FY 2020 Annual Report of Accomplishments and Results

Maryland
University of Maryland, College Park

I. Report Overview

The NIFA reviewer will refer to the executive summary submitted in your FY 2020 Plan of Work located in the Institutional Profile. Use this space to provide updates if needed.

1. Executive Summary (Optional)

Despite the COVID-19 pandemic and severe university restrictions that took effect on March 21, 2020, research and Extension activities continued to be conducted, in a limited capacity, in our campus laboratories, green houses and in the field where individuals were naturally social distancing. By mid-April about 400 faculty, staff and graduate students had signed up as 'essential' personnel. They took care of animals, plants, tissue culture and maintained important equipment in laboratories and Research and Education Centers. They also made sure that unique, one-of-a-kind collections are preserved and maintained. Work continued in the field for the 2020 spring planting so as not to delay and jeopardize research that depended on these crops. These dedicated personnel performed their duties while practicing CDC guidelines of social distancing, wearing masks, washing hands, staying home when sick and regularly getting COVID-19 testing. Negative test for COVID-19 is required from all university personnel and students, every 14 days. On June 1, 2020 the university transitioned to Phase 1 reopening allowing up to 25% occupancy and not to exceed 1 person/200sqft space requirement inside buildings. From August 24, 2020 to the present, the university is operating under Phase 2 reopening allowing up to 50% occupancy and 1 person per 150sqft space requirement.

Within Maryland, the Governor issued a stay at home order that led to University of Maryland Extension physical offices closing to the public and Extension employees began a number of weeks of telework status. Extension administration established a 90 day rapid response task force to address the needs of Extension workers across the state so programming could continue. Even though office doors were locked, Extension was still open. The task force worked quickly to establish a website where supportive software was posted along with instructions for use as well as instructional videos to assist with technology. A state wide survey was conducted to assess the learning needs of Extension faculty regarding distance teaching and use of virtual teaching options. Based on the results, a 12 weeks series of instructional webinars were offered. In the early fall of 2020, Extension began to reopen offices that met metrics to do so, as established by state government and University protocols. At the

time, a post survey was offered to faculty and staff to assess their level of confidence in continuing hybrid technology delivered programming, their perceptions of clientele readiness to continue to receive programs that way, and any personal challenges they may have experienced.

Additionally, according to the Institutional Review Board (IRB) guidelines during COVID-19 at UMD, no in-person or face-to-face research activities will take place until the University's Research Restrictions have been lifted or individual project approval has been granted after submitting the Safety Assuredness & Guidance Plan for Resuming In-Person Human Subject Research.

II. Merit and Scientific Peer Review Processes

The NIFA reviewer will refer to your 2020 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 ONLY
1. The Merit Review Process	No change
2. The Scientific Peer Review Process	No change

III. Stakeholder Input

The NIFA reviewer will refer to your 2020 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 ONLY
1. Actions taken to seek stakeholder input that encouraged their participation with a brief explanation	Extension and Research teams were able to interact with stakeholders in person prior to the COVID-19 restrictions that were put into effect by the university in March 2020. Our teams quickly and efficiently transitioned to online teaching and training. We experienced a significant increase in the number of audiences reached as meetings, trainings and seminars transitioned online during the pandemic and we used social media to advertise and invite people to these virtual events.
2. Methods to identify individuals and groups and brief explanation.	No change. However, the university, our college and units embarked on an extensive exercise to review current practices and to develop a robust Diversity, Equity, Inclusion and Respect (DEIR) Plan to ensure that the DEIR principles are ingrained in our research and Extension programs.
3. Methods for collecting stakeholder input and brief explanation.	Due to pandemic restrictions, stakeholder input was collected mainly through online technology and using social media tools.
4. A Statement of how the input will be considered and brief explanation of what you learned from your stakeholders.	The College of Agriculture and Natural Resources will continue to use stakeholder input in setting priorities for Extension and research activities. An important thing we learned during the pandemic was the dedication to serve our stakeholders as demonstrated by our faculty, staff and students. Over 400 individuals volunteered to sign up as 'essential personnel' so they can continue important research and outreach activities, care for animals, plants and tissue culture, and maintain our laboratories and research facilities amidst strict pandemic-related restrictions.

IV. Critical Issues Table of Contents

No.	Critical Issues in order of appearance in Table V. Activities and Accomplishments
1.	Food and Agriculture
2.	Climate Change
3.	Safe, Secure, Abundant Food Supply
4.	Human Health, Nutrition, & Wellness
5.	Environmental Stewardship
6.	Family & Community Resiliency
7.	Renewable Energy Resources

V. Activities and Accomplishments

Please provide information for activities that represent the best work of your institution(s). In your outcome or impact statement, please include the following elements (in any order): 1) the issue and its significance (e.g. who cares and why); 2) a brief description of key activities undertaken to achieve the goals and objectives; 3) changes in knowledge, behavior, or condition resulting from the project or program's activities; 4) who benefited and how. Please weave supporting data into the narrative.

No.	Project or Program Title	Outcome/Impact Statement	Critical Issue Name or No.
1.	**Entrepreneurial Coaching**	Issue: According to data from the U.S. Bureau of Labor Statistics, about 20% of U.S. small businesses fail within the first year. By the end of their fifth year, roughly 50% have faltered. After 10 years, only around a third of businesses have survived. Surprisingly, business failure rates are fairly consistent. Activities: The University of Maryland Extension, originally assisted by a Northeast Sustainable Agriculture Research and Education Community Development Grant, has developed new inter-active support and resources for Maryland's Ag and Food Systems Entrepreneurs. The program provides a hybrid delivery system of face-to-face consulting or a	Food and Agriculture

		scheduled virtual coaching session so as to provide options to both online and non- web-based clients. Outcome: Participants were then asked a series of pre and post questions about before and after the coaching session. Overall participants increased knowledge by 35% with the highest results in knowing which regulations pertain to my business (47%), knowing the next step (44%), and finding resources needed (34%) and writing a business and marketing plan (33%). Based on the coaching session participants next steps are to conduct market research (70%), work on my business plan (58%), estimate how much it cost me to produce my product (48%), survey potential or existing customers (33%) and seek a certification or permit (21%). A follow up survey to the coaching sessions was created and sent in the fall of 2020 to all 87 participants that completed an intake form. There were 24 respondents (28% response rate). The majority of participants have written or revised their business plan (57%), investigated regulations (43%), estimate how much it costs me to produce my product (43%), conducted other market research (36%), surveyed potential or existing customers (29%), applied for a certificate or permit (29%) and acquired insurance (29%). In the past year participants have expanded their business (46%), improved the financial viability of the business (31%), started a business that provides supplemental income (23%), purchased inputs from Maryland farms or businesses (23%). When asked about the income 40% are not generating income yet and the average income is approximately $29,500.	
2.	**Commercial Poultry Education**	Issue: Broiler (meat chickens) production is the largest agricultural revenue generator in Maryland. Approximately 35 percent of the cash farm income in Maryland is from broiler production. Maryland produced 303,500,000 broilers (1.851 billion pounds) in 2019 and ranked seventh among the states in the number of broilers produced. In 2019, Maryland broiler	Food and Agriculture

		production value was $1 billion. Five counties on the Eastern Shore of Maryland are among the leaders of broiler production in the United States, ranking in the top 100. Contract broiler production is concentrated in eight counties on the Eastern Shore of Maryland. The Delmarva Peninsula ranks in the top ten largest broiler producing areas in the U.S. The success of contract broiler production is directly related to the success of poultry companies and grain farmers located on Delmarva. Typically, most of the corn and soybeans grown in this region are used by the local poultry companies for broiler feed. Delmarva has benefited from the integrators' expansion to capitalize on increased consumer demand for poultry products. Poultry farmers in the Chesapeake Bay watershed are under the most stringent environmental regulations in the country. These farmers are regulated by the MDA, MDE and the EPA. Therefore, commercial broiler producers on the Eastern Shore need the most up-to-date, research-based information that is available concerning CAFO and Maryland Animal Feeding Operation (MAFO) regulations in order to maintain profitable operations and reduce environmental damage caused by nitrogen, phosphorous, and sediment that flows into the Chesapeake Bay. Activities: To help this growers we have developed programs to help educate them on management, health and compliance with regulations. Workshops where held in both MD and DE. However, because of Infectious Coryza, most programing was cancelled in January and February to prevent the spread of the disease. Then in Mid-March, most in person programing was cancelled due to COVID-19.Programs include: Seven Lunch and Learn webinars where conducted, each webinar was then transformed into a written document that was then sent to over 960 growers and allied industry personnel Annie's Project with an effaces on Commercial Poultry (one in Somerset county) Two workshops where held to help growers complete their CAFO Notice of Intent so they could continue coverage under the state permit. Worked with MDA and growers to make sure birds where composted correctly and safe for the environment before they	

