2020 Annual Report of Accomplishments and Results

NEW HAMPSHIRE
University of New Hampshire Cooperative Extension (UNHCE)
New Hampshire Agricultural Experiment Station (NHAES)

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)

See POW.

The impact statements selected for this FY2020 report fall along themes within each of our four critical issue areas, as described below. It is hoped that this approach helps to tell a story about how the research and extension efforts at the University of Delaware and Delaware State University work collaboratively and complimentarily to address the social, economic, and environmental issues facing our state. Additionally, due to the unprecedented disruption caused by COVID-19, we have also selected within each critical issue area a few impacts that feature the resiliency of our staff. These impact stories demonstrate their commitment to innovate programming to continue providing high quality education and outreach to Delawareans during the pandemic.

Within our Sustainable Production Systems for Agriculture and Urban Landscapes critical issue area, we have focused on impacts that feature work done on best practices in production. 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. With more than 7.7 billion people in the world, farmers are tasked with producing more food on fewer acres in manner that limits environmental degradation. This requires continual improvements in practices to maximize yield, maintain profitability, and efficiently and effectively use inputs. Impact stories feature the research and extension activities around bee health, weed management, pest management, resilient plant properties, practices to improve animal health, and research to support a new aquaculture industry in the state. These activities help to identify and promote the best practices keep our producers profitable and competitive and meeting consumer demands for food and ag products.

We have focused on research and extension activities to address food insecurity and food safety within our Nutrition & Wellness critical issue area. Given the food demands described above, it is not only necessary to produce enough food for the world population but also necessary to explore new crops for local production, explore safe methods for food storage and distribution, and educate consumers on safe food handling practices. Given the disruptions to food systems and changes in food purchasing habits by consumers in response to COVID-19 this issue was especially critical in 2020. According to a 2019 USDA report (Coleman-Jensen et al., 2019), more than 37 million people, including more than 11 million children, lived in a food insecure household before COVID-19. It is believed that these insecurities have been exacerbated by COVID-19 with disproportionate impacts to people of color. Additional pressures have been placed on food service industries because of the pandemic as capacities have been placed on indoor dining and consumer eating habits have transitioned to more take out and food preparation at home. Impact statements reflect UD and DSU research and extension efforts to improve food security and food safety within Delaware prior to and in response to the COVID-19 crisis.

Under the Personal & Economic Development critical issue area, impact stories feature efforts to build new skills in youth and adults. The 4-H program has a long history of youth skill building and creating new leaders. Exposing youth to careers in science, technology, engineering, art, and math (STEAM) has been identified as a critical need as these fields are expected to continue to grow in the future. And, adults still need support building their own skills to care for themselves and others. Again, the pandemic emphasized how critical these efforts are. Impact stories focus on efforts to create adult health insurance literacy, expand appreciation for STEAM fields in youth, and learn life skills and compassion for others in need.

Finally, under the Environmental Stewardship in a Changing Climate critical issue area, impact stories feature research and extension effort around climate adaptations and mitigations. Warming temperatures, changes to our precipitation regime, and rising seas are expected to impact nearly every walk of life from how natural systems function, to how our food and goods are produced, to where humans live, work, and recreate. Impact stories focus on efforts to identify crop varieties that are resilient to heat and drought, understanding contaminant and carbon cycling under changing climatic conditions, identifying opportunities for mitigating greenhouse gases on our natural and working lands and ecosystem services on these landscapes in Delaware, and efforts to make our coastal communities more resilient.

As mentioned previously, each critical issue area features impacts related to our institutions' response to COVID-19. Innovation has been at the forefront of Extension educational efforts during the pandemic. All extension programs have migrated to an online format with no lead time. The silver lining in COVID-19 is Extension's ability to be flexible and responsive and adapt as needed to continue to provide excellence in educational programming in an all-new format. Between UD and DSU, many hundreds of programs have been presented online since the pandemic began. UD Extension took this opportunity to enhance their web presence and now maintains a repository of online courses for individuals to watch asynchronously (https://www.udel.edu/academics/colleges/canr/cooperative-extension/online-courses/). We have continued to meet educational needs for certification in pesticides, nutrient management, and food safety at the level before COVID-19.

Coleman-Jensen, A., Rabbitt, M., Gregory, C., & Singh, A. (2019). Household Food Security in the United States in 2018, United States Department of Agriculture, Economic Research Service, Report Number 270.

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	In March 2020, UD Extension updated their Promotion Guidance document to more clearly articulate expected competencies for Agents and Specialists, especially those around program evaluation. Cooperative Extension has invested heavily in program evaluation to advance the scholarship of extension work. This has included contracting with the UD Center for Research on Social Policy to guide Extension in long-term program evaluation of critical issues such as food access and sustainability and leadership. As these evaluations are completed, the resulting reports will provide some of the first long-term, scholarly based evaluations completed by UD Extension and will be useful in informing our funding stakeholders of the value of their long-term investment in capacity of Cooperative Extension.
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	No Update

what you learned from your stakeholders.	

IV. Planned Program Table of Contents

V. Planned Program Activities and Accomplishments

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

No.	Title or Activity Description	Outcome/Impact Statement	Planned Program Name/No.
1.	**Healthier hives: Addressing information gaps in beekeeping** UD Extension Impact	**Issue:** During winter 2020, University of Delaware Cooperative Extension's Apiary Lab (UD Apiary Lab) and the Delaware Beekeepers Association (DBA) conducted a survey to identify information gaps among their members. The results identified gaps around the topics of overwintering colonies and disease monitoring. Because pests and pathogens are a consistent problem for beekeepers across the country, awareness about them and education about available tools to reduce their populations is key to helping colonies survive the winter. **Response:** Using the survey findings, UD Apiary Lab put together a series of informational videos on four topics relevant to the identified information gaps: overwintering, supplemental feeding, apiary location choice and pest and pathogen monitoring and treatment. Extension agents held a webinar for the DBA, featuring a screening of each video and question and answer session. The club also received recordings of the videos put on their website as educational information for members. **Results:** Many DBA members responded by sharing their treatment and wintering methods and talked about how they could modify their practices. They now have a baseline of the best management methods that they can use. The dissemination of sustainable management options is leading to more consistent management of honey bee populations in Delaware.	1. Sustainable Productions Systems for Agricultural and Urban landscapes

2.	**Integrated Weed Management: Reducing herbicide resistance in the Mid-Atlantic** UD Extension Impact	**Issue:** Herbicide-resistant weeds were first reported in the mid-Atlantic region in the 1970s. For the next thirty years, new herbicides were discovered and marketed to provide alternative options to farmers and prevent yield loss. However, weeds have continued to evolve resistance to new herbicides and new herbicide mechanisms of action. As a result, farmers are spraying more herbicides and making additional herbicide applications, changes that increase production cost and management. Furthermore, without incorporating non-chemical tactics for weed management, farmers are at risk for increasing this troubling trend in herbicide-resistance. **Response:** In 2020, the Cooperative Extension services from the University of Maryland, Virginia and the University of Delaware planned and presented the "Integrated Weed Management Workshop," a two-day virtual training for farmers and ag-businesses. Training topics included: • What is herbicide resistance? • How to select herbicides based on mechanism of action, • Integrated weed management for problem weeds, • Local farmers' perspective on herbicide resistance management, and • Online exercises for creating a weed management plan. **Results:** Approximately 450 virtual participants attended the workshops, primarily connecting from within the Mid-Atlantic Region with additional connections throughout the United States. Out of this group, 155 individuals responded to the post-event survey. One hundred fifty-four of these participants indicated that the workshop increased their knowledge of herbicide-resistant weeds. One hundred twenty-seven affirmed that they would "be able to improve [their] weed control program in 2021," while five answered "not sure," and 22 said the question did not pertain to them because they do not farm or make recommendations. Accounting for increased yield reduced input	1. Sustainable Productions Systems for Agricultural and Urban landscapes

		costs, workshop participants who were farmers indicated that they placed this workshop's value at $4.50 per acre; the advisor/consultant participants set its value at $3.33. Based on survey results, the economic impact of this program was $2.9 million overall.	
3.	**Applied reseaarch and outreach on pest control mechanisms in high tunnels** DSU Extension Impact	**Issue:** During a high tunnel workshop of 49 attendees, 85% of them indicated concerns of pest management. High Tunnels present environmental conditions that are attractive to pests, yet these semi-open structures lend themselves to proven principles of Integrated Pest Management (IPM). Their limitation in size, high, plant density and diversity contribute to pest management challenges. **Response:** Over the last three years, demonstration Trials at Smyrna Outreach Research Center- High Tunnels explored; the use biologicals, incorporating banker plants for natural enemy conservation; the role of vertical planting in high tunnels; use of synthetic pesticides and soil solarization. Some of these activities were also carried out in various grower high tunnels in the 3 counties in Delaware. Year-long high tunnel temperatures were monitored in 5 locations in the state. A total of 3 grower workshops in the previous 2 years included a tour of the high tunnels. **Results:** Participants increased their knowledge on pest management in high tunnels with the following points hitting closer to home. Having a scouting program in place and knowing your insect pests and beneficials are important. Timing of release of biocontrols is key to the success of their use in pest management control. Temperatures are crucial for their activity. The use of banker plants certainly helps retain predators. Maintaining a water source in the high tunnel is important for ladybugs. Insect screens may be integrated as pest exclusion technique. Soil solarization is a better way of weakening and killing fungi, bacteria, nematodes, and insect and mite pests along with weeds. Use of pesticides that are compatible with biological control agents is encouraged.	1. Sustainable Productions Systems for Agricultural and Urban landscapes

