheric fields like temperature and humidity in the vicinity of each severe weather event, so that a large statistical sample of events and corresponding atmospheric states could be constructed. From that sample, relationships between severe weather occurrence and various diagnostics of severe weather (including our new diagnostics incorporating dry air) have been investigated.

4. Associated Knowledge Areas

KA Code	Knowledge Area
102	Soil, Plant, Water, Nutrient Relationships
111	Conservation and Efficient Use of Water
131	Alternative Uses of Land
205	Plant Management Systems
721	Insects and Other Pests Affecting Humans

Outcome #4

1. Outcome Measures

Long Term - New Jersey's residents will reside, work and play in a healthy, safe, and sound environment-in their homes, gardens, schools, parks and workplaces.

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Explorations in the Turfgrass Phytobiome: Understanding Microbial Associations and Developing Tools for Management: Turfgrass is the most widely grown specialty crop in the United States and its wide distribution incurs stressful climatic conditions and pathogenic microbes that play a significant role in survival. One growing area of research involves research in the turfgrass phytobiome, which refers to the entire system of neighboring organisms that impact plant growth, both symbiotic and pathogenic. Recent improvements in next-generation sequencing technologies offer expanded resources to improve our understanding of entire microbial communities that reside in turfgrass ecosystems, whereas previous research focused mainly on culturable organisms. While turfgrass is often scrutinized for its use of irrigation water, fertilizers, and pesticide inputs, improvements in plant microbe interactions may reduce the need of these resources. However, collaboration amongst scientists and practitioners is needed to fully develop research projects that yield useful and practical applications for wide adoption throughout all sectors of the turfgrass industry.

In this project, NJAES researchers planned to describe the microbiomes associated with turf grasses in order to understand the causality of microbiomes and the plant health/performance. They aimed to translate this knowledge to develop new sustainable management strategies and other applications. While the proposed research initiative is a new concept in plant science, these innovative efforts could have long-lasting impacts in improving turfgrass crop characteristics in addition to improved ability to ward off disease causing pathogens and additional pests.

What has been done
NJAES researchers are creating and managing field plots used for studying microbial community dynamics within turfgrass. A number of turfgrass samples have been collected and preserved. A protocol for analysis of turfgrass associated microbiome was established. In addition, they are exploring phytobiome relationships with dollar spot disease activity on plant hosts that vary in

susceptibility to this disease.

Results
NJAES researchers analyzed the microbiome associated with tall fescue genotypes grown in a rainout shelter after prolonged periods of drought stress. Twelve plant samples were selected for analysis, comprised of six sets of siblings, one exhibiting a drought tolerant phenotype and the other a susceptible phenotype. The microbiome associated with the shoots, roots, and rhizosphere soil were evaluated for each tall fescue half-sib apir. Microbiome analysis was preformed utilizing an Illumina NGS metabarcoding approach that sequenced the 16S and ITS barcoding region to determine the composition of the bacterial and fungal communities, respectively. Comparative analysis of the differences in the microbiomes between the two drought tolerance phenotypes will shed light on which microbes are associated with improved drought tolerance or drought susceptibility.

4. Associated Knowledge Areas

KA Code	Knowledge Area
102	Soil, Plant, Water, Nutrient Relationships
111	Conservation and Efficient Use of Water
131	Alternative Uses of Land
205	Plant Management Systems
721	Insects and Other Pests Affecting Humans

Outcome #5

1. Outcome Measures

Long Term - New Jersey's residents will reside, work and play in a healthy, safe, and sound environment-in their homes, gardens, schools, parks and workplaces.

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

got Bats?: Bat exclusions are routinely performed as a strategy to resolve human-wildlife conflict. While guidelines are in place to prevent direct mortality of bats through separating mothers from pups or trapping bats inside the structure, evicting bats from their roost can cause severe stress or mortality, particularly when evening temperatures are low and insect food resources are scarce. In addition, bats in many U.S. states are not protected from harassment, injury or death. Treatment of bats roosting in structures is at the discretion of the nuisance wildlife control operator. Even where bats are humanely evicted from structures, mortality or lowered reproductive success can occur. Provisioning evicted bats with alternative roost structures may be an effective strategy for reducing human-bat conflicts (educating both professionals and homeowners on proper bat exclusion techniques) while also reducing the negative impacts exclusions have on evicted bats.

What has been done
Over the past 3 years, NJAES/RCE has implemented a bat management program in NJ to provide and install artificial roost structures on properties where bats have been evicted. Partners include homeowners, nuisance wildlife control companies, the NJ Division of Fish and Wildlife, and the Conserve Wildlife Foundation of New Jersey. This program provides a feasible amendment to an already established bat exclusion process that has the potential to significantly mitigate both the immediate and long-term negative impacts of eviction on affected bats. However, the effectiveness of the program has not been formally investigated. To date, 80 roost boxes have been installed.

Results
Although a formal survey of the participants did not occur, positive feedback is continually received from residents who have had bat houses installed on their property. An NJAES researcher is routinely called by wildlife control companies asking for assistance in locating bats, or asking for help in installing bat houses.

4. Associated Knowledge Areas

KA Code	Knowledge Area
721	Insects and Other Pests Affecting Humans

Outcome #6

1. Outcome Measures

Long Term - New Jersey's residents will reside, work and play in a healthy, safe, and sound environment-in their homes, gardens, schools, parks and workplaces.

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Rutgers Environmental Stewards: New Jersey has a diverse environment with a land area of almost 7,500 square miles but a population of over 8.1 million making it the most densely populated state in the nation. That fact plus its industrial past has provided and continues to provide environmental harms and challenges for clean water, clean air, clean soil, and a healthy environment. Residents of New Jersey are seeking information to become environmentally literate to be able to become the leaders of the change they want to see.

What has been done
Since 2005 the Rutgers Environmental Stewards (RES) Program has trained almost 600 volunteers in important environmental issues affecting New Jersey, enabling them to solve problems in their communities. The program involves twenty 3-hour class lectures provided by Rutgers faculty, governmental and non-governmental professionals on a different environmental topic each week. There are 4-5 field trips to sites of environmental importance in NJ. The program culminates in a 60-hour hands on internship that fits the needs of the community, the program and the passion of the Steward.

Results
This year 15 Stewards invested 1,551 hours of their own time on internships and recruited an additional 639 hours of volunteer time. They conducted internship projects in ten NJ counties. Environmental Stewards applied for and received small grants and project funding worth a combined total of $3,325. Projects ranged from environmental education, wildlife conservation, citizen science monitoring, and Sustainable Jersey initiatives. Over 166 miles of shoreline were cleaned during a series of health and wellness beach sweeps. In one particular county 5,626 street trees of 102 species were identified as part of a larger community tree cover and canopy inventory. 2,190 hours were invested in training 65 additional volunteers and educating 316 members of the public through outreach. A survey was conducted in 2017 of past Stewards to identify long term impacts of the Program on the Stewards and society. For the question "How much did your experience as a student in the Rutgers Environmental Steward program change your life, on a scale of 1-10, if at all: 1=not at all 10=profoundly" (n=86) 25.6% said "8" and 24.4 said 7. They were also asked about changes in professional life. Below are just a few examples of how the RES Program has made a significant difference in the professional lives of people in New Jersey. "Think of myself as part of the invisible "workers" of society that do stuff without pay these days. Still, if I still had to earn money to sustain life, I would seek opportunities that align with my healthy living values. Now I seek to support employers focused on green living, clean energy, addressing impacts of climate change, etc. in the hope that employment opportunities in these areas produce livable wages and flourish world-wide." "The program enabled me to switch careers and from what I understand not too many people use the program to do such a thing. With my ultimate goal of getting a full time job with a land trust or the National Park Service. I was able to fulfill my dream, and today I can proudly say I am employed as a full time National Park Service employee as a park guide/ranger at Independence National Historical Park in Philadelphia. I am not done yet. I have a few more challenges to accomplish, but because of the Rutgers Environmental Steward program, I am well on my way."

4. Associated Knowledge Areas

KA Code	Knowledge Area
102	Soil, Plant, Water, Nutrient Relationships
111	Conservation and Efficient Use of Water
131	Alternative Uses of Land
205	Plant Management Systems
721	Insects and Other Pests Affecting Humans

Outcome #7

1. Outcome Measures

Long Term - New Jersey's residents will reside, work and play in a healthy, safe, and sound environment-in their homes, gardens, schools, parks and workplaces.

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Protecting Human Health and Urban Environment Through Integrated Pest Management Programs: Many pests occur in homes. They are not only nuisances, but also can cause damage to food, furniture, and structures. German cockroach is the most frequently reported pest. Cockroaches contaminate food and product allergens that are asthma triggers. In recent years, bed bugs resurged as a common pest in homes. As high as 30% of the apartments are infested with bed bugs in some urban communities. Bed bugs bite symptoms include pain, itchiness, raised welts, loss of sleep, psychological distress, etc. Low-income communities often have higher pest infestation rates due to lack of financial sources, ineffective pest control practices, and lack of awareness. Cockroaches and bed bugs can easily spread among apartments in multi-unit dwellings through active dispersal. These pests also spread for long distances in our society through human activities. Reducing cockroach and bed bug infestations in multi-unit dwellings is critical to improve the living conditions of residents and reduce the source of new infestations in our society.