		were removed from the poultry barns after depopulation because of the slowdown in processing plants do to COVID-19. Mortality management and composting workshop All workshops are sponsored by businesses that paid for all costs associated with the meetings. ($25,700 received in sponsorship money in 2020)Mailed 600 postcards to poultry growers and allied groups to let them know of available assistance with mental issues. Outcome: Most growers (95%) found programing beneficial to their farm operation estimating an income increase of $2,450 to $5,200, with the average increase of $3,600 per flock as a result of UME programs. Additionally, 82% of growers reported improved compliance with government regulations as a result of programing. Other benefits growers reported include: improved biosecurity (75%), better farm safety (61%), and improved animal welfare (43%). Benefits to non-farmers included: better understanding of the poultry industry (67%), better understanding of the everyday challenges a poultry producer faces (63%), better able to serve clientele (59%), better understanding of the importance of biosecurity (59%), and helped poultry producers implement Best Management Practices (BMPs) (43%). Results from new and existing grower training's include:100% reported a moderate or greatly increased in knowledge or skills, 98% had a better understanding of broiler production,83 % better understanding of poultry welfare,88% better understanding of brooding,85% better understanding of composting,86% better understanding of basic poultry ventilation.	
3.	**Women In Agriculture**	Issue: The USDA Census of Agriculture has increased its emphasis on gender disaggregated data. Women are now the largest minority group in the agricultural sector, comprising more than 30% of all U.S. farm operators and 14% of farmers who are primarily responsible for farm operations. It is known that 42% of all U.S. farmland is owned by non-operators and that 40% are women. Overall, beginning farmers are more likely to be female. Women operators represent more than 17 percent of	Food and Agriculture

		beginners, but less than 14 percent of all principal operators. USDA's most recent 2012 Census of Agriculture found that in Maryland, 38 percent of all farms have women as the principal operators. Of the female principal operators, 30 percent are over the age of 65 and 63 percent are over 55 years old. It is estimated that during the next two decades, 70% of all farmland will change hands –with women possibly owning as much as 75% of all the land transferred. In Maryland, 41 percent of the farmers are over 65 and 61 percent are over 55 years old, illustrating the significant potential trend for more incoming women agricultural landowners. Additionally, research conducted by Penn State concluded that 46% of farm women surveyed preferred an all women audience. Furthermore, 58.7% of Extension educators surveyed felt that women audiences have educational needs that are somewhat or very different from those of their male farmer counterparts. Activities: A Regional Women in Agriculture conference has been held annually for the past 19 years. It is a combined effort of UME, the University of Delaware, Delaware State University, Virginia Tech University, and Rutgers University. Through grant funding, sponsorship, and fees this two-day conference reaches over 250 farm women annually, includes 3 keynote speakers, 15 breakout sessions, 30 exhibitor tables, and an evening reception the educator has served as presenter, committee member, and Conference Co-Chair since 2012. Outcome: The conference incorporated social media with tweets throughout the day as well as Turning Point Technology for audience polling, and end of class and final conference evaluations. There have been 149 webinars (2014–2020) on a variety of topics in farm and risk management with 13,379 registrations, of that 3,992 are unique registrants. All webinars are recorded and on YouTube. YouTube channel has 294 subscribers, 3.8K minutes of watch time, 25,680 total views. The audience for webinars include 26% service providers, 25% beginning farmers, 21% established farmers, 35% are from Maryland the other 65%	

		are from 18 other countries, 49 states and District of Columbia. There were 94% female, 84% white, 8% African American, 65% are over the age of 45, and 83% have a college degree or higher. The conference has served as an institution where attendees participate, learn, and improve management skills for their business and families. Another important aspect of this conference is the networking opportunity it provides for women to learn and share with other women in a similar business field. Conference result: 36% of participants have attended at least four conferences over the years, 36% made changes in their agricultural business as a result of past conferences, 99% rated the event as good or excellent, 96% rated the educational value as good or excellent, 94% rated the opportunity for discussion and networking as good or excellent, 97% felt more prepared to make informed decisions on the farm, 81% gained information on risk management for their farm, 93% networked with other participants and 96% gained resources material including fact sheets, websites, software and contacts. (n=689). As a result of 2020 conference, 93% feel they are better prepared to make informed decisions about specific areas of agribusiness. Participants report learning: risk management practices for the farm 23%, legal information for the farm 19%, financial information for the farm 26%, marketing for the farm 70%, business operations and plans 69%, gained resources 94%.Program Outcomes &Impacts: 2020 there were 22 webinars held with a total of 2,049 registrants (632 unique). The YouTube channel over the year had 11,408 views with 1,240 hours of watch time. J. Rhodes teaches at least one webinar annually. In 2015 this program was funded by Rural Maryland Council Grant (MAERDAF) and was evaluated in early 2016 and again in 2017 and 2018 for annual results (2019 survey has been distributed). The survey was sent to 972 registrants (324 responses 33% response rate). Of the participants: 66% were interested in the topic, 37% will use the information to help their clients, 29% will improve their farm business management, 74% are interested in marketing, 70% social media, 61% business planning, 53% in	

		finance, 43% on legal issues. Results concluded a statistically significant increase after attending the Webinars. Participants report increasing knowledge by 48%. Those that reported no knowledge or slight knowledge increased by 64%. 56% plan to make a change as a result of the webinars, 93% visited the website, 56% visited Facebook, 55% visited eXtension.org, 32% are beginning farmers, 28% are service providers, 24% are exploring farming options and 44% are from Maryland, 10% from Delaware, 43% outside of the MidAtlantic (16 states represented).	
4.	**Winter Agronomy Meeting**	Issue: Corn, soybeans and wheat are the major agronomic crops grown in Maryland representing over 900,000 acres of cropland and valued at over $700 million (NASS 2012). In order to provide the most current education and research, University of Maryland Extension provides winter agronomy meetings for Maryland farmers, crop advisors and agriculture professionals. Grains account for over 43% of agricultural sales in Harford County (NASS 2012), therefore represent the single largest commodity group for the County. Activities: Each year, this educator organizes, facilitates and contributes to the Harford County Mid-Winter Agronomy meeting. This county meeting consistently draws more than 80 growers, crop consultants and agriculture business personnel. In addition to the Harford County meeting, this educator helps facilitate the regional Northern Maryland Field Crops Day held in Baltimore County which draws a regional attendance of over 100 farmers and other agriculture professionals. Outcome: In the past five years over 3,200 participants have attended University of Maryland Extension sponsored agronomy days. Over 88% of the participants report that the session will benefit their farming operation. Participants report information and production practices that will be implemented following the program. These include: Improved pest management practices (28%),Improved fertility management (45%), Improved crop production practices(47%), Use of risk management tools (16%), Regulatory information (28%), A new product or practice	Food and Agriculture

		(22%).Winter agronomy meeting participants were asked the expected yield increase due to knowledge and skills gained from Extension programming. The average participant will increase yield per acre between 6.5% and 9.6%.Agronomy meeting participants were also asked the expected profitability increase per acre due to knowledge and skills gained from Extension programming. The average participant increases profitability between $16.23 and $25.23 per acre. Using the average acres farmed per person (from UME survey) the overall average profitability is ($20.23*605ac) = $12,239.15 per person.	
5.	**2020 AGsploration: The Science of Maryland Agriculture**	Issue: Maryland's number one industry is agriculture, but the state is urbanizing rapidly and is now the fifth-most densely populated state. Many families are separated by multiple generations from a direct connection to agriculture and lack knowledge of the origins of food and fiber. Data support this assertion: A survey conducted by U.S. Farmers & Ranchers Alliance (USFRA) found that 72 percent of consumers know nothing or very little about farming and ranching. Another study conducted by the Innovation Center for US Dairy found that 48% of people do not know where food items such as chocolate milk come from. There is a strong need to help Maryland residents understand the origins of food and fiber and the importance of agriculture in Maryland's economy (mda.state.md.us). Activities: A team of Maryland 4-H educators worked from 2011–2020 to improve agricultural literacy through development of a youth agriculture curriculum with supplementary resources and program activities. The University of Maryland Extension AGsploration program uses hands-on lessons from a peer-reviewed curriculum to teach participants about science and agriculture. The AGsploration team offers the program through a variety of venues including school enrichment, after-school and	Food and Agriculture

		summer programs, and club/outreach programs. The program is supported by a website with links to the curriculum and resources including career videos. The 4-H educators teach lessons directly, share curriculum resources, and conduct train-the-trainer sessions that prepare adults and teens to teach the curriculum. Outcome: AGsploration has delivered agricultural education to a large number of individuals through direct instruction and a train-the-trainer model. To date, the team has held 19 in-depth curriculum trainings for 502 teachers, volunteers, and teens along with shorter trainings for 888 participants of the National 4-H Youth Agri-Science Summit. UME educators, trained teen teachers, and trained adult volunteers and teachers have taught AGsploration lessons to 48,165 youth and adult participants. UME educators have also offered day programs for 396 youth. In an effort to achieve national reach, the team has shared the program at numerous professional conferences. To date, 697 people from 41 states; Washington, D.C.; U.S. territories; and Australia have accessed the curriculum and website materials. The educational career videos been viewed 12,247 times. Surveys of youth who participated in AGsploration lessons have documented increases in understanding of the benefits and connection of agriculture to daily life, interest in pursuing agricultural science careers, ability to identify careers connected to agriculture, and content knowledge related to the lessons. Teens and adults who received training reported increases in ability and confidence related to teaching the lessons. Program data have consistently provided evidence of positive outcomes for youth participants and teen and adult teachers. In summary, it is	