4.	**Optimizing maize brace roots for lodging-resistance** UD Research Impact	**Issue:** Climate change is negatively impacting crop production by changing water availability (drought and flooding) and increasing the prevalence of crop mechanical failure (lodging) due to increasingly severe storms. US corn crop losses due to lodging are reported to range between 5% and 25%. Considering that corn is a $50 billion per year industry in the US and over $124 million per year industry in Delaware, crop loss due to lodging has a significant economic impact both locally and nationally. **Response:** In maize, roots called "brace roots" are suggested to function in structural support. We have developed (and continue to develop) novel tools to measure the mechanical properties of plants and determine the brace root properties that contribute to lodging-resistance. **Results:** Using one of these tools, my lab recently published the first direct demonstration that brace roots contribute to anchorage in maize (Reneau et al., 2020). We additionally have data showing that the contribution of brace roots to anchorage varies by genotype and environment (Hostetler et al., in preparation).	1. Sustainable Productions Systems for Agricultural and Urban landscapes
5.	**How does production stress affect intestinal development and function?** UD Research Impact	**Issue:** Optimal gut health and feed efficiency has become a central focus in the animal agricultural industry. Practice induced early life stress (weaning, delayed feeding, transport) affects intestinal development, which lead to impaired growth rate, feed efficiency, and increased health cost that is observed throughout the animal's production lifespan. Therefore, a closer look at basic gut biology in pigs and poultry and how it changes during the stressors of production will be critical to design new strategies to achieve optimal gut health and overall production efficiency. **Response:** Two trials in modern broiler chickens have been done investigating the effect of early post hatching feed restriction on the intestinal development and function. Intestinal functional assessment of	1. Sustainable Productions Systems for Agricultural and Urban landscapes

		barrier function and nutrient transport function have been tested on the unique Using chamber system. Intestinal crypt derived enteroids culture have been developed to evaluated intestinal stem cell activity and its role in regulation intestinal development. **Results:** Early life stress impaired the barrier and nutrient sensing function of small intestine in broiler chickens up to day 42 of age. The enteroids forming ability, proliferation and size of enteroids were all repressed in stressed birds. Supplementation of glutamine tended to restore stress induced damage in enteroids in vitro. Our data generated preliminary data for future target of intestinal functional improvement as well as potential nutritional strategies mitigating stressed induced production lost in poultry industry.	
6.	**Educating small ruminant owners on parasite controls to minimize deaths and improve growth** DSU Extension Impact	**Issue:** There is an urgent need for small ruminant producers to gain information on the best ways to manage their herds/flocks to control or reduce the impact of internal parasitism on their farm. Additionally, they all need to be aware of current recommendations for treating animals with parasitic infection. Learning to control these parasites are detrimental to small ruminant production as they can limit growth and cause death. **Response:** In response, during spring and summer 2020, Dr. Kwame Matthews (Delaware State University) collaborated with University of Maryland (Susan Schoenian), Virginia State University (Dr. Dahlia O'Brien), and Fort Valley State University (Dr. Niki Whitley) to develop and implement an online webinar series. We hosted 8 zoom webinars where each of us as small ruminant specialists presented two topics. This allowed us to inform our clientele within Delaware, Virginia, Maryland, and Georgia how to effective control internal parasitism on their farm. Since this was a virtual series, we had attendance from small ruminant farmers nationally and internationally. **Results:** We had approximately 980 participants out of the 1,800 that registered. Of these participants approximately 95% percent of them learned information that they could use on their farm to improve	1. Sustainable Productions Systems for Agricultural and Urban landscapes

		production and management. About 87% of these producers also indicated that they will practice some of the new strategies learned and plan to implement the knowledge gained on their farm.	
7.	**Shellfish Culture for Sustainable Living** DSU Research Impact	**Issue:** Delaware recently initiated a shellfish aquaculture enterprise with the issuing of shellfish leasing areas beginning in December 2017. Presently, 38 acres have been leased for shellfish aquaculture, primarily eastern oyster (Crassostrea virginica), in Rehoboth Bay. In addition, the Delaware Center for Inland Bays established two pilot artificial oyster reefs within Rehoboth Bay beginning in 2019 in an effort to restore the functionally extinct native oyster population. The economic and cultural benefits of a thriving shellfish aquaculture industry are well known, and both shellfish aquaculture and wild oyster populations improve local water quality while providing valuable habitat for fish and invertebrates. The economic viability of oyster aquaculture, and the successful establishment of newly planted oyster reefs, depend on suitable oyster growing conditions that promote high survival and rapid growth. Oysters can be sensitive to water quality conditions including temperature, salinity, and turbidity; better monitoring of these conditions can inform aquaculture and restoration practices. Furthermore, there are extensive and changing land use practices within the Rehoboth Bay watershed that can affect water quality downstream. For example, fertilizer applied at agricultural sites and effluent produced by wastewater treatment plants can pollute the Bay with excess nutrients with potential harms to growing oysters. This project aims to enhance oyster aquaculture and restoration efforts by monitoring the growing environment within Rehoboth Bay, and to further characterize the impact of oyster aquaculture and oyster restoration on local fauna. Monitoring efforts include 1) monitoring water quality using a variety of field equipment and lab analyses 2) determining carbon and nitrogen stable isotopes in water, marine sediment, terrestrial soil, and oyster tissue and 3) identifying fish and invertebrates residing at locations of oyster aquaculture/ restored oyster reefs.	1. Sustainable Productions Systems for Agricultural and Urban landscapes

		Response: We began monitoring water quality in Rehoboth Bay for this project in 2019. When conditions permitted, we visited up to seven sites in Rehoboth Bay each week, including sites of oyster aquaculture, artificial oyster reefs, and nearby locations without oysters. Water quality was monitored using handheld instruments to determine surface water temperature, conductivity, salinity, pH, dissolved oxygen, turbidity, and chlorophyll a concentration. Water samples were collected for lab analysis of total suspended solids (TSS), nitrate, nitrite, ammonia, and orthophosphate. This year, we additionally deployed up to four long term continuous multiparameter water quality instruments (sondes) at some of these sites. At 30-minute intervals, these instruments record water temperature, salinity, pH, dissolved oxygen, and turbidity, providing a more continuous monitoring effort to complement the opportunistic field sampling. Our lab provided handheld water quality instruments to oyster shellfish farmers and instructed them on the use of the instruments. Farmers were asked to collect occasional water quality data at their growing plots when convenient. This was a pilot citizen science effort to strengthen collaborations with the aquaculture community and increase the coverage of water quality data collected for Rehoboth Bay. To track point and non-point nutrient pollution within Rehoboth Bay, we collected terrestrial soil, marine sediment, water, and oyster tissue samples for nitrogen and carbon stable isotope analysis. Samples were collected approximately once per month. Terrestrial soil was collected at various locations along the shoreline of Rehoboth Bay. Water and marine sediments were collected at the same sites that were visited for water quality monitoring. Oyster tissue samples were obtained from oysters provided by aquaculture farmers with leases located at various points around the Bay. Signature stable isotope ratios from upstream pollution sources remain largely conserved towards downstream impacted areas. Therefore, stable isotope analysis of these various media is expected to reveal links between potential pollution sources and sites. To characterize visiting fish and invertebrate community at	