What has been done

NJAES faculty have provided demonstrations of the new and cost-effective pest control methods. Assistance was given to two low-income communities to implement integrated pest management strategies for reducing cockroach infestations. The common bed bug has been resurging in many countries. Researching this pest's behavior will help design more effective control methods. NJAES faculty evaluated the effect of feeding history and time elapsed from field collection on bed bug movement behavior and response to chemical lure or carbon dioxide (CO2) stimulation in the laboratory. Both feeding history and time elapsed from field collection significantly affected bed bug movement, whereas bed bug's response to chemical lure or CO2 was unaffected by the time elapsed from field collection. The need for safe and effective bed bug control products propelled the development of numerous "green insecticides", mostly with essential oils listed as active ingredients. Various inorganic and organic oils also were used for bed bug management. NJAES researchers screened 18 essential oils, three silicone oils, and paraffin oil (C5-20 paraffins) for their toxicities against bed bugs. All the oils exhibited insecticidal activity in topical assays. Their toxicities varied significantly; all of the evaluated essential oils were less effective than silicone oils and paraffin oil. Results of this study indicate silicone oils and paraffin oil have the potential to be used as safer alternative bed bug control materials. The control of bed bugs is often challenging, due to their cryptic nature and resistance to commonly used insecticides. NJAES researchers evaluated the effect of the antiparasitic drug moxidectin on bed bug survival, reproduction, and development. Moxidectin reduced egg laying of bed bug females, but showed no significant effect on egg hatching. One time feeding on rabbit blood containing 20 and 40 ng/mL moxidectin showed no negative effects in bed bug feeding and blood meal ingestion, but significantly reduced digestion rates and nymph molting rates. Although moxidectin at concentrations of 20 and 40 ng/mL only caused moderate mortality in bed bugs, it significantly interrupted digestion, development, and oviposition of survived bed bugs for at least one week after feeding. Moxidectin is a promising supplement of the existing bed bug control materials if its use on humans can be approved in the future. Testing a Threshold-Based Bed Bug Management Approach in Apartment Buildings. Researchers tested a threshold-based bed bug management approach with the goal of achieving elimination with minimal or no insecticide application. Thirty-two bed bug infested apartments were identified. These apartments were divided into four treatment groups based on apartment size and initial bed bug count, obtained through a combination of visual inspection and bed bug monitors: I- Non-chemical only in apartments with 1-12 bed bug count, II- Chemical control only in apartments with 1-12 bed bug count, III- Non-chemical and chemical control in apartments with >12 bed bug count, and IV- Chemical control only in apartments with ≥11 bed bug count. All apartments were monitored or treated once every two weeks for a maximum of 28 weeks.

Results

Treatment I eliminated bed bugs in a similar amount of time to treatment II. Time to eliminate bed bugs was similar between treatment III and IV but required significantly less insecticide spray in treatment III than that in treatment IV. A threshold-based management approach (non-chemical only or non-chemical and chemical) can eliminate bed bugs in a similar amount of time, using little to no pesticide compared to a chemical only approach.

In one of the low-income communities, 85% of the cockroach infestations identified at the beginning were eliminated after 7 months. In the other low-income community, 69% of the cockroach infestations identified at the beginning were eliminated after 6 months. Post-seminar survey and face-to-face interactions with the audience showed that the presentations and new information developed were extremely helpful to them and they are very satisfied. Research and extension provided novel and more cost effective methods to the public. NJAES faculty conducted a 7-month study on cockroach control, the percentage of interviewed residents who used insecticides reduced by 79% (from 91% to 19%), while resident satisfaction increased from 29% to 91%. As a result of this effort, more residents are using safer materials and methods to

manage pests. Housing managers are more concerned about the quality of pest control service rather than using low cost as the only method when hiring pest management companies.

4. Associated Knowledge Areas

KA Code	Knowledge Area
721	Insects and Other Pests Affecting Humans

V(H). Planned Program (External Factors)

External factors which affected outcomes

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

Brief Explanation

None to report.

V(I). Planned Program (Evaluation Studies)

Evaluation Results

NJAES research and extension outcomes related to this planned program were evaluated utilizing a variety of evaluation methods appropriate for each initiative to determine effectiveness on both a qualitative and quantitative level. For KASA and practice change we included the measurement of knowledge gained as measured by pre/post Likert-scale assessments. Surveys were used to measure increase in skills acquired, behavior change and practice adoption. For process evaluation we focused on program delivery, participation, relevance and timeliness. Data was collected at appropriate times for each initiative that supports this planned program. IRB approved evaluation instruments were used to collect research and extension data. Data analyses and comparisons relevant to basic and applied research and demonstration were collected and analyzed and reported utilizing a variety of data collection methods appropriate to each research question. The major goal of evaluating is the demonstration of social, economic, behavior and environmental changes in conditions that contribute to improved quality of life as a result of participation in programs and benefits of research solutions. See state defined outcomes for detailed results of each initiative.

Key Items of Evaluation

None to report.

V(A). Planned Program (Summary)

Program # 6

1. Name of the Planned Program

Global Food Security and Hunger - Integrated Pest Management

☑ 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
216	Integrated Pest Management Systems	100%		100%	
	Total	100%		100%	

V(C). Planned Program (Inputs)

1. Actual amount of FTE/SYs expended this Program

Year: 2017	Extension		Research	
	1862	1890	1862	1890
Plan	20.0	0.0	10.0	0.0
Actual Paid	1.4	0.0	4.2	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**
123401	0	677796	0
1862 Matching	**1890 Matching**	**1862 Matching**	**1890 Matching**
2120477	0	1736652	0
1862 All Other	**1890 All Other**	**1862 All Other**	**1890 All Other**
96266	0	1095263	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

Research
• Develop new and novel techniques for pest management and pest detection
Delivery

• Provide IPM information to a wide variety of stakeholders
• Employ new methods for delivery IPM information

Education

• Conduct IPM educational programs for stakeholders
• Conduct IPM educational training for university students
• Conduct IPM educational training for Vo-Ag and FFA students
• Conduct IPM public awareness campaign

Extension

• Work with communities, schools, businesses to help them meet their regulatory responsibilities on pesticide application
• Help growers develop scouting programs to identify pest populations before significant plant damage occurs.
• Develop pest management options to be used in an integrated or rotational program.
• Identify indicators to help growers anticipate pest problems.
• Develop monitoring techniques and population damage thresholds for selected pests.
• Provide scientifically sound advice to state regulatory bodies on pest management and pesticide issues
• Create a multidisciplinary program comprising of faculty, staff, volunteers, industry partners and government officials
• Investigate IPM methods to help growers produce top quality crops, limiting or reducing production costs.
• Evaluate all pest and crop management practices into a set of commercially used methods. These include the use of: pesticides, economic/aesthetic threshold levels, resistant cultivars, optimum horticultural practices, environmental monitoring, pest scouting, and fertility monitoring and recommendations.

2. Brief description of the target audience

• Municipalities
• Pesticide applicators and their employers
• Commercial pesticide applicators
• State Dept. of Environmental Protection
• Staff and students who gain valuable scientific experience
• Industry partners in agriculture and related commodities
• Consumers
• NJAES Faculty and Staff involved in pest management research/outreach
• Farmers
• Commodity groups
• New Jersey residents
• School faculty, staff and children
• NJAES researchers
• Secondary and university students
• Governmental agencies
• Environmental organizations
• Agricultural, landscape, fine turf and other related industries

3. How was eXtension used?

Faculty participated in answering "ask the expert" questions, developing collaborative educational products and the development of professional development sessions.

V(E). Planned Program (Outputs)

1. Standard output measures

2017	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	21576	25217	255	0

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

Patent Applications Submitted

Year: 2017

Actual: 1

Patents listed

61/557,493 - Bed bug lure (Issued)

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2017	Extension	Research	Total
Actual	29	29	58

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- A variety of strategies will be implemented to reach target audiences. This will include and not be limited to workshops, field visits, classes, newsletters, media releases, electronic communications,publications. In addition a trained volunteer teaching base will be developed. Quantitative reports of participation will be collected

Year	Actual
2017	0

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O. No.	OUTCOME NAME
1	Short Term - Develop improved IPM delivery methods. Develop detection, monitoring and sampling methods that reliably predict pest levels. Develop novel management methods for a wide variety of pests. Develop IPM training for secondary and university students. Improve public awareness about IPM Determine the effectiveness of pheromones for mating disruption of pests. Greater understanding of entomopathogenic nematode species'effects on pests. Evaluation of the effectiveness of natural pesticides and crop management to reduce pests. Determine which types of plants attract pests to be used as a pest control method.
2	Medium Term - Research and educational programs, and public awareness campaign results in increased adoption of IPM in traditional and non-traditional systems. Research findings used to develop new projects. IPM training of students creates new IPM interns, professionals and researchers. Knowledge of various natural insecticides and their effectiveness on pests. Determining the best time and application method for IPM products. Greater understanding of pest biology and ecology. Greater understanding of entomopathogenic species biology and ecology.
3	Long Term - Protect commodities, homes and communities from pests. Increased abundance of high quality food and fiber products. Increased acreage in New Jersey grown under IPM practices. Reduced environmental problems associated with current pest management practices. A comprehensive understanding of best management practices for IPM that are economically viable and environmentally safe.
4	Long Term - Protect commodities, homes and communities from pests. Increased abundance of high quality food and fiber products. Increased acreage in New Jersey grown under IPM practices. Reduced environmental problems associated with current pest management practices. A comprehensive understanding of best management practices for IPM that are economically viable and environmentally safe.

Outcome #1

1. Outcome Measures

Short Term - Develop improved IPM delivery methods. Develop detection, monitoring and sampling methods that reliably predict pest levels. Develop novel management methods for a wide variety of pests. Develop IPM training for secondary and university students. Improve public awareness about IPM Determine the effectiveness of pheromones for mating disruption of pests. Greater understanding of entomopathogenic nematode species'effects on pests. Evaluation of the effectiveness of natural pesticides and crop management to reduce pests. Determine which types of plants attract pests to be used as a pest control method.

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	0

3c. Qualitative Outcome or Impact Statement

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

What has been done
{No Data Entered}

Results
{No Data Entered}

4. Associated Knowledge Areas

KA Code	Knowledge Area
216	Integrated Pest Management Systems

Outcome #2

1. Outcome Measures

Medium Term - Research and educational programs, and public awareness campaign results in increased adoption of IPM in traditional and non-traditional systems. Research findings used to develop new projects. IPM training of students creates new IPM interns, professionals and researchers. Knowledge of various natural insecticides and their effectiveness on pests. Determining the best time and application method for IPM products. Greater understanding of pest biology and ecology. Greater understanding of entomopathogenic species biology and ecology.

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Blueberry and Cranberry Insect Pest Management - Towards the Development and Implementation of Reduced-Risk Strategies: The blueberry and cranberry industry in New Jersey suffers major yield losses due to insect pests. Growers rely heavily on insecticides to manage pest problems.

What has been done
The Blueberry/Cranberry Entomology Program directed by a NJAES researcher delivers practical and effective strategies to blueberry and cranberry growers for the control of insect pests. These strategies are to reduce-risk and thus expected to impact positively the environment and the well-being of humans and their communities. NJAES faculty have focused on the development and implementation of cost-effective reduced-risk insect pest management practices in blueberries and cranberries and the dissemination of this information to blueberry and cranberry growers. Several methods of information transfer including annual grower meetings, field days, twilight meetings, newsletters, and electronic media are used to serve the blueberry and cranberry industry in New Jersey. Newsletter articles and blogs provide information on pest management and to update findings on new pesticides. Educational sessions are regularly offered in certain counties. These sessions provided an overview of research progress and future work. Twilight meetings are held during the growing season to provide seasonally-relevant pest management information. Summer sessions directed to the community (local schools and senior institutions) were conducted regularly during the growing season. The research program also delivered presentations at meetings to the scientific community.