		evident that AGsploration is reaching large numbers of people, helping to improve agricultural literacy in and beyond Maryland, and generating youth interest in pursuing agriculture and STEM careers. The AGsploration program has increased the knowledge and appreciation of agriculture in Maryland and has created a network of trained individuals to extend the program's educational reach.	
6.	**Alternative Specialty Crops**	Issue: The state of Maryland continues to undergo socioeconomic change. Population is increasing, land use is changing. Maryland crop and livestock producers are confronted with numerous challenges that can affect their profitability. Average age of landowners (farmers) both nationally and in MD is between 55 and 65 (NASS and UME Data). According to the 2017 National Young Farmer Survey, 2/3 of all farmland (573 million acres or 63%) will need a new farmer over the next two and a half decades as older farmers retire. One of the greatest challenges for transitioning farms to younger owners is land accessibility. Three-quarters of new farmers in the 2017 survey were not inheriting land since they do not come from traditional family farms. Land prices have doubled throughout the country over the past 10 years making land increasingly difficult for new farmers to find and afford. Alternatively, young urban farmers are finding spaces inside urban areas, either reclaimed land or on rooftops. An alternative, high-value specialty crop program was developed to assist new and early-adopting farmers find new high value crops and understand fundamentals of plant production to increase farm efficiency, productivity and profitability on smaller areas of land. Activities: A national/international extension outreach program was developed to outreach for the fruit crop, aronia. The 2017 USDA NASS	Food and Agriculture

		estimated 2000 growers nationally with 40% having aronia orchards over 5 acres and 10% having aronia orchards over 25 acres. Outcome: From the initiation of the alternative crop program, 24 growers in Maryland started aronia production. Results from fertility and pest management trials gave aronia and other specialty crop growers the management tools to successfully grow high quality fruit with research-based recommendations of nitrogen rates and pesticides, either conventional or organic. Two aronia growers grossed over $14,000 per acre per year in 2018, with net profits estimated to be around 50% to 75% of that gross. Results from a survey of our hemp pilot program partner farmers (50% responded) found that most did not have a return on investment, but that they would continue farming hemp. They were very appreciative of the University program giving them the opportunity to farm hemp.	
7.	**Advancing Sustainable Agriculture through improvements of Nitrogen Use Efficiency in Cereal Crops**	Issue: Nitrogen (N) fertilization increases crop yields, yet up to 50% of N fertilizers applied in agriculture are lost to the environment resulting in negative environmental impacts. Moreover, both the production of synthetic N fertilizers and their use also produces greenhouse gas emissions that contribute to climate change. Improving nitrogen (N) use efficiency (NUE) in crop production systems is essential for meeting the sustainability challenges in agriculture systems. Cereal crops, like wheat, account for the greatest use of synthetic N fertilizers in the United States and increasing the efficiency of how cereal crops acquire and use N will have a significant impact on the sustainability of agriculture. Although improving Nitrogen Use Efficiency (NUE) in wheat is critical to sustainable agriculture, progress has been limited by the lack of genetic variation for NUE traits in wheat. NUE of rye is greater than wheat and, in this project, novel germplasm consisting of wheat, rye and the wheat-rye hybrid,	Food and Agriculture

		triticale, will be used to phenotype for NUE related traits as an initial step to the identification of genetic factors in rye that can be used to improve NUE in wheat. Activities: The vast majority of comparative studies of rye, wheat and triticale NUE have used unrelated genotypes. The team is in a unique position since they have a collection of related germplasm that includes 1) two hexaploid triticale genotypes (AABBRRgenomes) and their parents (AABB and RR genomes) and 2) two different octaploid populations of triticale (AABBDDRRgenomes), their parents (AABBDD and RR genomes) and a complete set of rye substitution lines (AABBDD+1-7RR) for each population as well as a diverse set of winter triticale genome-wide-association (GWAS) panel consisting of 300 lines. The team analyzed the responses and distributions of triticale lines under different nitrogen applications. Outcome: Results showing normal distribution for the targeted traits, clearly indicate that the triticale AM panel provide an excellent germplasm resource to perform whole genome-based genome wide association analysis to identify major genomic loci controlling NUE related traits. Also, the data clearly indicated that the triticale panel contains several germplasm that are performing very efficiently or even better at 50% N-application than optimum or full N-application. These selected lines can also be directly used to develop biparental populations to perform biparental population based genetic mapping studies to map and fine map targeted genes and to develop NUE efficient triticale and wheat cultivars. This project provided training in experimental design, statistical and genomic analyses for a graduate student and a research assistant.	

8.	**Cover crops as a Biculture Intercrop to Manage Weeds in Vegetables**	Issue: novel information on the synergistic usage of conservation tillage and winter cover cropping to concurrently manage insect and weed pests. Vegetable growers need to reduce their disproportionate reliance on GMO technology, pesticides and/or tillage by generating knowledge on low input practices that provides similar benefits. Potential impacts include similar or enhanced yields at lower operational and environmental cost, which will boost Northeast vegetable farmers' confidence, profits and sustainability. Activities: Two field studies were conducted to investigate the ability of cover crop residue and living mulch with and without cover crop residue to prevent weed establishment and enhance natural enemy ability to reduce corn earworm survival as well as ear damage caused by the European corn borer. At this time, it appears that the greatest benefit of the living mulch treatments is weed suppression, specifically between the crop rows. We found that the living mulch treatments worked as well as using a pre- and post-emergent herbicide at planting in preventing weed establishment in sweet corn plantings. Outcomes: Training and professional development were administered to one post-doctoral scientist, two graduate students and six undergraduates. The two graduate students received experience as mentors as well as presenting their research to scientific and farming audiences. Graduate students and one undergraduate also prepared a virtual field day (YouTube) video. This provided them training in alternative method to communicate with stakeholders.	Food and Agriculture
9.	**Research on Potential Non-target Impacts of Insecticide**	Issue: Seed treatments have been the most convenient and economical way to protect a wide variety of crops from pests. Cruiser ®5FS	Food and Agriculture

	Seed Treatments in Maryland Grain Crops	(thiamethoxam, Syngenta Crop Protection) and Gaucho 600 Flowable (imidacloprid, Bayer CropScience) are neonicotinoid insecticide seed treatments that are registered for use on wheat, corn, and soybeans, though the rate varies by crop and pest targeted. These insecticides move into the soil from treated seed and can be persistent. In the mid-Atlantic, it is common to have a three year rotation of grain crops, starting with full season soybean, which is followed by fall planted wheat, then double-crop soybeans, and finally corn. Because seed treatments are so widely used, neonicotinoid treatments used in consecutive crops in the same field can result in higher soil concentrations than use in a single year alone. Repeated use of neonicotinoid treated seed from year to year can result in pest resistance development as well as potential negative impacts on beneficial organisms. Activities: Test the impact of thiamethoxam and imidacloprid treated wheat, soybean, and corn seeds in a back-to-back three year rotation on a wide range of non-target organisms. Specific objectives include determining whether treated seeds have an impact on (1) beneficial and pestiferous soil organisms including invertebrates and microorganisms, and (2) beneficial and pestiferous foliar invertebrates. Additionally, the team will (3) determine whether winter annual flowers contain neonicotinoid residue after planting these seed treated grains. This study has the added value of allowing (4) measurement of the effect of repeated use of neonicotinoid seed treatments during the crop rotations that occur in mid-Atlantic grain production. Outcome: The team completed Illumina sequencing of 16S rRNA from one set of soil samples for their previous full-season soybean, winter wheat	

		and corn field studies. A total of 34,270 unique prokaryotic amplicon sequence variants (ASVs) were identified, with 20,085 ASVs in full-season soybean, 20,205 ASVs in winter wheat, and 20,025 ASVs in corn. They also conducted a series of laboratory trials investigating the impacts of neonicotinoid seed treatments (NSTs) on the cereal aphid *Rhopalosiphim padi* and its parasitoids in Maryland winter wheat, specifically measuring changes in NST efficacy against *R. padi* over the course of the growing season, and the impact of aphid density on efficacy immediately post planting. They also designed an experiment to evaluate host-mediated sublethal impacts of NSTs on the aphid parasitoid *Aphidius colemani* but could not complete that experiment due to the COVID-19 pandemic. The team will complete their laboratory studies evaluating how long NSTs are effective against the bird cherry oat aphid, and also determine how aphid density and rainfall (simulated by watering) may impact efficacy and pesticide residues within the plant. This will improve our understanding of how NSTs can be used to protect winter wheat from cereal aphids and the potential limitations of this technology. This project has helped two graduate students, multiple undergraduate helpers, and one research technician to better understand the challenges of IPM in field crops. They have gained experience in planning and conducting field, greenhouse, and growth chamber studies, managing technicians, and problem solving. They also gained experience with analyzing various types of data, writing grants and reports, and presenting their findings to both the scientific community and growers.	
10.	**Climate Change Action Plan**	Issue: In Maryland, and especially on the Eastern Shore, many community organizations and local governments have limited staff, time, and resources to engage in project planning, pursue additional grant funding, conduct facilitation and strategic planning to improve their organizational	Climate Change

		capacity and effectiveness, or conduct project management and education for local water quality restoration activities. Activities: Extension educator provides technical and grant assistance by writing and reviewing grants and reports; conducting field work; informing jurisdictions and organizations about upcoming grant and professional development opportunities; serving on advisory groups and planning committees; performing project management; holding one-on-one consultations; educating about social marketing techniques; connecting groups with similar interests; and organizing and conducting site visits. Outcome: Anecdotal responses from Strategic Doing training participants indicate that they are interested in applying Strategic Doing principles in their work. Agent developed a stakeholder survey in 2015 to guide the Maryland Veterinary Medical Association in their strategic planning process. In 2020, Agent learned that the MVMA board has been using the survey every year since 2015 to poll stakeholders and update work plans as needed. To date, Agent has written/edited grants, provided direct participation or management, or written letters of support that resulted in $2,287,782 in awards to the applicants. It was beneficial for all Marylanders and other agencies such as the Partnership for the Delaware Estuary, the National Sea Grant Extension Assembly, the Chesapeake Stormwater Network, the Chesapeake Bay Funders Network, the Communications Workgroup of the Chesapeake Bay Program, and Delaware Sea Grant.	
11.	**Urban Nutrient Management**	Issue: Turf related fertilizers can potentially wash off the land and into drainage ditches, storm water drains, creeks, streams and rivers on the way to the Chesapeake Bay and the Coastal Bays, overloading the Bay	Climate Change