		sites of oyster aquaculture, artificial oyster reefs, and locations without oysters, we deployed bags of oyster shells to the seven sites we routinely monitor. Two rounds of shell bags were deployed and were left on site for at least one month before being collected. **Results:** Two professional staff, three graduate students, and four undergraduate students contributed to the program. In 2019, we conducted six field outings, and in 2020, we conducted 16 field outings to Rehoboth Bay water sites and land sites for water quality and stable isotope monitoring efforts, with more than 600 water quality readings and water samples collected. In 2020, water, marine sediment, terrestrial soil, and oyster tissues were collected in three rounds for pending stable isotope analyses. Sondes had a combined monitoring period of nearly 8000 hours for multiple key water quality parameters at up to four sites. Sonde data suggest important differences in water quality among locations within Rehoboth Bay, with important implications for oyster growth and survival. Preliminary shell bag data indicate differences in the visiting biological communities among the different sites, and oyster recruitment was observed at the oyster restoration sites, but not at the sites without oysters. Commercial aquaculture and artificial oyster reefs have the potential to improve water quality, enhance local fish and invertebrate populations, and promote local economies. Our program will enhance these programs by describing the conditions under which these oysters grow and identifying possible pollution sources. These findings will inform aquaculture practices, restoration efforts, and regulation within the Rehoboth Bay watershed.	
8.	**Virtual learning opportunities help technical service providers reach continuing education goals** UD Extension COVID Impact	**Issue:** Agricultural production in the Mid-Atlantic Region is integral to local, regional, national and even international food systems. Accordingly, maintaining and improving this industry's productivity and competitiveness is critical for both producers and consumers. This industry faces many environmental challenges, necessitating education on best management practices (BMPs) that can minimize negative	1. Sustainable Productions Systems for Agricultural and Urban landscapes

		impacts on soil, air and water quality 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. Certified professionals are often considered to have the necessary education and expertise to appropriately advise clientele on agronomic practices. There are currently more than 300 active CCAs in the Mid-Atlantic Region (Delaware, Maryland, Virginia, West Virginia and New Jersey) who must complete continuing education in the four major competency areas each year. These competency areas include nutrient management, soil and water management, integrated pest management and crop management. Professional development is also available. Additionally, many states within the region have certification requirements for nutrient management and pesticide management, which also requires those certified to receive annual continuing education. **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 USDA's Natural Resources Conservation Service. This event addresses the continuing education needs of the CCA clientele group and also provides an opportunity for other regional agricultural clientele to receive continuing education for state-required certification programs. In 2020, the COVID-19 pandemic led to a temporary format change for the Mid-Atlantic Crop Management School: week-long virtual workshops took the place of the traditional three-day, in-person format. Four presentations were broadcast to registrants each day from Monday, Nov. 16 through Friday, Nov. 20, providing participants with 20 CCA credits and many state-level nutrient management and pesticide credits. Presentations covered all of the core CCA areas of four major competency areas. The 2020 virtual Mid-Atlantic Crop Management School drew in approximately 200 participants for each individual	

		presentation. Participants included crop consultants, extension educators, farmers and farm managers, agribusiness professionals, soil conservationists and state department of agriculture and environmental personnel. **Impact:** Following each virtual presentation, participants were invited to provide feedback via online surveys. Of those completing the evaluations, 97 percent of respondents (2,918 out of 3,136) indicated that they gained knowledge in the CCA core competency areas, and 93 percent (3,047 out of 3,145) indicated that they planned to use this information in the future to implement BMPs, advise clients, and more. Results show that the participants that responded to the survey consult on more than 310,630 acres in the Mid-Atlantic region. This group estimated the economic value of the information they received at up to $100 per acre, setting the overall economic impact of the event at up to $1.5 million. Of the 278 people who registered for Crop School in 2020, 150 indicated that they also attended in 2019. Of those, 74 (49 percent) stated that they made a change to their operation.	
9.	**Reducing the spread and mitigating the infection of SARS-CoV-2 within small-scale, limited resource minority farms, food processing, and food service communities in the 1890 Land-Grant regional network** DSU Extension COVID Impact	**Issue:** Minorities are disproportionately being affected by the ravages of the current COVID-19 pandemic and deserve focused training to help mitigate fear and reduce viral spread. In the majority of states reporting COVID-19 data, Black people accounted for a higher share of confirmed cases (up to 4x higher) and deaths (up to 6x higher) compared to their share of the total population. A Pew Research Center survey reported that half of the Hispanics questioned said they or someone in their household had either lost a job or taken a pay cut, or both, because of the outbreak. This number is significantly higher than the national average of 1/3. These examples underscore a broader trend showing that coronavirus isn't an equalizer but a magnifier of inequality. Many differences in health outcomes seen in American minorities are produced by inadequate time to prepare healthy foods at home, inadequate money thus working three shifts, and battling really high stress levels. Minority communities are shouldering the heaviest burden	1. Sustainable Productions Systems for Agricultural and Urban landscapes

		of the COVID-19 pandemic and deserve the focused support offered by the 1890 Land Grant Institutions. In the current pandemic, news reports are generating panic about a failing U.S. food system as crops go unharvested, food prices rise, and grocery store shortages of meat and poultry make headlines. But the coronavirus pandemic did not create a vulnerable and unstable food system, it merely exposed it so more Americans can see it plainly. In light of the challenges faced by the food system during the COVID-19 pandemic, this situation can be viewed as an opportunity to highlight the importance of health and safety training to small and limited resource farmers as well as small-scale meat processors and food handlers. For the minority farmers it can be important to their survival that they recognize the availability and the urgency of timeliness to USDA Programs. The 1890 Institutions have found that when the underserved minority farmers are provided the necessary technical and financial support, they are able to maintain, and in many instances, increase their land productivity and profitability. Such training targeting food processing is of value to small-scale, limited resource minority farms; as well as continued educational training on financial planning and record keeping. **Response**: Delaware State University's, John Clendaniel took leadership of a team from nine 1890 Universities to develop, write and submit a $1,000,000 grant proposal to address this issue. Grant's Objectives: The primary goal of the project is to reduce the spread and mitigate infection of SARS-CoV-2 within small-scale, limited resource minority farms, food processing, and food service communities in the 1890 Land-Grant regional network. The specific objectives are: 1. To educate and train multiple users, focusing on: small-scale, limited-resource and minority producers and ranchers, small-scale packinghouses and processors, distributors, farmers' markets, CSA programs, and direct delivery on to consumers, small retailers, and small processors for the purpose of preventing the spread SARS-CoV-2 and mitigate infection and transmission of SARSCoV-2.	

		2. To Determine the socioeconomic impact of SARS-COV-2 on financial sustainability of local food supply chain in minority communities. These goal and objectives will be achieved through a collaborative process involving all nineteen, 1890 Land-Grant universities in the nation, the Telamon Hispanic organization, and in consultation with community organizations in the 1890 Land-Grant network. With measurable impact to slow the impacts of SARS-CoV2 on the target audience within 90 days and continued impact throughout the year-long proposed time. **Results**: This $1,000,000 proposal was selected as one of the 15 fully funded projects from the pool of over 400 proposals to be awarded. The team consists of representatives from every 1890 institution and currently we are wrapping of the curriculum for each area that we are training on as well as development of the research survey tool as well as the evaluation survey tool. We plan to start trainings in February 2021 and the project to be finalized by October 2021.	
10.	**Pawpaw As an Alternative Agriculture Enterprises in Delaware to Enhance Food Security** DSU Research Impact	**Issue:** Alternative agriculture enterprise of plant or livestock based could be the sustainable source of farm income for limited resource farmers of Delaware. Among many enterprises, the pawpaw (Asimina triloba) is one of the United States of America native fruits resembles flavor with tropical fruits banana, mango, and pineapple. The farming of the pawpaw as the US native fruit can be a profitable enterprise for limited resource farmers since the Pawpaw has been doing good in other parts of the US as it has both fresh market and processing appeal. **Response:** College of Agriculture, Science and Technology (CAST) of Delaware State University (DSU) started planting pawpaw during summer of 2019 in Outreach and Research Center of DSU located in Smyrna, DE. Before planting pawpaw in 2019, CAST, partnered with Pawpaw Research Efforts led by Kentucky State University. The purpose of the partnership was to conduct regional varietal trials to see the climatic impact on orchard establishment in north east regions. Total 60 plants have been planted in four rows and each row has 15 plants.	2. Nutrition & Wellness