NJAES faculty provide information on insect pest management to about 100 blueberry and cranberry growers in New Jersey, as well as to private IPM consultants, extension personnel including county agricultural agents, retail pesticide distributors and consultants, state and federal regulatory personnel, and environmental groups.

Results
NJAES faculty developed and implemented new tools for monitoring insect pest populations in blueberries and cranberries, worked with IR-4 on the registration of new insecticides in blueberries and cranberries, evaluated, implemented, and promoted adoption of new reduced-risk strategies for insect control in blueberries and cranberries, delivered presentations to more than 100 New Jersey blueberry and cranberry growers on the use of new insect pest management practices.

4. Associated Knowledge Areas

KA Code	Knowledge Area
216	Integrated Pest Management Systems

Outcome #3

1. Outcome Measures

Long Term - Protect commodities, homes and communities from pests. Increased abundance of high quality food and fiber products. Increased acreage in New Jersey grown under IPM practices. Reduced environmental problems associated with current pest management practices. A comprehensive understanding of best management practices for IPM that are economically viable and environmentally safe.

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Epidemiology and Management of Stone Fruit Diseases: Reduce loss from Plant Diseases on Tree Fruit Crops. A need exists to improve grower profitability and decrease pesticide usage with less impact on environment & residue on food, promoting sustainability.

What has been done

NJAES researchers conducted studies on use and integration of biorational materials for management of peach rusty spot. They examined the effect of host resistance on efficacy of integrated rusty spot programs; examined the importance of fungicide cover spray application rate, timing, and chemistry on ability to contribute to brown rot control during the pre-harvest period; employed novel bioassay for examining fungicide residues on fruit; examined efficacy of improved reduced risk conventional fungicides against all peach diseases; examined new antibiotic and biorational plant activator formulations for peach bacterialspot control. Allspray guides (peach, plum, cherry, apple, and pear) in the 2016 New Jersey Commercial Tree Fruit Production Guide (E002) were amended to include new information on fungicides and bactericides to control tree fruit diseases; included information on relative efficacies and application rates for each individual disease.

Results

Growers began adopting newer fungicide formulations and utilizing them in proposed mixture and alternating programs to fend off development of resistance by the brown rot pathogen. Outbreaks of resistant pathogens have been reported in many other peach growing regions. 2017 was favorable year for brown rot development; grower awareness of the resistance threat allowed them to take action in their disease control programs; no commercial economic losses were observed. Good efficacy of new antibiotic demonstrated; should material become registered for peach, growers have confidence to incorporate it into their current control programs. Plant Activator not effective, so growers know not to use (but more data needed) Peach rusty spot ? integrated biorational programs, which reduce use of conventional fungicide by 50%, show promise for rusty spot control on moderately susceptible cultivars; further data needed confirm findings before commercial use Production guide. A few new products were added to the latest guide.

4. Associated Knowledge Areas

KA Code	Knowledge Area
216	Integrated Pest Management Systems

Outcome #4

1. Outcome Measures

Long Term - Protect commodities, homes and communities from pests. Increased abundance of high quality food and fiber products. Increased acreage in New Jersey grown under IPM practices. Reduced environmental problems associated with current pest management practices. A comprehensive understanding of best management practices for IPM that are economically viable and environmentally safe.

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
New Jersey Integrated Pest Management Program: During 2017 the IPM programs coordinated by NJAES faculty/staff encompassed production agriculture in the areas of blueberries, nurseries, greenhouses, tree fruit, wine grapes and vegetables. Research conducted by faculty and staff connected to these various programs is helping to increase the adoption of IPM and at the same time reduce our reliance on pesticides as the sole pest management tool being used.

What has been done
Work was done to develop management strategies for use against the brown marmorated stink bug (BMSB) in vegetables and tree fruit. In addition, the vegetable IPM program was able to impact more acreage through the use of their website that tracks weekly European corn borer, corn earworm and BMSB population changes in the state. Overall, IPM adoption in the state was seen on ~7,000 acres of blueberries, 500 acres of nursery stock, 10 greenhouse acres, 8,600 acres of peaches, 2,500 acres of apples, 50 acres of wine grapes and 27,500 acres in vegetables (carrots, cole crops, high-tunnel tomato production, pumpkins, peppers, snap beans, staked tomatoes, sweet corn, and sweet potatoes). The vegetable and fruit IPM programs faculty and staff also conducted research evaluating the impacts of spotted wing drosophila (SWD) and the brown marmorated stink bug (BMSB) in their programs and participated the BMSB working group.

Results
As a result of this program, benefits were seen in the areas of fruit, grape, greenhouse, nursery and vegetable production systems. The various programs were able to document the following benefits: Pesticide use in tree fruit was reduced for Oriental fruit moth control. Grape growers were educated about the pests they face and how to effectively manage them. Growers in the vegetable IPM program received more timely information that resulted in less pesticide use, Nursery growers were better able to predict pest outbreaks and more effectively manage these outbreaks, Greenhouse growers were better able to manage pests and reduce insecticide and fungicide use because of the scouting program provided by the greenhouse IPM program. Growers were able to effectively manage BMSB in tree fruit and vegetables.

4. Associated Knowledge Areas

KA Code	Knowledge Area
216	Integrated Pest Management Systems

V(H). Planned Program (External Factors)

External factors which affected outcomes

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

Brief Explanation

None to report.

V(I). Planned Program (Evaluation Studies)

Evaluation Results

NJAES research and extension outcomes related to this planned program were evaluated utilizing a variety of evaluation methods appropriate for each initiative to determine the effectiveness on both a qualitative and quantitative level. For KASA and practice change we included the measurement of knowledge gained as measured by pre/post Likert-scale assessments. Surveys were used to measure increase in skills acquired, behavior change and practice adoption. For process evaluation we focused on program delivery, participation, relevance and timeliness. Data was collected at appropriate times for each initiative that supports this planned program. IRB approved evaluation instruments were used to collect research and extension data. Data analyses and comparisons relevant to basic and applied research and demonstration were collected and analyzed and reported utilizing a variety of data collection methods appropriate to each research question. The major goal of evaluating is the demonstration of social, economic, behavior and environmental changes in conditions that contribute to improved quality of life as a result of participation in programs and benefits of research solutions. See state defined outcomes for detailed results of each initiative.

Key Items of Evaluation

None of report.

V(A). Planned Program (Summary)

Program # 7

1. Name of the Planned Program

Global Food Security and Hunger - Aquaculture

☑ 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
135	Aquatic and Terrestrial Wildlife	100%		100%	
	Total	100%		100%	

V(C). Planned Program (Inputs)

1. Actual amount of FTE/SYs expended this Program

Year: 2017	Extension		Research	
	1862	1890	1862	1890
Plan	3.0	0.0	5.0	0.0
Actual Paid	0.2	0.0	2.9	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**
17063	0	144162	0
1862 Matching	**1890 Matching**	**1862 Matching**	**1890 Matching**
580479	0	638317	0
1862 All Other	**1890 All Other**	**1862 All Other**	**1890 All Other**
38940	0	616910	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

• Investigate the genetic mechanisms for disease resistance and improved quality in economically important shellfish

• Create a dynamic and cooperative partnership with faculty, staff, businesses, regulatory/advisory

councils and the government to research best management practices and discover effective solutions and management practices to address threats to NJ aquaculture as well as investigate opportunities to increase the quality and quantity of the aquaculture harvest.

- Collect and analyze data on how communities and businesses are affected by the aquaculture industry management practices.
- Examine the presence of unhealthy levels of contaminants in aquaculture products.
- Determine best techniques for shellfish hatcheries on and off shore.

2. Brief description of the target audience

- Aquaculture related businesses and employees
- State Department of Environmental Protection
- State Department of Agriculture
- Industry partners who learn ways to improve or protect their harvests
- Communities who depend on aquaculture-related revenue
- NJAES faculty and staff involved in water research/outreach
- Consumers of aquaculture products, including recreational fishing

3. How was eXtension used?

eXtension was not used in this program.

V(E). Planned Program (Outputs)

1. Standard output measures

2017	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	114	3000	230	0

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

Patent Applications Submitted

Year:	2017
Actual:	0

Patents listed

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2017	Extension	Research	Total
Actual	0	17	17

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- A variety of strategies will be implemented to reach target audiences. This will include and not be limited to workshops, field visits, classes, newsletters, media releases, electronic communications,publications. In addition a trained volunteer teaching base will be developed. Quantitative reports of participation will be collected.

Year	Actual
2017	0

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O. No.	OUTCOME NAME
1	Short Term - Knowledge of seasonal variations for shellfish diseases. Create census data on communities involved in aquaculture. Determine the level of pollutants in economically important fish species. Develop markers and maps of important genetic traits. Knowledge of shellfish hatchery techniques that decrease time for growth to market size.
2	Medium Term - Identify spatial and temporal relationships between patterns of shellfish diseases in NJ and environmental correlates. To develop disease-resistant strains of shellfish. Develop superior disease-resistant and larger genetic lines of shellfish.Measure the impact of communities on the aquaculture industry. Knowledge of the feasibility of off-shore shellfish farming.
3	Long Term - Clear and comprehensive understanding of community, environmental, genetic and physical regulators of aquaculture quality and quantity. A safe and secure aquaculture industry that can meet consumer demands for high-quality products and also be environment friendly and economically viable. Creation of superior aquaculture products that will be of high demand outside NJ.
4	Long Term - Clear and comprehensive understanding of community, environmental, genetic and physical regulators of aquaculture quality and quantity. A safe and secure aquaculture industry that can meet consumer demands for high-quality products and also be environment friendly and economically viable. Creation of superior aquaculture products that will be of high demand outside NJ.

Outcome #1

1. Outcome Measures

Short Term - Knowledge of seasonal variations for shellfish diseases. Create census data on communities involved in aquaculture. Determine the level of pollutants in economically important fish species. Develop markers and maps of important genetic traits. Knowledge of shellfish hatchery techniques that decrease time for growth to market size.

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	0

3c. Qualitative Outcome or Impact Statement

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

What has been done
{No Data Entered}

Results
{No Data Entered}

4. Associated Knowledge Areas

KA Code	Knowledge Area
135	Aquatic and Terrestrial Wildlife

Outcome #2

1. Outcome Measures

Medium Term - Identify spatial and temporal relationships between patterns of shellfish diseases in NJ and environmental correlates. To develop disease-resistant strains of shellfish. Develop superior disease-resistant and larger genetic lines of shellfish.Measure the impact of communities on the aquaculture industry. Knowledge of the feasibility of off-shore shellfish farming.