		waters with excessive nutrients. Poor Turfgrass stands had few nutrient collection roots, leading to both solid matter (soils) and nutrient runoff into the Chesapeake and Coastal Bays. The excessive nutrients caused algae blooms that shaded the submerged aquatic vegetation and caused them to die off as they decomposed they would utilize the available oxygen in the water. When the algae blooms died off, they also would utilize the oxygen in the Bays as they decomposed, robbing the water inhabitants of their oxygen. The submerged aquatic vegetation not only held the underwater soil in place, they would also generate oxygen to be available to the aquatic life, fish and shellfish. Activities: Maryland Department of Agriculture and the University of Maryland created a training manual for Professional Fertilizer Applicators (PFA) of Lawn Care. This Educator through UME has taught the PFA certification and re certification programs, calibration programs and created a YouTube video for both professional and homeowners on calibrating a fertilizer spreader that is available through MDA and on line. Outcome: Lawn fertilizer accounts for about 44% of all fertilizer sold in Maryland. Over 1,000 Professional Fertilizer Applicators have, through the University of Maryland Extension and MDA, received their training, passed their test and are now licensed PFA. They attend each year for 2 hours of recertification credits at the University of Maryland Extension offices, MDA in Annapolis and Pesticide Recertification programs put on by UME. Data is indicating that fertilizer used by professionals is not in the high quantity that the Bay Model suggested. The lower amount of nutrients used by professionals provides more information on needs to promote more homeowner education.	

12.	**Waste Management and Cover Cropping Systems Research to Enhance Soil Health, Water Quality and Climate Adaptation**	Issue: Nutrients provide a common thread that runs through the issues of waste management, farming systems, soil management, and water quality in the Mid-Atlantic region. Both N and P are major water quality pollutants in the Chesapeake Bay. At the same time, they are essential nutrients for productive agriculture and are needed to enhance soil productivity. These nutrients are an integral part of many types of wastes, especially organic wastes originating from animal industries such as poultry and dairy and from municipal solid wastes such as biosolids. This project will use an integrated systems approach to manage nutrients that will minimize the extent of pollution caused by N and P while maximizing their beneficial and profitable use on land and their integration into soil nutrient reserves. Improved nutrient management by understanding the fate, transformations, and transport of N and P from land to water is needed to improve water quality in the Chesapeake Bay. Cover crops represent a major nutrient management tool that is increasingly being used in agriculture to improve soil health and minimize negative environmental impacts. Appropriate cover cropping systems can be very efficient in capturing N, and to a lesser degree P, before these nutrients leave farmland and impact ground and surface waters. This project will investigate the use of organic wastes and cover crops to alleviate adverse soil conditions that result from urbanization and farming operations, while maintaining the productive value of the nutrients in the soils and wastes and minimizing impacts on water quality. All these nutrient management strategies and processes will be and are being affected by changes in the regional climate, which are bringing more severe and erratic weather patterns and causing a rise in sea levels. Therefore, this project will incorporate climate change models to identify	Climate Change

		adaptive practices that will allow effective nutrient management under changing climatic conditions. Activities: This project features a team of five faculty labs that focus on optimizing the cycling and management of nitrogen (N), phosphorus (P) and other essential nutrients. Specifically, each lab is working on the following objectives: 1. Develop improved cover crop and nutrient management systems that improve water quality, soil health and farm profitability. 2. Investigate the fate, transformations, and transport of nutrients from soil to water. 3. Determine the effect of waste to energy (WTE) technologies on solids and nutrient concentrations, transformations, and subsequent crop nutrient uptake. 4. Quantify impacts of organic matter addition on urban/suburban soil health and water quality. 5. Model how climate change, and selected adaptive management practices, will affect soil productivity, soil quality, erosion, and nutrient losses in Eastern US crop production. Outcomes: Objective #1 - Farmers, policymakers, environmental groups, state and federal agencies representative were informed and engaged concerning improved cover cropping and nutrient management systems. One journal article was accepted for publication. A new project was funded by federal agencies on managing and remediating nutrients in Urbanizing Landscapes and three projects were funded by the Maryland Soybean Board. Two presentations were made to national scientific conferences and five	

		extension publications and presentations were produced and viewed by several stakeholders. While cover crop adoption has been very high in Maryland for over a decade, this project has dramatically increased the effectiveness of cover cropping systems in use. Many more farmers are now planting early by interseeding cover crop seed into standing summer crops in order to improve the capture of nitrogen before it is leached away. In spring, an increasing number of farmers are allowing their cover crops to grow right up to cash crop planting time using the technique of "planting green". Partially because of our research results and outreach efforts, the Maryland Department of Agriculture has revised its cover crop subsidy regulations to incentivize these trends. Objective #2 - Farmers, policymakers, environmental groups, state and federal agencies representative were informed on nutrient management and water quality connections. Two journal articles were published. Two new projects funded by state and federal agencies on managing and remediating nutrients were initiated. Objective #3, Farmers, policymakers, and digester industry experts were informed on anaerobic digestion and how digestion affects nutrient cycling from manure. A patent was issued on an innovative method to remove ammonium from digester effluent as a separate product for better utilization of N input and fewer transportation costs for poultry litter applications (Patent # 15/971832). A Maryland Energy Innovation Institute grant was received to take this process from the lab-scale to the pilot-scale, with the Final Report of that grant submitted in Jan 2020 and a manuscript from this work was published. Laboratory and field studies	

		were conducted on food waste digestion and how nutrients change during this process. The effect of adding metal nanoparticles on increasing renewable energy from anaerobic digesters was assessed, as well as plant uptake from digester effluent used as fertilizer on butter crunch lettuce when nanoparticles were added to the digester reactor. A publication from this work was published in Bioresource Technology (impact factor of 6.7). A grant was received from Maryland Industrial Partnership (MIPS) to study the effect of adding poultry litter-derived biochar on bedding plants and turfgrass growth. Objective #4 – Five in-person "Homeowner Nutrient Management" trainings were conducted before the Covid-19 pandemic restrictions that were attended by 130 participants. A Zoom training was held on Oct. 29, 2020 with 120 participants. The PI provided policy support and guidance to the Bay Program and served in the Maryland Department of Agriculture (MDA) Animal Waste Technology Fund (AWTF) steering committee to set annual priorities.	
6.	**2020 Career AGsperience**	Issue: Research studies have documented the importance of workforce education in preparing young people for successful entry into the workforce. Workforce preparation can be general or targeted toward a specific career sector. Agriculture is a major economic sector in the United States, and as a result there is a strong need for workforce preparation programs that help become interested in and make the transition to careers related to agriculture. When youth are asked what they know about agriculture careers, they often only think about farmers and veterinarians. However, many jobs and career fields are connected to agriculture. In order to ensure a reliable and sustainable source of food and fiber within Maryland and across the U.S., there is a critical need to	Safe, Secure, Abundant Food Supply

		teach youth about agriculture-related careers and help them develop agriculture workforce preparation skills. Activities: The University of Maryland Extension AGsperience team created Career AGsperience, a career literacy program designed to increase participants' knowledge of agriculture-related careers and skills necessary for preparing to enter the workforce. The program highlights connections to animal science, environmental science, agri-business and leadership, and agriculture science and technology. Career AGsperience is based on a curriculum the team wrote with lessons on agriculture careers, career planning, resume development, internship acquisition, interviewing skills, and business etiquette. The team also created supplemental materials and assessment tools for virtual and in-person programming. Career AGsperience strives to increase the number of youth who pursue post-secondary degrees and careers in agriculture-related fields. The program is supplemented by a website and YouTube channel via the related AGsploration agricultural literacy program. In 2020, the Career AGsperience team created the program, wrote the lessons, and developed assessment and evaluation instruments. During fall 2020, the team held a six-session virtual Career AGsperience program/pilot test. Participants from five Northeastern U.S. states "Unlocked the Mysteries and Learned the Untold Secrets of Preparing for a Successful Career in Agriculture" as they expanded their knowledge of agricultural career connections and learned important career planning and acquisition skills. Teens learned about agriculture careers, career planning, resume development, internship acquisition, interviewing skills, and business etiquette. Two sessions included presentations from and interactions with individuals who are currently working in agriculture-	

		related careers. Four of the five career panelists were Maryland 4-H alumni and the fifth was a University of Maryland College Park College of Agriculture and Natural Resources faculty member. Outcome: A post-survey documented that 100 percent of participants reported that the presenters were effective in communicating the content of the program, were well-prepared, and were effective teachers. In addition, 100 percent of participants indicated that they learned a lot from the program.	
7.	**2020 Nutrition and Gardening for Families**	Issue: Food insecurity is a persistent problem across Maryland. Contributing factors include lack of access to nutritious foods and lack of knowledge about making healthy food choices. In rural Talbot County, food insecurity is widespread but goes largely unnoticed by many residents. The extremely high incomes of a small percentage of county residents skew the average per capita income, thereby over-representing the financial resources of many Talbot residents. In reality, the county's ten public schools have high percentages of students who qualify for free and reduced meals. There is a need for interventions that can empower Talbot families to improve their food security and contribute to improved health. Activities: During fiscal years 2017–2020 Talbot 4-H received a total of $127,600 of Governor's Office for Children funds through the local management board, Talbot Family Network. Talbot 4-H hired a part-time program coordinator/educator and purchased a variety of nutrition and gardening education materials. With support from the 4-H educator, the coordinator led educational programs in collaboration with community partners including food pantries, after-school programs, subsidized	Safe, Secure, Abundant Food Supply