		Plants are planted in 8 feet apart and row to row distance is 18 feet apart. Combination of 5 variety and 3 plastic tubes resulted 15 treatments which were randomized in 4 replication in Randomized Complete Block Design. The planted varieties are: 1. KSU-Atwood; 2. KSU-Chappell; 3. Shenandoah; 4. Sunflower; 5.Seedling rootstock and supporting tubes are: (a. no shelter; b. open mesh tree tube; c. solid tree tube) **Results:** Plants survival was observed during summer of 2020. Total 5 plants found dead. A plant found dead in first row (5a: seedling rootstock with no shelter; two plants found dead in second row (2A: KSU-Chappel with no shelter) and (5A: seedling rootstock with no shelter). Similarly, two plants found dead in third row (5B: seedling rootstock with open mesh) and (1A: KSU- Atwood with no shelter). No dead found in fourth row. This study shows that almost 92% plants have survived by the end of first year of pawpaw orchard establishment in Delaware climate which is at par with others findings in New England of USA.	
11.	**Spoilage and sensory observation of cinnamaldehyde and clove oil application to control microbial populations in catfish (ictalurus punctatus) and trout (oncorhynchus mykiss) fillet packaging.** DSU Research Impact	**Issue:** Seafood are highly perishable food products and serves as a major food source for the global community. Over fishing and storage issues serves as a major problem in ensuring demand for this food source. **Response:** I served as the major advisor for my graduate student where she investigated clove oil and cinnamaldehyde in seafood packing to identify under refrigeration to see if these natural extracts reduced and killed select spoilage organisms associated with seafood (strains of Aeromonas hydrophila, Shewanella baltica, Shewanella algae, and Pseudomonas fuorescens)and these oils influence on catfish and trout shelf life and overall quality. **Results:** These natural extracts have shown both bactericidal and bacteriostatic abilities in controlling the microbial population of spoilage	2. Nutrition & Wellness

		bacteria and total aerobic bacteria in absorbent food pads packaging of catfish and trout. The various degrees of the effectiveness of cinnamaldehyde and clove oil treatments as antimicrobials is attributed to their different chemical compositions. These natural preservatives have shown they can be used successfully in fish packaging to prevent and control bacterial spoilage of fish, while limiting adverse effects on sensory quality. The document has been submitted for a thesis topic and will also be submitted for an article publication.	
12.	**Development of a Point-of-use UV Appliance for Fresh Produce Decontamination** UD Research Impact	**Issue:** Over the last three decades, numerous outbreaks linked to fresh produce have occurred throughout the world. Current mitigation strategies are not very effective and focus mainly on produce processing facility. **Response**: A Point-of-use UV Appliance for Fresh Produce Decontamination was developed and evaluated. **Results:** The UV appliance was found to be effective for fresh produce decontamination. This appliance could be further fine-tuned and optimized to eventually construct a point-of-use UV appliance that can be used at home, cafeteria, restaurants, and hospitals for fresh produce decontamination and cleaning. The UV appliance could be an inexpensive and effective tool to improve fresh produce safety.	2. Nutrition & Wellness
13.	**Guiding produce growers marketers through the COVID-19 pandemic** UD Extension COVID Impact	**Issue:** Throughout the past year, wholesale and direct-marketing produce growers were impacted by the COVID-19 pandemic. Wholesale growers needed information on keeping their employees safe. Direct marketers needed advice about adjusting sales methods to protect both the patrons and employees of farm stands, farmer's markets and pick-your-own operations. **Response:** UD Cooperative Extension published two "Vegetable Grower" columns in the Delmarva Farmer, a regional newspaper that boasts a circulation of more than ten thousand copies. The first article, "Managing in a Time of Uncertainty," featured information on the basic	2. Nutrition & Wellness

		safety precautions necessary for produce growers and marketers. This article was also picked up nationally in the Vegetable GRowns News. Further, "COVID-19 and Wholesale Produce Farms" addressed issues facing the produce industry, such as alternative marketing strategies and organizing a safe work environment. Six articles were published in the "Weekly Crop Update," a newsletter and blog produced by University of Delaware Cooperative Extension read by more than 300 subscribers and accessed online by hundreds of produce growers and industry professionals. Topics included: • COVID-19 Considerations for Delaware Fruit and Vegetable Growers, • COVID-19 Resources for Delaware Producers and Food Providers, • Continuing Produce Sales with COVID-19 • COVID-19 Resource Links, • Gloves and COVID-19, and • Use of Face Masks Now Recommended for Reducing COVID-19 Spread. Dr. Gordon Johnson and Dr. Kali Kniel also advised the Lewes Farmers Market and the Delaware Farm Bureau on safely opening farmer's markets, recommendations that were incorporated into the statewide plan. Dr. Gordon Johnson and Dr. Kali Kniel incorporated COVID-19 information into a two to eight-hour Produce Safety Alliance Grower Training, with 37 attending remotely. UD Extension also provided 24 individual consultations with Delaware growers seeking expert advice on safely opening their farmer's market and establishing best practices for u-pick operations. **Results:** The published and presented information has reached more than one thousand growers and produce industry professionals. As a	

		result, safety improvements were made in sales practices, direct marketing and wholesale produce farm operations throughout the state. By helping farmer's markets and on-farm markets reopen safely, Delaware was able to protect an estimated $3 million in sales and prevent many COVID-19 illnesses.	
14.	**Safer Dining in Delaware: Education for Restaurants, Non-Profits and Entrepreneurs** UD Extension COVID Impact	**Issue:** Foodborne illnesses are a common and costly (yet preventable) public health issue. According to the Centers for Disease Control and Prevention (CDC), approximately one in six Americans (nearly 48 million people) get sick, 128,000 are hospitalized and 3,000 die of foodborne illnesses each year. Many foodborne illnesses, however, remain undiagnosed. For these reasons, the State of Delaware specifies that one person in charge of each shift at licensed food service establishments and individuals who want to produce certain foods from home must be certified in food safety. Many churches and other organizations that prepare food for the public also provide this education for their volunteers, though official training is not required. **Response:** The UD Cooperative Extension Family and Consumer Sciences program offers certification and food safety interest classes, including • Servsafe®, • Dinesafe, • Food Safety for Entrepreneurs, and • Would Your Kitchen Pass a Food Safety Inspection? In 2020, Servsafe® classes were scheduled monthly from January through November and Food Safety for Entrepreneurs was planned for April. Due to the COVID-19 pandemic, some scheduled classes were initially suspended, but due to their urgent nature, UD Extension made every effort to conduct these classes as safely as possible. Between March and December 2020, most courses were offered virtually, including Food Safety for Entrepreneurs, which included a final drive-up exam. In September, the University of Delaware granted permission to	2. Nutrition & Wellness

		resume in-person Servsafe® classes. Altogether, 13 classes were held throughout the year, including seven Servsafe® classes, one Dinesafe class, one Food Safety for Entrepreneurs training, and four Would Your Kitchen Pass a Food Safety Inspection? training sessions. **Results:** These courses served 221 individuals. • Nine individuals attended the Entrepreneur classes and all 9 passed the certification exam. • Eleven individuals attended a Dinesafe training program. • One hundred and ten individuals attended a Would Your Kitchen Pass a Food Safety Inspection? training sessions. • Ninety-one individuals attended Servsafe® classes and took the certification exam. Of those individuals, 68 passed the exam, becoming certified and meeting State of Delaware requirements. As a result of participating in a Servsafe® or Dinesafe class: • 85 percent will calibrate thermometers regularly, • 91 percent will thoroughly wash and sanitize all food surfaces, • 94 percent will wash hands properly, • 75 percent will cool foods more rapidly, • 85 percent will hold hot foods at or above 135 F, and • 88 percent will hold cold foods at or below 41 F.	
15.	**Sharing the Four Basic Food Safety Steps with Third Graders** DSU Extension COVID Impact	**Issue:** When most people think about food and health, they think about eating healthy and not food safety. Food safety is also very important. It is the steps you take to prevent bacteria from growing on food. This could lead to foodborne illnesses and even death. During the COVID, people are taking the necessary steps to prevent the spread of germs in the COVID-19 environment. These steps could also prevent the spread of bacteria on food. **Response:** Four virtual lessons were implemented with Jennie Smith's Elementary 3rd grade class. It consisted of the Four Basic Food Safety Steps which include Clean, Separate, Cook, and Chill using Fac Bac	2. Nutrition & Wellness

