2019 Annual Report of Accomplishments and Results

DELAWARE
UNIVERSITY OF DELAWARE
DELAWARE STATE UNIVERSITY

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)

Executive Summary

Agriculture in Delaware remains strong today, with the Delmarva broiler industry the biggest agriculture commodity. The state has 490,000 acres of cropland (45% irrigated) that provide the grain crops needed for a thriving poultry industry, an innovative and profitable fruit, and vegetable production industry, and a "green industry" that supports horticultural and natural resource interests of its citizens. A 2010 report led by the University of Delaware College of Agriculture & Natural Resources ("The Impact of Agriculture on Delaware's Economy") found that the total economic contribution of all categories of agriculture in Delaware was $7.95 billion in industry output and that the agricultural industry contributed $2.5 billion in value-added activity, and $1.6 billion in labor income, supporting 30,000 jobs.

Our plan of work is created and reportedly jointly with University of Delaware and Delaware State University. Our intention is to provide research-based solutions to the complex, global challenges facing Delaware today. It is important to note that divisions between these programmatic efforts are artificial. Our research and extension efforts are most commonly conducted by multi-disciplinary teams working across programs, in collaboration with colleagues in other disciplines. We also regularly plan and work with stakeholders in other University departments, other governmental agencies, foundations, community groups, universities, and political or policy-making positions. Delaware is also uniquely situated geographically to share across states in the mid-Atlantic region and positions and programs are utilized across state lines.

Our work is defined in four broad critical issues with several subheadings within some categories to further define the issues. It has been designed to help Delaware agriculture remain competitive, to meet its environmental challenges, sustain the state's natural resources and support our rural and urban youth, families, and communities. We focus on the following Critical Issue areas:

1. Sustainable Production Systems for Agricultural and Urban Landscapes

Situation: We will be continually challenged to feed the world’s growing population. There are currently 7.6 billion people in the world and population is estimated to be over 10 billion by 2050. Further increases in agricultural output are essential while maintaining economic and environmental integrity. In a 2018 Needs Assessment Survey conducted by Delaware Cooperative Extension, respondents indicated that “supporting family farms and local food systems”, “balance of environmental regulations and agricultural production”, and “profitability of agriculture” were very important. Delaware Cooperative Extension is working with individuals, farms, and the agricultural industry to improve and increase economic and environmental integrity and food security.
Cooperative extension is using research and education to develop, disseminate, and promote management practices that maximize yield, maintain profitability, and utilize nutrients, water, and pesticides efficiently and effectively.

2. Nutrition and Wellness

Situation: Nutrition & Wellness According to the Delaware Healthcare Commission report of June 2017, health care costs and spending per capita in Delaware are higher than the national average. Historically, health care spending has outpaced inflation and the state's economic growth. Health care costs consume 25% (or approximately 1 billion in FY 2017) of Delaware's budget. Medicaid cost per capita and the growth in per capita spending have been above the national average. Healthcare resources in Delaware are burdened by preventable conditions related to behavioral health and poor nutrition and the resulting chronic diseases. From the Cooperative Extension Survey of 2018, 69% of women and 57% of men surveyed rated prevention of chronic disease as very important. Sixty- nine percent of respondents to the Extension needs assessment survey indicated that preventing substance abuse was an important issue and 67% of respondents felt access to substance abuse services were important community issues.

In Delaware, the poverty rate for individuals was 12 percent in 2015. According to the 2011-2015 American Community Survey, the poverty rates in New Castle, Kent and Sussex counties were 11.4, 13.5 and 12.6 percent respectively. Research has indicated that poverty is associated with poor nutrition and increased risk of many diseases. The CDC reports that DE youth Dietary Behaviors were 36.9% of adolescents reported consuming fruit less than one time daily. For physical activity, only 23.7% of adolescents were physically active at least 60 minutes per day on all 7 days in the past week as recommended.

Situation: Food Safety Foodborne illnesses are common and costly – yet preventable – public health issue. According to the Centers for Disease Control and Prevention, approximately one in six Americans (nearly 48 million people) get sick, 128,000 are hospitalized and 3,000 die of foodborne illnesses each year (CDC, 2017). Food safety education is essential for individuals preparing food in their own home, farm workers growing produce, employees in food service establishments and individuals preparing and serving food as volunteers. Laws are in place to address this. For example, the State of Delaware now requires every permitted food establishment to designate a person in charge to demonstrate safe food handling practices. There are over 3,500 permitted food establishments in Delaware that prepare and serve food to the public and education is needed for their employees. The FDA Food Safety Modernization Act (FSMA) went into effect on January 26, 2016. The Produce Safety rule which is part of that act establishes for the first-time science-based minimum standards for the safe growing, harvesting, packing, and holding of fruits and vegetables grown for human consumption. FSMA affects over 100 farm families in Delaware that grow fresh produce. Every year, dozens of recalls occur. In an effort to help individuals in the food service industry comply with licensing regulations through the Delaware Division of Public Health, Cooperative Extension provides training for Delawareans.

3. Personal and Economic Development

Situation: Leadership Development- Working with volunteers is an Extension tradition (Patton, 1990) as well as the primary method of delivering 4-H programs. Extension professionals engage volunteers by involving them in a variety of roles and delegating to them responsibility for projects, programs, events, and activities. (https://www.joe.org/joe/2007december/a3.php). In Delaware, Extension volunteer programs continue to grow and expand to support our Extension professionals and programs in 4-H Youth Development, Agriculture and Natural Resources, Lawn and Garden, and Family and Consumer Sciences.

In 2018 a Needs Assessment Survey was conducted by Delaware Cooperative Extension; 30% of the respondents self-identified as Extension volunteers. Leadership Development surfaced as a high-priority community needs. Survey respondents identified the following as important: 68% developing leaders within schools, organizations, and communities; 69% access to community-based programs for youth; 81% exposing youth to science, technology, engineering, and math topics; and, 85% training youth and adults to think critically and use problem-solving skills. With this in mind, Delaware Cooperative Extension needs to expand volunteer and leadership development programs and opportunities to create a learning leadership environment for volunteers and Extension professionals to encourage the pursuit and acceptance of leadership roles in our system and across the state to help all, especially youth, reach their full potential.

Situation: STEAM Education-Today and in the future, there is a tremendous need for young people to know how to be innovative, creative, out-of-the-box

thinkers able to use computational thinking and technology to address real-world solutions. This is true across every industry, from business to creative arts to agriculture. Estimates show that 65% of today's students entering grade school this year will be employed in jobs that don't exist yet, and 60% of new jobs created this century will require Science Technology Engineering Arts and Math skills in a variety of fields. However, the stark reality is that not enough of today's young people are being drawn to STEAM in school. As a result, young people are not being adequately prepared with the STEAM skills needed for the new and lucrative jobs of the future. This poses a major threat to the country's economic prosperity. Delaware Cooperative Extension's 4-H and youth development programs know a major part of the solution to this problem is to continue the tradition of exposing youth to STEAM topics at an early age through learning experiences that are hands-on, sequential, fun and relatable to the real world.

Situation: Economic Development-The economic and financial wellbeing of individuals, families, agribusiness, other small business enterprises, and our communities throughout Delaware are inter-related and are connected to the broader economic context of our state and national economy .Prior to COVID19, job growth has increased, unemployment rates are down and consumer confidence has increased. However, wages have not kept up with inflation, health care has become more expensive, overall consumer prices have increased and US employees aren't confident about reaching their long-term goals. Retirement plans continue to serve as a safety valve for more immediate needs. Medical debt is on the rise. Employees stress over uncertainty regarding healthcare and are pressed to support both aging parents and grown children. Delaware citizens are facing health, food insecurity, financial, housing and job-related issues.

Well-being of individuals and families, especially minorities are determined by their access to jobs, health care, educational opportunities, and training. Small business including agribusiness, rely on healthy, skilled and well- trained operators/employees to build, sustain and expand their revenue.

In an era when Delaware is losing its manufacturing base, the agriculture industry can be a sector targeted to expand economic growth. Delaware faces ongoing challenges in ensuring food security and developing innovative means to improve productivity and profitability in the sector. The sector needs to generate additional revenues and provide new avenues for employment. Delaware's economic health is dependent on agricultural vitality.

4. Environmental Stewardship in a Changing Climate

Situation: Many of Delaware's natural resources, including our waters and natural landscapes, are stressed by human activities and a changing climate. For example, more than 90% of the streams, ponds, and bays in Delaware are classified as impaired, primarily by excess nitrogen and phosphorus, and pollution limits have been established by government agencies. Additionally, climate change is stressing Delaware's agriculture and natural ecosystems with new pest pressures, more intense weather events and saltwater inundation from sea level rise. Climate change is also likely to complicate existing efforts to reduce nutrient pollution in the state.

In a 2018 Needs Assessment Survey conducted by Delaware Cooperative Extension, 93% of respondents indicated that "ensuring the availability of clean water" was "very important". This was the highest ranked issue among the state level issues that were considered in the survey. Delaware Cooperative Extension is working with individuals, farms and the horticulture industry to promote environmental stewardship in the state. Cooperative Extension is using research to develop management practices that will allow Delawareans to adapt to a changing climate and protect and conserve our natural resources. One major focus has been reducing nutrient pollution from lawns and agriculture through education, development of science-based nutrient management practices, and promoting compliance with state nutrient management regulations. Additionally, integrated pest management practices are being developed and promoted to reduce the impact of pesticides on the environment.

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	No Update
2. The Scientific Peer Review Process	No Update

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	No Update
2. Methods to identify individuals and groups and brief explanation.	No Update
3. Methods for collecting stakeholder input and brief explanation.	No Update
4. A Statement of how the input will be considered and brief explanation of what you learned from your stakeholders.	No Update

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.	**Green Roof Systems** **Issue**: Green roof systems are roofs that have incorporated plant material to reduce energy costs. Management options for plants grown in these locations are extremely limited; therefore root-feeding insects are often very difficult to control with insecticides. Cooperative Extension agents, Stanton Gill (University of Maryland) and Brian Kunkel (University of Delaware), have been working with nurseries and greenhouses experiencing this particular pest problem.	**Response**: Cooperative's Extension's work on the management of root mealybugs began several years ago. Since this work did not completely rely on insecticides, it was used as a control. One of the trials conducted by Gill and Kunkel focused on the use of entomopathogenic nematodes (a parasitic thread worm that kills insects), entomopathogenic fungi (a fungus that can act as a parasite in insects), and growing location to control root-feeding insects. Non-neonicotinoid insecticides were also examined as a possible management tool. **Results:** Results found that the entomopathogenic nematode, Steinernema carpocapsae, and the entomopathogenic fungus, Beauveria bassianna, can significantly reduce root mealybug populations on Sedum grown in plug trays in a hoop house. Sedum is a genus of flowering leaf succulents also known as stonecrops. They also indicated that some non-neonicotinoid insecticides also significantly reduced populations of root mealybug. Gill and Kunkel conducted a workshop where they shared these findings, and we discovered that 25% of the attendees were previously unaware that biological control could be used to successfully target root mealybugs. 35% of the attendees said they learned there were non-neonicotinoid products that could be used to successfully manage mealybug populations, and 15% of attendees intended to use them if they proved to be cost-effective. Sixty-five percent of attendees stated the information generated by the studies was useful and that they appreciated the project's focus on difficult-to-manage pests. 30% of attendees also stated that they may try to use this information to control other labeled root feeding insects.	1. Sustainable Productions Systems for Agricultural and Urban landscapes
2.	**Teaching best practices: 2019 Mid-Atlantic Crop Management School** **Issue:** Agricultural production in the Mid-Atlantic Region is integral to local, regional, national and even international food systems. Maintaining and improving the productivity and competitiveness of this industry is critical for both	**RESPONSE**: The Mid-Atlantic Crop Management School was established in 1995 as a joint venture between the University of Delaware, University of Maryland, Virginia Tech, West Virginia University and the United States Department of Agriculture's Natural Resources Conservation Service. The school addresses the continuing education and required certification needs of both the Certified Crop Adviser program and other regional agricultural clientele. The 2019 school was held from Nov. 19 to 21 in Ocean City, Maryland. Five concurrent sessions featured speakers from across the country on the latest research and implementation strategies related to nutrient management (10 sessions), crop management (nine sessions), integrated pest	1. Sustainable Productions Systems for Agricultural and Urban landscapes

	producers and consumers. The Mid-Atlantic Region, however, also faces many environmental challenges. For this reason, is imperative that those operating within the agricultural industry in the region understand best practices to minimize negative impacts on soil, air, water and human health. The International Certified Crop Adviser (CCA) Certification Program is a voluntary program offered by the American Society of Agronomy that provides a benchmark for practicing agronomy professionals in the United States, Canada and India. Certification recipients must have the necessary education and expertise to advise clientele on agronomic practices. There are currently over 300 active CCAs in the Mid-Atlantic Region, consisting of Delaware (DE), Maryland (MD), Virginia (VA), West Virginia (WV) and New Jersey (NJ), that must complete continuing education in four major competency areas: nutrient management, soil and water management, integrated pest management and crop management, and professional development. Additionally, many states within the region have annual certification requirements for nutrient management (DE, MD, PA, VA, WV) and/or pesticide management (DE, MD, NJ, PA, VA, WV) that are	management (seven sessions), soil and water management (nine sessions), and an alternative session on specialty, vegetable and fruit crops (nine sessions). **IMPACT**: The 2019 school drew 279 participants including crop consultants, extension educators, farmers and farm managers, agribusiness professionals, soil conservationists and personnel from the Delaware Department of Agriculture and Environmental Control. A total of 1399 completed evaluations were received regarding individual speakers and total of 121 participants completed a program evaluation. On the speaker evaluations, 97% of participants indicated that the material presented in individual sessions was generally clear and well organized (1356 responses). In addition, 93% (1295 responses) indicated that they gained knowledge in the CCA core competency areas by attending the sessions at Crop School. Eighty-six percent (1211 responses) also indicated that they planned to use this information in the future. On the program evaluation, crop school participants responded to the survey consult on more than 747,000 acres in the Mid-Atlantic region. Respondents estimated the economic value of the information they received at the crop school was up to $250 per acre and that the overall economic impact of the 2019 Mid-Atlantic Crop Management School is estimated to be as much as $8.3 million. Sixty-one percent of those attending in 2019 indicated that they also attended in 2018 and more than half of those returning said that they had adopted a new management practice or system in the past year.	