		housing complexes, a multicultural center, and other organizations that serve residents experiencing food insecurity. Outcome: From 2017–2020, the program made 2,213 nutrition and/or gardening teaching contacts that focused on efforts to reduce food insecurity through education. To promote school and community gardening, with support of the 4-H educator the coordinator installed 16 raised garden beds around the county and used them as teaching tools for school and community gardening. Post-surveys documented that 95% of participants reported increased knowledge about making healthy food choices, 88% increased their knowledge of reading nutrition labels, 90% increased their knowledge of gardening's role in growing food, and 97% knew more about how to prepare a healthy meal on a budget. Program data highlight the effectiveness of nutrition and gardening education. Nutrition and gardening learning experiences improved the ability of Talbot families to grow and obtain fresh produce and prepare nutritious, balanced meals. Talbot families--youth and parents together--learned skills that can help to empower them to reduce their struggle with food insecurity and improve their health.	
8.	**Fruit and vegetable production**	Issue: In 2017, Maryland farmers planter over 27,000 acres in vegetables and melons. Vegetable growers face many of the same challenges as grain producers do, such as soil health, weed control, and weather. However, their smaller acreage, increased labor needs, and the direct-to-consumer nature of their crops often lead to extra challenges concerning pest control, marketing, and regulations. There is a growing need among produce farmers to diversify so they might be better insulated against an unfavorable harvest of one their crops. With the passing of the Food Safety Modernization Act (FSMA) in 2011, vegetable farmers, packers, and	Safe, Secure, Abundant Food Supply

		distributors of fresh market produce must follow new regulations to assist in the reduction of foodborne illness. The FSMA has added extra recordkeeping and training requirements for fresh market producers. Activities: In response to the needs and issues faced by Maryland vegetable growers, several annual vegetable production meetings are held across the state, including one on the Eastern Shore of Maryland. These meetings allow growers and UMD researchers to meet and share findings and ideas. Additional training workshops are held throughout the year, covering timely topics such as pest management and government regulations. To help with FSMA specifically UME, in partnership with the Maryland Department of Agriculture, is offering a voluntary assessment of farm food safety practices to help farmers in preparation for the FSMA. During the growing season, a monthly newsletter is written and distributed to farmers both via mail and email. Outcome: At the conclusion of the 2020 Eastern Shore Vegetable Growers Meeting a survey was administered to participants and 55% of survey participant's $10/acre or more in dollars saved or eared based on the knowledge or skills gained from extension programming thought the year. On average participants reported an 8.5% yield increase based on the knowledge or skills gained from extension programming thought the year. 34% of participants reported plans to implement improved pest management practice based on extension programming. 20% of participants reported plans to implement improved crop production practices based on extension programming.	
9.	**Grow It Eat It**	Issue: Food gardening, especially container & small-space gardening, community & school gardening, and organic gardening are all on the	Safe, Secure, Abundant Food Supply

		increase, along with the demand and need for science-based food production information. According to a National Gardening Association survey, 35% of U.S. households (42 million) in 2013 did some type of food gardening. This represents a 17% increase from 2008. The rate of increase was 63% for millennials. Activities: Grow It Eat It (GIEI) is the UME Signature Program that teaches Marylanders how to grow their own food. The Home & Garden Information Center provides digital resources and "Ask an Expert" consultations, and Master Gardener Volunteers teach residents through classes, workshops, and learning gardens. The COVID-19 pandemic greatly increased interest in gardening, especially food gardening, leading to large increases in demand for UME information and services. Grow It Eat It promotes, increases, and supports food gardening in Maryland. The work intersects social, political, and economic disciplines to address hunger, encourage self-sufficiency, support local food initiatives, and teach best practices. Outcome: Master Gardeners (MGs), trained by UME field faculty, developed and taught new online GIEI classes to residents. MGs contributed 3,021 hours of service valued at approximately $87,600 to the GIEI program. MGs from 11 different MG programs recorded 1,272 educational contacts for the GIEI program. Faculty produced 7 new web pages, 25 videos ("Garden of Weedin"), and 9 webinars. 22 GIEI posts for the Maryland Grows blog were viewed 13,125 times.	
10.	**Engineering for Food Safety and Quality**	Issue: Fresh produce safety continues to be a challenge as evident from frequent recalls and outbreaks. The microbial contamination in fresh produce can occur on farm, during transportation and handling and during post-harvest operations such as washing and slicing. The challenges are	Safe, Secure, Abundant Food Supply

		further exacerbated by a lack of 'kill step' for fresh produce. Conventional sanitizers used to reduce cross-contamination while effective, pose substantial limitations such as need for constant monitoring of concentrations, loss of activity in presence of organic matter and need for an accurate pH and temperature control. Activities: To address these needs researchers developed novel antimicrobial treatments based on synergistic action of physical stresses such as heat and light and natural compounds to enhance microbial inactivation. A range of such combinations have been identified and tested in simulated produce handling environment and have been shown to be effective against E. coli, Listeria and bacteriophages. These studies have been published in peer-reviewed publications. Research is ongoing to find more such combinations, evaluate the impact on produce safety and quality, and study scalability. Outcomes: PI led the initiation of a multi-institutional web based course involving members of NC-1023 multistate project. This multi-institutional course provides a broad perspective of innovation as applied to food engineering and processing. The course will provide a general overview and case studies of current and emerging research areas in food and agricultural engineering and processing by different research groups in the nation. The course will demonstrate the efforts among food engineers and scientists in the nation to advance engineering knowledge and technologies for the purpose of improving food safety, quality and security, and enhance health benefits of food products through extensive research in focused areas. PD collaborated with researchers in California and Nebraska stations.	
11.	**Food Safety – Combating Antibiotic Resistant Bacteria with Enzymes**	Issue: Foodborne illness is a costly public health problem that is both prevalent and preventable. The Centers for Disease Control(CDC) estimates that 1 in 6, or 48-million people in the United States each year are infected by foodborne pathogens by consuming contaminated foods or beverages, resulting in over 120,000 hospitalizations and 3,000 deaths.	Safe, Secure, Abundant Food Supply

		There have been over 250 different foodborne diseases elucidated, for many of which the causative agent is a bacterial species. The FDA's Center for Food Safety and Applied Nutrition (CFSAN) has constructed a list of foodborne pathogenic microorganisms that cause human disease in the United States. The major foodborne pathogenic bacteria involved in foodborne outbreaks include *Salmonella enterica* and *Escherichia coli* O157:H7, two Gram-negative pathogens. These organisms are often responsible for multi-state outbreaks of illness and recall of meat and vegetable crops that are either contaminated or ineffectively cleaned during the cleaning and processing steps at a production facility. Clearly, better methods to disinfect these agricultural products during cleaning, processing, and packaging are needed. Outcome: The team identified a number of endolysins that are active against Gram-negative organisms. The team have also benchmarked these enzymes against enzymes that are being developed commercially by public companies, including an enzyme that just received $18.0 million in funding from CARB-X (Combating Antibiotic Resistant Bacteria Biopharmaceutical Accelerator), a global non-profit partnership dedicated to accelerating antibacterial research and development. The enzymes from this project display similar activity to this enzyme. The graduate student supported by this project gave him significant training opportunities since most of the techniques were new to him. The PI worked one-on-one with the graduate student demonstrating the techniques. Data generated will be used for a publication in a peer-reviewed journal as well as posters and/or talks to be presented at national and international scientific meetings.	
12.	**Development of Antimicrobial Coating Materials for Food Safety and to Improve Shelf Life of Fruits and Food Products**	**Development of an effective and low toxic silver-based antimicrobial materials** Issue: Silver and silver-based composites are strong antimicrobial agents for their broad antimicrobial activities to gram positive and negative bacteria strains, fungi, and viruses. These composites have been used as antimicrobial agents for centuries by incorporating into containers, paints,	Safe, Secure, Abundant Food Supply

		medical devices, wound dressing, food packaging and so on. However, current reported silver-based antimicrobial composites have limitations, such as 1) uncontrolled release of silver could not ensure long-time antimicrobial efficacy; 2) high application dose of silver might diffuse to food systems and are toxic to humans; 3) silver cores might become environment hazards after usage. To meet these challenges, major strategies are undertaken, including 1) development of coreless silver composite, 2) decrease of the application dose of silver to reduce potential toxicity and, 3) controlled release of silver to restrict the diffusion of silver to food systems. The plan is to develop a novel silver-based coreless coating material by modifying an edible polysaccharide with alkynyl-Ag. Alkynyl-Ag will be chemically bounded to chitosan molecules and form antimicrobial coatings. This novel antimicrobial material will be systematically optimized in terms of their physicochemical and releasing properties, antimicrobial efficacy, and cytotoxicity to better enhance the inactivation of food-borne human pathogens and improve human health. Outcome: The team developed a novel antimicrobial coating material with alkynyl Ag substituted chitosan (Ag-CS), which possessed high-efficient antimicrobial effect and prolonged release of Ag. Unlike most antimicrobial Ag nanostructures with silver cores, Ag was substituted to CS through chemical bonds in Ag-CS. The coreless structure avoid the potential of incomplete degradation of silver core which could possibly cause heavy metal enrichment and pollutions to the environment. Ag-CS was characterized for its morphology, chemical structures, surface charge, and viscosity. In antimicrobial tests, Ag-CS demonstrated potent antimicrobial efficacy on both Gram+ and Gram- bacteria strains, and showed stronger antimicrobial activity against E. coli. A prolonged Ag release was also achieved with a superior release rate of 90% in 5 days. By coating on strawberry and shrimp, Ag-CS significantly extended their shelf life and improved food safety. The project also evaluated toxicity of Ag-CS by cell viability test and the mechanism of toxicity. Overall, results from this study indicated Ag-CS as a	