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Characterizing the Physical Environment of the Coastal Ocean and Its Relationship to Ecosystem Indicators: Coastal ecosystems span watersheds to the deep sea and are extremely complex. This complexity hinders planning for ocean resource management, sustainable development, energy policy, homeland security and emergency response. This lack of understanding is fueling governments around the world to build regional integrated coastal ocean observing networks. The networks are enabled by rapid advances in technology, from satellites in space to robots below the ocean surface. These systems are built to support both basic research and the practical needs of society, from offshore resource management to the economy. A need exists to work with the management communities to determine the best way to bring new information provided by ocean-observing systems into their decision-making.

The research uses continuous ocean observations enabled by rapid advances in technology to describe the physical environment. Of particular interest is defining the physical variables at the necessary temporal and spatial scales to describe the critical interactions with the ecosystem, from phytoplankton and bacteria to fishes. This can be accomplished by coordinating an extensive array of existing observational, data management, and modeling assets to generate and disseminate real-time data, nowcasts and forecasts of the ocean extending from Cape Cod to Cape Hatteras.

What has been done
NJAES researchers implemented a new program focused on water quality monitoring of our local river watershed, the Raritan. The overall goal of this project was to fill a gap in water quality monitoring along the tidal Raritan River between the Rutgers New Brunswick Campus and the Raritan Bay. Water quality monitoring of the Raritan was done through a student lead sampling

program aboard the newly acquired R/V Rutgers. Rutgers University uses their 36' Munson research boat as a mobile lab for the Rutgers Department of Marine and Coastal Sciences. This vessel was delivered with a US Coast Guard COI and is rated for 20 passengers and 2 crew members. Outfitting includes a Universal Sonar Mount (USM) for use with their Rio Grande Acoustic Doppler Current Profiler, fore and aft davits, side boarding door, 5kw generator, and a Garmin 1040xs radar/plotter/sounder.

Results

The specific activities of the new sampling program aboard the R/V Rutgers vessel were to: 1) Train students on a series of 4 river surveys with New Jersey Department of Environmental Protection (NJDEP) staff to sample four stations along the tidal Raritan River (Rutgers Campus, upstream of South River, downstream of South River, and the Raritan River mouth); and 2) Provide hourly student support for a student volunteer following each survey to prepare a survey data report suitable for submission to NJDEP as part of their monitoring. The group is now working with the NJDEP to formalize this program so that it can be sustained into the future. In addition to the sampling program, NJAES researchers worked within a network of stakeholders including fisheries scientists, oceanographers, managers, social scientists, and the commercial fishing industry to build the next generation of observatory informed single species habitat models. Their initial target species was butterfish in support of a planned stock assessment for this species in late 2013/early 2014. The habitat based estimate of availability developed using the approach was integrated into the catchability estimate used to scale population size in the butterfish stock assessment model accepted at the 59th NEFSC stock assessment review. The contribution of the availability estimate (along with an estimate of detectability) allowed for the development of fishery reference points, a change in stock status from unknown to known, and the establishment of a directed fishery with an allocation of 20,000 metric tons of quota. In 2015, the same method informed the assessments of two additional species in stock assessments, bluefish and scup. Finally, this year, the workgroup supported the 2017 stock assessment of Atlantic Mackerel. They participated in several workgroup activities that facilitated collaboration between scientists for government and academia with the fishing industry to identify science needs to inform the upcoming stock assessment. They finalized a thermal niche model and shared it with the stock assessment team at the NOAA National Marine Fisheries Service Population Dynamics group. The model was considered in the assessment this past fall.

4. Associated Knowledge Areas

KA Code	Knowledge Area
135	Aquatic and Terrestrial Wildlife

Outcome #3

1. Outcome Measures

Long Term - Clear and comprehensive understanding of community, environmental, genetic and physical regulators of aquaculture quality and quantity. A safe and secure aquaculture industry that can meet consumer demands for high-quality products and also be environment friendly and economically viable. Creation of superior aquaculture products that will be of high demand outside NJ.

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Population Dynamics, Heavy Metal Levels, and Food Chain Bioaccumulation in Colonial Waterbirds in New Jersey: New Jersey and all coastal states face increased population concentration along coasts, increased development, and shrinking natural environments, along with global change, temperature increases, and sea level rise. These changes have resulted in decreasing availability and suitability of habitats for a range of estuarine and coastal species. It is essential to track changes in biological communities to determine potential long-range effects, to assess the health and well-being of important ecosystem components, to assess food chain differences that have implications for several different trophic levels (including people), and to determine the relative role and importance of salt marsh ecosystems in preserving coastal ecosystem and providing resiliency to coastal human communities.

What has been done
NJAES researchers are using colonial nesting birds as bioindicators of coastal and bay ecosystem health, as indicators of the effects of severe storms and tidal floods/surges, and of sea level rise. Birds are excellent bioindicators because they represent different nodes on the food chain, are easy to see and census, represent different habitat uses and niches, and are of interest to the public. Further, the group has 37 years of data on colony numbers, and contaminant data since 1970. These represent one of the longest running data sets in the country (the only other one is for the Great Lakes). This data, especially when correlated with New Jersey weather and climate data, can be used to examine climate change and sea level rise. In nearly 40 years, several salt marsh islands have completely disappeared, others have undergone succession to unusable islands, and others remain usable. Only a long-term data set can be used to examine global changes (a major mission) and sea level rise, as well as assess the potential for salt marshes and other habitats to provide resiliency to human communities. To understand the potential risk to consumers of possibly contaminated fish and shellfish, it is essential to understand fishing rates, consumption rates, the reasons why people fish, and contaminant levels in those fish or other resources. Few scientists examine the whole process from how and why people fish, through understanding of the marine ecosystem, to contaminants in fish and other marine resources (e.g. shellfish, birds), to risk assessment and risk management. These issues relate directly to commercial fisheries, recreational fisheries, and food safety.
This research has investigated: 1) Population dynamics of colonial nesting birds in NJ, particularly Barnegat Bay, 2) Heavy metals levels in the eggs and feathers of colonial nesting birds and migratory shorebirds in New Jersey, 3) Heavy metals in fish that are eaten by larger fish, birds, and mammals, including humans, 4) Conservation issues with Red Knot, including conflicts with

oyster aquaculture, and 5) Perceptions of beach-goers and fishermen about protection of coastal environments and nesting birds. All of these topics are of interest to the Endangered and Nongame Species Program of the New Jersey Department of Environmental Protection, conservation organizations, and the United States Fish and Wildlife Service. To protect and enhance colonial nesting birds (including the federally endangered Piping Plover) and migratory shorebirds (including the federally endangered Red Knot) it is essential for managers, public policy makers and the public to understand whether populations of birds are increasing or decreasing, whether levels of toxic heavy metals are increasing or decreasing in the environment, and what the values and perceptions of the public using these resources feel about endangered species, restoration of habitat, and protection of birds and habitat.

Results

The group's research in Barnegat Bay over the last 40 + years has indicated that nearly all populations of colonial-nesting birds (except Great Egret and Great Black-backed Gull) have declined in both population numbers and number of colonies. This means New Jersey not only has fewer nesting birds, but they are concentrated in far fewer colonies, making their protection both more difficult and more essential. This research with intertidal habitat use by migratory shorebirds, and responses of shorebirds (including Red Knot) to aquaculture, are essential to fostering collaboration between state and federal agencies, conservationists, and oyster culture personnel. By providing needed data on these aspects, suitable compromises can be made that benefit both the local economy and development of aquaculture, and the protection and enhancement of birds. The resulting findings are being used to develop further research with heavy metals, exposure and effects of heavy metals on birds, importance of coastal restoration, and development of a recovery plan for the federally threatened Red Knot. Contaminants work with Red Knot is important to establish that metals may not be a cause for concern, or for their declines. Researchers have conducted interviews of fishermen and beach users to understand the significance of restoration of coastal environments (following Sandy and other severe storms), and of protection of endangered and threatened beach-nesting species. For there to be federal, state and local support for protecting birds and restoring beaches, it is essential to understand the public's perceptions and concerns. They have found that they strongly supported restoration for both flood protection and protection of beach-nesting habitat for birds.They have been conducting studies of the effect of oyster culture on the federally-threatened Red Knot. Both state and federal agencies are interested in knowing whether there is any effect of the oyster culture structures or the worker's activities. While such studies have been conducted in Europe, they have not been done so in the U.S., except for our pilot study along Delaware Bay. This information is important both for aquaculture and for conservation. We are working with aquaculture interests on this project. The group has conducted interviews with people living along the Jersey shore (as well as in Central New Jersey) to determine if they understood the relationship between ecological barriers (e.g. marshes, beaches, dunes) to coastal flooding and sea level rise. Understanding perceptions of the importance of ecological barriers is key to designing stakeholder driven protection and research. The research has importance and significance for New Jersey and the coastal environment in a number of ways, within this is professional development involving fishermen and beach users, coastal zone management, and restoration of coastal environments.

4. Associated Knowledge Areas

KA Code	Knowledge Area
135	Aquatic and Terrestrial Wildlife

Outcome #4

1. Outcome Measures

Long Term - Clear and comprehensive understanding of community, environmental, genetic and physical regulators of aquaculture quality and quantity. A safe and secure aquaculture industry that can meet consumer demands for high-quality products and also be environment friendly and economically viable. Creation of superior aquaculture products that will be of high demand outside NJ.

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Population Connectivity and Longterm Population Dynamics in Shellfisheries: With a global human population of nearly 6.9 billion, demand for global food is putting pressure on fisheries resources worldwide. The great challenge of managing fisheries is balancing the global need for marine food resources with the long-term sustainability and stability of the populations being fished. Fisheries rely on marine ecosystems for production of the animals that are harvested; however, the productivity of the natural systems is delicately balanced and can be damaged from human activity on land and at sea, and is changing in unexpected ways as the regional and global climate changes. A major objective of this proposal is to understand how patterns of population connectivity can help us understand dynamics in fishery productivity and the capacity of these populations to respond to stressors like fisheries and climate change. In New Jersey, over 85% of all commercial fishery landings are from invertebrate fisheries. The vast clam populations living in the sandy bottom along the Mid-Atlantic continental shelf are not only the basis of a major fishing industry, but also an important part of the marine coastal shelf ecosystem through their high filtration capacity and massive benthic biomass. Also fishing along the Mid-Atlantic shelf, the sea scallop fishery is currently the most valuable fishery in the U.S.; its ex-vessel value in 2011 was over $580 million. In state waters, oysters in Delaware Bay have provided a sustainable fishery resource, critical reef habitat and contributed to the local economy in New Jersey for centuries.