		curriculum. During these lessons, we perform experiments and show examples of real objects to keep the students engaged. **Results:** The 3rd food safety step is about cooking foods to the proper temperature. I showed meat in a pan with a thermometer. Some students have seen this before while others had not. When a picture of a thermometer showed up on a screen, a student suddenly became excited and ran and come back with a thermometer that resembled the picture. The student made the class aware that he rarely sees his parents using it. He was eager to tell his parents what he learned and what they should be doing. All the students became aware of this and its importance.	
16.	**Teaching Nutrition and Food Safety to Students Learning From Home** DSU Extension COVID Impact	**Issue:** In Delaware, more than 138,000 public school students were impacted by Gov. John Carney's declaration that school buildings remain closed for the rest of the 2019-2020 and the beginning of the school year 2021. Districts, schools, and educators shifted gears to serve students and families across the state remotely. With the Covid-19 pandemic putting Delaware in a state of emergency, school buildings were closed. Both teachers and state service centers that serve the school community faced a sudden transition into delivering 100% of their lessons online. Additionally, all community organization and after-school programs that we usually host additional extension programs were closed. We were tasked with delivering all of our programs virtually, so we had to develop new methods and ways of getting our Family Consumer Sciences program to our clientele. **Response:** Following school closer, teachers from New Castle and Kent County elementary schools contacted our educators to request nutrition education resources for the homebound students. Following this request, DSU SNAP-Ed educators were able to accomplish the following: 1) Provide nutrition education resources to students and parents; 2) Developed online nutrition education videos that contained pertinent information that corresponded to our state of a pandemic on various topics such as food safety, proper handwashing, and proper	2. Nutrition & Wellness

		food storage; and 3) Conducted nutrition education lessons via Zoom. Additionally, the EFNEP Program developed and delivered nutrition education through zoom and also designed and implemented electronic outreached material. We also developed a new recruitment strategy. **Results:** Over 900 SNAP-Ed participants were able to access the electronic materials that were developed to provide nutrition education. EFNEP participants were able to access nutrition education classes through zoom. Participants had access to more electronic nutrition education material compared to before.	
17.	**Pivoting SNAP-Ed outreach efforts in response to COVID-19 to to educate the public on purchasing and consuming healthy foods** UD Extension COVID Impact	**Issue:** In June 2019, an average of 126,974 individuals (representing 62,255 households) received SNAP benefits in Delaware. The SNAP-Ed program provides an opportunity to influence food resource usage, healthy food access and healthy food consumption of individuals and families eligible for these benefits. The COVID-19 pandemic provided opportunities to change educational strategies to match the shift in Delawarean's purchasing power and methods. **Response:** The pandemic led to a shift in how people purchased, used and consumed food. Many consumers stayed safe by shopping less often, which led to the challenge of stretching their food dollars a little bit further, utilizing emergency foods and finding resources (such as school meal sites) in their communities. To meet these new needs, UD Extension' SNAP-Ed team: • Developed a Produce of the Week campaign for social media to highlight the use of produce throughout the spring and summer, • Supported data-gathering related to emergency food assistance, • Reconsidered 2020 support for worksite wellness programs in light of quarantine restrictions, and • Adapted five middle school lessons to a virtual format. These changes helped UD Extension to reach more eligible Delawareans and teach them about purchasing and consuming healthy foods, particularly during a difficult time.	2. Nutrition & Wellness

		Impact: Seventeen social media videos and tips reached more than 8,200 viewers in total, averaging about 400 views per post. The most significant reach was for content related to strawberries — at more than 1,000 users! As a partner in local emergency food assistance work, an Extension scholar helped collect information about more than 220 emergency food sites mapped by the Institute for Public Administration. This information was used to inform conversations about the state of hunger and food insecurity in Delaware. The virtual Middle School lessons will be implemented in 2021 to accommodate the ongoing need to support virtual learning for both students and teachers. Additionally, a virtual walking program will be implemented in the spring to support worksite wellness efforts at Perdue Farms' Milford and Georgetown locations.	
18.	**Smart Choice/Smart Use: Increasing health insurance literacy in Delaware** UD Extension Impact	**Issue:** Most Americans are shown to be deficient in health insurance literacy, lacking a basic understanding of health insurance terms and how to use their plan. According to America's Health Insurance Plans, nearly 90 percent of adults have difficulty using available information to make an informed decision about their health. As a result, the Report on Economic Well-Being of U.S. Households indicates that in 2018, one in four adults skipped medical care due to cost and one in five was dealing with significant, unexpected medical bills. **Response:** In 2020, the University of Delaware and University of Maryland Cooperative Extension services collaborated on the Health Insurance Literacy Initiative (HILI) to offer free Smart Choice and Smart Use programs in Delaware and Maryland. These in-person and virtual programs aim to improve health insurance literacy: • Smart Choice Basics • Smart Use: Smart Actions	3. Personal & Economic Development

		• Smart Use: Essential Health Benefits • Smart Use: Understanding and Estimating Health Care Costs • Smart Choice: Smart Use Healthcare in Your Senior Years, and • Smart Use: Managing Health Insurance and Resolving Conflicts. **Results:** **Smart Choice Basics** was offered six times to a total of 65 individuals. Forty-three of these individuals also completed the post-event survey, indicating that the program significantly increased their confidence in understanding health insurance terms and applying knowledge and information to make a "smart choice." **Smart Use: Smart Actions** was offered five times and reached 49 individuals, 33 of whom completed the survey. The survey revealed that all 33 felt the program significantly increased their knowledge and confidence in understanding their healthcare coverage before receiving a service. **Smart Use: Essential Health Benefits** was offered twice, reaching 25 individuals. **Smart Use: Understanding and Estimating Health Care Costs** was offered twice, reaching 34 individuals. The twenty-eight participants who completed the survey indicated that the program significantly increased their confidence in estimating total health care costs and understanding health insurance terms. **Smart Choice: Smart Use Healthcare in Your Senior Years** was conducted 13 times, reaching 291 individuals. One hundred and five participants also completed the survey, indicating that the program significantly increased their confidence in understanding health insurance options and could estimate their total health care costs.	

		Smart Use: Managing Health Insurance and Resolving Conflicts was offered twice and reached 35 individuals. Of those, nine responded to the survey and felt that the program had significantly increased their likelihood to find the cost of a medical procedure before it occurs.	
19.	**Green Jobs Program and Itinerary - Enhancing Food Security for the Post COVID-19 Era** DSU Extension Impact	**Issue** As the demand for food production increases, the challenges to provide solid agricultural education to youth and adolescents increases as well. The challenges are even greater for youth from various underserved and economically-challenged communities—particularly in urban and inner-city communities. Minority youths in these areas have little interest in pursuing careers in the agricultural industry due to their limited access to plant and animal production systems. As a result, CAST at Delaware State University has adopted strategies and programs to deliver programs that stimulate agricultural science interest among youths and adolescents in theses areas. One of the major partnerships we develop is with the City of Wilmington`s Green Jobs Program The collaboration with The Green Jobs Program is, now in its nineth year, has introduced 510 youth participants from urban and underserved communities to agricultural sciences. The Green Jobs program provides 14-18-year-old Wilmington residents participants with six weeks of hands-on outdoor environmental work, career exploration, exposure to environmental issues, and mentoring. Participants work 25 hours per week and earn minimum wage. The program is coordinated by the University of Delaware Water Resources Agency and led by the City of Wilmington's Department of Parks and Recreation. **Response:** Delaware State University faculty, staff and students covered topics including, food and nutrition, aquaculture and aquaponics, small ruminant production (sheep and goats) high tunnel vegetable production, food science and technology (labelling, processing, chemistry), youth leadership, genetic and bioinformatics, food and nutrition including food safety. Participants also gained	3. Personal & Economic Development

		knowledge on the ongoing research and extension work that is going on at Delaware State University Thought the 3-day duration of the virtual webinar, students were informed about the list of degree and jobs option available in each field. Also, participants were informed on the range of degree options in the College of Agriculture, Science and Technology. In addition, participants were made aware on potential scholarship, internship and mentorship option that are available to high school students, and students at Delaware State University. They were informed on agricultural scholarship and work opportunities available at the United State Department of Agriculture. **Results:** Five of the 8 participants ages (14-19 years old) indicated that they may be interested in seeking a career of degree option in agriculture. Two have indicated they are interested in food science and technology and 3 have indicated they are interested in animal science and animal husbandry.	
20.	**Increasing knowledge of STEAM topics in 4-H afterschool youth** UD Extension Impact	**Issue:** Forbes author Barnard Marr believes students need increased science, technology, engineering, arts and math (STEAM) education to help them become better assets for a current and future labor force. This type of education is a priority in 4-H. In fact, according to the national 4-H organization, 4-H youth are twice as likely to have STEAM experiences than non-members. **Response:** Delaware's 4-H Afterschool Program prioritizes these STEAM experiences and offers hands-on opportunities to members in 12 schools and organizations across all three counties. Year-round STEAM activities include robotics, computer science, oceanography, engineering structures, biology, earth science, horticulture, performing arts, sewing, painting, poetry, mindfulness, music, hands-on experiments and more. **Results:** After participating in Delaware 4-H's STEAM activities after school and during the summer of 2020, 75 parents were surveyed and	3. Personal & Economic Development

