2019 Annual Report of Accomplishments and Results

New Jersey
Rutgers, The State University of New Jersey
Rutgers Cooperative Extension and the New Jersey Agricultural Experiment Station Office of Research

I. Report Overview

The NIFA reviewer will refer to the executive summary submitted in your Plan of Work. Use this space to provide updates to your state or institutions as needed.

1. Executive Summary (Optional)

II. Merit and Scientific Peer Review Processes

The NIFA reviewer will refer to your Plan of Work. Use this space to provide updates as needed or activities that you would like to bring to NIFA's attention.

Process	Updates
1. The Merit Review Process	
2. The Scientific Peer Review Process	

III. Stakeholder Input

The NIFA reviewer will refer to your Plan of Work. Use this space to provide updates as needed or activities that you would like to bring to NIFA's attention.

Stakeholder Input Aspects	Updates
1. Actions taken to seek stakeholder input that encouraged their participation with a brief explanation	
2. Methods to identify individuals and groups and brief explanation.	
3. Methods for collecting stakeholder input and brief explanation.	
4. A Statement of how the input will be considered and brief explanation of what you learned from your stakeholders.	

IV. Planned Program Table of Contents

V. Planned Program Activities and Accomplishments

Please provide information for activities that represent the best work of your institution(s). See Section V of the Guidance for information on what to include in the qualitative outcomes or impact statements. Add additional rows to convey additional accomplishments. You may expand each row as needed.

No.	Title or Activity Description	Outcome/Impact Statement	Planned Program Name/No.
1.	**Transformations and Bioavailability of Mercury in Aquatic Ecosystems**	Mercury is a potentially serious public health concern due to its accumulation in aquatic and terrestrial food chains. The consumption of marine and freshwater fish containing elevated concentrations of mercury by women of child-bearing age has been linked to adverse health outcomes for their children. The goal of this project was to examine the biological and abiotic mechanisms that lead to the mobilization, transformation, and bioaccumulation of mercury in subsurface, estuarine, and marine environments. Understanding the fate of mercury in some of the most densely populated states in the U.S. will link process studies focused on biological cycling, speciation, and bioaccumulation to environmental management of the nation's aquatic natural resources. This project supports the mission of the NJAES in that it will contribute to the development of effective management strategies related to mercury in New Jersey's coastal environment thereby protecting natural resources, fisheries, and public health. The audience primarily targeted during this period included earth and environmental scientists, regional policy makers, and environmental consultants. Several different important discoveries were made over the course of this project. A few of the more significant studies are as follows: A method for the separation of methylmercury from estuarine sediments for mercury isotope analysis was developed and tested. The mercury isotope fractionation factor associated with mercury methylation by the ubiquitous iron-reducing anaerobe Geobacter sulfurreducens was determined. These findings have implications for the use of mercury-stable isotopes to track methylmercury, the form of mercury that biomagnifies in aquatic food webs and is a developmental neurotoxin in humans, in estuarine ecosystems.	1. Water Quality & Quantity

		The development and testing of a microbial biosensor for mercury provides a tool to examine the bioavailability of various species of mercury in aquatic systems. These findings are relevant to the assessment of the accumulation of mercury at the base of aquatic food webs. These measurements of the mercury isotopic composition of methylmercury in estuarine sediments are the first such measurements in non-animal environmental samples. NJAES researchers have also determined the mercury isotopic fractionation factors during microbiologically-catalyzed mercury methylation. These findings, together with those for various consumers, may be used to track mercury from its sources through aquatic food webs to upper trophic level consumers including birds and mammals where methylmercury acts as a developmental neurotoxin. The group examined the effects of mercury exposure on the co-selection of mercury and antibiotic resistant bacteria that colonize the gastrointestinal tract of the mummichog (Fundulus heteroclitus), a small, estuarine fish. The results of this study highlight the possibility for the creation of antibiotic resistance gene pools as a result of exposure to mercury in contaminated environments	
2.	**Water Management and Quality for Ornamental Crop Production and Health**	Water is an essential, and heavily used, component in the production and management of green industry commodities (nursery and greenhouse crops, landscape plants and lawns). As their dependence on high-quality water sources is increasingly threatened by climate change, competition and allocation to other priority uses, the use of alternative water sources is now imperative. During this year, the target audiences reached were nursery and greenhouse growers and employees, county agricultural agents, landscape maintenance contractors and operators, tree care firms and personnel, parks and recreation employees, employees/supervisors/members of municipal and regional water boards and agencies. Efforts included laboratory instruction, workshops, seminars, extension and outreach teaching. NJAES researchers continue evaluating short- and long-term effects of alternative water sources, such as municipal reclaimed water and residential graywater on ornamental plants/crops, contrasting them to traditional good-quality water sources. Ongoing results imply that a systematic tracking of water quality parameters, and adjustments to irrigation management practices could allow for	1. Water Quality & Quantity

		satisfactory use of these alternative water sources. The short- and long-term effects of these water sources on the chemical, physical and biological properties of substrates and soils are currently being assessed. 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 group has completed greenhouse experiments evaluating residential laundry graywater as an irrigation source for ornamental plants and they are analyzing data and results. So far, the results to date point out that laundry effluents from biodegradable detergents and softeners do not affect plant growth and quality compared to the control, well-water, treatment. Conversely, graywater based on conventional detergents and softeners negatively affect plant growth and quality, and more so if they contain bleach (both hypochlorite- and peroxide-types), including leading to plant mortality. These effects are attributed to phytotoxic concentrations of chlorine, sodium, boron and chloride ions.	
3.	**Watershed Restoration for Healthy Ecosystems**	Eutrophication (high nutrient/organic loads) in lakes and ponds, along with conditions of warm, calm water, with elevated nutrients, can cause photosynthetic green and blue-green algae (cyanobacteria) to increase dramatically. These "blooms" may be visible as floating scum that resembles blue, green or even red paint on the surface of the water. Blooms can spoil water quality producing pungent odors or a thick scum, affecting recreational use, reducing oxygen levels, as well as impacting other plants and animals in the water. At night, respiration from blooms uses oxygen that can alter the balance of the ecosystem to the point of causing fish kills. Decomposition of the bloom also consumes oxygen in the pond. In addition, some species produce toxins that can cause illness in humans, pets or livestock. This program focuses on the basics of stream, lake and pond maintenance and repair with the emphasis on conditions encountered in the urban environment responding to upstream changes in hydrology, sediment, and pollutant transport. RCE faculty are educating individuals that own, live on, recreate on, or maintain a stream, river, lake or pond watershed restoration methodology and better management of stormwater and construction. Faculty are working on a joint project with the New Jersey Department of Environmental Protection along with the Burlington County and Camden County Parks Departments on lake water	1. Water Quality & Quantity

		quality improvement studies. They are looking at source tracking of toxic cyanobacteria in Smithville Lake and Hopkins Pond. The study is comparing the reliability of a relatively inexpensive and quick water toxicity test kit versus a full laboratory ELISA analysis to determine if the test kit is a useful tool for lake managers. Water quality parameters collected via field sampling is being used to determine "Bloom" characteristics of three species of toxic cyanobacteria: Microcystis, Aphanizomenon, and Anabaenopsis. The information from this program is being used to determine if water use activities should be restricted due to the potential toxic effects from the cyanobacteria. In addition, at Hopkins Pond an underwater aeration system was installed to break up summertime water layer stratification and get good mixing of oxygen throughout the water column. The underwater aeration system was successful at creating a constant turnover of the pond water column. This has resulted in oxygenated water all the way to the bottom. Having oxygen near the bottom sediment helps keep phosphorous locked up in the sediment. Phosphorous levels in Hopkins Pond have lowered to acceptable levels. Since the transducer was installed at Hopkins Pond little to no cyanobacteria has been measured.	
4.	**The Impacts of Maternal Exposure to Flame-Retardants and High-Fat Diets on Adult Offspring Energy Balance**	The impacts of chemicals that can mimic the actions of estrogens and the effects of maternal overnutrition or obesity on offspring physiological systems like energy balance (weight gain, food intake, glucose, etc.) is the main focus of this project. These developmental influences may contribute to the obesity epidemic in human populations and contribute to difficulties in animal livestock production. Furthermore, this area of study is increasingly of interest to the scientific community, regulatory organizations and the general population. The group will elucidate the interactions of flame retardants and maternal overnutrition on the hypothalamic mechanisms that control energy balance and associated pathophysiological consequences (obesity, metabolic syndrome, diabetes) using a combination of rodent-based techniques not readily available in livestock including electrophysiology and transgenic animal models. Findings from this research will contribute to the national goals for agriculture by identifying potential deleterious effects of chemical exposure, obesogenic diets, and its impacts on the production of livestock as well as human health (juvenile and adult obesity and other metabolic conditions).	2. Youth/Adult Obesity