What has been done

An NJAES researcher investigated the role of larval connectivity in the fishery ecology of New Jersey shellfisheries. For all of these fished populations to sustain themselves, their pelagic offspring have to survive weeks in the water column as developing microscopic larvae and then

find suitable habitat miles from their birthplace where they can grow to adulthood. Temporal trends in population characteristics such as abundance and gene frequencies influence the ability of a population to support a fishery and to respond to changing climate. Sustainable management of fishery resources relies on understanding and predicting these changes over time. Dynamics in abundance occur in part through changes in the supply of new individuals to a population, a process called larval dispersal. Genetics are likewise shared among populations of shellfish through larval dispersal. In this way larval dispersal is a mechanism that controls important dynamics in shellfishery stocks.

Results

Research examined historical trends and modern fleet dynamics in the surf clam fishery. Simulations evaluating the role of rotating closures in the scallop fishery in terms of population connectivity are complete and data is analyzed and manuscript nearly ready for submission. Oyster models were run, outputs analyzed and manuscript assessing the role of larval dispersal in the metapopulation response to disease pressure was published. Further, experiments concerning oyster settlement success on various surfaces, as well as early growth conditions for oysters were published as manuscripts. Analysis of the value of oyster fishery stock enhancement through shell planting to provide settlement habitat has been conducted using historical stock data.

Research efforts have been successful in identifying the possible drivers of climate driven changes in the surfclam fishable stock over the past 3 decades. Model simulations show that larval dispersal is sufficient to maintain the overall stock; however, changes in bottom ocean water temperature over time can lead to shifts in stock distribution and limits to maximum body size. Coupled biological and socio-economic models were used to test what these biological and ecological changes may mean to future alteration in fishery activity and the role individual captains' choices when fishing in fishery resilience. New studies were conducted in Barnegat Bay to examine larval dispersal of oysters and hard clams using both model-based and empirical approaches.

4. Associated Knowledge Areas

KA Code	Knowledge Area
135	Aquatic and Terrestrial Wildlife

V(H). Planned Program (External Factors)

External factors which affected outcomes

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

Brief Explanation

None to report.

V(I). Planned Program (Evaluation Studies)

Evaluation Results

NJAES research and extension outcomes related to this planned program were evaluated utilizing a variety of evaluation methods appropriate for each initiative to determine effectiveness on both a qualitative and quantitative level. For KASA and practice change we included the measurement of knowledge gained as measured by pre/post Likert-scale assessments. Surveys were used to measure increase in skills acquired, behavior change and practice adoption. For process evaluation we focused on program delivery, participation, relevance and timeliness. Data was collected at appropriate times for each initiative that supports this planned program. IRB approved evaluation instruments were used to collect research and extension data. Data analyses and comparisons relevant to basic and applied research and demonstration were collected and analyzed and reported utilizing a variety of data collection methods appropriate to each research question. The major goal of evaluating is the demonstration of social, economic, behavior and environmental changes in conditions that contribute to improved quality of life as a result of participation in programs and benefits of research solutions. See state defined outcomes for detailed results of each initiative.

Key Items of Evaluation

None to report.

V(A). Planned Program (Summary)

Program # 8

1. Name of the Planned Program

Food Safety

☑ 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	5%		5%	
104	Protect Soil from Harmful Effects of Natural Elements	5%		5%	
311	Animal Diseases	5%		5%	
314	Toxic Chemicals, Poisonous Plants, Naturally Occurring Toxins, and Other Hazards Affecting Animals	5%		5%	
404	Instrumentation and Control Systems	5%		5%	
501	New and Improved Food Processing Technologies	10%		10%	
502	New and Improved Food Products	10%		10%	
503	Quality Maintenance in Storing and Marketing Food Products	10%		10%	
504	Home and Commercial Food Service	15%		15%	
711	Ensure Food Products Free of Harmful Chemicals, Including Residues from Agricultural and Other Sources	10%		10%	
712	Protect Food from Contamination by Pathogenic Microorganisms, Parasites, and Naturally Occurring Toxins	10%		10%	
722	Zoonotic Diseases and Parasites Affecting Humans	5%		5%	
723	Hazards to Human Health and Safety	5%		5%	
	Total	100%		100%	

V(C). Planned Program (Inputs)

1. Actual amount of FTE/SYs expended this Program

Year: 2017	Extension		Research	
	1862	1890	1862	1890
Plan	3.0	0.0	4.0	0.0
Actual Paid	0.7	0.0	3.0	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**
112897	0	257506	0
1862 Matching	**1890 Matching**	**1862 Matching**	**1890 Matching**
663806	0	1727040	0
1862 All Other	**1890 All Other**	**1862 All Other**	**1890 All Other**
1418550	0	110883	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

• Conduct training and certificate programs for growers, producers, food workers, consumers and vendors to increase knowledge of food safety practicies.
• Design strategies, tools and processes to detect and eliminate pathogens, chemical and physical contaminants during production, transportation, processing and preparation of food.
• Invesitgate the ecology of threats to the food supply from microbial and chemical sources
• Develop technologies for the detection of food supply contaminants

2. Brief description of the target audience

• Producers
• Processors
• Retail - restaurants/vendors/supermarkets
• Department of Health
• Consumers, families, youth communities
• NJAES - faculty - staff - students
• Food manufacturers
• Schools - child care providers - food service workers

3. How was eXtension used?

Faculty have participated in answering "ask the expert" questions, developed collaborative educational products and provided leadership to the CoP.

V(E). Planned Program (Outputs)

1. Standard output measures

2017	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	18954	209524	601	0

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

Patent Applications Submitted

Year: 2017

Actual: 0

Patents listed

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2017	Extension	Research	Total
Actual	17	29	46

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- -New methods in technologies -Educational workshops -Newsletters -Scientific publications -Patents -Website development -Extension publications -Volunteers trained -Agricultural and Industry Certifications -Train the trainer programs -Audits conducted

Year	Actual
2017	0

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O. No.	OUTCOME NAME
1	Short Term - Increase knowledge of viable technologies, detection prevention, intervention and control technologies and practices to ensure food safety. Increase understanding of the ecology of threats to food safety from microbial and chemical sources.
2	Medium Term - Adoption of safe food handling practices at the individual, family, community, production and supply system levels.
3	Long Term - A safe food supply resulting from reduced incidence of food-borne illnesses.
4	Medium Term - Adoption of safe food handling practices at the individual, family, community, production and supply system levels.
5	Medium Term- Adoption of safe food handling practices at the individual, family, community, production and supply system levels.
6	Medium Term - Adoption of safe food handling practices at the individual, family, community, production and supply system levels.

Outcome #1

1. Outcome Measures

Short Term - Increase knowledge of viable technologies, detection prevention, intervention and control technologies and practices to ensure food safety. Increase understanding of the ecology of threats to food safety from microbial and chemical sources.

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Evaluating the Efficacy of Novel Sanitizers in Egg Washing:
FDA regulations require shell egg producers to implement measures to prevent Salmonella contamination of eggs. Current decontamination strategies may leave undesirable chemical residues, cause degradation of the cuticle, increase bacterial resistance, have adverse environmental impacts, and be of limited effectiveness. Novel methods are needed to effectively eliminate pathogens and significantly reduce the microbial load on eggs with less detrimental effects on the quality of eggs and the environment.

What has been done
NJAES researchers applied Plasma Activated Water (PAW) and plasma treated Acidified Electrolyzed Water (P- AEW) as novel and safe sanitizers during egg washing to inactivate Enterobacter aerogenes which is a non pathogenic surrogate for Salmonella Enteritidis. Efficacy of the novel sanitizers were compared with conventional methods (chlorine and quaternary ammonium sanitizers). PAW and P- AEW were generated using existing equipment at Rutgers University. The effects of all sanitizers on the structural integrity of washed eggs will be assessed based on the changes in surface color, porosity, microstructure, and mechanical properties of egg shells. Treatment temperature and time were optimized for each novel sanitizer based on microbial inactivation efficacy and shell integrity. The identification of novel treatments for egg washing provided egg producers with an attractive alternative strategy for control of Salmonella with minimal loss in quality. Farm fresh eggs with intact cuticle were stained with Cuticle Blu die (MS Technologies), both before and after treatment with novel sanitizers. Cuticle Blu die works with the principle of attachment of colored pigment to protein present in the cuticle. The intensity of green color on the egg determines the integrity of cuticle. This was measured using a Konica Minolta CR-410 colorimeter, in L*, a*, b* scale. The values thus obtained were compared to those of industrially washed and stained eggs, and eggs washed in industrially used sanitizer (Quat

ammonia). Comparison was made on the basis of the changes in the E-value which is an absolute value that accommodates changes in L*, a* and b* values.

Results
It was found by visual inspection that eggs washed in Plasma Activated Water (PAW) and plasma treated Acidified Electrolyzed Water (AEW) had similar color profiles, while eggs washed in Quat ammonia and market bought eggs had a very light green tinge. This indicates that the cuticle strength of market bought eggs is very weak. On the other hand, eggs washed in PAW and plasma treated AEW had preserved the integrity of the cuticle. Evaluation of the E-values revealed similar results, wherein PAW and plasma treated AEW washed eggs had values almost the same as that of unsanitized farm fresh eggs. This study supports the hypothesis that the novel sanitizers used do not cause significant detrimental effects to cuticle coverage on shell eggs. Further work will be done next year for determination of the efficacy of microbial inactivation of Enterobacter aerogenes, a non-pathogenic surrogate of the Salmonella family. This will be done by spot inoculating farm fresh eggs, and washing them with novel sanitizers, and enumerating the reduction in bacteria on egg shell.

4. Associated Knowledge Areas

KA Code	Knowledge Area
102	Soil, Plant, Water, Nutrient Relationships
104	Protect Soil from Harmful Effects of Natural Elements
314	Toxic Chemicals, Poisonous Plants, Naturally Occurring Toxins, and Other Hazards Affecting Animals
501	New and Improved Food Processing Technologies
711	Ensure Food Products Free of Harmful Chemicals, Including Residues from Agricultural and Other Sources
712	Protect Food from Contamination by Pathogenic Microorganisms, Parasites, and Naturally Occurring Toxins

Outcome #2

1. Outcome Measures

Medium Term - Adoption of safe food handling practices at the individual, family, community, production and supply system levels.