	completed via continuing education programs.		
3.	**Poultry Grower Basics Series** **Issue** – Poultry is Delaware agriculture's main economic engine and in recent years, the Delaware Nutrient Management Program has experienced a surge in the number of new poultry growers attending certification sessions. Both new and experienced growers face a variety of production issues from seasonal ventilation to environmental and financial concerns.	**Response** – Cooperative Extension's Poultry Grower Basics Series continued this year with the addition of a new program intended to address issues facing experienced and new growers. Topics presented during these programs included optimizing cold-weather performance, practicing sustainability and troubleshooting performance issues. The programs, held in Kent and Sussex Counties, offered Delaware Nutrient Management Continuing Education Credits for attendees. **Impact** –The 2019 Poultry Grower Basics Series attracted 80 participants, of whom 75 (93.7%) completed at least part of the program evaluation. Sixty-nine of the 75 total respondents answered the question specific to farm capacity, each indicating that their total poultry farm capacity was over 5.8 million birds. To help measure impact, participants were asked if they learned anything new during the program followed by a question about how likely they were to implement or change a practice based on this new knowledge. When considering optimizing cold-weather performance, 54 (96.4%) learned something new in the program and 59 (90.7%) intend to change how they manage their poultry houses in cold weather. Regarding sustainability practices, 53 (96.3%) learned something new and 61 (96.8%) will change how they manage their production for a sustainable future. Finally, 53 (98.1%) participants learned something new about troubleshooting performance issues and 60 (96.7%) intend to change their troubleshooting practices. Representative of the group, some of the evaluation comments read: "Excellent presentations and presenters – Thank you!" and "Very good information – education so important".	1. Sustainable Productions Systems for Agricultural and Urban landscapes
4.	**Small Ruminants** **Issue:** Small ruminant production has been increasing in the United States due to the niche market for small ruminant meat by ethnic communities and its recognition as a healthier red meat alternative. Many small ruminant producers are new to raising and managing small ruminants and are unaware of the economic opportunities available in the region	**Response:** Delaware State University's small ruminant specialist and University of Delaware's animal science extension agents planned an evening session for small ruminant producers during Delaware Ag Week and invited Cornell University's small ruminant specialist and goat producer, Tatiana Stanton, as the featured speaker. **Results:** The educational program had a total of 34 participants representing 592 acres and 492 head of sheep and goats from around Delaware. Seventeen post-program evaluations collected showed that 100% of participants rated the overall program as somewhat or very informative. Eighty-eight percent indicated that they had learned new information and 71% responded that they would be implementing a new practice on their operations as a result of what they had learned.	1. Sustainable Productions Systems for Agricultural and Urban landscapes

	for lamb and goat meat. Additionally, producers must develop skills to better manage their does, ewes, lambs and kids during lambing and kidding time.	Some of the producers indicated they would be implementing practices including being better prepared, acquiring a lambing and kidding kit, providing a heat source for newborns, practicing better handling of vaccines, checking ventilation, conducting fecal egg counts, using mineral salt, assuring the proper processing of kids, investigating local markets, trimming hooves while in lambing jug; One attendee commented, "The first-hand information and research was awesome — great workshop!" **Recognition of sponsors, in-kind contributors or partners (please provide name, organization, what was contributed).** ● Susan Garey — Animal Science Extension Agent, University of Delaware ● Kwame Matthews — Small Ruminant Specialist Delaware State University ● Dan Severson — New Castle County Agricultural Agent, University of Delaware ● Delmarva Feeds — sponsored the dinner for the meeting "#1 Sustainable Production Systems for Agricultural and Urban Landscapes."	
5.	**Weekly Crop Update** **Issue:** Farmers, agricultural consultants, Extension professionals and others need timely information on crop pests, recommended production practices and educational opportunities.	**Response:** The Weekly Crop Update (WCU) is a University of Delaware Cooperative Extension newsletter that covers production topics related to vegetable, fruit and agronomic crops. Extension specialists, agents and educators from the University of Delaware, Delaware State University and the University of Maryland contribute articles to this publication. The newsletter also includes announcements about upcoming educational events organized by Cooperative Extension and its partners. In 2019, the WCU was published on March 1 and then each Friday from April 5 through Sept. 27 for a total of 27 issues. The year 2019 marked the 27th year of the publication's release. Both the blog and PDF versions of the Weekly Crop Update are available online for free. There are currently about 860 subscribers who receive an email alert when a new issue is posted and, of these, approximately 200 click through to read the issue each week. **Impact:** In September and October 2019, 34 current Weekly Crop Update subscribers completed a survey. Responses indicated that this response group consisted of 24% growers, 21% agriculture consultants, 24% Cooperative Extension staff, 18% agriculture suppliers and 9% government agencies. The largest percentage of respondents marked that they lived in Delaware (41%), while a majority of the rest lived in the neighboring states of Maryland (26%), Pennsylvania (18%) and New Jersey (6%). Eighteen respondents reported the amount of acreage on which they find themselves using the information gained from the WCU: a total of 255,551 acres which they either manage or provide consultation for. Based on the responses to this question, the	1. Sustainable Productions Systems for Agricultural and Urban landscapes

		Weekly Crop Update is used by people managing farms of various sizes as well as those providing consultation for extensive acreage. The distribution of acreage size listed by these respondents was quite evenly divided between managing small farms of 50 acres or less (28%) or large farms of 250 to 5000 acres (44%), and consulting on farms over 10,000 acres (28%). One goal of this publication is to educate readers on a variety of crop production topics. The majority of respondents indicated that the WCU increased their knowledge of disease management (91%), insect/mite management (85%), vegetable crop management (79%), weed management (74%) and soil fertility and soil health (65%). Fifty percent of respondents also reported that the WCU increased their knowledge of irrigation management — a topic that received additional emphasis in the 2019 issues of the WCU due to the availability of new research-based recommendations. Survey respondents expressed that they have used knowledge gained through the WCU in a variety of ways. Many indicated that this new knowledge helps them identify insect pests, diseases, physiological disorders or weeds (76%) and implement effective pest, weed and disease control strategies (76%). Seventy-four percent reported that the information helped them to improve their skills in crop nutrient management, soil fertility and soil health management. Fifty-nine percent said that it helped them to improve skills in cultural (growing) practices. Fifty percent indicated that the WCU helped them to prevent yield loss and twelve percent said that it helped them to start growing a new crop. Twenty-four percent of respondents used the information provided to manage their irrigation for optimal yield. Respondents also indicated that the WCU had prompted them to scout fields for insects (65%), disease (68%) or weeds (41%) that they otherwise would not have looked for. For nearly all of the respondents (97%), the publication had helped them identify an insect, disease, weed or disorder/nutrient deficiency that they were unfamiliar with. Finally, past WCU articles available in the web archive serve as a valuable resource for readers. Ninety-one percent of respondents indicated that they often (38%) or sometimes (53%) reference information from past articles of the Weekly Crop Update.	
6.	**Women in Ag** **Issue:** U.S. agriculture census data confirms that women are increasingly	**Response:** Cooperative Extension staff, university staff and women involved in the agricultural industry from Maryland, Delaware and Virginia collaborated to plan and carry-out the 2019 Women in Agriculture Conference held at Dover Downs, in Dover, Delaware. Conference attendees had the opportunity to listen to 3 keynote speakers,	1. Sustainable Productions Systems for Agricultural and Urban landscapes

	involved in managing farm operations. Recent census data revealed that 36% of U.S. farmers are women and 56% of all farms have at least one female decision-maker. Also, of note, according to the United States Department of Agriculture, farms where female producers are making decisions tend to be smaller than average in both acres and value of production. Women farmers are most heavily engaged in day-to-day farm and ranch decisions, along with recordkeeping and financial management. Regional Women in Ag Conference attendees were asked questions about their current farming operations. Weather was the biggest challenge for 61% of participants, followed by regulations (37%), markets (35%), input costs (32%) and pests and diseases (24%). Attendees were also asked to rate their stress level in the past month on a scale of 0-10. Over half (51%) rated their stress level as an eight or higher. When asked about their stress level compared to the previous year, 38% felt it was about the same with 42% rating it as slightly or much higher. Contributing factors to stress included financial (60%), regulatory (24%), family (24%), other (18%) and political (17%).	attend 15 breakout sessions, visit with 31 vendors and take advantage of on-site healthcare screenings (an opportunity that 50 participants took advantage of). The goal of this conference is to enhance skills and increase knowledge for women in agriculture to enable them to better cope in a challenging agricultural environment. **Results:** Two hundred and sixty individuals participated in the 2019 Women in Agriculture conference representing Delaware (53%), Maryland (40%) and Virginia (4%). 41% indicated that they were first-time attendees. As a result of past Women in Agriculture conferences, 36% have made changes to their agricultural operation or home planning. When asked how they found out about the conference, 47% were aware of the conference from Women in Agriculture emails, 43% from a friend and 27% from social media. Participants rated their overall experience as excellent or good (99%), educational value of the conference as excellent or good (97%) and opportunities for discussion and networking excellent or good (93%). As a result of this conference: 97% felt they are better prepared to make informed decisions about specific areas of agribusiness. Participants reported learning: Risk management practices for the farm (19%), Legal information for the farm (22%), Financial information for the farm (30%), Marketing for the farm (61%), Business operations and plans (49%) and Gained resources (96%).	

7.	**2019 Small Ruminant Field Day** **Issue**: Small ruminant production has been increasing in the U.S. due to the niche market for small ruminant meat by ethnic communities and as a relatively healthier red meat alternative. Many small ruminant producers are new to the management of small ruminants and are unaware of the best ways to maintain their herd's/flock's nutrition in order to increase or maintain production. Additionally, most producers do not realize that they can get an effective animal production on just pasture (especially for goats). Also, many people associate low-input with no-input production and therefore tend to feed the animals below the nutrition needed for them to meet optimum production and even enough to maintain.	Response: Delaware State University's small ruminant specialist and University of Delaware's animal science extension agents planned an all-day small ruminant field day that featured lectures in Raising Animals on Pasture, Basic nutrition for raising production sheep and goats, and Pregnancy and Kidding nutrition. Additionally, hands-on sessions were focused on conducting body condition score, calculation of simple Pearson's squares, evaluating hay quality, and grinding and mixing feed rations on farm. Impact: The field day had a total of 17 participants from Delaware, Maryland and Virginia. Post conference evaluations collected showed that 91% of participants rated the overall conference was excellent and thought the information was very clear and in a concise manner. Additionally, all the producers indicated on the farm that they learned several information they were unaware of about feeding their animals and intend to make several changes to get their animals at optimum production. 100% of the farmers intend to utilize the knowledge gain at the workshop on their famers in order to improve production. Recognition of sponsors, in-kind contributors or partners (please provide name, organization, what was contributed). #1 DSU Sustainable Production Systems for Agricultural and Urban Landscapes	1. Sustainable Productions Systems for Agricultural and Urban landscapes
8.	**Farm on Tour** **Issue**: The next upcoming generation is not exposed to agriculture because they have no connection within their families to farming. Most of the youth do not know where the food they eat comes from or the career opportunities in today's agriculture**.**	**Response**: DSU Extension has piloted a project named "Farm on Tour" with William Henry Middle School to expand the knowledge about Agriculture and Nutrition to the school's 1000 students. This project gave exposer to basic games to promote exercise, nutritional tools, livestock (small ruminants and chickens), Ag equipment, connection between crops grown and textiles (clothing), as well as locally grown grains and their purpose. The 5th and 6th graders moved through the stations in small groups over two days on their school's property. This gave the school a chance to have 100% participation without much disruption to the teaching day as well as no transportation cost for students or the school. **Impact**: As a result of this event, we were able to reach 991 youth to both educate but also to create awareness that there could be an opportunity within agriculture for them as a future college student or as a career path. After a follow-up meeting with the school's principle, Mr. Clendaniel was told that the students, teachers as well as administration not only enjoyed the event but also learned something at each of the six	1. Sustainable Productions Systems for Agricultural and Urban landscapes