		promising antimicrobial coating material that is antimicrobial efficient and environmentally friendly. A Ph.D. student was trained to advance her knowledge and experience in food safety and microbiology. Results were shared with colleagues at USDA-BARC that resulted in further collaboration. Publications were also produced under this project.	
13.	**Developing an Effective Vaccine Delivery for Influenza Virus**	Issue: In 2020, studies that are crucial to understanding the Coronavirus became the forefront and focus of several faculty in the Department of Veterinary Medicine. Among these are projects that are helpful in increasing our knowledge on vaccine development and effective delivery. Respiratory infections are particularly significant causes of illnesses and deaths. Vaccination decreases the spread, severity and complications of respiratory diseases by inducing mucosal immunity in the airway. FcRn mediates IgG transfer across the respiratory epithelium. The strategy is to target FcRn to deliver vaccines to the entire airway surface. The project aims to design an intranasal vaccine based on a model influenza virus hemagglutinin antigen, and will show that this FcRn-targeted mucosal vaccine delivery pathway can induce remarkable and long-lasting T-cell responses and IgA and IgG antibodies in the airway and blood. The achieved immunity or memory immune responses are effective against lethal virus infections. Thus, FcRn-targeted respiratory immunization offers an effective platform for generating protective immune responses against influenza virus infection and other common respiratory pathogens. Activities and Outcome: The team defined protective immune responses and mechanisms relevant to this route for mucosal vaccination in the lung in a mouse model. Their data concluded that FcRn-mediated intranasal delivery of influenza virus HA antigen induces high levels of long-lasting antibody and T-cell responses, including tissue resident memory (TRM) T	Human Health, Nutrition, & Wellness

		cells in the lung, to provide potent protection against lethal influenza virus challenge. Furthermore, the data demonstrate that FcRn-targeted delivery of an influenza virus antigen in the respiratory tract comprises an effective vaccine delivery platform. These data lay a foundation to deliver influenza universal vaccine antigens.	
14.	**DIVA Vaccine against Porcine Reproductive and Respiratory Syndrome (PRRS)**	Issue: Porcine reproductive and respiratory syndrome (PRRS) has caused significant economic losses to the swine industry since it was first reported in 1987. The prevalence of PRRS virus (PRRSV) infection in swine herds is high and current strategies are inadequate to control the disease. An improved vaccine is a top priority in PRRSV research. The objective of this project is to construct an infectious clone of the virus and generate a chimeric clone with an insert of a marker for the development of a DIVA (differentiation of infected and vaccinated animals) vaccine. Completion of this project will facilitate the development of an effective DIVA vaccine against PRRS. Activities and Outcome: The objective is to construct an infectious cDNA clone of A2MC2 passage 75 and establish a chimeric A2MC2 clone with an insert of a marker sequence for the development of a DIVA (differentiation of infected and vaccinated animals) vaccine. In 2020, the A2MC2 passage 75 is amplified for RNA isolation and cDNA synthesis. The cDNA infectious clone is being constructed. With the goal of training future experts, a graduate student working on this project enabled him to learn reverse genetics and gene cloning, as well as gain virology and immunology knowledge.	Human Health, Nutrition, & Wellness
15.	**Vaccine Development Against Highly Pathogenic Avian Influenza Viruses**	Issue: The highly pathogenic avian influenza viruses (HPAIV) caused multiple devastating outbreaks affecting poultry industry worldwide.	Human Health, Nutrition, & Wellness

		Moreover, these viruses are known to jump the species barrier and can rapidly adapt to replication in mammalian hosts, including humans. Activities and Outcomes: The project intends to develop a novel approach to influenza vaccine development, maximizing the level of expression of protective antigens and therefore increasing the protective efficacy of the vaccine. The team evaluated two different strategies of expressing HA antigen from a Newcastle Disease virus (NDV) vector -the first one was to design the HA expression module under control of the RNA cis-elements of the highly expressed NDV genes, the second was to express HA as a fusion with NDV proteins which can be processed into individual peptides via different protein-encoded elements. Both strategies provided important data that will be presented in two papers. These data will also guide further efforts on improvement of the performance of the vectored vaccines against highly pathogenic avian influenza viruses. Two graduate students working on this project got excellent training in vectored virus vaccine design, vector construction and characterization.	
16.	**Study of Mitochondrial Functions to Improve Poultry Health**	Issue: During embryonic-to-post-hatch transition in chicken there is a dramatic metabolic switch from the embryo deriving over 90% of energy from yolk-lipid oxidation to, the neonatal chick liver upregulating new lipid synthesis (lipogenesis). Interestingly, a similar metabolic milieu is evident in fatty liver hemorrhagic syndrome (FLHS) in poultry layers and non-alcoholic fatty liver disease (NAFLD) in mice and humans, but along with the toxic effects of oxidative stress and inflammation. Inefficient embryonic-to-post-hatch transition is also a significant source of mortality and economic loss to the poultry industry. Losses in productivity from high morbidity and mortality rates during the first week post-hatch is a	Human Health, Nutrition, & Wellness

		significant economic burden to the poultry industry. This is especially true for hatchlings from smaller eggs from younger flocks. Inefficient embryonic-to-post-hatch transition, and there by weaker hatchlings at hatch, is thought to contribute to this problem, the economic burden calculated to be ~$650 million for every 1% mortality post-hatch. This is significant considering that the demand for poultry meat has doubled in the last two decades and is estimated to be 128million tons by 2022. Very few effective strategies exist to improve metabolic transition during embryonic to post-hatch, and prevent early productivity losses. Activities and Outcomes: Preliminary data was generated to highlight the relevance and potential of the embryonic-to-neonatal period in chicken as an ideal model to understand the regulation of lipid oxidation and synthesis. With this data the PD successfully obtained funding from NIFA-AFRI for further study of mitochondrial networks and how it relates to metabolic health. Targeting mitochondrial function will be a new paradigm to improve poultry production and economics, specifically by a) optimizing the metabolic health of the embryonic and hatchling liver, b) identifying metabolic mechanisms which can help prevent the onset of fatty liver syndromes. This study may eventually help in better understanding of mitochondrial function as it relates to humans and develop strategies to prevent onset of fatty liver. The preliminary data generated by this project will form part of the dissertation of a doctoral student, who is being trained in profiling metabolism during embryonic-to-neonatal transition in poultry. Furthermore, two undergraduate students majoring in Animal Sciences also gained valuable research experience in terms of conducting basic	

		experiments in the laboratory, mass spectrometry analysis of metabolites and data analysis.	
17.	**Zoonosis Education**	Issue: In the fall of 2017, an outbreak of variant swine influenza occurred at several county agricultural fairs in Maryland. According to the Maryland Department of Health, in total, 40 people, all of whom had exposure to swine at one of three Maryland county agricultural fairs, were diagnosed with influenza A(H3N2) variant virus infection (A(H3N2)v). People who contracted the infection included swine exhibitors and their families, as well as fairgoers. Multiple swine exhibited at county fairs were also diagnosed with the influenza A(H3N2) virus. The Maryland Department of Health (MDH), local health departments of the affected counties, the Maryland Department of Agriculture (MDA), University of Maryland Extension/4-H, fair officials, and influenza subject matter experts at CDC, utilized a One Health approach to collaboratively respond to this outbreak. Activities: During 2019 and 2020, supported by a grant sub-award received through Maryland Department of Health from CDC/USDA/CSTE Project Development Grant, a partnership between University of Maryland Extension 4-H, Maryland Department of Health, and the Maryland Department of Agriculture created and implemented zoonosis education resources. For example, Utilized the existing Maryland and West Virginia 4-H Animal Husbandry and Quality Assurance (AH&QA) online training program as a foundation for also delivering novel influenza and other zoonotic disease subject matter content in a One Health framework to 4-H and FFA students in Maryland and West Virginia. Augmented the AH&QA training with Healthy Animals | Healthy YOUth Zoonoses Education Project for Youth in Agriculture Facilitator Guide and Activity Kit created by the MD 4-H Zoonoses education team, for 4-H/FFA groups. During 2020, the team created	Human Health, Nutrition, & Wellness

		videos to guide facilitators through five lessons to compliment the Resource Notebook for the index categories and lessons. Outcome: Evaluation of novel influenza and zoonotic disease content in the AH&QA program with pre-test/post-test questions focused on these topics. Preliminary data based on responses of 581 Juniors and 1,278 Intermediates and Seniors shows: Both pre and post tests showed that greater than 90% of Juniors responded correctly to the course content questions after attending the program. 40 additional Zoonosis Kits and Activity Lesson Plan Resource Books were produced. A virtually conducted train-the-trainer session was held in July, 10 additional staff/volunteer facilitators were trained to conduct zoonosis prevention activities. 537 youth and 18 adults have participated in zoonosis education sessions led by trained facilitators.	
18.	**Fresh Conversations 2020**	Issue: Older adults are a vulnerable population for chronic diseases. According to the America's Health Rankings (2018), 31.2% of Maryland residents 65+ are obese, 10.5% have heart disease, 62.6% have hypertension, and 21.6% have diabetes.1 In addition, 31.8% of Maryland residents 65+ are physically inactive,1 only 13.9% eat three or more vegetables daily,2 and 36.4% eat two or more fruits daily.2 According to the World Organization, physical, psychological, and social stressors become more common later in life, which can result in isolation, loneliness, and other psychological distress.3 Maintaining a healthy diet, daily exercise, and socialization play a critical role in promoting wellness and independence as we age. Activities: The University of Maryland Extension (UME) Family and Consumer Sciences educators partnered with the Maryland Department of	Human Health, Nutrition, & Wellness