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Edible Luminescent Probes of Food Quality: Ensuring and improving the overall quality, including stability and safety, of processed foods is a perennial concern of the food industry. Consequently, instrumental techniques have long been used to monitor specific physical and chemical properties of foods and food materials that are thought to relate to the generation and maintenance of quality during processing, distribution, storage, and sale. The development of instrumental methods to monitor physical and chemical properties relevant to food quality has been an important area of research within food science and technology supported by both the NJ Agricultural Experiment Station and NIFA. Luminescence, that is, fluorescence and phosphorescence, techniques involving the emission of light following optical excitation by a lamp, light emitting diode, or laser, offers significant potential to monitor the physical and chemical properties of foods and food biomaterials on the molecular level because of the extraordinary sensitivity of luminescence emission wavelength, intensity, and polarization of specific chromophores to the local molecular environment.

Such techniques are currently underused in food science and technology despite their selectivity, sensitivity and versatility and despite their potential as the basis for novel and easy-to-use sensors of food quality (using, for example, a smart phone). Luminescence techniques, moreover, offer significant potential applications to foods due to the large number of aromatic molecules that are either found naturally in foods (amino acids, colors, aromas, flavors, antioxidants, etc.) or are routinely added during processing or manufacture (vitamins, artificial colors and flavors, etc.)

What has been done

NJAES researchers investigated how measurements of luminescence emission from molecules found in foods can be used to monitor physical and chemical properties related to the overall quality, including stability and safety, of foods. Hopefully, this research will lead to the development of inexpensive optical sensors that can monitor quality parameters in whole foods and food ingredients, sensors that are sensitive to low signal levels, that are rapid, convenient, inexpensive, and easy to use, and that can be used to monitor food quality from manufacture to point of sale.

Results

NJAES researchers are extending their investigation of how edible molecular rotors such as fast green provide fluorescence signals that are sensitive to crosslinking and gelation of animal gelatin at low temperatures. This work demonstrates that the probe fast green (a synthetic food dye) increases fluorescence intensity upon cooling gelatin solutions, even under conditions where gelatin concentrations are too low to support gel formation (0.1 mg gelatin per mL solution), indicating that the probe may bind to local regions of cross-linked gelatin or even to triple helical regions in gelatin.

Another project examines dynamic coupling of proteins with solid matrix. The long term stability of proteins is enhanced in the solid state when proteins are embedded in an excipient (sucrose, for example) that can be made glassy. Previous work suggests that stability depends upon how tightly coupled the local protein motions are to the motions within the glassy excipient. The group is testing this theory using intrinsic tryptophan phosphorescence to directly monitor local molecular mobility within the protein.

Finally, protein nanoparticles are useful vehicles to encapsulate bioactive food components of low

aqueous solubility. Rutgers researchers are using fluorescent probes (both intrinsic tryptophan and tyrosine as well as synthetic molecular rotors) to investigate the structure and properties of protein nanoparticles assembled by liquid anti-solvent precipitation of whey proteins into ethanol.

4. Associated Knowledge Areas

KA Code	Knowledge Area
504	Home and Commercial Food Service
711	Ensure Food Products Free of Harmful Chemicals, Including Residues from Agricultural and Other Sources
712	Protect Food from Contamination by Pathogenic Microorganisms, Parasites, and Naturally Occurring Toxins
723	Hazards to Human Health and Safety

Outcome #3

1. Outcome Measures

Long Term - A safe food supply resulting from reduced incidence of food-borne illnesses.

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Improving Food Safety Through Predictive Models, Microbial Risk Assessment and Quantitative Methods: Food manufacturers are under a variety of regulatory, economic and environmental pressures. Retaining a strong manufacturing base still an essential component for the state's economic growth.

What has been done
The NJAES researcher provides technical assistance for small and medium-sized companies, helping to keep them in business, while still assuring the safety of the food supply. The NJAES researcher continually assists the industry through short courses, in the current reporting year there were three different instances where one-on-one assistance had a specific and direct economic benefit to NJ companies. In 2017 the NJAES researcher assisted three NJ companies: NJ based meat company with salami shelf stable claims; NJ based disinfectant wipes company

with design of experiments to evaluate product effectiveness; NJ based food company with design of microbiological specifications In addition to the assistance provided to NJ-based companies, as time allows, a NJAES researcher provides technical assistance to other states and internationally. Twenty-four such examples occurred in 2017 with assistance provided to companies or groups as follows: California based produce safety center with design and population of a searchable food safety database; Washington state-based food delivery company with guidance on temperature control of foods during unrefrigerated shipment; Chicago based quick service company with review of cooking validation methods for food safety; California based trade association with process safety evaluation; Georgia based tea company with microbiological testing requirements; Virginia based trade association with a quantitative microbial risk assessment for nuts; Minnesota based sanitation company with hand hygiene strategy; Maryland based meat processor with extended cooling times and with a cooling deviation; New York state based apple sauce company for help with a spoilage problem; FDA colleague with food safety evaluation; Colorado based meat processor with a food safety assessment review; Pennsylvania based Potato Chip company with food safety validation of their process; Georgia based trade association with a quantitative microbial risk assessment for their members; Wisconsin based food processor with challenge study design; California based startup with process safety evaluation; Pennsylvania based meat processor with cooling deviation; Virginia based trade association with help on understanding and managing Listeria risk for their members; Pennsylvania based food processor with four different cooling deviations; Pennsylvania based food processor with cooking time question; Michigan based meat processor with multiple cooking and cooling deviation from power outage; North Carolina based company with Salmonella in chicken risk assessment; Washington state-based hardware company with food safety software development; FDA with safe food handling review of nursing home foods; New York based meat processor with cooking delay deviation.

Results

In several cases costly recalls, rework, or product destruction were avoided. In some cases federal agencies, trade associations or food processing companies were able to use risk-based decision-making to guide them in their policy discussions. The value of the food products in question was estimated to exceed $5 million.

4. Associated Knowledge Areas

KA Code	Knowledge Area
102	Soil, Plant, Water, Nutrient Relationships
104	Protect Soil from Harmful Effects of Natural Elements
311	Animal Diseases
314	Toxic Chemicals, Poisonous Plants, Naturally Occurring Toxins, and Other Hazards Affecting Animals
404	Instrumentation and Control Systems
501	New and Improved Food Processing Technologies
502	New and Improved Food Products
503	Quality Maintenance in Storing and Marketing Food Products
504	Home and Commercial Food Service
711	Ensure Food Products Free of Harmful Chemicals, Including Residues from Agricultural and Other Sources
712	Protect Food from Contamination by Pathogenic Microorganisms, Parasites, and Naturally Occurring Toxins

722	Zoonotic Diseases and Parasites Affecting Humans
723	Hazards to Human Health and Safety

Outcome #4

1. Outcome Measures

Medium Term - Adoption of safe food handling practices at the individual, family, community, production and supply system levels.

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Chlorine Dioxide Releasing Packaging Systems to Improve Microbial Safety of Fresh-Cut Produce: While the market of ready-to-eat fresh produce products is rapidly growing in recent years, there is a critical need to develop better intervention technology to improve food safety since these products contain items that are highly susceptible to microbial risks, as documented by the recent foodborne outbreaks in Romaine lettuce, sliced apple, cantaloupes, spinach, and many others. Postharvest loss of fresh produce is also a major problem, estimated to range from 10 to 30% in the United States.

What has been done
Chlorine dioxide (ClO_2) is traditionally applied in the washing of fresh produce in order to remove dirt and inactivate microorganisms on the surface. This washing process has been found to be effective for lettuce, cabbage, green bell pepper, baby carrot, apple, tomato, mungbean sprout, and blueberry. However, the washing process has two disadvantages: (1) due to high surface tension of water, ClO_2 in the aqueous phase cannot access the hard-to-reach areas such as pores and crevices on fresh produce where microbes are usually attached, and (2) once the washing process is completed, ClO_2 is no longer available to combat the surviving microbes. Recently, these limitations have motivated scientists to explore the use of ClO_2 gas treatment to complement the washing process. ClO_2 gas can penetrate the areas inaccessible by washing. In fact, the use of ClO_2 gas treatment has shown to be effective in microbial inactivation for a number of fresh produce products including lettuce, cabbage, green bell pepper, baby carrot, apple, tomato, blueberry, and so on. The objective of this project is to develop a packaging system that can generate and release chlorine dioxide in a controlled manner to improve the quality and microbial safety of fresh-cut produce. These package systems may be used alone, or

in combination with other technologies such as modified atmosphere packaging and controlled release packaging, to provide the most cost effective solution for the particular application.

Results

In the previous year of this project, Rutgers researchers developed an innovative sachet to generate chlorine dioxide (ClO2) to improve food safety and reduce postharvest loss of fresh produce. During the past year, they have demonstrated the technical feasibility of developing an innovative package label to generate ClO2 to inhibit microbial growth of fresh produce in individual food packages. Although both the sachet and the label generate ClO2, their manufacture and activation principles are quite different. The manufacture of the label involves extruding packaging plastics (such as ethylene vinyl acetate copolymer) to incorporate citric acid. The activation of the label involves (1) spraying the surface with sodium chlorite, (2) heat pressing the label to facilitate physical contact between citric acid and sodium chlorite, and (3) trigging the generation and release of ClO2 by moisture emanating from fresh foods. The release of ClO2 from the label has been demonstrated to be effective in inhibiting against Salmonella growth. The sachet and the label developed in this project complement each other by providing the industry the ability to improve food safety and reduce postharvest loss of fresh produce products for a wider range of applications.

4. Associated Knowledge Areas

KA Code	Knowledge Area
404	Instrumentation and Control Systems
503	Quality Maintenance in Storing and Marketing Food Products
711	Ensure Food Products Free of Harmful Chemicals, Including Residues from Agricultural and Other Sources
712	Protect Food from Contamination by Pathogenic Microorganisms, Parasites, and Naturally Occurring Toxins
723	Hazards to Human Health and Safety

Outcome #5

1. Outcome Measures

Medium Term- Adoption of safe food handling practices at the individual, family, community, production and supply system levels.

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual

2017 0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Survival strategies of foodborne pathogens and commodity contamination in production fields and retail outlets: Most of the major supermarkets in the United States crisp and mist fresh vegetables or at minimum mist vegetables in display cases. Crisping generally entails soaking of a commodity in water to rehydrate and misting is done on commodities while in display cabinets to limit wilting and improve appearance. During crisping product may become contaminated through exposure to contaminated equipment, workers, and other product. Misting of product may have unintended consequences if for example the lines delivering water develop biofilms harboring human pathogens. In the present study, formation of biofilms in mist water systems and its effect on microbial load of misted/crisped product is investigated. Experiments are also conducted to evaluate the efficacy of various sanitizers to reduce or eliminate cross-contamination during crisping. The shelf-life of crisped and misted product in retail and home setting is determined. Collectively, crisping and misting may contribute to improving product quality and shelf-life, but may also increase the likelihood of product and equipment contamination. Potential also exist for increase in harmful chemical by-products.