		The target audiences for this research are food producers and food handlers (both agribusiness and factory producers) and includes those that are interested in the deleterious effect of contaminants and natural toxins on child development, behavior and normal physiological functions that control obesity. Other target audiences include parents and women of reproductive age who are concerned about the effects of food contaminants and high-fat diets on their infants and children. The goal of these studies is to improve the understanding of the effect of endocrine disruption on hypothalamic functions especially energy balance and glucose metabolism through either adult or developmental exposures and how those exposures interacts with maternal obesity or high-fat diets. As obesity rates increase and the population of people capable of pregnancy increase, researchers are concerned about how multiple external influences (chemical exposures, high-fat diets, etc.) can alter physiology in the offspring. The group has collected baseline data for experiments involving exposure to organophosphate flame-retardants (OPFR) during adulthood and during development (in utero to lactation, also called perinatal). They have found that exposure of the dams alters gene expression in the brain and the liver of juvenile (2-week) pups and alters locomotor and exploratory behaviors in the adult offspring. The have also found that OPFR exposure alters how the adult mice respond to a high-fat diet in terms of glucose metabolism, insulin sensitivity, energy expenditure and activity. This data suggests that developmental exposures to OPFRs can influence how the brain and the body respond to an obesogenic diet and that these influences include regulation of genes involved in the control of metabolism. NJAES researchers have also completed initial studies examining the effects of different dietary fatty acids (saturated fats vs. omega-6 polyunsaturated fats (PUFA)) on the influence of maternal high-fat diet on offspring energy balance in mice. They fed virgin females two different high-fat that vary in their concentrations of saturated and omega-6 polyunsaturated fats prior to mating and continued feeding them these diets during pregnancy, lactation, and through to weaning of the pups. The major effect we observed was that the maternal high-fat diets high in omega-6 PUFA disrupted glucose metabolism and insulin	

		sensitivity in the offspring more than the high saturated fat diet when the offspring were fed a high-fat diet. This data suggests that the increase in dietary fatty acid intake of omega-6 PUFA, found in most vegetable oils, in humans may be contributing to the increases in type II diabetes and metabolic syndrome through direct actions in adults and through a developmental effect from pregnant mothers passing it on to their children.	
5.	**Customized & Community-Based Diabetes Education for South Asians in New Jersey**	Diabetes is the 6th leading cause of death in New Jersey as reported by the New Jersey State Assessment data (SHAD) System, New Jersey Department of Health. According to 2010 census data, NJ has the highest proportion of South Asians living in the United States. South Asians have a higher prevalence of Type 2 diabetes at relatively lower BMI compared to other populations. Although a majority of South Asians are educated, multiple native languages and cultural barriers result in disparities in access to care, service utilization and health outcomes. Since the risk for diabetes is high in this population, developing programs to increase awareness and educate community about causes, symptoms, diagnosis, and management of diabetes is crucial. South Asians speak many different native languages and maintain a variety of traditional diets. Thus, it is important to adapt and customize the available diabetes education materials to meet their cultural, and dietary needs. This past year 14 South Asian peer leaders, speaking 6 native languages were recruited and trained by health educators, including FCHS faculty/staff, on the evidence based Stanford University curriculum, *Steps to Healthier Living*, *Diabetes Self Management Program*. These peer leaders have diabetes, pre-diabetes or are caregivers for family member living with diabetes. In addition, they were trained on a culturally tailored curriculum focusing on diabetes pathology, medications and South Asian dietary patterns. This network of trained peer leaders conducts DSMP trainings in their communities reaching South Asian families living in New Jersey. Dietary intake, physical activity, diabetes self-care patterns biometric measures (blood glucose, cholesterol) and anthropometric measures were collected. These same measures are being collected from community participants. As a result of the 6 months of multiple trainings provided to peer leaders, 25% of peer leaders weighed 3.5 to 4.4 lbs. less; 33.3% peer leaders had lower blood	2. Youth/Adult Obesity

		pressure figures; changing from Hypertension 1 or Hypertension 2 categories to normal blood pressure category; 8% peer leaders dropped HbA1C measure from 7.8 to 6.8 (normal category for a person with diabetes). Two people were classified as having depression symptoms during pre-survey. Both reported lower scores (non-depression category) at the post-survey point. 92 % Peer leaders reported that they were paying more attention to reading labels, watching portion sizes and learned how to count carbohydrates in traditional South Asian foods.	
6.	**Diet Dilemmas: High Protein and Ketogenic Diets and Intermittent Fasting**	With mounting evidence of the link between nutrition and health, there has been a surge of nutrition misinformation, food fads, fad diets and even misleading health claims about food. Among the newest health claims to improve health are the high protein and ketogenic diets. The ketogenic diet consists of a high-fat moderate protein and low carbohydrate diet, while the high protein diet as its name suggests has high amounts of protein with moderate amounts of fat and low carbohydrates. More and more individuals claim to have tried these diets to improve their health. As individuals start taking control of their health they look to websites, television, radio, family, and friends for relevant nutrition information. This is deeply troubling due to the critical consequences of much of this misleading nutrition information. Florida State Extension created a series of webinars titled "Diet Dilemmas: Fads, Facts and Fundamental" with a focus on trending nutritional advice and teaching extension educators what they need to know to teach their communities on these topics. This spring Rutgers Cooperative Extension Educators presented a webinar for this series on the high protein and ketogenic diets. The primary audience for this program was the Extension community, especially agents and paraprofessionals that receive a great deal of questions during their nutrition education activities on diet trends. At least 258 participants attended the webinar and many indicated that they were watching the webinar in a group setting with colleagues. Of the 258 participants who attended the webinar, 174 responded to a post-survey about the training. 91%-93% of the respondents indicated they increased their knowledge of the components of and positive health effects of eating plans, and the potential challenges of the eating plan. Additionally, 83% of respondents	2. Youth/Adult Obesity

		indicated they will be using this data to answer questions on popular diets in their professional work. Finally, 90.2% of the participants indicated they had an increased ability and confidence to discuss the topic with clients and 79% indicated that they had an increased ability to evaluate sources of information for popular diets. By improving the knowledge and abilities of nutrition extension educators nationally this results in better evidence-based nutrition information to residents everywhere.	
7.	**Beneficial and Adverse Effects of Natural Chemicals on Human Health and Food Safety**	Red raspberry (*Rubus idaeus*) contain numerous phenolic compounds with purported health benefits. The purpose of this study is whether a phenolic-enriched raspberry fruit extract has a potential to prevent the excess weight gain and metabolic alterations associated with the development of diet-induced obesity. The hypothesis was that the phenolic-enriched raspberry extract would prevent diet-induced excessive weight gain. The target audiences for this project are the general public, fellow scientists, and engaged students. Findings were presented at several scientific meetings open to the public and publications are posted on PubMed Central freely available for general public to read. The group tested whether phenolic-enriched raspberry extracts, compared with raspberry ketone, would be more resilient to the metabolic alterations caused by an obesogenic diet. Male mice (8 weeks old) received a daily oral dose of vehicle (VEH), raspberry extract low (REL), raspberry extract high (REH), or raspberry ketone (RK). Coincident with daily dosing, mice were placed on a high-fat diet. After 4 weeks, REH and RK reduced body weight gain and white adipose mass compared with VEH. REH treatment increased total ambulatory behavior. Energy expenditure/lean mass was higher in REH compared with REL treatment. There were no treatment differences in cumulative intake, meal patterns, or hypothalamic feed-related gene expression. The results suggest that raspberry ketone and a phenolic-enriched raspberry extract both have the capacity to prevent weight gain but differ in the preventative mechanisms for excess fat accumulation following high-fat diet exposure. Future studies will characterize the metabolic signature of a standard -	2. Youth/Adult Obesity

		prepared phenolic-enriched raspberry extract and raspberry ketone to further understand the preventative actions on the development of diet-induced obesity	
8.	**The Emergency Preparedness Training for Teens (EPTT)**	This program is based off the *My Preparedness Initiative (MyPI) - Teen Emergency Preparedness Program.* MyPI is a national Extension program designed to help teens learn to be safe before and during a disaster, and to help families and communities after a disaster. The decision to evolve EPTT from MyPI was to be strategic in best meeting the needs of the community served and deliver a program catered to the local situation. In this program teens enhance their understanding of threats, prepare to assist families and others in the community, build their lifesaving skill set, strengthen their decision making abilities, improve their communication skills, learn about state-of-the-art technology for disaster prevention/response, become aware of potential weather emergencies, and enhance their teamwork and leadership abilities. Teens completed a three-day (22 hours) U.S. Department of Homeland Security/Federal Emergency Management Agency-certified Teen CERT training that included: Developing a communication plan for family disaster response; disaster preparedness; fire safety and utility control; disaster medical operations; light search and rescue; CERT organization; disaster psychology; terrorism; CPR and AED method and process. Working in coordination with RCE faculty, volunteers, and the Burlington Office of Emergency Management, the team worked together advancing the plan and completing the tasks including, securing meeting facilities and resources, recruiting teen participants, creating registration database, marketing of the program, recruiting collaborative, local partner organizations, raising funds, and planning program teen commitment. Over the summer of 2019, nineteen teenagers participated in the training program. Participants completed pre and post-tests assessing their knowledge gained. They also participated in training to describe and demonstrate the use of resources (including but not limited to a fire blanket, first aid kit, flashlight, safety glasses, etc.) that were provided after successful completion of EPTT. The teens	3. Youth Development

		demonstrated statistically significant (P < .01) improvements on the assessment (30 items) over time (mean scores – 35.26% pre-training, 86.84% post training). T-test analyses of the Burlington County EPTT program (n= 19) indicated statistically significant (P < .01) improvements. In a post program evaluation, a sample of participants offered the following feedback: Student 1 = After this program, I learned that any minute you can spare is a minute you could put toward saving someone's life Student 2 = I plan to create a (sic) emergency plan for my family and now that I understand how to use a fire extinguisher I will be able to put that ability to good use when the time comes. Student 3 = I found this inspiring and I want to make a career out of this.	
9.	**Rutgers 4-H STEM Ambassador Program**	This program was established in 2009 as an opportunity for traditionally underserved urban youth to learn more about science, explore research occurring on campus, and gain a better understanding of opportunities available in science, engineering, and technology; explore opportunities available at Rutgers University, experience campus life, learn about post-secondary education; and prepare to serve as a 4-H STEM Ambassador in their home community. The program specifically targets youth from backgrounds that are underrepresented in STEM majors and careers. In its eleventh year, fifty-seven (57) high school youth from seven urban counties throughout New Jersey participated in the campus-based portion of the program in the summer of 2019 at the Rutgers School of Environmental and Biological Sciences. During their weeklong residential experience, they explored science through hands-on activities in animal science, biotechnology, computer science, engineering, environmental science, exercise physiology, food science, geospatial technology, horticulture, marine science, microbiology, neuroscience, nursing, and nutritional science. Youth participated in discussions, workshops, lab tours, and a full-day research project alongside faculty, staff, and graduate students. During the week, they also learned about campus life and the opportunities available at Rutgers from an undergraduate student panel and representatives from the School of Environmental and Biological Sciences. In addition to exploring science, the youth participated in personal development and teambuilding activities – including a campus scavenger hunt, evening social events, and a trip to one of the recreation centers. The experience helped prepared them to become 4-H STEM Ambassadors. They prepared and presented posters of their	3. Youth Development