		19 responded. The responses primarily represented the experiences of black elementary and middle school students: • 100 percent agreed 4-H increased their student's knowledge in STEAM and how it relates to the world. • 31 percent agreed virtual STEAM learning was an essential element of the program. • 37 percent agreed the STEAM packets mailed and delivered to their homes were an important element of the program.	
21.	**Increasing interest in STEM careers in 4-H afterschool youth** DSU Extension Impact	**Issue**: After school programs have been extremely important in providing exposure and learning in the areas of Science, Technology, Engineering, Agriculture, and Math. Many elementary students have not had the opportunity to work hands on with STEM projects throughout their typical school day. **Response:** Because of the lack of STEM programming DSU 4-H partnered with the Marbrook Elementary school program to provide STEM learning. Programming took place once a week with 20 youths. The programming was designed to be hands on, fun and engaging for students to learn about science and math with engineering principles. Programs ranged from building simple rockets, robots, along with a variety of other activities. Youth were given a survey during the first week of programming where 15 out of 20 youths stated they were not interested in STEM. **Results:** At the end of the program youth were once again surveyed with 20 of out 20 participants acknowledging an interest in STEM while possibly considering a career in STEM when they get older.	3. Personal & Economic Development
22.	**Establishing a satellite lab and Ag science program for teachers' educational development** DSU Research Impact	**Issue:** This project supports high schoolers and STEM teachers to introduce a food science for the new opportunity in academic and private sectors and support program/curriculum development in their schools.	3. Personal & Economic Development

		Response: We open outreach programs (summer camp and workshop) for students and teachers every year, as well as support a partner high school to develop a food science lab and program. **Results:** The area of food science and DSU food science program was introduced to high school students, parents, and teachers in Delaware. They have participated in the summer program and workshop successfully.	
23.	**Leaders of tomorrow: Skill development for a virtual world** UD Extension COVID Impact	**Issue**: In March 2020, Delaware 4-H transitioned to a virtual environment due to the COVID-19 pandemic. Program leaders worked hard to keep 4-H programming moving forward while also planning for the unknown. These challenges, however, also brought new opportunities to help 4-H youth develop leadership skills. A 2005 study published in the Journal of Labor Economics suggested that students who hold leadership positions in student organizations outperform their peers on scales of educational participation, career development and involvement in cultural and standard of living planning. In fact, the Social Science Computer Review found that virtual learning experiences optimize collaboration, group interaction and effective communication — all essential skills for our youth to develop as they move forward to college and the workforce. **Response:** Despite the change to a new virtual environment, Delaware 4-H was committed to ensuring teen leaders still had opportunities to build valuable leadership skills. To do so, program leaders organized training events to teach presentation, communication and leadership skills needed for virtual environments. Participants then took these skills and demonstrated them to their respective 4-H clubs. **Impact:** Forty-seven 4-H teens participated in the virtual programming events, each of whom demonstrated tremendous leadership growth and development. Post-program surveys revealed that:	3. Personal & Economic Development

		• 96 percent agreed they had all the equipment they needed to teach virtually • 24 percent strongly agreed and 64 percent agreed they felt prepared to teach a lesson or class virtually • 52 percent strongly agreed and 31 percent agreed they were successful in providing leadership in a virtual environment • 75 percent agreed that they would serve as a leader in a virtual environment in the future	
24.	**4-H goes virtual: Meaningful engagement online** UD Extension COVID Impact	**Issue:** The COVID-19 pandemic has proven to be more than a health crisis — it has changed our way of life. Youth nationwide have not only had to face a new way of learning in school but have also had to miss out on in-person social interaction and extracurricular activities: including the in-person opportunities through the Delaware 4-H program. But these changes can have devastating effects on young people. According to a 2020 article in The Current Opinion of Psychiatry, "[these changes] may be some of the factors that can increase anxiety, behavioral difficulties, and adversely affect child and adolescent mental health..." **Response:** Throughout 2020, Delaware 4-H worked hard to keep members engaged with meaningful opportunities in a virtual environment. Delaware 4-H did not miss a beat and was quick to switch to virtual programming for many events and activities, including demonstration contests, public speaking, summer camps and Delaware State Fair competitions. A variety of new virtual offerings were also developed to keep 4-H'ers engaged with their peers, such as virtual spirit month prompts, judging training and project area workshops about horticulture, photography, wildlife and STEAM. **Results:** After five full months of virtual programming (March to August 2020), Delaware 4-H surveyed participating members to help analyze the effect of this new type of programming. The survey received responses from 132 members:	3. Personal & Economic Development

		• 86 percent had access to the technology needed for virtual 4-H programs • 78 percent of participants were satisfied with our virtual program offerings • 57 percent participated in virtual summer camp activities • 44 percent participated in virtual judging training or project groups • 40 percent participated in virtual 4-H events (demonstrations or public speaking) • 52 percent participated in virtual State Fair competitions • 33 percent participated to keep a connection to their 4-H friends • 25 percent participated to learn, be engaged and have something to do • 79 percent indicated they would participate in 4-H virtual offerings in the future Although many expressed that they would prefer to meet in-person, a majority of participants indicated that they have continued to learn from these programs and will continue to take part in virtual activities. Delaware 4-H leaders are aware, however, of the difficulties of planning virtual events and activities at a time when many members are already attending school online and using screens throughout the day. Moving into 2021, program leaders will continue to explore additional safe alternatives to virtual programming.	
25.	**A mask making challenge to teach sewing and creative problem-solving skills** DSU Extension COVID Impact	**Issue:** Due to the COVID pandemic 4-H youths had to adapt to virtual club meetings. Youths were asked to identify types of activities they would like to participate in that would be relevant to the new normal. **Response:** The youth decided to participate in a 4-h mask making challenge. The program was conducted through Zoom on computers. The children were asked to make functional masks out of any materials available to them at home.	3. Personal & Economic Development

		Results: The youth were able to create masks out of a variety materials and techniques. Some children learned simple ways of sewing while others learned techniques on how to tie knots along with other ways to complete the task at hand. The program was able help the children use creativity to solve the problem of how to make masks.	
26.	**Engaging the 4-H network to aid families in need** DSU Extension COVID Impact	**Issue:** The pandemic has caused the loss of jobs and crippled society on the ability to provide simple things that we considered norm in the family structure. Outreach programs and organizations have increased their ability to provide food at no charge to those who are able to get to the locations of distribution. In many underserved communities the three healthy meals per day have decreased and the struggle to have food readily available is no more. The times in which your neighbor was able to help has decreased because the neighbor now has the same worry of where the next meal maybe coming from. There are so many other challenges for the family structure during this time of uncertainty. In an open zoom discussion among 4-H members and adult volunteers the concern of what can we do to help became a topic of discussion. **Response:** The 4-H group was divided into teams of responsibilities. The adults that volunteer, selected several households that would benefit from the unexpected outpour of surprised love and concern. During the research such as: the size of the family and family make-up; what the selected families actual needed to supplement their shortages; and location and availability of family transportation, the teams began their goal to provide the simple desires to assist the family through not so easy times. The groups partnered with a few local churches to see what is available. Several joint efforts were combined, and the drive began. The 4-H families were asked to stuff at least on large grocery bag with non-perishable food and another bag could also include toilet paper, paper towels, cleaning supplies, and masks. Once the 4-H families filled the bag or bags, they were asked to put the bag outside on their steps by the designated date and time and the volunteer would pick up the items and deliver to selected family by leaving it on their	3. Personal & Economic Development