What has been done

The practices of washing and crisping have the potential to result in cross-contamination of commodity. A prudent practice would be the addition of a chemical antimicrobial agent in the water to control microbial populations in the water and thereby reduce the likelihood of cross-contamination. In this project, experiments were designed based on retail practices, and commercial equipment used. The water antimicrobial agents Produce Maxx (hypochlorous acid-based electrolyzed water, Chemstar/Sterilox), Suma Eden Antimicrobial Fruits & Vegetable Wash (lactic acid/phosphoric acid-based, Diversey) and Ecolab Antimicrobial Fruits & Vegetable Treatment (AFVT; Sodium dodecylbenzenesulfonate/lactic acid-based, Ecolab) were evaluated. Potable water served as a control. Commodities used in the study included whole head Romaine and red leaf lettuce, cantaloupes, and strawberries. Shiga toxin-producing E. coli (STEC) and L. monocytogenes associated with fresh produce outbreaks were used to inoculate product.

Results

In this phase of the researchproject, studies were conducted to evaluate high volume processing and cross-contamination; a scenario in which soak water was used three times and 24 heads of lettuce (one case) processed each time (soaking for 5 minutes). Produce Maxx was more effective in mitigating cross-contamination with Listeria monocytogenes and STEC of Romaine (2 of 48 heads) and Red leaf (0 of 48 heads) lettuce heads compared to water alone or other water antimicrobials evaluated. Foodborne pathogens (L. monocytogenes and STEC) and native microbiota were not detected in 100 ml samples collected after each consecutive usage of process water containing Produce Maxx. Importantly, the APC (CFU/100 ml treatment water) for the Produce Maxx treatment remained negative after three consecutive uses; the APC increased following each use for water alone and other chemical antimicrobials.

Cantaloupes are typically washed prior to cutting and preparation of edible flesh (cutting into pieces or "cubes"). The prepared cubes are then washed and ready for sale to the consumer. In this study, two batches of cantaloupe were washed/soaked, the treatment water replaced and cubes of edible flesh treated. In brief, whole inoculated (three cantaloupes) and non-inoculated (nine cantaloupes) cantaloupes were soaked for 5 minutes in water alone or water with one of the indicated chemical antimicrobials. The soak water was then re-used to process a second batch of

12 non-inoculated cantaloupes. Compared to other treatments Produce Maxx was more effective in preventing cross-contamination of whole cantaloupes with STEC and L. monocytogenes. However, no chemical antimicrobial was effective in effective in preventing cross-contamination of cantaloupe cubes soaked for 90 seconds in treated water. Since the water containing Produce Maxx was negative for L. monocytogenes and STEC, physical contact of cantaloupe cubes prepared from contaminated cantaloupe with cubes from non-contaminated cantaloupe prior to soaking was the likely route of cross-contamination.

Strawberries are a high value commodity that when not handled and held under appropriate conditions will rapidly decline in quality. Studies were designed to evaluate benefit of using chemical antimicrobials in treatment water to control microbial load of the water, prevent cross-contamination, and influence product quality during refrigerated storage. Strawberries inoculated with L. monocytogenes or STEC were soaked for 60 seconds in water alone or one of the chemical antimicrobials indicated previously. The strawberries were removed from the soak water, transferred to aluminum trays, and held at 4oC for 3 days. Produce Maxx was more effective at inactivating microorganisms (i.e., product microbiota, STEC, and L. monocytogenes) in soaking water compared to other antimicrobials evaluated. Cross-contamination of L. monocytogenes did not occur, whereas cross-contamination with STEC was noted with water alone and with the product "Antimicrobial Fruits & Vegetable Treatment". Regardless of treatment, aerobic plate count, yeast and mold, and psychrotrophic bacteria counts for strawberries were not significantly different at days 0, 1, and 3 of storage at 4oC. Produce Maxx was more effective in controlling microbial populations on equipment surfaces compared to other treatments.

4. Associated Knowledge Areas

KA Code	Knowledge Area
404	Instrumentation and Control Systems
503	Quality Maintenance in Storing and Marketing Food Products
711	Ensure Food Products Free of Harmful Chemicals, Including Residues from Agricultural and Other Sources
712	Protect Food from Contamination by Pathogenic Microorganisms, Parasites, and Naturally Occurring Toxins
722	Zoonotic Diseases and Parasites Affecting Humans
723	Hazards to Human Health and Safety

Outcome #6

1. Outcome Measures

Medium Term - Adoption of safe food handling practices at the individual, family, community, production and supply system levels.

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

On-Farm Food Safety: The Center for Disease Control and Prevention estimates 48 million people get sick, 128,000 are hospitalized, and 3,000 die from food borne diseases each year in the United States. There have been several fresh fruits and vegetable implicated in outbreaks e.g. leafy greens, tomatoes, berries, herbs, etc. The fruit and vegetable industry is under increased pressure to improve their food safety practices and to obtain a third party audit confirming they are improving their practices. This is even more important with the enactment of the Food Safety Modernization Act which will be implemented over the next several years. Fresh produce growers who average over $500,000 in produce sales will need to start complying January 2018; growers between $250,000 and $500,000, January 2019 and $25,000 and $250,000, January 2020. The industry must find out: What are the issues that need to be addressed i.e. agricultural water quality, worker health and hygiene, biological soil amendments (manure and compost use), domesticated and wildlife activity and equipment, tools and building sanitation; How to carry out a risk assessment and prepare an individualized food safety plan. 3. How to write standard operating procedures and the role they play in a food safety plan; How to develop a record-keeping and traceability system that is the most efficient for their operation; How third-party audits are carried out; How to evaluate different third-party audit firms; How the Food Safety Modernization Act will impact their operations and what modifications may be needing to comply with the act.

What has been done

The project was initiated at the request of the produce industry in 1999. Growers received letters from supermarkets requesting they have food safety plans and third party audits in place for the 1999 growing season. Growers did not have an understanding as to what was required. Fundamentals for training needs were solicited from individual growers and buyers to help design the project. The goals and objectives include training the produce industry basic food safety, training wholesale/retail growers on how to carry out a risk assessment on their operations; write a food safety plan and prepare for a third-party audit; training first level buyers on food safety and how to prepare for third party audits; having growers and buyers who participate in food safety training pass their third-party audits; training growers in the requirements of the Food Safety Modernization Act and how to prepare for it, etc. The project was delivered through the following methods: presentations at produce industry meetings across the state; monthly and weekly newsletter articles; Factsheet publications; website where training materials are placed for self-training and new food safety information is reported; Facebook page used to inform followers of timely food safety information specific to the production of fresh produce and blog; in-depth training sessions growers and buyers; one-on-one critiques of food safety plans on individual farms; webinar and power point presentations. Since the inception the program in 1999 there has been continual consultation with growers and the produce industry at the wholesale and retail level. This has been accomplished through individual contacts and evaluations at each training

session. The team receives questions almost daily by telephone or email. The responses to these questions then are used to develop presentations and articles for the wider audience. The program continues to be conducted in the same manner since its inception with the addition of social media. Growers continue to express the desire for direct contact sessions.

Results

Growers have changed their practices as it relates to food safety. Even if they do not need a third party audit, growers are considering food safety as part of doing business. This awareness has expanded as retail buyers are questioning food safety at the farm level. Approximately 120 operations have passed their third party audit. As a result of these one-day workshops since 2016, growers indicated the following: 98% (n=216) indicated that the level of FSMA PSR information provided was sufficient to guide them in implementing the regulatory requirements; 93% of survey participants indicated (n=252) that they agreed or strongly agreed that the information presented in the training modules increased their knowledge of produce safety principles and practices. Participants rated their level of confidence in assessing risks and implementing key produce safety practices in the following areas: 94% Farm wide commitment to food safety (n=213); 93% Worker training (n=213); 92% Worker health and hygiene practices (n=214); 89% Soil amendment management (n=213); 92% Wildlife and domesticated animal management (n=205); 92% Land use management (n=210); 91% Production water management (n=207); 92% Postharvest water management (n=207); 94% Implementation and management of sanitation practices (n=205); 87% Writing a farm food safety plan (n=202) 73% of participants (n= 236) expect that their farm will need to comply with the FSMA PSR publications.

4. Associated Knowledge Areas

KA Code	Knowledge Area
102	Soil, Plant, Water, Nutrient Relationships
104	Protect Soil from Harmful Effects of Natural Elements
404	Instrumentation and Control Systems
503	Quality Maintenance in Storing and Marketing Food Products
504	Home and Commercial Food Service
711	Ensure Food Products Free of Harmful Chemicals, Including Residues from Agricultural and Other Sources
712	Protect Food from Contamination by Pathogenic Microorganisms, Parasites, and Naturally Occurring Toxins
722	Zoonotic Diseases and Parasites Affecting Humans
723	Hazards to Human Health and Safety

V(H). Planned Program (External Factors)

External factors which affected outcomes

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

Brief Explanation

None to report.

V(I). Planned Program (Evaluation Studies)

Evaluation Results

NJAES research and extension outcomes related to this planned program were evaluated utilizing a variety of evaluation methods appropriate for each initiative to determine the effectiveness on both a qualitative and quantitative level. For KASA and practice change we included the measurement of knowledge gained as measured by pre/post Likert-scale assessments. Surveys were used to measure increase in skills acquired, behavior change and practice adoption. For process evaluation we focused on program delivery, participation, relevance and timeliness. Data was collected at appropriate times for each initiative that supports this planned program. IRB approved evaluation instruments were used to collect research and extension data. Data analyses and comparisons relevant to basic and applied research and demonstration were collected and analyzed and reported utilizing a variety of data collection methods appropriate to each research question. The major goal of evaluating is the demonstration of social, economic, behavior and environmental changes in conditions that contribute to improved quality of life as a result of participation in programs and benefits of research solutions. See state defined outcomes for detailed results of each initiative.

Key Items of Evaluation

None to report.