		full-day research projects to partners, administrators, parents, and other guests. As 4-H STEM Ambassadors, they returned home and worked with their local 4-H program to promote 4-H and science to other youth. To date, 529 youth (more than 50% female) from urban areas in primarily seven New Jersey counties have participated in this program. Each year, the cohort averages about 40–45% African American and 40–45% Latino. The remainder is Caucasian and/or Asian and those who prefer not to identify with a single group. Annual Surveys each year pre- and post-surveys gauge participants' weeklong summer experience, as well as measuring interest and engagement in STEM. Results from 2018 show that Ambassadors reported significant increases in their interest in science, as well as their interest in having a STEM career (including as a scientist, engineer, or STEM educator) from the beginning to the end of the week. Based on the results of a Wilcoxon Signed Rank Test, the number of students out of 48 (total # 2018 participants) whose interest increased from the beginning to the end of the week was 14 in science, 13 in engineering, and 21 in STEM education. All test results were statistically significant. Ambassadors who said that the scientists supported their learning were more likely to see themselves as STEM professionals, a relationship that was statistically significant. "I can see how learning about my options in STEM, understanding the research process, and being more aware of my opportunities as Ambassadors will help me figure out my career pathway." "This week was probably the best week of my life. I met so many new people and learned so many new things … I am very glad to say I might have found what I want to be." These results are consistent with those from previous years. In the longitudinal survey, a total of 243 youth participated in the STEM Ambassadors program from 2009 to 2014 and were phone-interviewed in 2015 about their experience (n = 105, a 43% response rate). Analyses of the data show the following: 82% believe interactions with scientists motivated and supported learning; 70% felt participation better prepared them for college; 55% could see themselves as STEM professionals; 50% reported positive change in motivation to learn about science. Of those past participants who were still in high school (n=68) 72% are interested in pursuing a STEM major/career; 39% are interested in attending Rutgers University. Of those past participants who reported graduating high school (n=35), 94% attend or graduated from a college or university, 31%	

		attend Rutgers University, 59% enrolled in a STEM major or are interested in a STEM career, 34% enrolled or are interested in a medical major or career. In terms of long-term engagement, 96% of Ambassadors stayed involved with their local 4-H program by teaching hands-on science to youth and becoming 4-H club members. Ambassadors also participated in other opportunities, including teen community service clubs, state conferences, and national 4-H events. For many, the STEM Ambassadors program is a gateway to a long-term relationship with 4-H. Some teens even find jobs working with 4-H. "4-H provided a foundation for understanding the diversity of science based fields." "I feel like my interest for engineering increased the most as well as my interest in the math field." "It let me realize that science isn't just laboratory work and all inside in a confined space. Going with the ecologists let me know that there are different options and paths I could take."	
10.	**ENIGMA**	In collaboration with two local K-8 schools, the New Brunswick Public School System and the Supervisor of Science in K-12 New Brunswick Public Schools, Rutgers Cooperative Extension faculty and staff implemented two 6-week Short Term Exploratory Program (STEP) clubs for urban youth during Fall/Winter 2019. 4-H STEP Club activities emphasize STEM learning and building leadership skills through a learn by doing approach, as well as employing activities from the current research of NASA funded ENIGMA Scientists. The participants utilized effective practices from the existing NASA Astrobiology Science Learning Activities for Afterschool guide, 4-H STEP Club activities which emphasize STEM learning and building leadership skills through a learn by doing approach, as well as employing activities from the current research of ENIGMA Scientists. They used everyday activities as examples to describe the scientific importance of finding water on Mars and searching for life on other planets. Each school had consistently 25-30 students in attendance during the course of the 6-week program. In addition, two family science programs were offered and centered around the complex topic of Astrobiology in two local New Brunswick schools for K-8 students and their families. These first interactive K-8 Family Science Nights entitled "Exploring Life on Other Planets", were interdisciplinary focused involving staff from the Department of Youth Development, Rutgers Scientists and post-docs within the ENIGMA cohort, Rutgers Faculty and graduate students from the Geology Museum as well as the Physics department. Bi-lingual	3. Youth Development

		Spanish student volunteers were present to provide program support and make sure all family members were included in the discussion and activities on Astrobiology. The Family Nights centered around the complex topic of Astrobiology. The premise for each family to visit five stations where they would learn the tools needed to find life on other planets. Families were given passports, in both Spanish and English to help guide them through each station and record some of the enduring ideas. There were close to 200 in attendance at each Family Science Night. The 4-H STEM program utilized the 4-H STEP (Short Term Exploratory Program) Club model to translate complex science topics into common concepts relatable to urban youth. The Spanish speaking community was engaged by providing bi-lingual program support. 100% of participants agreed they learned new things about science in the ENIGMA club. Most participants (92%) strongly agreed or agreed: "I like experimenting and testing ideas. I get excited about new discoveries. I want to learn more about science. I like science. I am good at science. I would like to have a job related to science someday. I do science activities not related to school." Finally, 63% strongly agreed or agreed: "I can do an experiment and answer a question. I can tell others how to do an experiment. I can explain why things happen in an experiment" as a result of my experiences in ENIGMA.	
11.	**Montclair Community Farm 4-H Association (MCF)**	In New Jersey 1 in 10 (or 1.1 million) people struggle with hunger including 1 in 7 children. In Essex County, this number is even higher with 17% of people experiencing food insecurity and alarmingly this number increases significantly at Montclair State University where a yet to be published survey showed, an alarming 46% of students' experience food insecurity. In Montclair, the closing of a grocery store in 2015 led to many people living with limited access to affordable and healthy food. Interest in the future of food from farming and community gardens, to the environment and climate changing are growing. Despite an abundance of wealth and resources in many parts of Montclair and the surrounding community, there continues to be significant health disparities among community members including access to local and affordable produce. Implementing holistic programs to address food security is one of the best ways to address the social determinants of health and directly improve health and livelihood outcomes.	3. Youth Development

		The program was established to offer youth the opportunity to grow and sell vegetables and to increase access to affordable fresh produce in local neighborhoods. Since then, MCF has expanded to include Montclair State University (MSU) and Rutgers Cooperative Extension of Essex 4-H, adding greater educational and service learning components to the project, Montclair History Center (MHC), the Rutgers Master Gardeners, HomeCorps and the Senior Citizen Advisory Committee (SCAC). Together, these organizations comprise the MCF Coalition. Since 2011, MCF has engaged and educated the community through farm, food, and health. MCF has grown, sold and/or donated over 3,300 lbs. of affordable produce to seniors and the community, produced 2,500 eggs and 16 jars of honey. In 2018, MCF reached over 120 seniors (50+ every week), had over 3,400 youth and adult engagements (over 10,000 hours) through a variety of programs. MCF has become a place for Coalition partners to offer programming and scholarship. MCF continues to strengthen their impact from the amount of food grown to expanding community engagement and the organization The goal of MCF continues to be a vibrant and sustainable educational hub for growing and sharing food with the community by increasing the availability of Montclair Grown fresh produce for the most vulnerable members of our community, increasing opportunities to expand community partnerships with a focus on pre-K-12 and higher education institutions, and mobilizing new resources and engaging the community to strengthen the program's impact and sustainability. This year MSU community gardeners joined the coalition and are being mentored throughout the growing season. MSU community gardens will host farm stand days at the student pantry and MSU will glean extra produce for the mobile farm stand. Community partnerships with a focus on Pre-K-12 and higher-education institutions and organizations representing underserved individuals are expanding. This expansion includes hosting a day for Pre-K-12 and higher education educators to visit the farm and identify opportunities for partnership and hiring an Educational Coordinator to develop programming for Pre-K-12 students, and engaging and re-engaging organizations that focus on youth, seniors and underserved populations.	