		Aging (MDoA) to pilot an evidence-based program online called Fresh Conversations to promote healthy behavior changes through diet and physical activity and to encourage socialization during the COVID-19 pandemic. Eleven UME educators facilitated this online program statewide (some educators co-taught). Educators facilitated a total of 57 sessions and reached 619 older adults. Outcome: The percentage for knowledge, confidence, and intent to change is reported as “agree” by combining “agree” and “strongly agree.” Also, the percentage for online satisfaction is reported as “satisfied” by combining “satisfied” and “extremely satisfied.” The post-survey for each session indicated the following: 100% of respondents agree that after the program, they understand the difference between natural sugar and added sugar; they can identify three foods that contain healthy fats; they understand the new Menu Labeling Law and its restrictions; they can identify two ways to control blood pressure to reduce stroke risk; they can identify two foods rich in Vitamin D; they understand the differences between cow's milk and plant-based "milk" beverages; and they can state the number of grams of fiber they should consume daily for good health; and they feel more confident that they can increase their fiber intake to meet the recommended daily intake. 100% of respondents "agree" that after today, they feel more confident that I can identify added sugar listed on the new Nutrition Facts label; they are confident that they can choose three foods that contain good bacteria for a healthy microbiome; they are confident that they can choose more foods that contain healthy fats; they are confident that they understand	

		sodium information on food packages; they feel more confident that they can maintain an adequate vitamin D status. 100% of respondents "agree" that after today, they plan to limit foods that contain a high amount of added sugar in my diet; they plan to include more foods that contain good bacteria in their diet; they plan to use the Nutrition Facts label more often to find sources of saturated fats and unsaturated fats; they plan to limit foods that contain a high amount of sodium in their diet; they plan to include more foods that are fortified with Vitamin D in their diet; and they plan to include more foods that contain fiber in their diet. 100% of respondents were "satisfied" with all online sessions.	
19.	**Financial Literacy**	Issue: According to the 2015 Census estimates, the percentage of people living in poverty in Maryland was 10.1%. The three counties in the Western Cluster (Allegany 18.5%, Garrett 12.4%, and Washington 13.8%) were above the average percentage in the state. Maryland data also indicates the unemployment rates for 2019 in the Western Maryland Cluster (Allegany5.2%, Garrett 4.4%, and Washington 3.9%) is higher than the state average, 3.6%. A closer analysis of the Census data shows the category, "Persons over 65" is greater in each of the counties (Allegany 19.4%, Garrett 20.7%, Washington 16.2%) than the state average, 14.1%. Although the high school graduation rate is respective of the state level, the number of individuals that obtained a bachelor's degree (Allegany 17%, Garrett 18.4%, and Washington19.9%) is lower than the state average, 37.3%. The median household income for the counties (Allegany $39,794, Garrett 24,974, and Washington$56,477) is well below the state average, $74,149. Activities: Programs were offered to groups such as Young Mothers, and Allegany Workforce Experience. A programmatic emphasis was the credit program and working with college students within the cluster. As a member of the Health Insurance Literacy Initiative (HILI), the educator	Human Health, Nutrition, & Wellness

		along with other teaching faculty provided webinars on six modules. The Financial Wellness team provided train-the-train workshops using the Your Money Your Goals toolkit by the FDIC and the Master Money Mentors curriculum, in addition to the Personal Finance Seminar. As a result of the pandemic, all programs moved to a virtual format in March. Outcome: In 2020, the educator facilitated or co-facilitated 131 programs to 1,925 participants (1,649 adults and 276 youth) to increase basic financial literacy across all ages. Based on responses from 701 teacher effectiveness surveys, 93.7% indicated the presenter was well-prepared and 90.4% reported learning a lot from the workshop. Participants indicated effectiveness as a teacher at 93.7%. **Personal Finance Seminar** There were 173 attendees representing thirty-four states in the 2020 PFS conference. Participants reported a potential reach of 366,675 individual in PFS training in2020.PFS participants were asked to complete a pre- and post-survey and the results found that 100% plan to apply knowledge and/or skills gained and 97.4% learned tools and techniques for use in financial counseling and education. **YMYG** This educator hosted one YMYG training in 2020 and supported two additional workshops throughout the state. There were a total of 70 participants in the three trainings. Pre- and post- surveys were administered to assess confidence in items related to the training and CFPB resources. Post program evaluation data revealed that 94% of participants stated they agreed or strongly agreed that they had the confidence to discuss core financial management topics with the people they serve, and 97% agreed or strongly agreed that they had the confidence to assess individuals' financial conditions or situations. **College Students**	

		In working with the local community college and 4-year institution, there were8 programs offered reaching 95 students. The Choices with a Financial Impact program was offered 4 times in the fall semester. Responses (32pre/post surveys) indicate an 8.5% increase in confidence to make choices to increase income, 8% increase in confidence to make choices that will reduce my debt, and a 5.75% increase to set financial goals. **Understanding Credit Program** The understanding credit program was taught eleven times throughout 2020by this educator. The pre/post survey indicates an increase in confidence to use/manage credit responsibly (3.25%) and to improve credit history (3%). Of those that responded to the question I intend to request and review my credit report, 98.9% indicated an intent. **HILI** In 2020 this educator taught or co-taught, 2 Smart Choice Basics programs reaching 17 individuals, 4 Smart Use Smart Actions programs reaching 20 individuals, 2 Smart Use Understanding and Estimating Health Care Costs reaching 34 individuals, 10 Smart Choice Smart Use Healthcare in Your Senior Years programs reaching 213 individuals, and 1 Smart Use Managing Health Insurance and Resolving Conflicts reached 15 individuals. Evaluation data includes workshops provided by all educators. After taking the Smart Choice Basics workshop, participants (N=43) significantly increased their confidence in understanding health insurance terms and applying knowledge and information to make a smart choice health insurance decision (p<.001).After taking the Smart Choice Smart Actions workshops, participants (N=33) significantly increased their knowledge and confidence in knowing how to find out what is and is not covered before receiving a health care service and can apply knowledge and information to be a Smart User of health insurance(p<.001). After taking the Smart Use Understanding and Estimating Costs workshop, participants (N=28) significantly increased their confidence in estimating their total health care costs and understanding health insurance costs terms (p<.001). After	

		taking the Healthcare in Your Senior Years workshop, participants (N=105) significantly increased their confidence in understanding health insurance options in their senior years and could estimate their total health care costs (p<.001). After taking the Managing Health Insurance and Resolving Conflicts workshop, participants (9)significantly increased their likelihood to find the cost of a medical procedure before it occurs (p<.001). **Farm Stress** In 2020 this educator was involved in 11 programs that involved identifying farm stress, building resilience, or succession planning reaching 457individuals. Limited data was collected on the programs and not available at the time of this report.	
20.	**Mental Health Promotion**	Issue: Data from the Maryland YRBS and Maryland BRFSS suggest that Marylanders face significant mental health needs. Approximately 27.6% of respondents to the BRFSS reported 3 or more days per month of poor mental health. This suggests that over 1.2 million Maryland adults suffers from poor mental health at least 3 days per month. Furthermore, 23.6% of Maryland adults reported experiencing at least 3 adverse childhood experiences, which places them at significantly greater risk for current and future mental health challenges. This baseline level of stress was exacerbated by the 2020 COVID-19 Pandemic, which caused innumerable disruptions to daily life, routines, and mental health overall. Activities: A pandemic-oriented stress management series was created and presented across multiple virtual venues. The goals of the series were to provide specific guidance on stress management issues that were particularly affected by the restrictions of the pandemic. The topics included managing grief and loss, maintaining couple relationships, family routines, and work/family balance. Developing news articles and peer-reviewed fact sheets for distribution were also part of the response. The specialist's news article on managing grief and loss was published in the Frederick News Post, which has a paid subscription base of approximately	Human Health, Nutrition, & Wellness