		stations. Recognition of sponsors, in-kind contributors or partners (please provide name, organization, what was contributed). William Henry Middle School was a partner in allowing this event on their property as well as requiring all teams within the school to participate.	
9.	**Fecal Egg Counting and FAMCAHA© Workshop (WPHS) 2019** **Issue**: Farming has traditionally been done by older people and the youth that are interested in farming is normally involve with 4-H. However, at the William Penn High School in New Castle Delaware, the agriculture teach allows her students to gain hands on experience with animals. The school has turkeys, chicken, geese, and goats. With goats being an animal, these students are raising, the knowledge of parasites that affect these animals are important. Particularly, the blood sucking abomasa parasite, Haemanthus contortus (barber pole worm) which is the most problematic parasite in this industry. This parasite is a major threat because once in the abomasum of the animal it consumes large amounts of blood causing sickness and death that can hinder production. Therefore, there is a need to understand the best mechanisms to control this parasite.	**Response**: Delaware State University's small ruminant specialist conducted a one-day fecal egg counting and FAMACHA© workshop at DSU's Hickory Hill Farm that was designed to help high school students learn information about the types of parasites that affect small ruminants, the possibility of resistance, and the basics of selective internal parasite control. We provided hands-on training to certify these students in the use of FAMACHA© score card and fecal egg counts. In the morning, an integrative parasite management lecture was done to educate students on parasites, life cycles, control and resistance, followed by hands-on FAMACHA© eyelid color scoring and fecal egg counting sessions in the afternoon of the program. **Impact**: A total of 22 participants attended the training (2 adults and 20 high school students). All the students that attended indicated that they learned new information about these parasites, and they were all ready and willing to work with the animals for the afternoon session. Each student did a FAMACHA© score and collected fecal samples from the animals. The event was a success as several students indicated that they would like to attend DSU for an undergraduate degree and majority of the students were interested in doing agriculture, particularly, animal science or pre-veterinary science.	1. Sustainable Productions Systems for Agricultural and Urban landscapes
10.	**High Tunnels** **Issue**: High tunnel growers are interested in workable Integrated Pest Management activities and protocols that would include release and	**Response**: An array of crop plants was incorporated in two high tunnels at Smyrna Outreach Center to present variety and appropriate environment/ecosystem for biologicals to thrive in. Selection of crops included mostly trellised crops (Tomatoes, lima beans, cucumber) were included in the mix. Flowering plants, herbs and bunker plants were included. Three students worked all through the summer to help maintain the plants and acquire hands on experience. During 2 workshops carried out at SORC, a	1. Sustainable Productions Systems for Agricultural and Urban landscapes

	maintenance of beneficial insects' populations'/biologicals. Ventilation in high tunnels is an important aspect, and demonstration of different types of trellising of plants was done. These very crop production principles are relevant to urban gardening	total of 83 participants toured the high tunnels and acquired knowledge associated with IPM in high tunnels. Extension professionals shared a lot of knowledge of subject matter relating to the subject matter. 34 youth visited high tunnels and had a chance to practice soil sampling and in situ soil pH determination. **Impact**: Participants appreciated the principle of ventilation in high tunnels as it relates to pest management. Participants acquired knowledge on sources of biologicals and the timing of their release in high tunnels. Participants also gained knowledge on house pests and how to manage them. A lush environment abounded in the high tunnels. Populations of beneficial insects that had been released were maintained during the growing season. More bumble bees and butterflies' pollinators were observed. There was an enhanced performance of cucumbers. Thanks to USDA-NIFA-ARD/NEIPM- Crop Management, Pest Management (CPPM) funding for 'Extension Implementation of IPM in Delaware. Delaware State University and University of Delaware partnered during this project. Speakers came from University of Maryland, College Park and form North East-IPM.	
11.	**Youth Agri science Programs** **Issue**: As demand for food production increases, the challenge to provide agricultural education to adolescents and youth from urban and economically challenged neighborhoods increases as well. Minorities in economically challenged urban areas have little interest in pursuing careers within the agricultural industries due to limited access to plant and animal production systems.	**Response**: The College of Agriculture, Science and Technology at Delaware State University has developed strategies and programs aimed to address the low participation in agriculture related sciences among Delaware's minority youth. The Green Jobs Program and DSU's Agri science and Technology Youth Camp jointly developed by Biological and Environmental Research (CIBER) and Extension are two programs targeting underserved youth. The Agri science and Technology Youth Camp educates youth 9-12 years in elements of Agri science which includes fruit and vegetable production; nutrition education; vegetable gardening; greenhouse management; and biotechnology. The Green Jobs is a 6-week program for youth 14-18 years that offers career exploration in the environmental area and introduction to entrepreneurship. The program is coordinated by the University Water Resource Center and led by the City of Wilmington, Department of Parks and Recreation. Participants receive lessons in nutrition education; specialty fruit and vegetable production; aquaculture; and small ruminant production. **Impact**: In its 8th year of outreach, the program has provided over 500 youth with agriculture knowledge and has provided experiential learning opportunities for as many as 21 student interns in a single year.	1. Sustainable Productions Systems for Agricultural and Urban landscapes

12.	**Development of Chesapeake Bay Technology Assessment Protocol for Manufactured Stormwater Treatment Devices** **Issue**: For ultra-urban locations or other high density new or retrofitted sites, space constraints or "footprint" area of the stormwater control measures is a crucial factor. Because of their reduced area footprint, proprietary manufactured stormwater treatment devices (MTDs) have the potential to address needs in such settings, but little or no data are typically available regarding their performance for reduction of nutrients, sediment or other pollutants. The lack of clear data-driven design criteria for proprietary MTDs contributes to great uncertainty in site design and has caused numerous instances of observed performance problems with MTDs. Consequently, many regulatory agencies do not grant water quality credit for use of MTDs unless they fully conform to specifications of approved (nonproprietary) BMPs.	**Response**: We developed a testing protocol that meets the needs of the Chesapeake Bay. We joined forces with the Water Environment Federation (WEF) Stormwater Testing and Evaluation for Products and Practices (STEPP) initiative for development of an ASTM standard or standards for evaluation and testing of manufactured stormwater treatment devices (MTDs) **Impact**: The STEPP effort is ongoing. In addition to the ASTM standard, STEPP has shown interest in assuming administrative responsibilities for oversight of the evaluation protocol and dissemination of data for MTDs evaluated by its strictures.	1. Sustainable Productions Systems for Agricultural and Urban landscapes
13.	**G2P in VOM: An experimental and analytical framework for genome to phenome connections in viruses of microbes** **Issue:** Soybeans are an important resource in the food industry and as feedstock for biofuels. As a cost effective and sustainable alternative to nitrogen fertilizers, the N2-fixing bacterial symbionts of soybean	**Response**: Phenotypic and genotypic characterizations of accessions (cultures) in the University of Delaware Bradyrhizobium Collection (UDBCC, n=382 cultures) were performed in order to explore the diversity and presence of viruses within the SB genomes. The complete genomes of 25 SB have been sequenced and are being assembled and analyzed for various features including the presence of resident viruses (prophages). Additionally, sequencing and analysis of the associated viruses, both virulent (lytic; isolated from Delaware soils) and temperate (lysogenic; residing in SB accessions), are in progress. **Impact:** The results of the UDBCC characterizations have recently been accepted for publication, although not within the timeframe of this report. Approximately 100 SB	1. Sustainable Productions Systems for Agricultural and Urban landscapes

	(soybean bradyrhizobia, SB) are critical to crop yield. It is therefore important to understand how viruses of SB influence SB ecology and soybean yield. Manipulating SB has been shown to increase soybean yield by ~30%.	16S and 100 SB ITS sequences have been made available on NCBI. Publication efforts are underway to report the analyses of the 25 SB genomes sequenced.	
14.	**Development and Function of Maize Brace Roots** **Issue**: The failure of plants to stay upright is called lodging and results in significant crop yield losses worldwide. In maize, specialized aerial roots called brace roots are proposed to play an important role in lodging-resistance. However, there is little known about the development or function of these roots	**Response**: We have developed field-based mechanical testing approaches to determine the contribution of brace roots to anchorage in maize. To determine what features of brace roots are important for anchorage, we have further developed methods for field-based phenotyping and lab-based mechanical testing protocols. **Impact**: We have determined that the brace root contribution of anchorage is affected by genotype and environment. This result has been consistent for both research inbred lines and commercial hybrids. We are currently working to identify the brace root ideotypes that promote anchorage and identify breeding targets for lodging-resistance	1. Sustainable Productions Systems for Agricultural and Urban landscapes
15.	**Field Crops Extension Plant Pathology** **Issue**: Delaware farmers lose millions of dollars annually to plant diseases that reduce yield potential and grain quality. In corn production alone, Delaware yield losses due to disease are estimated at 3 to 10 million dollars annually	**Response**: The University of Delaware Field Crops Extension Plant Pathology program aims to reduce crop loss due to disease and support sustainable disease management strategies through applied field research and laboratory investigations to better elucidate pathogen biology. Throughout 2019, applied research was conducted in small grains, corn, soybean, and stevia. **Impact**: Outputs of this program included fungicide efficacy and timing recommendations, survey results of nematode pressure in soybean fields, characterization and improved understanding of pathogen diversity within wheat, barley, corn, soybean, and stevia production systems. This research serves as a foundation to improve understanding of regional pathogens and better inform management recommendations. Research results are shared through an active extension program that reaches growers through face-to-face interaction, training meetings, peer reviewed and extension publications, and an active web and social media presence.	1. Sustainable Productions Systems for Agricultural and Urban landscapes
16.	**Development of genetic maps, molecular markers for heat stress tolerance in Blueberries**	RESPONSE: We are utilizing the cutting edge genomic technologies available, biparental population and diversity panel to explore genetic diversities by deploying Genotyping-by- Sequencing, identifying Single Nucleotide Polymorphism (SNPs),	1. Sustainable Productions Systems for Agricultural and Urban landscapes

	Issue: Northern high bush blueberries are known for their taste and health benefits and are the most cultivated blueberry type worldwide. They are grown mainly in temperate regions including Northern America and requires certain chill hours in order to set flowers and fruits in the following summer. However the seasonal heat waves and high temperatures during summers affects plants and reducing the quality of the fruits. Even though genome sequence and molecular markers are available for many fruit crops, blueberry is lacking with these resources. Moreover development of molecular markers for heat / high temperature stress tolerance is very important for northern high bush blueberries. .	development of quantitative traits, association maps and identification of candidate genes Impact: We have genotyped more than 300 F2 biparental population and diversity panel genotypes using Illunina sequencing. Identified more than 90 thousand SNPs, phenotyped heat stress tolerance and three more related traits. We are in the process of developing Quantitative Trait Loci (QTL) and association maps for these traits utilizing high density SNP markers.	
17.	**Utilizing an Integrative Approach and Identification of Novel Products in an Emphasis to Control Haemonchus contortus in Sheep and Goats.** ISSUE The small ruminant industry plays an integral role in livestock production worldwide and is a growing enterprise in the United States (U.S.). This enterprise is of great economically importance for limited resource and beginning farmers as the current demand for lamb and goat meat is far greater than the supply. These animals are deemed profitable because they are great at converting low quality	**Response**: I have conducted research projects on how to effectively control parasites by investigating the effects of novel chemical compounds and plant extracts on these parasites in vitro. These projects include the testing of chemicals received from the National Cancer Institute and extracts from pumpkins, hemp and elderberry. If these products have a drastic impact on the parasites then we will move to in vivo testing after doing a cytotoxicity test on mammalian cells. Additionally, I have held several workshops to help enhance the knowledge of small ruminant producers in ways they can maintain or control the effects of parasites by using an integrative approach. This integrative approach include deworming only animals that need it after using a FAMACHA system, look at five different signs before deciding to deworm animals, practicing pasture rotation and selecting animals that are naturally parasite resistant. **Impact**: In the preliminary data we found two novel compounds that reduced parasite motility and we also found that pumpkin seed and elderberry extract is effective in slowing down parasite. However, more testing is needed in order to confirm data. Additionally, we have noticed that ethanol as a substrate leads to the death of the parasite and not the compound itself. As for the workshops, we had more than 40	1. Sustainable Productions Systems for Agricultural and Urban landscapes