		Over 1,400 individuals engaged for over 10,000 hours, including nearly 300 older adults and 1,600 lbs. of produce distributed with 1,000 lbs. from MCF (vs. 460 lbs. in 2018), and 600 lbs. supplemented by Montclair Community Food Co-op and CSA. 95% of farm seedlings grown in greenhouse with support from Master Gardeners, 15 chickens and 600 eggs. 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. Some of the results of the surveys included: 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	
12.	**4-H/Middle Earth Students Ambassadors for Community Health (SACH)**	"Why are you choosing this park? Nobody cares about us here" a resident next door asked as students gathered measurements of the park. This comment is a reflection of the unmet need that exists; a lack of pride in one's community, and a feeling that no cares to devote time and resources to certain neighborhoods. It was this conversation that was the catalyst for the students to become invested and passionate about the improvements they were about to make in this community. When identifying problems and creating solutions that support the community culture of health, youth provide a unique perspective. Unfortunately, this perspective is often overlooked and undervalued despite the energy and fresh ideas they bring to the table. The 4-H/Middle Earth Students Ambassadors for Community Health (SACH) are a group of teens from Bound Brook, NJ ages 14-19, who implement self-designed projects to make their communities healthier and more vibrant. To advance this work, the Somerset County 4-H Youth Development Program partners with Middle Earth, an at-risk youth service provider to create the SACH club. The participants in this club are from traditionally at risk communities and are not the customary youth who participate in Somerset County, NJ 4-H clubs. The program was started through a grant from Robert Wood Johnson New Jersey Health Initiatives (RWJ NJHI), which seeks to empower young people to learn about issues that affect their community and to utilize tools and support systems already in place to make a difference. Adult coaches from Somerset County 4-H	3. Youth Development

		and Middle Earth partnered to advise and coach the youth. Through this program, these teens develop the leadership skills and confidence to work with municipal governments, cross-sector coalitions focused on health, school boards, and other organizations. They receive guidance from trained community-based coaches to better understand topics around population health and the importance of social determinants of health and their impact on building a sustainable culture of health. The youth also participate in a statewide alumni network to mentor the incoming students and stay connected to their peers as they continue their leadership paths. By brainstorming ideas, reviewing community health surveys, and hearing from local experts, the Student Ambassadors decide on their focus each year, and then are paid during the summer to implement the project. Research clearly points to the contribution that social, economic and physical environment conditions make to overall health and well-being. The County Health Rankings and Roadmaps model of population health points to these "social determinants of health" as critical "upstream" factors that must be addressed in order to systematically and equitably ensure good health and well-being for all individuals. Student-led projects show that youth can bring about real change with lasting impact. The target area for this program is one of the neediest communities in Somerset County, with a large number of residents who struggle with the high cost of living. It has a high immigrant population and the highest percentage of Hispanics in the County. It has the 2nd highest concentration of low-income families in the County, with the lowest median income. It ranks 1st in children receiving Food Stamps, with over half of students receiving free/reduced lunches. It is the 2nd highest-risk community with issues such as child abuse, poor school performance, truancy, gangs, delinquency, bullying, lack of supervision/support, mental health, & substance abuse. It has the highest percentage of workers 16 & over without transportation. The SACH teens address these community needs by creating spaces where residents can feel safe and feel a sense of pride and belonging. They partner with Healthier Somerset, a coalition that since 2010 has been working to identify health needs in the community and to create collaborative partnerships that will improve the physical and mental health of everyone who lives and works in Somerset County. The SACH teens have made huge impacts in the community. By continuing projects that bring people and beauty back to forgotten areas, the teens	

		demonstrate that they are not only addressing problems in underserved areas but bridging the divide between youth, the community, and elected officials. Over the summer months, the youth returned to Maltex Park to implement the plans they developed and completely revitalized Maltex Park. The park had been neglected for years. They unveiled their hard work in August, inviting the public to a neighborhood block party at the park. One of the first steps involved the students petitioning to rename the park "Mariposa Park" (Spanish for butterfly) to symbolize the transformation of the park from a caterpillar into a beautiful butterfly. SACH partnered with a newly formed Bound Brook Community Garden Committee to revive the abandoned park that had become an unused space in the neighborhood. The Garden Committee had already created a community garden in the park, allowing residents to raise their own vegetables in a rented plot. The youth added herb boxes and a vegetable stand to enhance this service. They planted two peach trees and several raspberry bushes that anyone visiting the park may pick for free.	
13.	**Effects of Rotational Vs Continuous Grazing Systems for Horses on Environmental Quality, Animal Health, and Production Cost**	Grazing livestock on pasture is an effective way to meet nutritional needs if done properly. However, it is important to understand the needs of the pasture vegetation and soils as well as those of the grazing animals. This interaction has been studied in many livestock species, but data is lacking for horses. Equine recommendations cannot be extrapolated from other livestock data because horses exhibit different grazing behavior, such as biting plants closer to the ground and choosing plants more selectively than other species. These behaviors have different environmental impacts than those of other livestock species. Clients varied widely from horse and small livestock farm owners and managers, to members of county agriculture boards and township governments. On occasion the group has also catered to Extension and NRCS staff as well as horse enthusiasts in general. This project investigated the role of grazing system on the interaction between pasture plants, soil, and grazing horses. Rotational grazing is often recommended but not widely adopted in the horse industry in the Northeast. This project measures the effect of grazing system on plant production, soil quality, animal health, and production costs by grazing horses in one continuous system and one rotational system for a period of approximately two years. Plant production was measured by vegetative cover, species composition, available forage, and	4. Agricultural Viability

		nutritional composition of the forage. Soil quality was measured by soil fertility, bulk density, and water infiltration. Horse health was measured by body weight, body condition score, rump fat depth, and voluntary movement. The economics of each grazing system was analyzed by comparing production costs and documenting how much additional feed horses need when pasture forage is insufficient. The average monthly grazing days was 50% greater for the horses grazing on the continuous system vs. the rotational grazing system. However, there were no significant differences between grazing system for average monthly amount of hay fed or cost of pasture maintenance. This is interesting to note because the body condition score and fat content in the horses grazing in the continuous system was higher than those in the rotational grazing system. This could potentially mean that the horses in the continuously graze pastures consumed more of the forage that was available to them than the rotationally grazed horses. The largest difference witnessed between grazing system was for vegetative cover, sward height and herbage mass; these measures were greater in the rotational grazing system across all months after the first 6 months of the study. This means more forage available for horses to consume during the grazing periods. For pasture species composition the group found that the originally planted grasses (orchard grass and the tall fescue) maintained a higher proportion in the rotationally grazed system than in the continuous system. The grasses planted in the continuously grazed pastures were replaced by grass weeds (those grasses we did not plant) and other things like bare ground, dead grasses and leaf litter, etc. In terms of nutrient content of these pastures, over the course of the study the rotational system had a higher content of energy(calories), fiber and calcium, while the amount of protein was lower compared to the continuously grazed pastures. Again, meaning that despite the higher nutritional quality of the grasses and the taller, denser forage in the rotationally grazed pastures horses were better able to maintain their weight. The study can conclude that rotationally grazing horses might be a good option for horses that require a weight control diet. This study is one of few replicated experiments that compares rotational and continuous grazing for horses on both	

		pasture and horse condition and production costs. The results here support the recommendation of rotational grazing for horse health and production costs, environmental and ecological purposes.	
14.	**Sustainable Practices, Economic Contributions, Consumer Behavior, and Labor Management in the U.S. Environmental Horticulture Industry**	The U.S. floricultural and nursery industry is the second most important sector in U.S. agriculture in terms of economic output. It is the number one agricultural commodity in five northeastern U.S. states. 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 addresses way producers can hone their marketing and management skills to continue to survive and respond to current trends. This year, the group developed *Annie's Project*: Farming in New Jersey's Cities and the Urban Fringe to provide more in-depth production and business management skills specifically geared to urban farmers and the unique challenges they face. These include soil quality issues such as lead contamination, off-farm employment requiring time management skills, irrigation water quality and availability, direct marketing in food deserts, food safety, working with WIC and SNAP-Ed clients, overcoming language and cultural barriers, and acquiring short-term leased land. Target audiences for Urban Annie's Project are women producers, beginning farmers, and military veterans. This six-week, one evening class per week program is being offered in three urban locations. A former program organized by Rutgers Cooperative Extension of Essex County that trained unemployed NJ military veterans for jobs in urban agriculture found that 25% of the military veterans were women, who expressed interest in additional training in urban farm business management. Participants gain a better understanding of communications and marketing strategies, business planning and finances, and the beneficial impacts on their families and future business goals.	4. Agricultural Viability

		Annie's Project gives New Jersey women farmers the tools to help them succeed by focusing on five areas of farm risk – marketing and pricing, production risk, financial management, human and personal risk, and legal risk. The course covered a wide range of topics including personal finance and business management practices, developing marketing plans, farm transfer and estate planning, using social media, advertising and media outreach, production record keeping and food safety issues. Participants learn about becoming better risk takers and risk managers in the production, marketing, financial, legal and human resource areas of farming.	
15.	**Supporting Wine Grape Industry of New Jersey**	The Wine Grape industry has been one of the fastest growing agricultural sectors in New Jersey over the past decade. Given the popularity of wine, agro-tourism, and supporting local agriculture, it is not surprising that many vineyard owners are first generation growers transitioning into agriculture with limited experience. These novice growers require unique educational support to assist them in avoiding costly mistakes with this perennial crop. Training this cohort of growers has become a significant focus for RCE faculty. New Jersey is uniquely suited to produce high-quality wine grapes. Its varied climates create an opportunity for producing a rich and varied suite of wines. However, major biotic and abiotic stresses such as (1) harsh winters leading to cold injuries and subsequent scourge of crown gall disease; (2) high humidity causing high disease pressure and excess precipitation causing excess canopy, and (3) viral diseases, caused by infected planting material sourced from the non-certified nurseries, affects the long-term sustainability of the wine industry. These threats resulted in developing and implementing a Best Management Practices (BMP) program. Pricing for wine is greatly determined by its quality which, apart from fruit quality, is determined by the process of wine making itself. Quality Wine Analysis (QWA) of New Jersey wines strongly implied that there is a huge need for improvement in the operation of wineries across the state. Four beginners were consulted in site assessment using Rutgers interactive site assessment tool, of these, three vineyards had the conditional agreement where decision was made after the site suitability was confirmed. The participating vineyards received information related to vineyard establishment and	4. Ag Viability

		consultation (on-site, one-on-one and follow-up visits), saving an estimated $4,000 in private consulting charges. Growers were educated on the primary cause of virus infection and the importance of cutting-edge technology based planting material. Average saving was in the range of $4200-$4800 per acre, which is the cost of replanting an acre of virus infected block. Also, two major nurseries reported substantial increase in demand for 2010-protocol based scions and root-stocks from NJ growers compared to five years ago. A factsheet on this topic is widely used by NJ growers, other institutions, and industry for identifying and management of these stressed Red Leaves in the Vineyard. Survey results indicated that 100% of growers agreed that seasonal twilights and winter meetings are a major source of information for scouting based pest management. 80% of growers changed their disease management practices after attending twilight meetings; 90% of growers indicated that twilight helped them develop better disease management programs; 95% of growers indicated the Twilight meetings helped with identifying the pest and insect damage symptoms at the early stage of development, and 95% of growers indicated that twilight meetings provided adequate pesticide re-certification credits. According to the survey more than 22 beginners avoided planting cold tender varieties. Considering the cost of replanting a vineyard after the cold damage, many growers saved $4200-$4800 in replanting after the cold damage. Also, estate wineries savings resulted in $43,000 - $72,000d bottled wines sales.	
16.	**Strawberry Breeding and Development Program**	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 an average of 15,000 pounds of strawberries per acre. The primary goals for the NJAES breeding program are to produce better tasting strawberries that are disease resistant and better adapted to the challenges of	4. Ag Viability