V(A). Planned Program (Summary)

Program # 9

1. Name of the Planned Program

Sustainable Energy

☑ 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
605	Natural Resource and Environmental Economics	100%		100%	
	Total	100%		100%	

V(C). Planned Program (Inputs)

1. Actual amount of FTE/SYs expended this Program

Year: 2017	Extension		Research	
	1862	1890	1862	1890
Plan	4.0	0.0	2.0	0.0
Actual Paid	0.2	0.0	0.7	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**
64185	0	37527	0
1862 Matching	**1890 Matching**	**1862 Matching**	**1890 Matching**
436404	0	213118	0
1862 All Other	**1890 All Other**	**1862 All Other**	**1890 All Other**
21985	0	0	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

- Perform experiments to investigate renewable energy production.

- Develop methodologies and scientifically sound alternatives to fossil fuels
- Educate homeowners, business owners, farmers and agri-related businesses, youth and families about conservation and efficiency practices related to energy use.
- Provide education and training to enhance bio energy related job development and careers.

2. Brief description of the target audience

- University faculty, staff and students
- School aged youth
- Families
- Homeowners
- Farmers
- Agri-businesses
- State agencies and organizations
- Industry partners
- Small businesses
- Entrepreneurs
- Policy and decision makers

3. How was eXtension used?

eXtension was not used in this program

V(E). Planned Program (Outputs)

1. Standard output measures

2017	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	2505	18000	1100	0

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

Patent Applications Submitted

Year: 2017

Actual: 0

Patents listed

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2017	Extension	Research	Total
Actual	0	12	12

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- -Scientific publications and patents produced -Participants reach through direct and indeirect education -New methodologies and technologies developed

Year	Actual
2017	0

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O. No.	OUTCOME NAME
1	Short Term - Increase knowledge, energy efficiency technologies and conservation practices related to energy use. Explore research strategies to replace fossil fuel consumption.
2	Medium Term - Participants in direct and indirect educational methods will adopt practices to conserve energy use and reliance on fossil fuels. Business owners will create and maintain green jobs/careers as a result of bioenergy development. Newly developed plants and technologies will be adopted to enhance energy independence.
3	Long Term - Fossil fuel consumption will be replaced with biofuels. Economic development will be enhanced through an increase of jobs and careers as a result of bioenergy development. Environment quality enhanced as a result of sustainable biofuel production and utilization.
4	Long Term - Fossil fuel consumption will be replaced with biofuels. Economic development will be enhanced through an increase of jobs and careers as a result of bioenergy development. Environment quality enhanced as a result of sustainable biofuel production and utilization.
5	Long Term- Fossil fuel consumption will be replaced with biofuels. Economic development will be enhanced through an increase of jobs and careers as a result of bioenergy development. Environment quality enhanced as a result of sustainable biofuel production and utilization.

Outcome #1

1. Outcome Measures

Short Term - Increase knowledge, energy efficiency technologies and conservation practices related to energy use. Explore research strategies to replace fossil fuel consumption.

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

What has been done

Results

4. Associated Knowledge Areas

KA Code	Knowledge Area
605	Natural Resource and Environmental Economics

Outcome #2

1. Outcome Measures

Medium Term - Participants in direct and indirect educational methods will adopt practices to conserve energy use and reliance on fossil fuels. Business owners will create and maintain green jobs/careers as a result of bioenergy development. Newly developed plants and technologies will be adopted to enhance energy independence.

2. Associated Institution Types

- 1862 Extension
- 1862 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	0

3c. Qualitative Outcome or Impact Statement

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

What has been done
{No Data Entered}

Results
{No Data Entered}

4. Associated Knowledge Areas

KA Code	Knowledge Area
605	Natural Resource and Environmental Economics

Outcome #3

1. Outcome Measures

Long Term - Fossil fuel consumption will be replaced with biofuels. Economic development will be enhanced through an increase of jobs and careers as a result of bioenergy development. Environment quality enhanced as a result of sustainable biofuel production and utilization.

Not Reporting on this Outcome Measure

Outcome #4

1. Outcome Measures

Long Term - Fossil fuel consumption will be replaced with biofuels. Economic development will be enhanced through an increase of jobs and careers as a result of bioenergy development. Environment quality enhanced as a result of sustainable biofuel production and utilization.

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
Impact Analyses and Decision Strategies for Agricultural Research: The conceptual framework underlying the research does not naively take the availability of new technologies as given. While it is critical to assess current producer demand for new technologies, it is equally important to examine how socio-economic factors affect the supply of innovations and how evolving factors will change these demands. The research will investigate how policies, regulations, and environmental factors affect the size and focus of investments in research and innovation, and the pace and direction of technological change.

What has been done
The research conducted investigates the determinants and effects of adoption of new agricultural technologies, particularly biotechnologies and bioenergy systems, and contribute to the improved design of biotechnology regulations. The research will also evaluate the implications of environmental forces on agricultural productivity.

Results
Haber-Bosch (H-B) is an energy intensive process and currently, most of the production uses natural gas as a fuel and feed for hydrogen production. So, any increase in ammonia production through H-B means an increase in natural gas consumption and a loss of natural gas pollutants to the environment. This creates a need for an alternative method of hydrogen production and better management of agroecosystem to reduce nitrogen losses. Electrolysis of water and direct nitrogen reduction are potential methods of hydrogen synthesis which can use renewable sources of electricity thus significantly reducing the environment and energy cost of ammonia production. The distributed sources of renewable electricity like biomass, wind and solar energy in rural areas can be coupled with the alternative forms of hydrogen synthesis which can further reduce the cost of transportation to agricultural regions. This past year the group evaluated this proposition, and

showed the economic and environmental value of direct nitrogen reduction technologies. Building on this analysis, this next year the group plans on evaluating the economic and environmental benefits of this technology to an urban region.

4. Associated Knowledge Areas

KA Code	Knowledge Area
605	Natural Resource and Environmental Economics

Outcome #5

1. Outcome Measures

Long Term- Fossil fuel consumption will be replaced with biofuels. Economic development will be enhanced through an increase of jobs and careers as a result of bioenergy development. Environment quality enhanced as a result of sustainable biofuel production and utilization.

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)
The Science and Engineering for a Biobased Industry and Economy: The new biobased industry, be it for food, fuel, biomaterials or other co-products, is rooted in a sustainable and productive biomass production system. As outlined in this project description, the Land Grant University system provides a unique capability to enable research for biobased products by providing a world-class research network. Replacing petroleum products with those originating from biological sources will require significant fundamental and applied research efforts. Using empirical, as well as conceptual tools, science-based knowledge will be developed. Numerical tools will be used to simulate a biorefinery, while statistical tools will be used to estimate parameters of interest. The conceptual framework will be used to improve our scientific understanding of the various processes and their economic implications.

What has been done
This project first evaluated how the use of technology leads to internalization of the negative externalities, through a combination of fish-farming with hydroponic, namely, aquaponics systems. Because this method internalizes the negative externalities without the need for regulatory intervention, there is a larger output of fish than the regulated outcome and cost-savings in the fish-farming process due to decrease in the need to purchase fertilizers. The aquaponics systems

diversify the sources of income of the farmer as well as the resulting "double dividend" from savings in water purification and savings in the purchase of fertilizer for plants growth.

Next, researchers showed how duckweed can add value to an aquaponics system and how this can benefit the development of a biorefinery that uses duckweeds to produce bioplastics. Duckweed serves as fish feed and a biological filter, as well as feedstock for the bioplastic process. Preliminary results suggest that the addition of duckweed results in a decrease in feed cost and effluent disposal cost, as well as significantly reduced the area needed to build the integrated system. This last reporting period, NJAES researchers are working on a study that investigates the barriers to the use of technologies that convert pollution and waste in one process to an input to another process.

Results

The study highlights the importance of information and knowledge in the use of these technologies, and it shows the role institutions can play via cooperatives to facilitate the extensive use of these technologies. If the cost of using these technologies is sufficiently low, utilizing pollution as an input results in a positive externality.

An aquaponics case study was used to show that the negative externalities could be internalized without regulatory intervention through a combination of fish farming and hydroponics. The introduction of aquaponics diversified the sources of income, yielded savings in the cost of water purification and the cost of fertilizer for the plants' growth, and resulted in more fish output than the unregulated scenario.

Still in the development stages, the second experiment will help NJAES researchers further understand the value of the pacu-duckweed system, and how to optimize it. Work with the Rutgers Aquaculture Innovation Center (AIC) in Cape May, NJ will also help disseminate findings to the industry and thus facilitate its developments, resulting in added economic value to the various stakeholders.

4. Associated Knowledge Areas

KA Code	Knowledge Area
605	Natural Resource and Environmental Economics

V(H). Planned Program (External Factors)

External factors which affected outcomes

- Natural Disasters (drought, weather extremes, etc.)
- Economy
- Public Policy changes
- Government Regulations
- Competing Public priorities
- Competing Programmatic Challenges
- Other (Consumption Practices)

Brief Explanation

None to report.

V(I). Planned Program (Evaluation Studies)

Evaluation Results

NJAES research and extension outcomes related to this planned program were evaluated utilizing a variety of evaluation methods appropriate for each initiative to determine the effectiveness on both a qualitative and quantitative level. For KASA and practice change we included the measurement of knowledge gained as measured by pre/post Likert-scale assessments. Surveys were used to measure increase in skills acquired, behavior change and practice adoption. For process evaluation we focused on program delivery, participation, relevance and timeliness. Data was collected at appropriate times for each initiative that supports this planned program. IRB approved evaluation instruments were used to collect research and extension data. Data analyses and comparisons relevant to basic and applied research and demonstration were collected and analyzed and reported utilizing a variety of data collection methods appropriate to each research question. The major goal of evaluating is the demonstration of social, economic, behavior and environmental changes in conditions that contribute to improved quality of life as a result of participation in programs and benefits of research solutions. See state defined outcomes for detailed results of each initiative.

Key Items of Evaluation

None to report.

VI. National Outcomes and Indicators

1. NIFA Selected Outcomes and Indicators

Childhood Obesity (Outcome 1, Indicator 1.c)	
0	Number of children and youth who reported eating more of healthy foods.
Climate Change (Outcome 1, Indicator 4)	
0	Number of new crop varieties, animal breeds, and genotypes whit climate adaptive traits.
Global Food Security and Hunger (Outcome 1, Indicator 4.a)	
0	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)	
0	Number of new or improved innovations developed for food enterprises.
Food Safety (Outcome 1, Indicator 1)	
0	Number of viable technologies developed or modified for the detection and
Sustainable Energy (Outcome 3, Indicator 2)	
0	Number of farmers who adopted a dedicated bioenergy crop
Sustainable Energy (Outcome 3, Indicator 4)	
0	Tons of feedstocks delivered.