	forages into meat, graze in native environments, and have high reproductive rates with low input cost. One of the biggest management issues currently facing small ruminant producers is the management of internal parasites, most specifically Haemonchus contortus (barberpole worm, stomach worm) which can cause blood plasma and protein loss resulting in anemia in sheep and goats when present at high levels. These parasites have become increasingly difficult to manage because they have developed resistance to nearly all of the currently available anthelmintic drugs and new drugs are not coming on the market. Data from Delaware State University shows that there is a high level of resistance to the ivermectin and benzimidazole classes of dewomers on the Delmarva Peninsula.	participants and more than 50% of these participants are willing to practice utilizing an integrative approach to combat parasitism on their farm.	
18.	**Escape the Vape** **Issue**: The National Institute of Drug Abuse reports that the United States, between 2017 and 2018, has experienced an almost 100% increase in the number of high school aged students who report using vape products within the past month—an increase from 11% to 21%. Studies also report that the high school past month use rate has increased to 25% and that eighth grade past month use also has almost doubled (from 3.5% to 6.1%) in 2019. Eighty percent of youth	**Response:** At the end of 2018, Delaware 4-H obtained a 6-month mini grant from the American Lung Association. This mini-grant provided funds for staff to research the topic, develop training materials, purchase educational videos and facilitate 45 to 60-minute sessions with youth and adults. The sessions aim to increase awareness of youth e-cigarette use and educate both youth and adults on the severity of health issues associated with these products. Previously they were believed to be less harmful than traditional cigarettes. From January to December 2019, Delaware 4-H reached 601 youth and 272 adults with these sessions. Initially led only by Extension Educators, they are now led by teens and volunteers across the state and region. **Results:** Post training results:	2. Nutrition & Wellness

	now believe that e-cigarettes do not cause great risk of harm. Many adults are still not aware of the e-cigarette industry, products and problem of youth access. In a 2017 article, the Child Mind Institute explains the challenge clearly: "JUUL, a popular vape device that comes in fun flavors, looks like a flash drive and can be charged in a USB port, is especially concerning. JUUL delivers high levels of nicotine, making the product extremely addictive. The company that makes and markets JUUL recently exceeded a $10 billion valuation faster than any company, including Facebook."	• 86% of participants reported "definitely yes" and 10% "probably yes" that young people risk harming themselves if they smoke from 1-5 cigarettes per day. • 72% of participants reported "definitely yes" and 24% "probably yes" that young people risk harming themselves if they vape 1-5 times per day. • 96% of participants reported that vapes are not safe just because they produce only steam or water vapor. • 97% of participants reported that there is not any type of cigarette, vape or other tobacco product that is safe to use. • 52% of participants reported "definitely yes" and 25% reported "probably yes", that they would share the information about the health risks of vaping/e-cigarettes learned today with others. Recognition of sponsors, in-kind contributors or partners (please provide name, organization, what was contributed). This effort was supplemented by a mini-grant from the Delaware American Lung Foundation (ALA) managed by Tanny Dickerson.	
19.	**Farm Health and Vitality** **Issue**: For the past five years, bad weather, volatile markets, declining commodity prices, tariffs and regulations have contributed pressure on farming enterprises and on the health and vitality of farmers, ranchers and farm families. Those pressures are also felt by professionals who provide education and services for the farming population. In Delaware, building a network for farmers, ranchers, their families and those that serve them, is critical. These networks can address stress, financial and overall wellness and mental health issues to protect the vitality of farming operations and Delaware's economy	**Response**: During 2019, a Mental Health First Aid (MHFA) training was offered once in each county in Delaware. This full-day training provides information about a variety of mental health diagnoses including how they present and strategies to support and help affected individuals. Training sessions were held from 8 a.m. to 4 p.m. in Dover, Lewes and Newark, Delaware and morning snack and lunch were strategically provided to help retain attendees throughout the day. The target audience included professionals working with farm audiences or their families. Marketing was conducted through farm organizations and health care service providers. **Impact**: Seventy-one individuals participated in the hands-on workshops. To determine if longer-term behavior change or an impact on the professional's organization had occurred, a post-program evaluation was conducted via an online Qualtrics survey, 6 months after the training. Eighteen respondents provided feedback: ten who work in education, three who work in mental health and five who work supporting farmers. The following 5 statements began with "As a result of the MHFA training, how confident are you now that you can": (from 1 not at all to 5 very confident). Results shown are the percent of respondents who indicated that they were moderately confident to very confident. • 94% Identify stress symptoms in your clientele • 67% Talk with clientele about their mental well-being • 72% Assist clients who are facing challenges that impact their mental health	2. Nutrition & Wellness

		● 72% Provide assistance to someone who says they are considering suicide ● 89% Contact the correct community assistance if someone says they are considering suicide The following 4 statements began with "As a result of the MHFA training, as of right now how likely are you to:" (from 1 Not at All Likely to 5 Very Likely). Results shown are the percent of respondents who indicated that they were Moderately or Very Likely. ● 61% Talk with distressed clients about their mental well-being ● 67 % Assist clients who are facing challenges that impact their mental health ● 78% Share what you learned during the Mental Health First Aid training with others in your organization ● 55% Taken leadership roles related to mental health within your organization Individuals were asked to share how they had acted upon what they had learned from the MHFA training. Quotes from attendees included: ● "Built information into educational programming for farm audiences." ● "I have a toolkit of resources should the need arise." ● "I focus on listening to what people say to see if they are giving any indications of needing help." ● "Will set up training for my colleagues and I have updated my resource list so I know who to refer clientele too if need be." ● "I have learned to really listen, not get excited, and be calming." ● "I am using what I have learned to help the teens that I counsel in my organization's camp. This training has helped me to understand the teenage mind differently, not just at work, but also at home." ● "I have not had any occasion to help someone who is mentally stressed to apply what I learned in first aid training." ● "Assessing for suicidality." ● "Applied concepts learned to personal family experience." ● "I have discussed with coworkers and clientele signs and options for help." ● "I really just thought about how I might use what I learned - haven't had an opportunity yet (thankfully)." ● "Talked with a few who have lost a spouse recently. One in a heterosexual relationship and one in a gay marriage. Both are devastated and need counseling. I did refer them and, in a few months, seem to be better adjusted though it takes time." ● "Trying to cope better with a sibling who was diagnosed Bipolar Schizophrenia at age 15 (35 years ago) but since then, is in complete denial, has not been	

		medicated or treated since age 15, and makes life a total hell for everyone in our family." ● "I volunteer at my church as director of crisis medical emergencies. I am almost always on the alert for a potential or actual crisis." ● "We provide a Mental Health Support Following a Disaster course. I have incorporated some of what I learned into this course." ● "Shared the information with my staff and other HR professionals and also shared the resources mentioned during the workshop." ● "I have an Improved awareness of clients, friends, and family." <u>Partners:</u> This program was underwritten by the Sustainable Coastal Communities Initiative and offered as part of a partnership between the Mental Health Association in Delaware, Beebe Health and the Delaware Farm Bureau.	
20.	**Food Safety Modernization Act** **Issue:** The Food Safety Modernization Act (FSMA) Produce Rule went into effect in 2016. Under the rule, growers of fresh consumed produce must attend an approved training. The Produce Safety Alliance (PSA) Grower Training Course is the current way to satisfy the FSMA Produce Safety Rule requirement outlined in § 112.22(c) that requires "at least one supervisor from the farm must complete food safety training at least equivalent to the standardized curriculum recognized by the [U.S. Food and Drug Administration (FDA)]." In addition, produce farms will be coming into regulation according to size and income with the first farms to be inspected in 2019. The Food Safety Modernization Act (FSMA) brought	**Response** <u>Produce Safety Alliance (PSA) Grower Training</u> Gordon Johnson, Kali Kniel and Jennifer Jones took the Produce Safety Alliance's train the trainer course and have served as trainers for sessions offered in Delaware and Maryland. Extension Agents Dan Severson and Jake Jones, in New Castle and Kent counties respectively, also qualified as trainers in 2019. Johnson further qualified as lead trainer (one is required for each session) and has since served in that capacity as the only lead trainer in Delaware. A total of four PSA trainings were conducted in 2019. In Delaware, each attendee gets a detailed 358-page manual with the training slides, references to the regulations and explanations of the regulations. Growers that complete the training receive a nationally recognized certificate from the Association of Food and Drug Officials (AFDO) that is recognized by the FDA. On-Farm Readiness Review (<u>OFRR)</u> To help growers comply with FSMA on-farm inspections, a team comprised of food safety leaders from the National Association of State Departments of Agriculture (NASDA), the state, the FDA and Cooperative Extension, developed the On-Farm Readiness Review (OFRR). Designed to move farmers away from the audit checklist scheme, the OFRR is meant to foster a dialogue between the farmer, the regulator and the educator about the requirements of the Produce Safety Rule.	2. Nutrition & Wellness

	fresh consumed produce production under FDA regulation starting in 2016 under the Produce Rule of FSMA. State Departments of Agriculture are administering and regulating compliance with this Produce Rule.	In Delaware, the On-Farm Readiness Reviews are conducted jointly by Produce Safety Specialists from University Delaware (UD) Cooperative Extension and staff from the Delaware Department of Agriculture (DDA). A team consisting of Gordon Johnson, Kali Kniel and Jennifer Jones (UD) and Andrea Jackson and Anna Wicks (DDA) received the required training in May of 2018. The OFRR consists of on-farm observations that identify areas for produce safety improvements, help growers prepare for FSMA Produce Safety Rule inspections and assist growers in utilizing best produce safety practices on their farm. Each farm receives an OFRR manual and checklists to comply with the FSMA Produce Rule. **Results** <u>Produce Safety Alliance (PSA) Grower Training</u> • In 2019, 109 PSA attendees received AFDO certificates. This included growers from Delaware and Maryland as well as several agency officials. • 31 attended the February 9, 2019 training at the Delaware Department of Agriculture (DDA) • 46 attended the March 19, 2019 training at the Delaware State Fair • 17 attended the March 20, 2019 training at Delaware Technical Community College Georgetown campus • 15 attended the November 6, 2019 training at the Delaware Department of Agriculture (DDA) <u>To evaluate the PSA Grower Training sessions,</u> pre and post tests are given and each session is evaluated using a nationally standardized evaluation. • The average increase in score after the training is 21%. • After 3 years of PSA trainings, 95 % of attendees felt that the level of FSMA Produce Safety Rule information provided in the curriculum materials prepared them to implement regulatory requirements. • Comments throughout the evaluations include: o "It was nice- friendly meeting" o "Great lunch" o "Increased my knowledge of what I was doing wrong" o "Great class" o "Good materials distributed, good presenters" o Under additional education materials that should be included : "post-harvest cleaning and sanitizing procedures by produce type", "sample food safety plans and SOPs"	

		On-Farm Readiness Review (OFRR) Ten On-Farm Readiness Reviews were conducted in 2019 with 23 farm personnel present during the reviews. Growers valued the suggestions for farm improvements to comply with FSMA during sessions that averaged 3 hours per site. Some specific issues identified during reviews: • Lack of adequate hand washing facilities • Poor restroom or portable toilet sanitation • Poor employee hygiene • Cold storage facilities with condensation • Produce contact surfaces that are difficult to clean or are not cleaned with adequate frequency • Inadequate employee training on produce food safety • Produce wash facilities without good drains to handle used water • Inadequate understanding of cleaning and sanitizing procedures These issues are being address through follow up communications or visits. Outreach to Asian Growers on Produce Food Safety During 2019, University of Delaware Extension agent, Jennifer Jones, and Delaware Department of Agriculture staff, Anna Wicks and Amanda Ziegler, visited nine farms operated by Asian growers of Korean, Chinese and Japanese background. Because these growers and their employees had no produce food safety training, a program is being developed to bring training to and improve produce food safety on these farms.	
21.	**Mindfulness Skills and Practice** **Issue:** Stress affects people in their daily lives and can reduce memory and emotion processing as well as mental connections. Persistent stress can increase incidence of depression, anxiety, sleep disorders and cardiovascular disease. Mindfulness therapeutic interventions have been	**Response** The mindfulness program includes lessons on mindfulness-based stress management designed for ages ten and up. The program is interactive with a focus on teaching stress coping and relaxation techniques. Four hundred people participated in the program in 2019, including 142 youth and 258 adults. Participants were reached in a variety of settings, including schools (George Read Middle School, Milford Central Academy, Milford High School, University of Delaware), community locations (Bear Library, Camp Fresh) professional development opportunities (Kent County Office Professional Development Lunch and Learn, Agriculture Team Statewide Staff Meeting, Administrative Assistant Annual Conference, Sussex Master Gardeners, FCE Group, Milford After-school, 4-H Military), conferences	2. Nutrition & Wellness

	proven effective in managing stress and stress-related symptoms. Mindfulness decreases perceived stress levels, medical and anxiety symptoms and blood pressure and also increases awareness, acceptance, emotion processing and coping skills in individuals.	(National Extension Association of Family and Consumer Sciences, National Association of 4-H Extension Agents, 4-H Healthy Living Summit), Cooperative Extension Events and Trainings (4-H Leaders Forum, 4-H Experience Extension Camp, 4-H Cloverbuds Camp) and Train-the-Trainers events (University of Delaware, Cornell Cooperative Extension).
		Impact This year, University of Delaware Cooperative Extension Agents reached a total of 400 individuals, including youth and adults, throughout the state and nationally. Extension professionals administered the general survey to a total of 16 youth who received five lessons of mindfulness training in stress management skills and validated pre-post research scales to 36 youth who participated in a research study at George Read (**See "School-based Mindfulness Training for Adolescents with Program Referrals: A Mixed Method Approach for research analysis and results). Of the 16 youth from the Milford After-school sites, 31% reported an increased ability to identify personal stressors, 44% reported an increased ability to define mindfulness and how it relates to health and wellness and 100% planned to adopt at least one new mindfulness-based stress management technique as a result of the program. Extension professionals also administered the survey to a total of 26 adults who received mindfulness training in stress management skills. After the adult program, 69% of participants reported an increased ability to identify personal stressors, 69% reported an increased ability to define mindfulness and how it relates to health and wellness and over 92% planned to adopt at least one new positive stress technique as a result of the program.
		