		Northeast growing conditions. Utilizing traditional plant breeding the Rutgers NJAES strawberry team has developed new strawberry varieties which have provided new selections to help farmers enhance local production and marketing. The new strawberry selections were tested at two NJAES Rutgers University research stations in addition to several other University sites and on four farms throughout the state using both organic and conventional production systems. Rutgers NJAES developed partnerships with two commercial strawberry nurseries to produce new NJAES varieties for distribution to farmers throughout the state and nation. Farmers and industry professionals were educated on this research and local strawberry production techniques through state and regional presentations, on-farm meetings and Extension conferences. Consumers were informed about the project through Extension training sessions, newspaper and journal articles and television segments. The University field research and on-farms trials resulted in one plant patent and an additional application in process. One of the selections was released for commercial production and named Rutgers ScarletTM. In 2019, two licensed nurseries sold over 250,650 Rutgers Scarlet™ strawberry plants to over 340 growers from 42 states and three Canadian provinces for an estimated projected average wholesale production value of over $700,000 for 2019. Three hundred and forty farmers were able to learn about the NJAES selections firsthand at educational meetings. An additional 30,000 farmers were made aware of the strawberry selections and their potential through the Nourse catalog, grower newsletters, and other media outlets. Consumer awareness about local strawberry production as well as the NJAES strawberry breeding and release project and new NJAES selections was accomplished through educational tours, TV and radio segments, newspaper articles, educational videos, taste panels and web based press releases that went out to over 200,000 people. This interaction helped create a stronger research and Extension network to help advance regional strawberry production and variety development and release.	
17.	**Piloting a Path to Successful Community Gardens**	Food insecurity is an issue that can confront families when events such as job loss, low wages, health problems, medical bills or even the lack of affordable housing stretch household budgets so that food purchases may become challenges. According to 2018 US Census Data, 9% of the children and 10% of seniors in Union County are living at poverty level, yet families living above	5. Home, Garden and Environment

		poverty level still struggle with managing household finances. Supplementing local food pantries with fresh produce grown at community gardens provides residents with fruits and vegetables and allows food pantries to use funding for other perishable goods such as meat and dairy products. Rutgers Cooperative Extension in Union County meets this challenge on two fronts: training and supporting volunteer Master Gardeners who grow vegetables and small fruits for local food pantries and providing educational programs for community garden groups. The Union County Board of Chosen Freeholders has a community and school garden grant program in which schools and organizations receive start up community gardens of raised beds and vegetable transplants. RCE Agents/Educators lectured at the county's "Come Grow with Us" Community Garden Conference for 150 county grant recipients program. Participants learned about soil testing, improving soil fertility and proper composting techniques in community garden settings. RCE Agents/Educators worked with the faculty at a local school, providing an in-service workshop for teachers on vegetable gardening, planting supervision and a school assembly on vegetable garden care. Teachers and students maintained the gardens over the summer months. Rutgers Master Gardeners assisted with eight community gardens though-out the county ranging in size from two beds to twelve beds. The Master Gardeners have taken leadership roles in establishing and maintaining the gardens, many at food pantry locations and senior citizen centers. They work with fellow gardeners to supply fresh produce to their clientele. The Master Gardeners' flagship garden is a 24 raised bed vegetable garden and annex, small fruit production area and herb garden located at Trailside in the Watchung Reservation. RCE faculty and staff hosted an evening community gardening series at the Demonstration Garden at Trailside during the growing season. An average of 20 residents attended each session. Each program began with a tour of the Sharing Vegetable Garden emphasizing the lecture topic: composting; pest and disease management; and harvesting and food safety. The Rutgers Master Gardeners have provided 14 Community Food Pantries with fresh produce over the years. Their clients appreciate the opportunity to prepare meals for their families with fresh produce. Students from a local school harvested their own tomatoes, carrots, peppers, eggplants and cucumbers from	

		their gardens. A teacher wrote "Our garden was a success because of you and your commitment. Thank you soooo much for all that you did." The community gardens maintained by Master Gardeners yielded almost 2000 pounds of produce donated within the local communities. The "Sharing Garden" located in the demonstration garden at Trailside, in which Master Gardeners have been growing vegetables, small fruits and herbs for local food pantries, since 2002, surpasses 16 tons (32,743 pounds) of donated produce with a retail value of $57,866. In the 2019 growing season, the garden yielded 1,765 pounds of fresh produce for families in need of assistance. The "Sharing Garden" provided families with $3,446.68 worth of fresh herbs, vegetable and berries to enjoy.	
18.	**Agrochemical Impacts on Human and Environmental Health: Mechanisms and Mitigation**	Heavy metals affect the health and well-being at all nodes on the food chain (including humans); this is especially true for vulnerable, environmental justice communities in New Jersey. To manage the risk to humans and biota from agricultural and natural chemicals, it is essential to measure levels, and to relate them to known adverse effects in humans and biota, and to human health standards. Researchers continue to investigate how the behavior of people affects exposure to agro-and other anthropogenic chemicals, whether exposure levels in biota and humans are in the toxic effects levels, what mitigations measures may be implemented for biota, and whether behavior of humans can be influenced to reduce exposure to toxic chemicals. The appropriate audiences include growers, aquaculturalists, fruit, vegetable and grain farmers, conservationists, fisherman, ornithologists, New Jersey state agencies and other scientists. The group has collected biota and other environmental samples to analyze them for heavy metals and other contaminants, assess the potential risks to humans and eco-receptors, and examine human concerns and perceptions of environmental hazards. Thailand continues to be used as a model system for examining pesticide exposure and associated human behavior because there are much higher levels of exposure. The information gained can be applied to farmers world-wide. The estuaries and bays in New Jersey are a model system for examining exposure to legacy agricultural chemicals, chemicals from other human activities, and chemicals from natural bedrock and ecosystems. The NJ bays have thriving aquaculture, industries and shipping, and are bounded by	5. Home, Garden and Environment

		human communities that are vulnerable to several weather events and extreme flooding. The latter also places additional stresses on the fate and transport of chemicals within these systems. Consumption levels were determined by interviews with fisher people, allowing for the determination of site-specific advisories. Working with fisherman and organizations, a database was developed of information necessary to adequately inform the public about their risks. One of the issues is whether when people buy fish the species is correctly labelled; otherwise they cannot determine if it might have high mercury or other contaminant levels. In one study of fish from supermarkets researchers found that many were mislabeled. This leads to concern, especially when there are major differences in metals levels by fish species. Another concern is the consumption of bird eggs, some of which have higher than allowable mercury levels. This illustrates the importance of examining the consumption patterns of some low-income people. Data from the project in Thailand has indicated that farmers, especially those that also fish, are exposed to higher levels of pesticides than are healthy, and that children are especially at risk. The increased risk of children is due to their accompaniment with parents when they work in the field, manage supplies of pesticides, and handled the pesticides during application. Data from the project in New Jersey indicates that levels of chemicals in fish in NJ and elsewhere have generally decreased, but recent events may result in increased levels of legacy and current chemicals, resulting in high exposures.	
19.	**Increasing Climate Resiliency through Ecological Restoration of Floodplains**	Dense urbanization has significantly modified New Jersey's natural landscape, reducing the ecological and economic benefits it provides. Low-lying developed areas in close proximity to surface waters are particularly affected. During storms, these locations receive elevated stormwater inputs from upland areas and storm surge from overflowing riverbanks and marsh fringes. The resulting flooding severely jeopardizes health and human safety, compromises the integrity of development and infrastructure, and furthers environmental degradation through sediment and chemical pollutant deposition into adjacent ecosystems. Improving resiliency in urbanized coastal areas requires an integrated approach of shoreline retreat, ecological restoration, and green infrastructure construction,	5.Home, Garden and Environment