		step or by their door. Once the items were delivered, the delivery person would knock on the door and return to their vehicle watching to see if the someone in the resident retrieved the package. **Results:** A total of 40 families were serviced throughout several neighborhoods. This number was based on how much was collected. A church food pantry was able to provide the meat to the families. The relief packages were aimed to assist families and have them not worry about a meal. It did not matter which meal of the day a family received. Transportation was provided by the volunteers within the neighborhood. The volunteers also re-bagged the donations to equally divide the food among the selected families. The food went to seniors' citizens as well. The 4-H program extended citizenship by being unselfish in this endeavor. The effort exemplified togetherness with the community. It demonstrated empathy, kindness and generosity. The 4-H teams played an unmeasurable role in their attempt to bring joy in the mist of storming times.	
27.	**Assessing willow leaf trait in lima bean for disease and stress avoidance** UD Extension Impact	**Issue:** Baby lima beans are an important processing vegetable crop for Delaware farmers, but heat stress, drought and diseases cause yield loss each year. A narrow leaf shape (willow leaf) variant exists in lima beans and this trait could be useful in helping plants to avoid stress and disease effects by altering the microclimate of the plant canopy in a way that makes it less conducive to disease development and helps the plant conserve water. However, the effect of the willow leaf trait on lima bean productivity and stress tolerance is unknown. **Response:** In 2019 and 2020, field experiments that included Near Isogenic Line (NIL) pairs (genetically identical except for the gene controlling the trait of interest) with and without the willow leaf trait were established at the UD Extension Newark and Georgetown research farms. The Newark plots were inoculated with *Phytophthora phaseoli* (which causes lima bean downy mildew) and rated for disease to determine if the willow leaf trait affected disease development.	4. Environmental Stewardship in a Changing Climate

		Georgetown plots were inoculated with *Phytophthora capsici* (which causes lima bean pod rot) to evaluate for avoidance of this disease. Additionally, in 2020 a plot with four of the NIL pairs was established at Georgetown to compare yield and other agronomic traits of the willow leaf versus typical leaf shape. Temperature and humidity loggers were placed in these plots to monitor plant canopy conditions throughout the season. **Results:** In 2019 and 2020, the willow leaf line for two of five NIL pairs had lower downy mildew disease severity ratings. For pod rot, disease did not establish well in the 2019 trial, but in 2020, disease severity was lower in the willow leaf line for three of five NIL pairs. Additionally, yield was significantly higher for the willow leaf lines in the 2020 pod rot trial, suggesting that disease decreased yield. In the uninoculated plot at Georgetown, yields of the NIL pairs were equivalent and not affected by leaf shape. The temperature and humidity loggers in the plant canopy yielded very interesting information about leaf shape effects on canopy conditions. Relative humidity was significantly lower in the willow leaf lines during the day. Canopy temperatures were significantly lower at night for the willow leaf lines but significantly higher during the day, except on hot, dry days. On hot, dry days, canopy temperatures were three degrees Fahrenheit lower in the willow leaf lines. This suggests that lower canopy humidity may help willow leaf plants avoid disease and that willow leaf lines may be less susceptible to both drought stress and the heat stress effects on photosynthesis which result from drought stress. Additional research is planned to confirm the effects seen in these studies and test willow leaf lines for yield in the annual lima bean variety trials.	

28.	**Impact of Climate Change on Contaminant Cycling** UD Research Impact	**Issue:** Rising seas and flooding, resulting from a changing climate, are an increasing problem in coastal, low lying states like Delaware. We are seeing increasing salinization of coastal land, impacting agriculture and people. How these impacts affect cycling of nutrients and metals is not well understood. **Response: We have been conducting studies in our laboratory with nutrients,** such as phosphorus, and metals such as arsenic, to simulate flooding conditions and salinization of soils at field sites. Both soils and important soil components, such as iron-oxides are being investigated. **Results**: As salinization increases we observe less release of arsenic from iron-oxides which we believe is related to competition from high sulfate in the sea water, impacts on microbial activity, and perhaps most of the arsenic being in an occluded form in the iron oxides. The studies with phosphorus and salinity are still on going and are inconclusive at this point.	4. Environmental Stewardship in a Changing Climate
29.	**Quantification and molecular characterization of organo-mineral associations as influenced by redox oscillations: Relevance in carbon cycling and stabilization** UD Research Impact	**Impact:** Understanding the mechanisms governing the dynamics of colloids and colloidal organic carbon in soils are critical for better predicting the cycling, transport, and stability of the colloids and associated organic carbon. **Response:** We conducted laboratory experiments and extensive field sampling from a wetland to quantify the amount and characterize the properties of soil colloids and associated organic carbon in multiple size fractions. **Results**: We confirmed that natural nanoparticles (NNP, 2.3-100 nm) and fine colloids (100-450 nm) fractions should be considered separately as opposed to combining them into the “dissolved” fraction following the conventional definition of 450 nm. Our findings provide new insights into the differences in the concentration and molecular composition of size-fractionated COC in a depressional wetland, both as	4. Environmental Stewardship in a Changing Climate

		a function of redox conditions as well as in soil depth. We published one article, completed one Ph.D. dissertation and have 2 more articles in preparation based on this research. Afsar*, M.Z., C. Goodwin, T.P. Beebe, Jr., D.P. Jaisi, and Y. Jin. 2020. Quantification and molecular characterization of organo-mineral associations as influenced by redox oscillations, Science of the Total Environment, 704 (2020) 1354549, https://doi.org/10.1016/j.scitotenv.2019.135454. Mohammad Afsar (Ph.D.) Quantification and molecular characterization of organo-mineral associations as influenced by redox oscillations: Relevance in carbon cycling and stabilization. Summer 2020, University of Delaware.	
30.	**Documenting the GHG benefits of Delaware's natural and working lands** UD Extension Impact	**Issue:** In 2020, the state of Delaware began developing its first statewide Climate Action Plan. This effort, led by the Department of Natural Resources and Environmental Control (DNREC), includes evaluating strategies for minimizing greenhouse gas emissions and maximizing climate impact resiliency. One of the areas of focus in Delaware's Climate Action Plan is "Natural and Working Lands." Natural and working lands — including forests, grasslands, croplands, wetlands and urban greenspaces — are landscapes that sequester carbon and provide significant and cost-effective opportunities to reduce greenhouse gas emissions. Many of these practices can also improve water quality, provide habitat for pollinator species and wildlife and increase resilience to climate change impacts. Enhancing carbon sequestration and storage on natural and working lands is an important strategy for achieving Delaware's climate goals. **Response:** To better understand the opportunities for climate action on Delaware's natural and working lands, DNREC contracted with the University of Delaware Cooperative Extension to research and prepare a summary report. The report highlights best management practices	4. Environmental Stewardship in a Changing Climate

		currently used in the state to promote environmental benefits and present opportunities for the maintenance and increase of carbon storage and sequestration on cropland, forests, urban greenspaces, and wetlands. The report also identifies current programmatic and numeric goals for the implementation of best management practices that will offset greenhouse gas emissions. **Impact:** Delaware's natural and working lands and the best management practices existing in these spaces already provide the benefits of sequestering carbon dioxide and reducing greenhouse gases in the atmosphere through avoided emissions on these lands. Various partner organizations have plans to implement additional practices in each sector to improve water quality, habitat and provide other natural resource benefits. These same practices could increase the greenhouse gas benefit of Delaware's natural and working lands. To retain these benefits, these lands and the practices implemented on them must be protected and remain in place. Beyond the next five-year time frame, additional opportunities exist to continue advancing implementation efforts on agriculture, forests, urban greenspaces and wetlands. Increased funding, technical support and outreach for the policies and programs that implement these practices will further advance these efforts. Additionally, new knowledge and data will become available in the future to aid in better characterizing the benefits these lands provide.	
31.	**Quantifying ecosystem services from wetlands in Delaware** DSU Research Impact	**Issue:** Understanding ecosystem services, or the many benefits to humans from ecosystems, are important to understand for making the best possible management decisions. For example, wetlands offer a myriad benefits, such as water purification, pollination of crops, biodiversity preservation, and nutrient treatment.	4. Environmental Stewardship in a Changing Climate