		Bullets for Infographic:
		• Participants reached: 400 individuals
		  ○ Including youth and adults
		  ○ In Delaware and nationally
		• Youth survey participants: 16 youth who received five lessons of mindfulness training in stress management skills.
		  ○ Validated pre-post research scales: 36 youth who participated in a research study at George Read (**See "School-based Mindfulness Training for Adolescents with Program Referrals: A Mixed Method Approach for research analysis and results).
		• Results from youth program participants at Milford After-school sites
		  ○ 31% increased their ability to identify personal stressors.
		  ○ 44% increased their ability to define mindfulness and how it relates to health and wellness.
		  ○ 100% plan to adopt at least one new mindfulness-based stress management technique as a result of the program.	

		• Results from 26 surveyed adults who received mindfulness training in stress management skills:
		  ○ 69% increased their ability to identify personal stressors.
		  ○ 69% increased their ability to identify personal stressors.
		  ○ 69% increased their ability to define mindfulness and how it relates to health and wellness.
		Over 92% of adult participants plan to adopt at least one new positive stress technique as a result of the program.	

22.	**Nutrition Food Labels** **Issue**: How do we know what we are eating? How do we know a store-bought muffin contains carrots? Nutrition facts labels are found on most food packaging and are used to determine how much of each nutrient is found in a food or drink. DSU SNAP-Ed conducts a lesson based on nutrition facts labels to educate students to be aware of what they are always consuming.	**Response**: During a nutrition education class at Elbert-Palmer Elementary school, the topic was about food labels and how best to use them. Students were taught how to read nutrition facts such as measurements of fats, sodium, carbohydrates, sugar, protein, vitamins, minerals, calories, and serving size. The lesson included a guessing game where six food items were placed on a table alongside covered food labels. Students were challenged to guess the matching food label for each food item. Once the results were revealed, many of the students were surprised to discover which food labels aligned with the corresponding food. The homework assignment was for them to bring a food label from home to discuss at the next class. **Impact**: At the following class, approximately 5 students returned with food labels of items they had at home. One student stated: "I look at food labels all the time now!" The lesson taught students to be mindful of the nutritional breakdown of packaged food items purchased from grocery stores, as well as learning how to determine whether foods are high or low nutrients—which ultimately decides whether the food is a healthy choice	2. Nutrition & Wellness
23.	**Which is Better Name Brand vs. Generic** **Issue**: Name-brand cereals seem to be a favorite when it comes to shoppers. Some consumers refuse to buy cereals that are not popular name-brands they recognize, such as Cheerios. The facts; however, suggest generic cereals are not only cheaper in price, but have similar tastes too.	**Response**: During a nutrition education class at Pulaski Elementary School, students were able to taste both name-brand and generic cereals. The cereals were prepped into "A" and "B" bags prior to the class. The activity was to have the students guess which cereal was in each bag based on their individual senses, i.e. taste, sight, smell, etc. Most students chose Bag "A" (Tasteeos) over Bag "B" (Cheerios). Students barely noticed a difference in the organoleptic qualities between the name-brand and generic cereals. **Impact**: A vote was taken, where most students selected Bag "A" (Tasteeos) as their favorite. This was a fun, but important lesson, as they learned that generic brands can be just as satisfying as the more popular name brand competitor. The takeaway message is for kids and their families to consider generic brands over some name brand food items, as they can be equally satisfying and cheaper too. In many situations, it's the advertising that influences our decisions on what to buy, or not buy.	2. Nutrition & Wellness

24.	**Community Youth Day, East Side Charter, Wilmington, Delaware** **Issue**: Community Youth Day is an annual summer festival sponsored by East Side Charter Elementary School in Wilmington, Delaware that promotes youth education, health, and spiritual growth. Deterring youth violence and dissuading substance abuse is an additional objective for the event. On June 8, 2019, the community was treated to live music, food, a host of activities, community agencies, services and vendors.	**Response**: SNAP-Ed offered a demonstration on "Rethink Your Drink" a visual comparison of the sugar content found in a variety of popular drinks and beverages. The objective is to discourage audiences from selecting high sugary drinks, while encouraging greater consumption of water. The display consisted of educational materials, giveaways, and a wide variety of drinks with the corresponding sugar measurement. **Impact**: Participants were shocked over the amount of sugar in sodas, juices and energy drinks that were displayed. Many participants took pictures of the display to document their experience and share with family and friends, while an adult female was observed writing down the sugar amounts of each drink displayed, while stating, "I know people who drink these drinks, I want to show them this." People tend to glance at sugar amounts on nutrition fact labels without realizing how much it is, until they see it is measured out.	2. Nutrition & Wellness
25.	**Traditional Medicinal Plant Constituents as Antioxidants, Antimicrobial and Chemotherapeutic agents** **ISSUE**: Certain plants have long been used in folklore medicine as readily available, cheap, effective and alternative remedy in the prevention and treatment of diseases. The efficacy of these medicinal plants has been linked to their rich secondary metabolites - phytochemicals, especially phenolic compounds. Phytochemicals have exhibited antioxidant, anticancer, antimicrobial, anti-inflammatory, anti-allergic, antimutagenic, antiviral, antithrombotic, and vasodilatory effects. Certain diseases such as cancer have significantly contributed to morbidity and mortality worldwide.	**Response**: We investigated the influence of location (Cameroon and Kenya), plant (Prunus africana, Pausinystalia yohimbe, Moringa oleifera, Momordica charantia and Orthero spp.), plant part (root, leaves, and bark) and solvent (water, ethanol, methanol, acetone, and dichloromethane), on the type and content of phytochemicals extracted. Plants were extracted with aqueous (80%) or absolute solvents and the total phenolics, flavonoids and antioxidant properties of the solvent extracts of the different plant parts were determined using the Folin-Ciocalteu, 2,2-diphenyl-1-picrylhydrazyl radical scavenging activity (DPPH), ferric reducing antioxidant power (FRAP), and 2,2'-Azino-bis(3-ethylbenzthiazoline-6-sulfonic acid) radical scavenging (ABTS) assays, and antiradical power (ARP) by spectrophotometric, GC and HPLC methods. An AI cell line, C4-2, reproducibly and consistently follows the metastatic patterns of hormone-refractory prostate cancer by producing lymph node and bone metastases when injected either subcutaneously or orthotopically in either hormonally intact or castrated mice was used. This model permits the study of factors that determine the tropism of prostate cancer cells for the skeletal microenvironment and allows for testing novel extract ability to inhibit AI prostate cancer growth. Antimicrobial activity was demonstrated using the agar disc diffusion assay followed by the measurement of the average zone of inhibition (ZOI) in which the first five extracts in the order of decreasing antioxidant power were tested against two clinical foodborne bacteria (gram-negative E. coli and gram-positive S. aureus).	2. Nutrition & Wellness

	Conventional treatment modalities such as surgery, radiation therapy, cryosurgery, and hormone therapies have not been effective for advanced stages of prostate cancer, which is hormonally resistant. The exposure to ubiquitous free radicals which participate in oxidation and negatively alter lipids, proteins, genetic material causes diseases. In foods, oxidation is responsible for deterioration in quality, and development of off-flavors and off-odors. The use of synthetic antioxidants is longer attractive to consumers due to increased concerns about the negative health impacts of synthetic materials. The threat of global health with the emergence of multidrug-resistant microorganisms, and against antibiotic treatments remains a public health risk. The broad spectrum of bioactivities exhibited by plant extracts could be used for novel antioxidants, antimicrobials, anti-cancer agents and drug development in the food and pharmaceutical industries. The aim of these research projects is to advance the discovery and design of selective compounds with drug-like properties that will improve our understanding of novel pathways for disease therapies, and antioxidants and antimicrobial agents	**Impact:** The use of bark and root extracts of P. africana on C4-2 cells showed a concentration-dependent cytotoxicity, with the bark methanol extract showing the strongest effect. There was complete lysis of all cells above 0.05 mg/mL for all cells treated with bark and root extracts, while cells treated with leaf extracts showed a proliferation effect and clustering of cells compared to the control. Antimicrobial activity in the selected extracts was dependent on their concentrations. An increase in concentration results in an increase the zone of inhibition. Of all the tested extracts, both concentrations (50 and 100 mg/mL) of acetonic extracts of P. africana (C) bark exhibited no growth inhibition against E. coli but an active to highly active inhibitory zone against S. aureus (8.0 to 17.33 mm). The highest growth inhibition was exhibited by the ethanolic extract of P. africana (C) bark against S. aureus (17.33 mm). Traditional medicinal plants can serve as potential sources for developing new drugs and more effective anti-cancer agents for future therapy as well as as antimicrobials and antioxidants. These results clearly support the potential uses of these plant parts in a wide range of applications	

26.	**Monitoring Total Vibrionaceae to Identify Pathogenic Vibrio Species and Market Oyster (Crassostrea virginica) Quality for Consumption** **Issue**: Consumption of raw oysters is known to cause serious health conditions due to bioaccumulation of contaminants. As filter feeders, oysters ingest bacteria along with phytoplankton from their surrounding habitats. Ensuring seafood safety for human consumption is always a concern. Since oysters are consumed raw, disease causing organisms, environmental contaminants, toxins, chemicals, and even physical hazards such as soils and metals retained in the oysters can enter through feeding. Vibrio bacteria are the primary cause of bacteria-associated illness and deaths from seafood in the United States, most often from the consumption of raw or lightly cooked oysters. Vibrio infections have been increasing over the past decade. Methods used for the detection of pathogenic (disease-causing) vibrios are tedious, expensive and time consuming. Leadership of USDA-ARS scientists, a simple and rapid procedure known as the colony overlay procedure for peptidases (COPP assay) was developed, which is a test to identify total vibrios in oysters and seawater. However, it is not known whether total vibrios can be used as an indicator of the	**Response**: For the first project, we determined the quality of oysters collected from Delaware Inland Bays (DIB) and compared them with market oysters. Environmental parameters were monitored from local waters of DIB classified as closed versus open for shellfish harvesting. For the second project, the COPP assay with more complicated DNA-based methods was compared. Specifically, we evaluated the distribution of total vibrios (COPP assay) and pathogenic vibrios (DNA-assays) in oyster and seawater samples collected from the Delaware Inland Bays, Delaware and the Chesapeake Bay, Maryland to determine if the simple COPP assay results might relate to the levels of pathogenic Vibrio species. We also validated the use of the COPP assay as a practical, rapid, and cost-effective alternative to currently used methods. **Impact**: For the first project, total aerobic bacteria and vibrio were higher in market oysters during the warmer months, with open water having the least microbial loads. There were no differences in total vibrio counts between the study sites, but significant differences were recorded over time. Water temperature and turbidity were directly proportional to total vibrio in oysters, and salinity was inversely related. Research findings in this study may help bring awareness of changes in bacterial loads due to seasonal changes and additional handling and storage. The second study indicated that the COPP assay is a viable alternative to the other methods for the detection of Vibrio vulnificus v in oysters and seawater, and it is currently under further evaluation for its ability to serve as an indicator for Vibrio parahaemolyticus. Reducing analysis time from 3 days to 24 hours provides a practical method for monitoring pathogenic Vibrio species in shellfish and the aquatic environments and enhances the ability of regulatory laboratories to monitor the safety of more samples at less cost, and ultimately reduce illnesses caused by Vibrio-contaminated shellfish. We currently are transferring the results of this research and the COPP assay to commercial growers and state resource manager through training and development of outreach materials. This study has contributed to the development of a user friendly testing method for Vibrio presence, will eventually enhance the ability of regulatory laboratories to monitor the safety of more samples at less cost, and ultimately reduce illnesses caused by Vibrio-contaminated shellfish. The unique combination of multi-institutional research and outreach activities has also enhanced the research capacity of Delaware State University and the University of Maryland Eastern Shore in food and agricultural sciences. This project has also benefited tremendously a cadre of	2. Nutrition & Wellness