		coupled with community education and acceptance of resilience strategies through tangible socioeconomic outcomes. Rutgers Cooperative Extension has partnered with multiple towns to better understand opportunities for maximizing community resilience in these areas through ecologically centered land stewardship. NJAES faculty have completed 5 open space and floodplain restoration plans, which included recommendations for ecological restoration, stormwater management and flood storage, landscape buffer establishment, and increased public access. Through a series of demonstration projects, the partners (which also includes the United States Fish and Wildlife Service – New Jersey Field Office) have initiated a phased implementation strategy for one Township. The work has resulted thus far in the removal of ~1.5 ac of paved road, installation of ~3 ac of native warm season meadow, 1 acre of wetland, management of invasive vegetation across ~20 acres, and the planting of ~1250 native trees and shrubs. The partners are in the planning stages of developing engineering plans to integrate ecological restoration and green infrastructure to increase landscape resilience to flooding in these areas and are preparing a guidance document for undergoing this landscape adaptation work throughout the state. The project includes green infrastructure practices that manage stormwater runoff from approximately 10% of impervious surfaces in these areas (or 200 acres). Road/sidewalk removal will also reduce impervious cover and promote stormwater infiltration. On an annual basis, these green infrastructure practices will capture over 240 million gallons of stormwater. The floodplain restoration activities are expected to increase storage volume within the floodplain by ~525,000 gallons. Together, the green infrastructure and floodplain restoration interventions will help reduce localized flooding and improve water quality. Green infrastructure practices are very effective at reducing sediment and nutrient loads. These practices are estimated to reduce the annual pollutant loads to the relevant surface waters by 36,000 pounds of sediment, 1,320 pounds of nitrogen, and 250 pounds of phosphorus. These systems are also very effective at reducing pathogen loads to the waterway, as well as other pollutants such as heavy metals. In addition to the green infrastructure practices, the floodplain restoration will help filter pollutants from the rising river and the overland flow from adjacent lands. The post-restoration monitoring plan will include strategies for evaluating the success of designed interventions in improving overall water quality. The floodplains in these areas are a matrix of moderately to highly	

		disturbed habitats characteristic of the central New Jersey urban landscape. Dominant ecotypes within the unmanaged portions of the floodplain include saline and Phragmites dominated marshlands, deciduous woodland, and scrub/shrub habitat. There are also substantial areas of mowed turf and edge habitat. Taken together, this landscape has limited value for wildlife. This work lays the foundation for increased plant and wildlife biodiversity by identifying areas of invasive species, replacing mowed turf with native vegetation, reducing edge habitats through additional plantings, and diversifying the ecotypes within the project area. The ecological monitoring will provide a baseline dataset of both existing vegetation conditions, as well as avian, amphibian, reptile, and benthic taxa diversity. The engineering and design plans is expected to increase community resilience in four areas: 1) human health and safety; 2) property and infrastructure protection; 3) economic resilience; and 4) community competence and empowerment. The baseline socioeconomic monitoring informs the development of specific resiliency goals (e.g., # of homes/businesses with reduced flood risk) for which our plans are designed to achieve.	
20.	**Biology, Ecology & Management of Emerging Disease Vectors**	Mosquitoes vector harmful viral diseases where no vaccines are available, leaving mosquito control as the default strategy to prevent or reduce mosquito-borne diseases. And there is little question that nuisance biting significantly reduces the duration and enjoyment of outdoor recreational activities for virtually every U.S. taxpayer. Federal and state guidelines for mosquito control are focused on insecticide use. Yet we are increasingly challenged to diminish pesticide use and do more with less. This is of particular importance for *Aedes albopictus* which exploits small, scattered, laborious to locate artificial containers as larval habitats that are often inaccessible to conventional insecticidal sprays. This laboratory's research program has been focused on developing a new toolbox for mosquito control and surveillance focused in large part on precision delivery of insecticides. The target audience for this research includes local mosquito control units, private pest control operators that include mosquito control among their services, private companies that provide mosquito control technologies, mosquito researchers in govt. and academic positions and county health officers. Due to regulatory constraints and the minor economic market that mosquito control represents, few new active ingredients for mosquito insecticides are	5. Home, Garden and Environment

		being developed. Researchers have demonstrated multiple new approaches to repurpose pyriproxyfen, a powerful insect growth regulator used in agriculture but with low mammalian toxicity, for mosquito control in area wide vehicle mounted (either ground or airborne), drone, or autodissemination applications. Combining area-wide applications of the larvicides VectoBac WDG (Bacillus thuringiensis var. israelensis) and NyGuard IGR® (pyriproxyfen) with the adulticide DuetTM (sumithrin and prallethrin) achieves extended suppression of Ae. albopictus populations. In addition, they showed that barrier applications, treating vegetation and other potential mosquito resting areas, can reduce Ae. albopictus populations for an extended duration. Unmanned aircraft (i.e., UAS or drones) offer tremendous potential to mosquito control programs. Compared to their full scale fixed-wing or helicopter counterparts, they are less expensive to operate, pose less risk, and can navigate in congested environments. This group has developed and submitted multiple patents for electric multi-rotor drones to perform adult and larval mosquito control activities including aerial surveillance, pesticide application, and sample collection. Missions are preprogrammed on a tablet or smart phone and executed completely autonomously without any input from the user. Onboard sensors and a global positioning system allow for very precise delivery of pesticides. While current UAS models cannot compare to full scale aircraft in terms of payload capacity or flight time, in many environments or for mosquito programs with limited resources, they provide a viable alternative. They have completed construction and testing of a radical new larval collector for mosquito surveillance. The design capitalizes on the ease of use and reliability of an aerial drone to remotely conduct larval surveillance in otherwise inaccessible areas. Also, researchers have completed construction and testing of a new ultra-low volume (ULV) sprayer for adult mosquito control as a module which attaches to drones.	
21.	**Reducing Pest Infestations and Pesticide Use in the Urban Environment**	The urban environment is surrounded by multiple pests that are both economically and medically important. Among them, German cockroach, bed bugs, house mouse, termites, and ants are the most common and important urban pests. To reduce their economic damage, nuisance, or health risks caused	6.Integrated Pest Management

		by these pests, effective methods and materials need to be developed and used. The public also need to be aware of the importance of urban pests and methods to prevent and control them. The audience affected by this research includes low-income residents living in multi-unit dwellings, housing managers and staff, pest control staff. Insecticide use in homes leads to human exposure to insecticide residues that persist in the environment. Integrated pest management (IPM) programs have been known to be more environmentally friendly for managing German cockroach infestations, but their effect on indoor insecticide residue levels are not well understood. An IPM program consisting of applying cockroach gel baits and placing insect sticky traps as the primary treatment methods were implemented. During this period, NJAES researchers studied the spatial distribution patterns of German cockroaches in a high-rise apartment building. They found that they are spatially related to each other. If an apartment is infested, its neighbors sharing common walls, ceilings, or across the hallway are more likely infested. A collaborative study group found that after implementing a cockroach IPM program in a low-income community, insecticide residue in the kitchen floor wipe samples decreased by 90% after 7 months. Among the 49 cockroach-infested apartments that were sampled twice for insecticide residues, at 12 months, only one apartment still had cockroaches (total trap count of 4 cockroaches), indicating the IPM program, utilizing baits, was highly successful in eliminating most of the German cockroach infestations. Seven apartments no longer had detectable insecticide residues. An IPM program, including the use baits rather than insecticide sprays or total release foggers, is not only highly effective in eliminating German cockroach infestations but can also significantly reduce the number of insecticide residues in apartments	
22.	**Upland Fruit (Tree Fruit and Grape) Integrated Pest Management (IPM) Delivery**	According to the latest agricultural statistics, NJ peach production is valued at just under $30 million and apples at $28.5 million. The industry in southern counties is heavily oriented towards wholesale markets and peach production, while the industry in northern counties is heavily dependent on direct markets and apple production. Retail market fruit production in northern counties is valued at	6. Integrated Pest Management

		approx. $15-18 million. New Jersey fruit growers produce commodities that are susceptible to more than two dozen arthropod and disease pests. Management of this pest complex can cost producers up to $500 or more per acre. Some large NJ growers may spend up to $350,000 for pesticides alone. Fertilizers also represent a major cost impact. Growers can experience depressed prices from foreign and west coast competition, often leading to deficits in the farming operation. Production costs are high due to labor, fertilizer and energy costs, and pesticide costs. Pest management costs have increased due to label restrictions on old products and the introduction of newer more expensive pesticides. The Food Quality Protection Act has led to restrictions and changes in the types of pesticides that may be used to produce many fruits. Many of the new pesticides are narrow spectrum, that control only one or a few pests and must be used with degree day phenology models and other integrated pest management (IPM) practices. While customers continue to demand high quality clean fruit, they are also aware of pesticide use, and want an assurance of safe food with little to no pesticide residues. An IPM delivery program has been delivered to commercial growers, statewide. The New Jersey wine grape industry has doubled since 2002, with at least 50 wineries and over 100 vineyards. NJ is 5th in the U.S. in wine production, producing 1.7 million gal. of wine, valued between $36-$40 million. Since there has been no IPM programming for grapes, and little baseline data, many grape growers tend to either overuse pesticides or not adequately control pests. Therefore, a pilot IPM program was started in 2010 to focus on pest surveys and grape berry moth timing. New invasive species such as the brown marmorated stink bug and the spotted wing drosophila will demand changes in pest management practices and educational and research needs on a regional basis. An integrated crop management (ICM) program was also delivered to commercial fruit growers who produced apples, peaches, and nectarines. The program reached both primary and secondary participants. Secondary participants attend extension update meetings, and receive other IPM/ICM information through personal visits, fax broadcasts, articles, newsletters and the Internet. Primary participants are those growers who access all the above information and participate in a field scouting program. While some primary participants do self-scouting, the majority contribute funding through acreage participation fees	