		Response: My lab is bringing together datasets from different sources to visualize the distribution of different kinds of ecosystem services from wetlands in Delaware. **Results:** This project is still in progress, but will offer information on what wetlands deliver the most benefits, and the project will produce products to plan future management actions (such as agriculture BMPs).	
32.	**Coastal Resilience Design** UD Research Impact	**Issue**: More than 40% of the U.S. population lives in coastal counties (Kildow et al., 2016; Neumann et al., 2015). By 2060, the number of Americans living in low elevation coastal zones will nearly double from the 2000 level. Flooding hazards to coastal communities and the built and natural coastal environments are increasing in scope and intensity. Damage to infrastructure and livelihoods manifests most dramatically in the devastation from acute and episodic events such as storms and nuisance tides, but ongoing degradation due to longer timescale climate change and sea-level rise (SLR) may ultimately cause more significant harm (NRC, 2008). **Response**: The Coastal Resilience Design Studio works with DE communities. Our focus is on designing green infrastructure to address coastal challenges that stem from historic decisions, human settlement, sea-level rise, and necessary compliance with water quality mandates. CRDS employs undergraduate and graduate students to work on behalf of select communities and calls on interdisciplinary experts to evaluate student work. Students develop environmental, social, and economic resilience strategies and present solutions to community and agency members. Ultimately, the studio hopes to challenge and drive policy to benefit coastal communities through more sustainable land use, planning, and education. **Results**: In 2020, we supported 7 full-time students (6 landscape architecture and 1 civil engineer), and we worked with 6 communities/agencies (Frederica, Little Creek, Lewes, Dover, NW	4. Environmental Stewardship in a Changing Climate

		Wilmington, and State Parks). Each project is in different phases but we complete conceptual designs for environmental improvements (specifically green infrastructure conceptual plans and planting plans), social and safety improvements (parks, walking trails, alternative transportation ideas), and economic improvements (micro-retail, site plans, and concepts for commercial districts and phased implementation plans). After the plans are delivered, we work with the town to contact the proper agency to start feasibility studies or next steps - and we stay connected as the project progresses.	
33.	**Improving knowledge of blue crab ecology to enhance their management within a changing estuary environment** DSU Extension Impact	**Issue:** One aspect of implementing an ecosystem-based management approach to wild fisheries is to understand the feeding ecology of target species, which provides hints as to the prey base necessary for sustainable harvest of a consumer species. The blue crab, *Callinectes sapidus*, is a bottom-dwelling decapod crab found throughout Delaware and the Chesapeake Bays. As a commercially important wild harvest fishery species, there is considerable interest in monitoring blue crab population levels and improving understanding of their ecology to enhance their management. Blue crabs are opportunistic omnivores with a broad potential prey base including plants, detritus, worms, bivalves, small fish, and even other blue crabs. It is expected that blue crabs in different locations would have different diets reflecting different available prey bases, which may be reflected in their growth, survival, and population size. Blackbird Creek, located in northern Delaware, is characterized by extensive salt marshes populated by saltmarsh cordgrass (*Sporoboros alterniflorous*, also known as *Spartina alterniflora*) and the invasive common reed (*Phragmites australis*). It is the only estuarine system in Delaware that has not been physically altered and is a National Estuarine Research Reserve System. Blackbird Creek hosts a widespread native blue crab population and local Delawareans routinely visit the creek for crabbing. However, as the shoreline of Blackbird Creek changes with the spread of the common reed, biodiversity within the Creek has declined. This highlights the need to better understand the	4. Environmental Stewardship in a Changing Climate

		feeding ecology of the blue crab within Blackbird Creek, to predict how the blue crab population will change under changing ecology, and to promote effective management of the remaining population. There are many ways to address the feeding ecology of a specific species. For this project, we focus on two complementary approaches: 1) Stomach content analyses which provide insight into prey items recently consumed by individual blue crabs, and 2) stable isotope analyses which, when taken from different target tissues, provide longer term trends on blue crab feeding ecology integrated over different time scales. The feeding ecology of blue crabs are compared among sites in Blackbird Creek that differ in the dominant shoreline vegetation, which may indicate differences in local biodiversity and available prey bases. **Response:** We collected blue crabs from five sites in Blackbird Creek using baited crab traps deployed overnight. These sites have been previously characterized by the dominant vegetation on the shoreline. Water quality data was taken onsite using handheld instruments, and water samples were collected for lab analyses of sediment and nutrient content. Collected crabs were frozen for stomach content analyses. Tissue samples will be taken for stable isotope analyses. **Results:** Two professional staff, three graduate students, and one undergraduate student contributed to the program. In 2020, crabs were collected on two separate occasions in early and late October. Prey items found in crab stomachs will be compared among sites. Carbon and nitrogen stable isotope ratios will also be compared among sites. Relationships between each crab's stomach contents and that crab's stable isotope ratios will be examined. Blue crabs are an important top predator within salt marsh estuary environments. They are also a valuable fishery for recreational and commercial operations. Our program will enhance our understanding of blue crab feeding ecology within Blackbird Creek, providing insight for the management of this valuable population.	

34.	**Virtual tours allow horticultural education at a distance** UD Extension COVID Impact	**Issue:** Each year, the University of Delaware Cooperative Extension designs and offers exciting and informative short courses to horticulture industry professionals in Delaware. Topics often include sustainable landscapes, plant selection and integrated pest management. These courses help satisfy pesticide and nutrient management recertification requirements as well as provide essential information on developments in the industry. **Response:** Due to the health and safety restrictions caused by the COVID-19 pandemic, UD Extension staff adapted the courses into a virtual format. The new online courses focused on pests, beneficial insects and the signs and symptoms used to identify plant pests and diseases. Tips and techniques were shared live over Zoom using videos and pictures, live virtual tours and the microscope and hand lens. **Impact:** A total of 89 people participated in the virtual short courses. Following each session, participants were invited to complete a survey to measure knowledge gained in the topics covered. • 17 percent of attendees learned that insects do not necessarily cause problems in the landscape • 11 percent learned that proper plant placement in the landscape relates to plant susceptibility to pests • 3 percent learned that a dead branch does not always indicate disease • 20 percent learned that spiders are beneficial and help reduce arthropod pest pressure • 29 percent learned about reduced-risk control products • 17 percent learned that actively searching through the landscape (scouting) is an integral part of a successful IPM program Participants indicated that, after their participation in this training, they would make a number of changes to their practices, including: • Scouting in their landscapes more often,	4. Environmental Stewardship in a Changing Climate

		• Paying closer attention to the plants and the insects, • Being more careful in considering all the variables before determining a diagnosis, • Performing more analysis before attempting to fix issues, • Using natural predators to help combat pests, and • Plant more diversely to support a more diverse insect community to help with pests. An enthusiastic participant later shared that they appreciated "[the] level of expertise that the instructors have..."	
35.	**Flexible opportunities offered for nutrient management continuing education** UD Extension COVID Impact	**Issue:** As required by Delaware law, those who are certified through Delaware's Nutrient Management Program must maintain certification by attending continuing education programs. Throughout 2020, UD Cooperative Extension offered 223.5 Nutrient Management Continuing Education Credits through 123 face-to-face and virtual programs. Yet, participation in these programs can be prohibitive for some individuals due to travel and time constraints. These challenges were compounded further by the disruption, health and safety issues caused by the COVID-19 pandemic, creating a dire need for self-paced online continuing education opportunities. **Response:** UD Extension's Nutrient Management program released 12 new self-paced online modules to accommodate this growing need, increasing the total from 11 (6.5 total credits) to 23 modules (16.25 total credits). The subject matter was also expanded to include equine, turf and stormwater-specific topics in addition to the existing agronomic production, manure management, soil testing, poultry production and general nutrient management modules. All self-paced online continuing education modules are free and available in a variety of formats, including readings, webinars and recorded presentations. To earn credit for each module, individuals	4. Environmental Stewardship in a Changing Climate

		must review the materials and earn a minimum score of 80 percent on the associated quiz.
		
		Results: In 2020, 458 online modules were completed by 234 users registered in the official online crediting system — 9.4 percent of the total number of individuals currently certified by the Delaware Nutrient Management Program. The most popular new modules include:
		• Rotational Grazing: When and How It Works (Completed by 21 users)
		  ○ 67 percent of participants felt they knew more about rotational grazing after completing the course
		  ○ 100 percent indicated that the information was useful and would be applied to their operation
		• Water Quality Impacts on Broiler Production (completed by 16 users)
		  ○ 80 percent of participants felt they knew more about water quality impacts on broilers after completing the course
		  ○ 94 percent found the information useful
		  ○ 81 percent said they would apply the information they learned to their operation
		• Healthy Soil, Healthy Turf (completed by 17 users)
		  ○ 100 percent of participants felt that they knew more about turfgrass management after completing the course
		  ○ 94 percent said the information in the module was useful to their operation
		  ○ 94 percent said they would apply the information they learned to their operation	