	presence of pathogenic vibrios. Regulatory agencies and industry currently use comparable testing of fecal coliform bacteria as an indicator of fecal pollution, so the use of the COPP assay might serve a similar role as an indicator of pathogenic vibrios.	undergraduate and graduate students to learn valuable new techniques for assessing bacterial contamination of shellfish and their environment.	
27.	**The UD ENVISION Program: Undergraduate Research, Education, and Extension Exploring One Health and Food Sustainability** **Issue**: The number of underrepresented groups is acutely obvious in many of the Agricultural Sciences. Careers in these disciplines can be transformative in terms of economic opportunity and life-changing attitudes	**Response**: I initiated a program (Envision) that is an outreach Summer undergraduate research and education experience three years ago with regional HBCUs (Lincoln University, Delaware State University, and the University of Maryland, Eastern Shore), as well as UD. This program brought ~13 students each Summer to campus with proscribed trainings and mentoring for each student to develop and report on research projects (at the Delaware State Fair and at the UD Undergraduate Research Symposium). Each student was trained in videography and made short (2 - 3 minute) videos detailing their research. This requirement helped to change the perspective of the students from being passive to being more active participants, taking ownership of their projects and allowing them to Envision themselves as scientist. RESULTS: **Impact**: As Summer 2019 was to be the final year of funding, I wrote a renewal proposal for this program, including faculty from other departments within CANR (PLSC, ENWE with program assessment advisers from APEC), which was fully funded ($500K for 5 additional years). In addition to the regional HBCUs originally in Envision, we have added Cheyney University (first US HBCU) and Wesley College (private, primarily minority-serving college in Dover). I have personally made recruitment visits to these schools for Summer 2020 and we currently have ~50 applicants (total) from all 5 of these regional HBCUs, as well as UD students and two from other schools that found our program on UD's Summer program webpage. Given the prior success of Envision, and the subsequent follow-up funding for at least the next 5 years, the Graduate College has listed UD Envision on their Summer program page and requested that I report on all of the other opportunities for Summer research at UD during my recruitment visits. In addition, the Grad College hopes to establish clear and continuous pipelines from these participating schools into UD's graduate programs.	2. Nutrition & Wellness
28.	**Gut Health and Disease** **Issue**: The gut is the main nutritional organ, absorbing all of the energy required by the animal to live,	**Response**: My lab is researching the development of the chicken gastrointestinal immune system from hatch to processing. We hope to learn how the immune system develops to improve animal health. We also are researching the mechanism of action of feed additives / antibiotic alternatives to find the best intervention strategies to improve gut health. Finally, we are studying the pathogenesis of infectious disease to	2. Nutrition & Wellness

	function, grow and reproduce. Thus, it is the center of nutrition. It is also the major immunological organ, by nearly any measure (immunoglobulin production, lymphocyte count, immune development, etc.). The gut is also a nexus of connections and communication with the rest of the body; circulatory system, lymphatics, nervous system, neurotransmitters, hormones, all intersect at the gut. Thus, the gut impacts most aspects of health and disease in vertebrate organisms	find treatment strategies or preventatives. These include Salmonella, Clostridium perfringens, coccidiosis and avian influenza. **Impact**: We have conducted trials and generated data on the potential mechanisms of action for coccidiosis infection of the gut, as well as for sub-therapeutic doses of antibiotics. We have also generated reports on organic zinc and algae has alternatives to antibiotics. These could lead to advances in techniques to improve disease resistance. My lab has published 3 original research peer-reviewed publications, 1 review article, 1 book chapter and submitted an additional manuscript that is currently under review. In addition, 5 meeting abstracts were accepted.	
29.	**4H Teen Leadership** **Issue**: For many years, Delaware 4-H has been empowering youth by helping them cultivate leadership skills such as decision-making, self-confidence and public speaking — all tools that will help them throughout life. In fact, a Tufts University survey found that youth involved in 4-H leadership programs are four times more likely to give back to their communities! In a compelling study, Empowering Presenters found that 15% of people inhibit themselves from a promotion at work by not having good communication skills and being unable to lead a group. Luckily, the leadership skills that Delaware 4-H teaches open up a multitude of opportunities as participants move on to college, start their first jobs and enter the next stages of life	**Response**: In an effort to build leadership skills in local youth, Delaware 4-H conducted four weekend trainings and 10 monthly meetings for youth ages 13 and older throughout 2019. Held at both county and state levels, these events saw participants come together for hands-on training led by experienced 4-H leaders. Participants then worked together in small groups where they used their newly acquired skills to build confidence and support in each other. Often, these exercises encouraged participants to later use their leadership capabilities in club settings, at community events and in school projects. **Impact:** The 93 youth who have participated in the 2019 Delaware 4-H Teen Leadership programs over the past several years have shown tremendous leadership growth and development. In 2019, this group completed surveys to help determine how the program has enhanced their leadership skills and to ascertain what parts of the program they most enjoy. The following survey results were reported: • 84% strongly agreed they learned new leadership skills while at these events • 83% strongly agreed that they feel more comfortable leading a group in decision making • 80% strongly agree that 4-H has increased their self-confidence • 45% strongly agree and 39% agreed that they gained more confidence speaking in front of a group of their peers The following testimonies were received from the youth who participated in the leadership activities: • "I have learned to always have a backup plan as things can change quickly." • "I plan to use my leadership skills in my everyday life."	3. Personal & Economic Development

		• "While utilizing my leadership skills, I have been able to realize what stresses affect my communication skills." • "I am now more able to take charge in groups as I want my voice to be heard." Recognition of Sponsors: Kaitlin Klair, Jill Jackson, Betsy Morris, Kristin Cook, Kaleb Scott, Jenny Trunfio, Breanna Banks and Karen Johnston Delaware 4-H Extension Staff	
30.	**Developing Healthy Habits: Up for the Challenge & Kids in the Kitchen** **Issue**: High obesity rates, poor diet choices and lack of physical activity all pose a threat to the health of future generations. Youth in the United States are currently not consuming the recommended amounts of fruits, vegetables and whole grains, but are instead consuming excess amounts of high-fat foods and high-sugar beverages. According to Healthy People 2020, over 80% of American adolescents do not currently meet the recommended amount of physical activity. Alarmingly, the obesity rate for youth ages 10 to 17 is 33.2% in Delaware and 31.6% nationally, according to the Child Policy Resource Center.	**Response**: Extension professionals are currently working to address these problems. The Healthy Habits Program: Up for the Challenge & Kids in the Kitchen is a partnership and team collaboration between Walmart and the National 4-H Council, along with the Expanded Food and Nutrition Education Program (EFNEP) and Supplemental Nutrition Assistance Program Education (SNAP-Ed). <u>Direct Participants:</u> In 2019, Healthy Habits reached 5,009 Delaware youth ages 5 to 18 at 74 community partner locations statewide. These programs each offered six hours of nutrition and fitness training through the Up for the Challenge (school year) and Kids in the Kitchen (summer) curriculums. Over 1,500 of the participating youth were from low-income SNAP-Ed community eligible middle schools. Notably, this audience represented a diverse population of program participants: Forty-two percent of participants were reported as black/African American, 20% were reported as Hispanic/Latino and 14% were of mixed race. <u>Healthy Living Ambassadors - A Youth-Adult Partnership Model</u>: Healthy Habits has also trained 144 teen leaders to assist with program implementation in the community. Extension staff and Healthy Living Ambassadors are trained to facilitate the curriculum and implement direct programming in schools, after-school clubs, summer camps, YMCA's, Boys and Girls Clubs and other community centers and youth organizations. The collaboration with EFNEP staff helps to support a youth and adult partnership where the Healthy Living Program Coordinator pairs Teen Leaders with Nutrition Assistants. **Results:** • 5,009 youth were exposed to at least six hours of nutrition education aimed to increase knowledge of healthy behaviors and likelihood for behavior change. For the EFNEP-funded Kids in the Kitchen curriculum, a pre and post survey was administered to participants. Results showed that participating youth are increasing their knowledge and improving their behaviors related to healthy habits. As a result of the program,	3. Personal & Economic Development

		• 34% of participants reduced the number of fruit flavored and sports drinks they were consuming (276/802), • 27% of participants reduced the number of sodas they were drinking (219/798), • 29% of participants are eating more vegetables (233/802), • 27% of participants are eating more fruits as snacks (216/794), • 25% of participants are tasting new foods (200/794), • 21% of participants are reading more nutrition labels (165/789), • 27% of participants increased their physical activity frequency (218/794), • 25% of participants increased their physical activity duration (200/791), and 27% of participants decreased the amount of screen time (211/794).	
31.	**2019 Delaware State University Juneteenth Visits Milford Hospice** **Issue**: When children learn what Hospice Care is, in addition to the host of valuable services it offers, they understand hospice is not a place, but a service of "people helping people". The purpose of hospice is to provide comfort, by reducing pain and suffering, and to preserve patient dignity.	**Response**: This year, Juneteenth participants experienced the depth of human kindness and the ultimate gift of giving. Participants were interested in visiting the center to share gifts, and to show appreciation for the caregivers who work so diligently in providing medical, emotional, and spiritual care to the dying. The gift of kindness and compassion shown to others whose illnesses have advanced beyond a cure was at the heart of the experience. **Impact**: It was a powerful act of kindness and heart-felt gesture coming from Little Big Hearts to show appreciation to the staff at Milford Hospice Center.	3. Personal & Economic Development
32.	**Green Jobs** **Issue**: Over the summer, Green Job students visited Delaware State University's Cooperative Extension's Small Farms program. Small Farms coordinator, Andy Wetherill, noted the lack of financial education for students (despite this being the first job for many). The Green Jobs program, administered through the mayor's office in Wilmington Delaware, provides 14-18-year-old Wilmington residents with a six-week experiential outdoor experience in	**Response**: As a partner organization in the program, Delaware State University provides 25 hours of experiential learning in Agriculture, food and nutrition, finance and entrepreneurship. To further enhance program goals, Mr. Wetherill requested the integration of financial literacy to enhance career readiness among the students that participated in the programs. Quadia Muhammad, educator for Family and Consumer Sciences, delivered the financial literacy training to participants. A total of 14 participants benefited from this training in 2019. Approximately 35 students from 3 different youth organizations will benefit from a similar program in 2020. Ninety percent of the students indicated that they benefited greatly from the training and further stated that they will adopt some of the learned practices in the future. By introducing financial literacy education into the Green Jobs program, students were better equipped to handle financial situations, learned how to save and budget, and increased their knowledge of banking and credit, with the overall goal of establishing a habit of saving. The course included a PowerPoint titled "Money Lessons with Jay-Z"	3. Personal & Economic Development

	environmental work, career exploration, agriculture, business and mentoring.	and a budgeting activity. The session was followed by a Q&A session which was open and engaging. **Impact**: The three-hour training provided students with practical knowledge, skill-building opportunities, and resources they could use to manage their finances with confidence. Students discussed their future goals which included attending college, purchasing a home, and starting a business. By providing comprehensive financial education, Green Jobs is helping its students to enhance their financial skills and to become good financial stewards. As a result, students gained or improved knowledge, skills, and confidence to manage their money effectively, to achieve economic independence, and to reach their future financial goals.	
33.	**T-shirt Recycling for FCS Teachers** **Issue**: A plethora of T-shirts are being thrown away or donated (of which only 10% donated items get resold), and Delaware State is going to be banning the use of plastic bags in 2021. Therefore, there needs to be a new use for t-shirts to be converted into bags for Delaware State Residences to use at grocery stores	**Response**: Previous YouTube videos have been created to show how to convert t-shirts into bags. Therefore, FCS teachers were taught how to convert t-shirts into bags to share this skill with students. **Impact**: The group of 14 participants were excited to learn a new technique and the prospect of sharing these skills with their 30+ students over the next few years and have decided to use their skills for fundraising activities to off-set the cost of educational programs.	3. Personal & Economic Development
34.	**Teaching High School Students Tips to do Laundry** **Issue**: High school students do not know how to do laundry and therefore have purchased more clothing items at the store rather than maintaining their own clothing. This is a problem due to the unsustainable nature of misuse of resources	**Response**: Since these students have not been trained by family members or teachers on how to maintain laundry, I developed a fun curriculum, so students can learn laundry care and have fun by doing the following: relay races to sort and fold laundry correctly as well as magic tricks/scientific experiments to get stains out. **Impact**: Over thirty students at the Boys and Girls Club, enjoyed learning how to do laundry and successfully demonstrated the skill of sorting and folding correctly. This will make them economically viable in the future and gives them a skill set they can use forever.	3. Personal & Economic Development
35.	**Apparel Life skills** **Issue**: People are discarding clothing because they don't know how to sew on a button. This is unsustainable since clothing can be used longer if	**Response**: I taught over 50 students to thread a needle, knot thread, and sew on a button. **Impact**: These students now have the life skill of sewing on a button, which will help with their clothing budget in the future as well as be better stewards of their possessions. This program was well received and will be given in the future.	3. Personal & Economic Development

	people know how to sew on a button rather than tossing a shirt		
36.	**STEM** **Issue**: There is an abundance of careers and opportunities in Science, Technology, Engineering, and Math that many school age children are not aware of and have not been exposed to.	**Response**: Delaware State University 4-H has partnered with various after school programs to conduct evidence-based programming that exposes children to STEM. This programming is designed to expose and increase interest of STEM amongst children in elementary and middle schools. **Impact**: The children are given a pre and post test to determine if knowledge and skills have been gained along with increased interest in STEM fields of study. On average over 50% of the children gained interest in STEM after programming has been completed.	3. Personal & Economic Development
37.	**Brown Bag Parenting Education Program** **Issue**: Strong families are the basic building unit for our future citizens, yet those charged with this important responsibility often lack the resources to become the best parents possible. For clients receiving Temporary Assistance for Needy Families (TANF), access to parent education resources can be especially challenging. The Brown Bag Parenting Education Program fills this gap by providing access to research-based education to Delaware's most vulnerable citizens.	**Response**: Brown Bag Parenting (BBP) is an at-home learning program that is a compilation of disciplinary, nutritional, financial, and educational activities that parents, grandparents or caregivers can use with their pre-K to 13-year old children. Clients who complete and pass the program receive a certificate that is accepted by Delaware Health and Human Services - Temporary Assistance for Needy Families (TANF). From January through mid-December 2019, clients enrolled in the Brown Bag Parenting Education program. Of the 402 clients enrolled, 186 clients completed the program and received a parenting education certificate. This resulted in a 46% completion rate. Over 2019, there was an increase in client participation in Kent and Sussex counties resulting in a 20% increase from 2018. Eight lessons comprise the program, along with quizzes and assessments to evaluate the client's knowledge. Parents who have completed the program shared that the lessons on communicating within the family have helped them to resolve familial issues, to work together as a team, and to become better listeners. Additionally, BBP places a lot of emphasis on nutrition. **Impact**: Parents have commented on how these lessons have taught them to be conscientious decision-makers when they are buying food, preparing meals, and feeding their families. BBP gives parents the knowledge and resources to be engaged, thoughtful, parents. And parents can then pour this knowledge into their little people. The Brown Bag Parenting Education program is now more accessible, and communication is more efficient for low-income Delawareans receiving TANF. The Family and Consumer Science Educator received positive feedback about the program from clients and case managers alike.	3. Personal & Economic Development