		which fund seasonal field scouts, travel, supplies, and laboratory costs. Weekly field scouting forms the program core and data source for newsletter articles, and from which pest management recommendations were made, with nutrition and nematode management included at specific times of the season. A broadcast fax service was used in two counties to advise of timely pest events and supplement the Plant and Pest Advisory Fruit Edition Newsletter. Organized grower meeting contact reached a total of 1,230 audience members, while on-farm consultations totaled 2,287 visits. The Plant and Pest Advisory Newsletter was changed to a blog format on the Web. A total of 26 weekly articles were written in that format, with a total circulation of 2067 subscribers in NJ and other states. Acreage impacted by primary participants totaled 80% of all state tree fruit acreage. Over 95% of total state tree fruit acreage was impacted by the program. IPM information reached over 90% of NJ grape growers. Growers and industry personnel were trained throughout the season and at several annual winter meetings. Primary participants included 24 tree fruit growers in northern counties and 15 growers in southern counties. Growers return every year to the program. During 2019 primary participants in northern counties contributed just over $22,000 for programming on 445 acres. Growers in southern counties supported the program with over $35,000 on farms which managed over 3,500 acres of tree fruit. The program demonstrated reduced risk methods that included the use of mating disruption and ground cover management as tools to replace insecticide use for Oriental fruit moth, tarnished plant bug and stink bugs and two species of peach tree borers. Degree-day pest phenology models were updated, and proper use was advised to growers. Demonstrations were conducted on commercial farms to encourage use of alternative practices. Alternative practices include use of mating disruption and reduced risk pesticides. In southern counties, where the bulk of commercial peaches are produced, 75% of growers used alternative, 'reduced risk' insecticides, and 80% of growers used reduced risk fungicides. In total, program participants reduced pesticide use by 26-80% compared to standard spray schedules, depending on the practices used. Other IPM practices included grower use of degree day based pest models, reducing insecticide use by 40% compared to standard calendar spray methods. Laboratory tests where completed in 2019 as part of the fertility component. Over 75% of areas sampled	

		were shown to have sufficient to excessive phosphorous levels, which led to decreased phosphorous use on those sites. The invasive insect, brown marmorated stink bug (BMSB) has set pest management programs back 30-40 years. A grant funded research and demonstration project showed that growers could treat field edges while using mating disruption and ground cover management to reduce insecticide use by up to 75% compared to most commercial practices now being used for BMSB.	
23.	**The Working Group on Improving Microbial Control of Arthropod Pests**	Turfgrass areas cover about 20 million ha in the USA and the size of the turfgrass industry is estimated at $40 billion per year. Many different types of insect pests can cause damage to different turfgrass areas including white grubs, mole crickets, lepidopteran larvae (cutworms, armyworms, sod webworms), weevils (billbugs, annual bluegrass weevil), crane flies, and many others. As the result of high standards and expectations, application of synthetic insecticides has been the primary method used to control insect pest in turfgrass. However, concerns about health risks and environmental hazards have restricted and will continue to restrict the use and availability of these pesticides. Products based on microbial control agents (bacteria, fungi, viruses, nematodes) offer safer alternatives. Research is being conducted to improve the efficacy, ease of use, and reliability of many already existing microbial control agents, to find new and more effective species and strains, and to integrate these agents better into turfgrass management systems. The project will produce substantial benefits for both producer and consumer stakeholder groups. Stakeholders include farmers (specifically blueberry and cranberry) and turf and landscape professional, biocontrol producers, the scientific community and the general public. A field experiment targeting the externally feeding mid-size larvae of the annual bluegrass weevil (ABW), was conducted in spring of 2019 at four golf courses. At each site, the experiment was placed in an area with a history of ABW problems arranged along the edge of fairways. Entomopathogenic fungi such as M. brunneum are used for biological control of insect pests. and has potential to control ABW but by the experiments conducted in 2019, effectiveness was best when these are combined with high concentrations of the insecticide imidacloprid. It should be noted that imidacloprid applied in these combination treatments in spring would also control white grubs for the full season.	6.Integrated Pest Management

		The effect of all fungal treatments was likely somewhat limited by the relatively low temperatures during the experiments that were conducted in spring. Higher efficacy may be achieved when targeting ABW larvae in summer. However, the need for frequent fungicide applications on golf course turf during summer to suppress fungal turf diseases would make coordination of M. brunneum treatments with fungicides treatments to avoid negative interactions challenging	
24.	**Barnegat Bay Shellfish Restoration Program**	The Barnegat Bay ecosystem remains a very stressed system due to a combination of human activities and environmental changes. Shellfish provide many ecosystem services, such as improving water quality by filtering the water, serving as habitat and prey for other species, mitigating erosion by stabilizing shorelines, and helping to restore wild populations through reproduction. Therefore, restoring wild shellfish populations and commercial shellfish aquaculture farming provide many benefits which can improve the health of coastal marine ecosystems. Extension education programming through the Barnegat Bay Shellfish Restoration Program (BBSRP) is required to educate clientele on the status of our coastal marine ecosystems, the important role of shellfish within these ecosystems, and how they can change their behaviors to help improve the health of coastal marine ecosystems. The goal of the Barnegat Bay Shellfish Restoration Program (BBSRP) is to restore depleted shellfish populations and improve the health of the Barnegat Bay ecosystem through educational programming and applied research which use shellfish biology, restoration, and aquaculture as the primary teaching tools. As a part of the BBSRP, the Shellfish Gardener course educates stakeholders about the ecology of Barnegat Bay and recommended practices for being responsible stewards of marine resource while focusing on shellfish. Additionally, ongoing collaborations with ReClam the Bay involve volunteers and BBSRP students in community-based shellfish restoration efforts where shellfish are raised at land-based nurseries (i.e., upwellers) and then planted in the wild to help restore wild populations. Participants of the Shellfish Gardener course reported a significant increase in knowledge gained with respect to topics related to estuarine ecology and shellfish restoration based on their average knowledge before (4.0 out of 10) versus after (8.2 out of 10) the course. Shellfish Gardener students committed	7. Aquaculture

		945 hours of volunteer time towards restoration and education efforts involving shellfish and improving the health of the Barnegat Bay ecosystem, which has an estimated value of $27,235. As a part of collaborations between BBSRP and ReClam the Bay, there were 400,00 hard clam seed grown in support of shellfish restoration and education efforts to improve the health of the Barnegat Bay ecosystem. The primary clientele served by the BBSRP are members of the general public and prospective commercial shellfish farmers. The Shellfish Gardener course had 38 students enrolled and the average course evaluation response (n=21 respondents) rated both the overall program quality and organization as 4.6 out 5.0. The average response was 4.8 out of 5.0 when asked if they were pleased that they participated in the program.	
25.	**Sustainable and scalable production of food and feed using the aquatic crop plants of the Lemnaceae family.**	Agriculture in the 21st Century is facing the challenge of producing sufficient food and bioproducts to provide for more than an estimated 9.6 billion people by 2050. In order to meet this demand, it has been projected that an increase of current crop productivity by about 30% would be needed. At the same time, strategies and technologies to improve crop resilience to more extreme weather conditions resulting from Climate Change and to increase environmental sustainability through reduction in use of Ag chemicals are urgently needed. Plants of the Lemnaceae family, commonly called duckweeds, are aquatic plants found worldwide. These macrophytes are known to be the fastest growing plants in the world and through their rapid growth, can effectively remediate polluted water by assimilation of nitrogen and phosphate into biomass. The audience reached during this period is the scientific community related to duckweed and microbiome research. To meet the challenge posed by population increase and environmental degradation due to application of large quantities of agricultural chemicals, this project seeks to create a scalable platform for biomass production using the aquatic plant duckweed. The growth characteristics of this small, floating plant are ideal for vertical farming strategies through modular designs that can tailor productivity per unit area according to need. Systematic standardization of the operating parameters for this prototype will enable its rapid deployment in various application pipelines. This project's success can unleash this potentially	7. Aquaculture

		game-changing technology platform for sustainable and continuous biomass production that can create a new sector of crop products, especially in the area of aquaculture. Some key advantages of this approach is that it will not compete with existing crops for arable land while minimizing environmental costs. The laboratory at Rutgers University has helped to nucleate a nascent international community of duckweed researchers as well as established a comprehensive germplasm collection, genomic tools and biochemical approaches for the duckweed platform. NJAES researchers are now poised to begin systematic deployment of duckweed as a novel scalable biomass production platform that will complement traditional crops as a sustainable source of nutrition for food and feed. Rapid growth and easily digestible walls that are naturally low in lignin make the aquatic plant family Lemnaceae, or duckweed, a promising feedstock for biofuel production. Researchers are carrying out systematic studies on the interaction between duckweed and microbes, specifically the bacterial microbiome, by combining both culture-independent and culture-dependent approaches. They have now characterized the bacterial microbiome of duckweed from various wild-populations as well as reassembled through inoculation of gnotobiotically grown plants with wastewater. A conserved "core" community structure has been uncovered and they are working toward the creation of synthetic communities of defined combinations of bacteria strains to help dissect the functions and roles of these bacteria	
26.	**Understanding the ecology of shellfish and their pathogens to improve shellfish management and production**	Risks associated with disease spread from fish and shellfish farming have plagued the growth and public perception of aquaculture worldwide. However, by processing nutrients and organic material from the water column, the culture of many suspension-feeding bivalves has been proposed as novel solution toward mitigating problems facing coastal water quality, including the removal of disease-causing parasites. This Hatch project targets shellfish researchers, producers (farmers) and harvesters (fishermen) as well as the regulatory agencies and the non-profit shellfish restoration community involved with and interested in shellfish resources in coastal and marine habitats. In many rural areas, shellfish producers and harvesters are members of economically depressed communities that are often educationally disadvantaged as a result. During this reporting period, the project targeted the Delaware Bay oyster fishery and aquaculture communities,	7. Aquaculture

		the federal and state regulatory agencies overseeing shellfish production and resources in New Jersey, the bird conservation community over the potential impact between oyster aquaculture and protection of the federally threated red knot, and the East Coast shellfish aqua culturists and regulators working on shellfish importation issues. A specific target has been the community of shellfish hatcheries and regulatory agencies overseeing their activities. An additional target audience has been the regulators and practitioners of Living Shorelines. Maintaining the long-term monitoring of oyster disease in Delaware Bay continues to provide key information and advice to sustainably manage the Delaware Bay oyster fishery as one of the only sustainable oyster fisheries in the US and an example for all oyster fisheries. Oysters can be sustainably harvested while maintaining the population and consequent ecosystem services provided by the oysters. Work on human pathogens has been completed and is being prepared for publication. Interest in adding human pathogens to our developing shellfish health database is growing and may be explored in the future once the database is completed, tested and fully operational. As part of the Hatchery Certification program and Shellfish Health Database the NJAES group is working with USDA APHIS, NOAA Aquaculture and state agencies to improve surveillance reporting and access to surveillance data. This work is identifying data gaps in the understanding of shellfish pathogen distributions and highlighting areas in need of additional surveillance. They continue working collaboratively with the Partnership for the Delaware Estuary on their living shoreline initiatives and have begun participating in a coast-wide evaluation of living shoreline efforts stimulated by interest from Australian researchers The researchers have continued to monitor, evaluate and recommend shell planting strategies to the New Jersey DEP and the Delaware Bay Shellfisheries Councils	
27.	**Survival strategies of foodborne pathogens and commodity contamination in production fields and retail outlets**.	Poultry consumption continues to increase globally. In 2018, the global consumption of poultry was estimated to be around 93 million tons, with an expected 2% increase in the poultry production in 2019. Although poultry is seldom consumed raw, it carries a high safety risk as it provides optimum conditions for bacterial growth: high water activity, near neutral pH, and abundant nutrients. These conditions increase the survival and growth of bacteria, perhaps exacerbating cross-contamination. From 1998 to 2008, foodborne outbreaks associated with poultry resulted in the greatest number of deaths (19%), which were two times higher than for leafy vegetables (Painter et	8.Food Safety

		al., 2013). It was reported that Listeria monocytogenes and Salmonella spp. were the main contributors, accounting for 63% and 26% of poultry-associated deaths. A new research area has emerged in the area of photosensitizers that have potential application on fruits and vegetables and poultry. This opens the target audience beyond the retail level and into commercial processing. Although poultry is seldom consumed raw, it carries a high safety risk as it provides optimum conditions for bacterial growth: high water activity, near neutral pH, and abundant nutrients. These conditions increase the survival and growth of bacteria, perhaps exacerbating cross-contamination. Chlorine and acids are the two most common chemical interventions to decontaminate the surfaces of poultry carcasses. However, high concentrations of chlorine and acids may result in off-flavor, discoloration, equipment corrosion, and other problems. The EU has prohibited the import of poultry products that are treated with chlorine, trisodium phosphate, and peracetic acid; leading to an estimated loss of $200 - $300 million annually. The concept of natural antimicrobials has become more and more popular; and served as a driver of the present study to search for natural antimicrobials that can replace or augment conventional chemical interventions. Photoinactivation using photosensitizers has been widely studied in clinical medicine as a potential treatment of bacterial infections such as skin diseases and cavities. Curcumin, which can be extracted naturally from *Curcuma longa* plants, is one of the most well-studied photosensitizers. A recent collaborative study demonstrated that this water-soluble photosensitizer curcumin (PSC) inactivated *L. monocytogenes* and *Salmonella* in liquid media and on chicken skin. Under the experimental conditions in this study, incubation time and light dose did not influence the antimicrobial activity of PSC, suggesting that photoinactivation can be achieved in a short time	
28.	**Controlled Release Packaging to Improve Food Safety and Quality of Fresh Produce**	The objective of this project is to develop an effective technology to improve food safety and quality of fresh produce during distribution and storage. This technology, known as controlled release packaging, involves incorporating food grade, natural active compounds, such as antimicrobials and antioxidant from plants, into the package such that these active compounds can be released from the package in a controlled manner to inhibit microbial growth and improve the storage quality of fresh produce. This new technology can also be combined with	8.Food Safety

		existing technologies, such as modified atmosphere packaging, in a cost-effective manner to achieve good results not possible otherwise. Although the consumption of fresh produce has been increasing in recent years due to its health benefits, the major concerns with these products are microbial safety, short shelf life, and product loss. This new technology can provide significant value to the consumers by providing them with safe, high quality, and healthy fresh produce. It can also provide the growers, the distributors, and the retailers with significant economic benefits by enabling them to extend shelf life, reduce product loss, and sell their products at a higher price. The target audience is researchers, graduate students, and companies interested in food preservation technology. Thymol, also known as 2-isopropyl-5-methylphenol, is a natural monoterpenoid phenol and a major constituent of thyme oil. It is being chosen as a natural antimicrobial for the development of a controlled release packaging system to inhibit microbial growth and improve the storage quality of fresh produce. Over the past decades, thymol's antimicrobial activity has been studied against a wide range of microorganisms including Gram-positive and -negative bacteria, yeasts, and molds. In these studies, thymol was added to liquid- or solid-phase medium and brought into direct contact with target microorganisms. The results shed light on the potential of using thymol as a natural antimicrobial in foods, by directly adding it into the formulation, a delivery mode called "instant addition." However, a problem with instant addition of liquid- or solid-phase thymol is that it often requires high concentrations to be effective, due to continuous consumption by microorganisms and complex interaction with the food matrix. The strong odor from high concentration could potentially alter the organoleptic quality of the food, causing consumers to reject the food product. Based on research conducted by NJAES researches, it was hypothesized that the above problem could be overcome by using vapor-phase thymol and controlled release packaging to reduce the required thymol concentration for microbial inhibition to below the sensory threshold. To test this hypothesis, researchers begin by conducting experiments to compare the effectiveness of instant addition of thymol in vapor phase, liquid phase, and solid phase.	

29.	**On Farm For Safety**	The Center for Disease Control and Prevention estimates 48 million individuals get sick, 128,000 are hospitalized and 3,000 die from foodborne diseases each year in the United States. There have been several fresh fruits and vegetables implicated in outbreaks e.g. leafy greens, tomatoes, berries, herbs, etc. Romaine lettuce is especially a concern for New Jersey growers since there have been four outbreaks in the last two years in other parts of the United States. The fruit and vegetable industry are 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 (FSMA) which is being implemented. Fresh produce growers who average over $500,000 in produce sales started complying January 2018; growers between $250,000 and $500,000, January 2019. Growers with sales between $25,000 and $250,000 must start complying by January 2020. The value of utilized production in New Jersey is over $220,000,000, most of which is fresh market production. This requires growers to either obtain a third-party audit if they are wholesale growers or at least be inspected under the Food Safety Modernization Act provisions. The On-Farm Food Safety program trains the produce industry (wholesale/retail growers and distributors) in basic food safety, 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 or FSMA inspection. Also, the program trains first level buyers on food safety and how to prepare for third party audits, have growers and buyers who participate in a food safety training pass their third-party audits or inspection, train growers in the requirements of the Food Safety Modernization Act and how to prepare for it, determine research needs in the food safety area, design and carry out research that directly benefits the fruit and vegetable industry. The project was delivered through presentations at produce industry meetings across the state (30-60 minutes), monthly and weekly newsletter articles, Factsheet publications, on several websites (65,000 hits in this reporting period) where training materials are placed for self-training and new food safety information is reported, and a Facebook page. This Facebook page is used to inform followers of timely food safety information specific to the production of fresh produce. In addition, in-depth training sessions were held for growers and buyers, one-on-one critiques of food safety plans on individual farms (mock/second party audit), and educational displays at industry trade shows.	8. Food Safety

		Twenty-two (80 hours) training sessions were held during this reporting period for 848 individuals. The audience was diverse in the fact that some growers had not been involved in food safety in the past. Sessions were divided between beginner and advanced growers which allowed the team to better tailor the program to the group. As part of the Produce Safety Alliance training, required by the Food and Drug Administration for the Food Safety Modernization Act, 15 On-Farm Readiness Reviews were completed in collaboration with The New Jersey Department of Agriculture. These farm visits assist growers in assessing their farms' specific food safety risks. Focus is on Good Agricultural Practices, USDA Third Party Audit preparedness and compliance with the Food Safety Modernization Act (FSMA) Produce Rule. Farm visits typically last approximately three hours, with a farm walk through assessing risk reduction measures. The survey results of five Produce Safety Alliance Trainings in which growers indicated the following: 92%-100% (n=130) indicated that the level of FSMA PSR information provided was sufficient to guide them in implementing the regulatory requirements; Participants rated their level of confidence in assessing risks and implementing key produce safety practices in the following areas: 87%-100% Farm Wide Commitment to Food Safety (n=131); 92%-100% Worker Health and Hygiene Practices (n=131); 80%-100% Soil Amendment and Management (n=130); 92%-100% Wildlife and Domestic Animal and Land Use Management (n=130); 90%-100% Production Water management (n=130); 90%-100% Postharvest Water Management (n=129); 88%-100% Postharvest Handling and Sanitation (n=128); 86%-100% Developing a Traceability System (n=127); 89%-100% Writing a Farm Food Safety Plan (n=127). In total the group has provided training to 323 farms for a 62% total. The New Jersey Department of Agriculture carried out 100 inspections on these operations. Third Party Audits are important for wholesale growers. During this reporting period 160 farms passed a USDA audit. The On-Farm Food Safety educational display was maned at the New Jersey Agricultural Convention. This provides the team the opportunity to interact with growers and buyers on a one-on-one basis (800 attendees). As part of our national collaboration with the National Association of State Departments of Agriculture (NASDA) trainings were held in five states. RCE faculty held three webinars for the Food and Drug Administration, and two regional food safety centers (173 participants) and	

		reported at the National Food Safety Consortium on the national On-Farm Readiness Review Survey that the On-Farm Food Safety Team maintains for the NASDA project (300 participants).	