38.	**Behavioral and Experimental Research Related to Agri-Environmental Issues** **Issue**: My research applies behavioral and experimental economics approaches to understand behavior and inform policies in the nexus of agriculture and the environment. These issues impact landowners throughout the country and consumers interested in the process by which their foods are produced	**Response**: I continue to be the co-Director of the USDA-funded Center of Behavioral & Experimental Agri-Environmental Research (CBEAR), which was named a USDA Center of Excellence in 2019. I also serve as the Principal Investigator and Project Director of the NSF-supported projected entitled, "Water in the Changing Coastal Environment of Delaware". In these roles, I engaged students in cutting-edge research designed to provide increased understanding of basic behavioral issues and also provide a strong evidence base to inform agri-environmental policies **Impact**: Our research has many impacts, many of which are beyond the simple publication of the papers and presentations at academic conferences. A key outreach activity in 2019 was the development of educational materials for USDA that were used by FPAC and NRCS to explain the roll-out of the new Farm Bill provision and to develop new and improved ways of interacting with landowners to encourage greater enrollment in conservation programs	3. Personal & Economic Development
39.	**Using behavioral and experimental economics to better understand consumer decision-making** **Issue**: The primary goal of my research is to produce knowledge concerning contemporary issues at the nexus of food consumption and production. Researching these topics allows me to provide timely information to stakeholders about current and future challenges in the food system	**Response**: Conducted an experiment to determine the difficulty in reducing carbon emissions through the personal actions of reducing beef consumption and vehicle use and conducted focus groups to determine perceptions of gene-editing technology. **Impact**: These are now working papers	3. Personal & Economic Development
40.	**Delaware Nutrient Management Certification for Urban Horticulture** **Issue:** Many of Delaware's waters are impaired by excess amounts of nitrogen (N) and phosphorus (P), nutrients that come from non-point sources in agricultural and urban areas. From urban sources, these nutrients often stem from the use of fertilizers on lawns and landscapes.	**Response:** University of Delaware Cooperative Extension offers initial nutrient management certification training to urban horticulture professionals as required by law. State-wide training sessions are led by UD Cooperative Extension, with oversight by the Delaware Nutrient Management Commission and the Delaware Department of Agriculture. In 2019, UD Cooperative Extension offered initial certification sessions and one examination session specifically for the urban horticulture audience**.** **Results:** In 2019, twenty-one urban horticulture professionals attended the initial certification sessions for horticulture. Based on their certification pre- and post-examination, 15 of 18 tested and surveyed participants (83%) increased their knowledge of Delaware's nutrient management issues and certification requirements. The average knowledge increase was 31% for those attending both sessions I and II.	4. Environmental Stewardship in a Changing Climate

	To mitigate this issue, urban horticulture professionals who fertilize more than 10 acres of land (i.e., private nutrient handlers) or apply nutrients for a fee (i.e., commercial nutrient handlers) must become nutrient certified as mandated in the 1999 Delaware Nutrient Management Act. In addition, the Delaware Nursery and Landscape Association requires Livable Lawns certified businesses to employ a certified nutrient handler.	Evaluations were also conducted after each individual session. Here, respondents indicated they were responsible for nutrient management decisions on more than 1,257 acres of lawns and landscapes. Those surveyed also indicated they had gained skills as a result of attending the sessions. For example, 11 respondents (100%) indicating that they learned how to better interpret a soil test report. Willingness to adopt new or change existing management practices after attending the certification session was also measured using this survey: 6 respondents (55%) indicated that they would change how they manage turfgrass and 11 respondents (92%) indicated they would change the ornamental plants they recommend/plant for clients or their business. Ten individuals registered to take the Commercial Nutrient Handler examination, of which 7 (70%) passed and were certified as Commercial Nutrient Handlers with the Delaware Department of Agriculture. Eight additional individuals were newly certified as Private Nutrient Handlers. Recognition of sponsors, in-kind contributors or partners (please provide name, organization, what was contributed). Funding to support the Delaware Nutrient Management Certification program is provided by the Delaware Nutrient Management Commission.	
41.	**Healthy Forest, Health Farm, Healthy Family** **ISSUE:** According to the U.S. Department of Agriculture (USDA), approximately 27 percent of the State of Delaware (356,000 acres) existed as forestland in 2017. Of these acres, about 22 percent are owned by local, state and federal agencies with the remaining 78 percent in private ownership. The Delaware Department of Agriculture's Forest Service program provides technical assistance to large forest landowners, but this organization does not have the resources to address all issues and needs of those owning less than 10 acres of forestland. With	**RESPONSE:** Extension Agents and Specialists from both UD and Delaware State University collaborated with staff from the Delaware Department of Agriculture's (DDA) Forest Service to plan the 2019 Woodland Workshop, held during Delaware Ag Week. The "Healthy Forest, Healthy Farm, Healthy Family" theme was geared toward small forest landowners and managers in Delaware and the region. Talks focused on chainsaw safety and firewood selection, tick borne diseases, and personal and mental health resources that can help strengthen the overall vitality of an operation. The session concluded with a panel discussion about current and future forestry issues and needs in Delaware. Panel representatives included USDA, DDA, Delaware Center for Horticulture, Delaware's Urban and Community Forestry Council, and forestry consultants. **IMPACT:** The 2019 Woodland Workshop drew 38 participants, including forest landowners, forest managers, and public and private technical service providers. Following the event, participants were surveyed to measure knowledge gained and 15 responses were received (39 percent response rate). Of those surveyed: • Nine indicated that they own wooded lands within Delaware or the region (ranging in size from four to more than 110 acres) for 10 to 60 years, • Only two of the woodlands are currently under a forest management plan,	4. Environmental Stewardship in a Changing Climate

	development pressures, lack of forest product markets in the area and other management challenges around climate and pests, small forest parcels are particularly at risk of being lost	• Approximately 85 percent of those responding indicated that they learned something new about chainsaw use and safety, and • 62 percent will change how they operate a chainsaw to be safer and prevent accidents and injuries. Of those responding: • 75 percent indicated that they learned something new about firewood, • 36 percent will change how they use and select firewood in the future, • 100 percent of the respondents learned about tick borne diseases, • 92 percent indicated that they now know how to prevent or respond to a tick bite, • 85 percent of those responding learned how to strengthen health and farm vitality, and • 77 percent will change how they manage personal and family health. All responding found the panel discussion around forestry issues and needs valuable. The most prominent issues affecting Delaware forestry as listed by respondents include land conversion, alternative sources of income or niche enterprises from forests (ginseng, mushrooms, hunting), and forest health issues.	
42.	**Identification of Physiological and Genetic Mechanisms Underlying Heat Stress Response in Lima Bean** **Issue:** Baby lima beans are an important processing vegetable crop for Delaware farmers and large seeded lima beans are both a profitable fresh market crop and a potential processing crop. Heat stress causes delayed pod set, split sets and reduced yield in lima bean plantings that flower during high temperature conditions (usually in July and early August). In Delaware, lima bean growers and processors have identified heat stress as the major yield limiting factor for lima bean production.	**Response:** From 2016 to 2019, Emmalea Ernest, the Associate Scientist for UD Cooperative Extension's Vegetable & Fruit Program, carried out field, greenhouse and laboratory experiments to determine the physiological effects of heat stress on lima beans and understand the genetic architecture underlying this heat stress response. Ernest developed effective heat tolerance screening methods and used them to identify the heat tolerant lima bean varieties and landraces she would use as parents in the breeding program. These screening techniques were subsequently used to select heat tolerant individuals from diverse breeding populations. **Impact:** Analysis of data from eight years of past yield trials indicates that lima beans are most susceptible to high night temperature stress during their early flowering period. As a result, growers are now being advised to provide adequate irrigation, especially during this time period, in order to mitigate heat stress exacerbated by drought stress. In heat susceptible lima bean genotypes, heat stress causes the lima bean flowers to release less and/or lower quality pollen. Across a diverse set of more than 130 lima bean lines, the amount of pollen released under heat stress was correlated with lima bean yield under heat stress — i.e., the more pollen released under heat stress, the larger the yield under heat stress. The release of pollen was found to be controlled by only a few genes meaning that heat tolerance, in terms of pollen release, can be transferred to susceptible types of lima bean through breeding.	4. Environmental Stewardship in a Changing Climate

		In the course of screening a wide variety of lima genotypes for heat tolerance, other heat stress responses were noted. When exposed to ongoing heat stress, some types failed to fill seed after pollination and others had a loss of seed quality. Screening for these traits under heat stress is important for maximizing yield and for the quality of heat tolerant lima bean varieties being developed in the UD breeding program. **Recognition of Sponsors:** This work was partially funded by two Specialty Crop Block Grants administered by Delaware Department of Agriculture entitled "Investigation of Genetic and Physiological Factors Underlying Heat Tolerance in Lima Bean and Development and Selection of Heat Tolerant Lima Bean Breeding Lines" and "Development of Lima Bean Varieties with Resistance to Downy Mildew, Root Knot Nematode and High Temperatures".	
43.	**Improving Access to Turfgrass Management Programs** **Issue**: Some turfgrass managers who are certified by the Delaware Nutrient Management Program have indicated that they find it difficult to maintain their nutrient management and pesticide certifications. A different approach is needed to assist this segment of the turfgrass management community in order to better address current issues facing the horticulture industry.	**Response**: This was a great opportunity to offer a different type of program geared toward those who find it challenging to obtain their continuing education credits. The new Turfgrass Management Program premiered in New Castle County on Dec. 6, 2019 led by Erik Ervin and Kerry Richards of the University of Delaware and Amy Shober of University of Delaware Cooperative Extension. Topics presented included best management practices for turf managers, soil health on new construction sites and reducing pesticide mishaps. Recertification credits in Delaware, Maryland and New Jersey's nutrient management and pesticide programs were offered to accommodate those who work in Delaware as well as the surrounding states. Registration for this program was $15. **Impact:** Forty-one turfgrass managers attended the program, 35 of whom complete at least some part of the program evaluation. Participants reported that they manage an average of over 7,700 acres of turfgrass. When asked if they learned anything new during the program, participants reported that 94% (33) learned something new about best management practices for turf managers, 88.5% (31) learned something new related to regaining soil health when construction is over and 85.7% (30) learned something new about ways to reduce pesticide mishaps. Participants were also asked if they would implement or change a practice based on the information they learned during the programs. One-hundred percent (34) of participants agreed that they will implement best management practices, 80% (24) said they will change how they manage soils on new construction sites and 77% (27) indicated that they will implement or change how they handle pesticides.	4. Environmental Stewardship in a Changing Climate

44.	**Oyster Aquaculture** **Issue**: Promoting oyster aquaculture in Delaware Inland Bays to restore habitat and to enhance the economy. Delaware is the last state on the Northeast Atlantic seaboard with commercial shellfish aquaculture. Legislation is still developing policy and protocols for successful implementation, as the push for legalized aquaculture grows. Neighboring states have shown the economic and cultural benefits of this functioning industry. Three inland bays in southern Delaware, due to protection from open waters and ease of access for workers, offer promising future locations for bottom leases. Oysters are functionally extinct within the bays and with the rapid development of the local watershed, the ecological services oysters contribute are more important than ever. Oyster aquaculture can help restore depleted wild populations of oysters while filtering the water, providing structural habitat, and creating new jobs. There is a unique opportunity to study directly how aquaculture facilitates restoration, but baseline statistics are essential. The research aims to further understand the current oyster population by 1) developing baseline population locations and standardized survey methods to be used as a management to measure changes over time and 2) investigating	**Response**: This multi-institutional effort to grow and enhance oyster growth using aquaculture gears in the bays has provided baseline data to the policy makers and resource managers to pass legislation to promote commercial oyster aquaculture practices in the Delaware Inland Bays (DIB). Our 14 years of oyster restoration effort by using oyster aquaculture gear provides baseline information on the ecological value of oyster aquaculture in Delaware's Inland Bays. We have been using seed oysters that belong to a disease resistant line that was developed at Rutgers Haskin Shellfish Research Laboratory (NEH). We found newly settled juvenile oysters within floating oyster gear in man-made, residential canal systems, and on riprap shorelines around the DIB. **Impact**: The effects of aquaculture and continued enhancement efforts in this lagoon system, both on the oyster population and on associated fauna become clearer with continued monitoring and improved water quality in the bays. Many species of economic and ecological importance are considered habitat-limited in the Inland Bays, particularly regarding juvenile refuge and forage areas. Oyster aquaculture gear provides habitat for these native estuarine fauna at small scales, while supplementing oyster spawning stocks and enhancing natural recruitment, without difficult and costly types of habitat modifications. The DIB's wild oyster populations are poorly understood due to their rare occurrence in the system. Its' unique genome has been compared to spat collected in the field in order to determine if there is any contribution to the local populations. Microsatellites, a repeat base pair sequence in a non-coding region of the genome, can be a powerful tool for analyzing population genetic diversity. Short, highly polymorphic regions provide the best candidates to detect change over relatively short evolutionary time. A knowledge gap of the native oyster population abundance and distribution exists. Intertidal surveys of the rip-rap were used to develop possible source sink dynamics previously. This has allowed us to identify current locations and densities of oysters throughout the DIBs.	4. Environmental Stewardship in a Changing Climate

	population dynamics by analyzing genetics of spat fall within the Delaware Inland Bays. This project aims to establish baseline measurements to quantify population abundance change over.		
45.	**Master Gardener Training** **Issue**: Master Gardener Training 2019 The Master Gardener training course is an intensive14–week course designed to prepare Master Gardener candidates for the volunteer phase of the program. Master Gardener training does not end with the formal training course. Each Master Garden candidate must dedicate 30 hours of their pre-agreed to 45 hours of volunteer time to the Garden Helpline. In addition, they must receive 5 hours of advanced training to be qualified as a Delaware Master Gardener. Training was held in Kent and Sussex County in 2019.	**Response**: Master Gardener training includes topics such as: plant identification, soils and plant nutrition, plant growth and propagation, integrated pest management, diagnosing plant problems, home landscaping and maintenance, disease control, turf management, fruit and vegetable production, plant selection, education methodology, program design and evaluation, and presentation technology. Master Gardener training does not end with the formal training course; advanced training opportunities include state, regional, and national workshops, lectures at monthly business meetings, special training sessions, and the shared experiences of a group of skilled, experienced gardeners. The Delaware population has increased due to many individuals that have relocated here and/or moved to a new home they have many questions and concerns regarding home landscapes (native and invasive plants), lawns, interior and exterior pests, vegetable, flower, and/or herb gardening, wildlife problems or habitat enhancement and water conservation. It is important to have highly trained volunteers, Master Gardeners, to help meet the growing calls that come in daily the county Extension offices. The partnership is between DSU and UD Cooperative Extension, and both Universities had professors teach some of the classes for the trainees. The classes were held twice a week, alternating between Kent and Sussex Counties. They also used the DSU Greenhouse and the Herbarium for a couple of the training sessions. In November 2019, thirty- one Master Gardener candidates completed their formal training and were prepared to begin their pre-agreed to forty-five volunteer hours to Delaware Cooperative Extension for Kent and Sussex Counties. Once they have completed their 30 hours on the Garden Helpline and a total of forty-five hours plus the 5 hours of advanced training, they obtain their Delaware Master Gardener title. There was a total of 12 Kent County Candidates and 19 Sussex County Candidates. **Impact**: A total of 31 Master Gardener Candidates completed the training for Kent and Sussex Counties. This year the training class is made up of the most diverse volunteers we have ever seen in the history of the program. The coordinator tried some out of the box techniques to try to target some minority volunteers by promoting as some local events, advertising in the newspaper and reaching out to the DSU Alumni	4. Environmental Stewardship in a Changing Climate

		association. The coordinators are really excited to see what new experiences and opportunities are in the future for the Delaware Master Gardener Program in 2020	
46.	**Kent County Master Gardener Helpline** **Issue**: Kent County Master Gardener Helpline Services 2019 The Kent County Helpline runs from April thru October for Kent County residents. Each year clients call with gardening questions for the Master Gardeners working the helpline.	**Response**: The purpose of the helpline is to help individuals make informed decisions about plants and to protect and conserve the natural resources of the state by promoting sustainable practices. The helpline is designed to use horticulture to empower gardeners, develop partnerships and build stronger community awareness. In 2019, the Kent County Master Gardener volunteers helped nearly 400 residents of the Kent County area answer their gardening and home horticulture needs. The Master gardeners rely on researched based information from Cooperative Extension and its partners. All information presented to the public must come from research and tested sources. The questions that come thru the Master Gardener Helpline range from plant identification and disease issues to growing requirements and plant spacing questions. Turf, Insect, and small animals may be some of the topics discussed on the helpline services. Impact: The Master Gardener Volunteers have been educated on many topics during their initial training and rely heavily on Extension Educators for their expertise. This service is truly an asset to the Kent county community.	4. Environmental Stewardship in a Changing Climate
47.	**Coastal Resilience by Design** **Issue**: Working with Delaware communities to develop long range conceptual designs to address issues related to sea level rise and intensifying storms. This is important because Delaware is a low lying coastal state and many towns are unable to pay for master planning to help them secure grant funding to make significant changes to infrastructure.	**Response:** I created the Coastal Resilience Design Studio. Undergraduate and graduate students from diverse majors (landscape architecture, environmental and civil engineering, and public policy) work together on teams to create master plans for Delaware communities. **Impact**: We completed a pilot project in Lewes, DE and are ready to install a shoreline stabilization and meadow project. We have a second contract with Lewes as well as contracts with Frederica and Little Creek to develop master plans. All plans require agency coordination and we partner with various state agencies such as DNREC, and DelDOT to give students practice on presentation skills and high-quality feedback loops. In a spin-off project we created a citizen science application for the public to upload geo-located images of flooding and storm related issues. We are collecting data with the Coastal Observer App to share with other scientists interested in tracking areas of extreme flooding	4. Environmental Stewardship in a Changing Climate
48.	**Role of Carbon Sequestration with Soil Minerals** **Issue**: Soils are one of the most important components of Planet Earth which bind (sequester) large amounts of carbon. One of the main mechanisms of the sequestration is	**Response**: We studied how carbon binds to soil using an array of studies in the laboratory and at national labs. At the latter, we employed strong X-rays such that we could investigate the binding mechanisms at the molecular i.e., small spatial scales. We wanted to see what components of soil, e.g., aluminum and iron oxides and clay minerals, were most important in sequestering the carbon.	4. Environmental Stewardship in a Changing Climate

	complexation with soil minerals such as iron-oxides. Through this sequestration, carbon is kept in the soil and not released to the atmosphere. This helps to mitigate the amount of carbon dioxide emanating into the atmosphere which helps to lessen the deleterious impacts of climate change on people and on environmental and agricultural sustainability	**Impact**: We found that iron-oxides were the most important component in the soil for strongly binding carbon. Clay minerals, while less important, served as important binding sites for the iron oxides to sequester the carbon.	
49.	**Promoting oyster aquaculture and artificial reefs in Delaware Inland Bays to restore habitat and enhance economy** **Issue**: Delaware is the last state on the Northeast Atlantic seaboard with commercial shellfish aquaculture. Legislation is still developing policy and protocols for successful implementation, as the push for legalized aquaculture grows. Neighboring states have shown the economic and cultural benefits of functioning industry. Three inland bays in southern Delaware, due to protection from open waters and ease of access for workers, offer promising future locations for bottom leases. Oysters are functionally extinct within the bays and with the rapid development of the local watershed, the ecological services oysters contribute are more important than ever. Oyster aquaculture can help restore depleted wild populations of oysters while filtering the water, providing structural habitat, and	**Response**: This multi-institutional effort to grow and enhance oyster growth using aquaculture gears in the bays has provided baseline data to the policy makers and resource managers to pass legislation to promote commercial oyster aquaculture practices in the Delaware Inland Bays (DIB). Our 14 years of oyster restoration effort by using oyster aquaculture gear provides baseline information on the ecological value of oyster aquaculture in Delaware's Inland Bays. We have been using seed oysters that belong to a disease resistant line that was developed at Rutgers Haskin Shellfish Research Laboratory (NEH). We found newly settled juvenile oysters within floating oyster gear in man-made, residential canal systems, and on riprap shorelines around the DIB. The effects of aquaculture and continued enhancement efforts in this lagoon system, both on the oyster population and on associated fauna become clearer with continued monitoring and improved water quality in the bays. Many species of economic and ecological importance are considered habitat-limited in the Inland Bays, particularly regarding juvenile refuge and forage areas. Oyster aquaculture gear provides habitat for these native estuarine fauna at small scales, while supplementing oyster spawning stocks and enhancing natural recruitment, without difficult and costly types of habitat modifications. The DIB's wild oyster populations are poorly understood due to their rare occurrence in the system. Its' unique genome has been compared to spat collected in the field in order to determine if there is any contribution to the local populations. Microsatellites, a repeat base pair sequence in a non-coding region of the genome, can be a powerful tool for analyzing population genetic diversity. Short, highly polymorphic regions provide the best candidates to detect change over relatively short evolutionary time. A knowledge gap of the native oyster population abundance and distribution exists. Intertidal surveys of the rip-rap were used to develop possible source sink dynamics previously. This has allowed us to identify current locations and densities of oysters throughout the DIBs.	4. Environmental Stewardship in a Changing Climate

	creating new jobs. There is an unique opportunity to study directly how aquaculture facilitates restoration, but baseline statistics are essential. The research aims to further understand the current oyster population by 1) developing baseline population locations and standardized survey methods to be used as a management to measure changes over time, 2) investigating population dynamics by analyzing genetics of spatfall within the Delaware Inland Bays. This project aims to establish baseline measurements to quantify population abundance change over, 3) investigating ecological and economical benefits of establishing aquaculture farms, and 4) creating artificial reefs to monitor ecological benefits of establishing viable oyster population	Most recent efforts focus on monitoring water quality and oyster growth in newly established oyster farmers and compare the ecological parameters with newly formed artificial reefs. Land use related stressors on water quality, oyster growth, artificial reef and aquatic species diversity are being monitored through isotope analysis of N and C. **Impact**: Years of program efforts generated valuable research data confirming the ecological and economic values of oysters in Delaware. Oyster growth and survival data have been promising during our restoration-based aquaculture assuring commercial aquaculture industry to flourish. Various gear types promote oyster growth and enhance aquatic species diversity while off-bottom gears provide better growth for oysters in the bays. Remote set practices and spat fall surveys along the Delaware Inland Bays confirm that water quality conditions promote potential seed production for oyster aquaculture in the bays. Oyster population assessment in Delaware Inland Bays shows different oyster populations confirming diverse genetic pool of the existing oysters in the bays. Finally, surveys along the rip-raps in Delaware Inland Bays provide detail assessments of the bays with highest oyster population recorded in the Indian River Bay. We have monitored positive correlation between increased oyster population and improved water quality, between the oyster farmers and artificial oyster reefs and increase aquatic species in and around them. Currently, we are analyzing water, oyster and sediment for isotope analysis for C and N to identify the land use stressors for water quality near oyster farmers and artificial oyster reefs. As part of the species diversity monitoring, we have been monitoring predatory species for oysters and fouling organisms that will become potential threat for oyster growth and survival in Delaware Inland Bays.	
50.	**Systematic Evaluation of Biochar Amendment for Improving Soil Health and Plant Growth** Issue: Healthy soil is the foundation of a sustainable agricultural ecosystem. Practical land management measures are needed to effectively sustain and improve the overall health of agricultural soils. Future agricultural professionals have to be prepared with soil health strategies and techniques. Biochar	**Response**: Laboratory, greenhouse, and field experimental trials were conducted to systematically assess the potency of different biochar application programs for ameliorating soil physical, chemical, and biological properties and the overall soil health. Faculty and graduate students attended soil health training workshops and soil health professional conferences to learn the science of soil health including the connotation of soil health, soil health assessment systems, and soil health improvement techniques. **Impact**: The soil health training and education capacity was built through the project efforts. Soil health teaching materials and training modules were developed. The soil health content was integrated in existing curriculum and delivered to students through lectures, hands-on exercises, and internship projects. It was clear that the efficacy of biochar amendment for improving soil properties and enhancing soil health was	4. Environmental Stewardship in a Changing Climate

	amendment has been explored as an effectual approach for persistently improving soil health and plant growth, yet the existing research results are not consistent due to the great variability of biochar-soil testing systems. It is necessary to develop appropriate biochar application programs that can achieve the desirable soil health-enhancing effects	determined by the biochar source, amendment dosage, and placement in soil and influenced by the soil type and characteristics. Both biochar and soil need to be considered in designing biochar application programs for immediate plant growth promotion effects and long-term soil health improvement effects	