		19,000 readers. In addition, the specialist made several news appearances for a television station serving Western Maryland. Outcome: Data collected from one of the final pandemic response sessions in December (related to coping with grief) showed that out of 126 healthcare professionals who completed a post-class evaluation, 98% either agreed or strongly agreed that they could identify the stress associated with grief and how it affects their practice as healthcare professionals. 98% also indicated that they agreed or strongly agreed that they could apply new self-help strategies for managing grief. A bulk of the qualitative comments indicated that they planned to apply the content of the specialist's program to enhance their visits with patients. In response to how participants planned to change their practice, one respondent wrote, "It is important to recognize our own loss and work through it as we can become re traumatized through those we serve, which hinders our ability to treat. As in the training I been in so far, it is a reminder to me to be self-loving and allow myself to be cared upon. Wet end to be pushed to do more and more, but sometimes we have to step back. It is okay to do this. "	
21.	**Wetland Management, Engineering and Restoration**	Issue: Wetlands are among the most productive ecosystems on Earth, support a diverse array of wildlife, and have been used for centuries to provide numerous services to humans, including water quality improvement, flood and storm protection, and habitat for plants and animals. Furthermore, it is increasingly clear that wetlands play a major role in global cycles of carbon and nitrogen, which have been tremendously altered by human activities such as burning of fossil fuels and fertilizer production. However, many wetlands have been degraded or lost due to human activities, and efforts to restore their functions have had mixed results. Activities: The team conducted a series of linked research activities, with each PI taking a leading role in advancing the research for a particular	Environmental Stewardship

		area. The overarching question is "How do fundamental processes of vegetation, ecosystem self-organization, sea-level rise, soil, and microbial communities relate to sustainable management, engineering, and restoration of the ecological functioning of saline and freshwater wetlands and their ability to provide important ecosystem services." The hypothesis is that these processes singly and in combination strongly alter structure and ecosystem functioning of wetlands. Outcomes: 1. Vegetation dynamics, ecosystem functions, and responses to natural and anthropogenic variables Activities related to this goal resulted in seven refereed articles and one book chapter. These products contributed to emerging research on dynamics of plant communities, soil biogeochemistry, and microbial communities in restored and natural wetlands. Specific examples of new knowledge resulting from studies conducted under this goal include: (1) organic soil amendments have mixed results in restored wetlands; (2) grazing impacts wetland soil structure; and (3) endophytic fungi alter salinity tolerance in an invasive plant species. 2. Wetland self-organization Activities related to this goal for our algal ecotechnology resulted in one refereed article. This paper reports on a major step in demonstrating how nutrients sequestered in algal biomass can be processed in a bioenergy technology (e.g., anaerobicdigestion). The project that this paper was based on won an award for Excellence for Environmental Mitigation from the American Association of Port Authorities. Work on our vertical wetland ecotechnology advanced with a successful multi-season demonstration on the Anacostia River. This is a major extension of the system over previous work which had resulted in only short-term demonstrations. Finally, work at Biosphere 2 on self-organization was	

		summarized in a third annual report on work based on short-term research visits. 3. Role of soil management and restoration practices in increasing tidal marsh resilience to sea-level rise and reducing marsh greenhouse gas emissions Activities included working with the Coastal Carbon Research Coordination Network to synthesize data on methane emissions from North American tidal marshes to better understand factors controlling these emissions (presented one presentation in 2020). Also published a journal article on methods to improve soil mapping to better identify wetland soils in depressional landscapes on Maryland Eastern Shore. Finally, prepared a manuscript for submission on research that found that using vegetation and hydrologic characteristics of tidal wetlands can be used to better predict their rates of methane emissions. 4. Pedological and biogeochemical processes leading to distinctive hydromorphology and other soil ecosystem services Activities related to this goal resulted in two refereed articles, two conference presentations and one PhD dissertation. These products contributed to emerging research on 1) technologies for recognizing problematic Wetlands; 2) advancements in using Fe and Mn coated IRIS devices to assess soil reduction; and 3) Pedogenesis and interpretation of subaqueous landscapes. Specific examples of new knowledge resulting from studies conducted under this goal include: 1) a new simple field test was developed for recognizing soils formed from Problematic Red Prent Materials (PRPM); 2) reduction and dissolution of Mn oxide coatings from IRIS devices is especially useful (and much more useful than Fe oxide coated IRIS) in recognizing reducing conditions in wetlands early in the growing season when soil temperatures are cool; 3) pedological approaches to subaqueous soil mapping have been statistically demonstrated to be well justified in Western Shore sub-estuaries of Chesapeake Bay; 4) information gathered during our investigation of	

		subaqueous soils in the Rhode River estuary, has been incorporated into (i.e. become publicly accessible in) the USDA-NRCS spatial dataset called Web SoilSurvey. 5. Microbial community composition and function, specifically examining the role of microbial communities in carbon storage Activities related to this goal resulted in eight refereed articles and nine conference presentations, a Ph.D. thesis, and a master's thesis. These products contributed to emerging research on wetland soil organic matter, microbial community structure, and methane dynamics in restored and natural wetlands. Specific examples of new knowledge resulting from studies conducted under this goal include: (1) soil C amendments lead to increased methane emissions in restored wetlands, (2) soil aggregates are important in carbon accumulation in wetlands; and (3) including wetland microbial community characterization increases predicted rates of denitrification.	
22.	**Water Quality and Economic Incentives for Conservation Practices**	Issue: Nonpoint source (NPS) pollution from agricultural sources accounts for a large and growing share of water quality impairments in the United States, including hypoxic zones in the Gulf of Mexico, Lake Erie, Chesapeake Bay and other regions globally (Diaz and Rosenberg 2008). Policies aimed at reducing agricultural NPS pollution have largely involved subsidy payments for ecosystem services, paying farmers either to retire cropland or adopt conservation practices on working lands. Since 2002, the federal government has turned increasingly to the latter through increased funding for cost-share programs. For example, the Environmental Quality Incentives Program (EQIP) and Conservation Stewardship Program (CSP) spent $2.4 billion in 2014 to subsidize conservation practices, over twenty-five times the $93 million spent on EQIP and the Conservation Security Program a decade earlier. Evaluating the effectiveness of cost-share programs is complicated by several factors mainly by farmer behavioral responses. However, these behavioral responses have been ignored in integrated models linking the	Environmental Stewardship

		adoption of conservation practices and water quality impacts. Accounting for behavioral effects has important policy implications for understanding the effectiveness of cost-share funds in achieving actual water quality improvements. Activities: The overarching goal is to improve the understanding of the cost effectiveness of cost-share payments to change landowner behavior for practice adoption and environmental outcomes. This research program has the following two main objectives: (1) to evaluate the behavioral response to cost-share subsidies for increasing conservation practice adoption; and (2) to assess policy simulation to determine the relative magnitudes of behavioral responses in terms of water quality impacts. The team conducted an empirical policy simulation model to analyze the cost-effectiveness of water quality trading in the presence of a cost-share program for cover crops. Outcome: The analysis showed that the cost-effectiveness of water quality trading is much lower when farmers can choose between the existing cost-share program and the new water quality trading program. It also demonstrated that the behavioral responses, such as slippage effects, may reduce the cost-effectiveness of water quality trading. The research was shared with government agency staff at the Maryland Department of Agriculture who administer the cost-share program for cover crops, the largest statewide program to reduce agricultural nonpoint source pollution in the Chesapeake Bay. Results were presented at national conference venues for academic audiences. The graduate student involved in the project completed his Ph.D. dissertation and is now an assistant professor in a tenure-track position.	
23.	**Master Gardeners Program**	Issue: The National Gardening Association found that 74% of all U.S. households participated in lawn and garden activities, and 35% of households participated in growing food either at home or in a community	Environmental Stewardship

		garden. There are over 937,000 acres of single-family lawns and yards in Maryland, which are being managed by either the resident or a contracted landscape company. Residents often have questions about how to care for their lawn, food gardens, and flower gardens concerning fertilizer, pest management, plant health, and insect identification. Residential insect questions are not limited to the outdoors. Over 30% of insect samples brought or sent into the Dorchester County Extension office by residents were “pests” found inside the home. House hold pest such as bed bugs are costly, hard to treat, and can be stressful for those living with them. Activities: To help Maryland residents with garden and yard issues UME Home and Garden Information Center (HGIC) and home horticulture extension agent work proactively to provide residents with timely information via the website, social media, and local news outlets. Residents may also submit specific garden-related questions, photos, and samples to their local extension office, Master Gardener Plant Clinics, or the "Ask an Expert" found on the HGIC website. The Garden Thyme podcast is an additional way for UME to engage and educate the public about timely garden related topics. Since it started in 2019, 17 episodes have been released, providing the public with 620 minutes of content. The podcast has over 4,650 downloads. Listeners spend the State of Maryland, Country, and World. To help address plant and garden questions during the 2020 pandemic, three virtual Q&A were held by the Garden Thyme hosts. Outcome: In 2020, the Dorchester Extension Office saved Maryland residents $16,200 in pest control and arborist services.	

		Over 40% of people who attended a "Garden Thyme Virtual Plant Q&A" rated that the class increased their plant diagnostic knowledge. 75% of participants were going to plant more native plants in the upcoming year, 25% of participants were going to get a soil test, and 28% of participants were going to contact local Extension service in the future with plant or insect I.D.	
24.	**Land Use and Watershed**	Issue: Master Naturalist (MN) programs, found nationwide in 39 states, are conservation-based collaborative ventures between state and local groups formed for the purpose of producing an educated corps of volunteer environmental stewards. The economic impact of MN programs benefit partners by providing a large knowledgeable volunteer base on which to draw for projects that might not be affordable otherwise. As indicated in a 2006 needs assessment of 128 Maryland outdoor education centers, nature centers, and state & local parks, 59% of respondents indicated the need for educated volunteers. According to a 2018 report on volunteering in the United States released by the Corporation for National and Community Service, Maryland has shown an economic impact of the volunteer work force valued at $4.3 billion by over 1.7 million volunteers contributing 181.9 million hours of service. Activities: Based on a need expressed by Maryland's natural resource agencies and organizations, the Maryland Master Naturalist Program was developed and piloted in2010. Unlike many other UME volunteer training programs, the volunteers trained through this program are managed directly by staff at the site where they were trained instead of by Extension faculty. Another difference is that the program is totally self-supported by funds raised through class registration fees and donations. These two differences enabled a needed volunteer training program in the	Environmental Stewardship

		critical realm of natural resources education and conservation to exist without being a financial burden to the University. Outcome: Maryland's diverse natural resources and ecosystems are experiencing increasing pressure and negative impacts due to expanding population and development. The degree of conservation awareness and use of conservation management practices is limited. In the past ten years, a cumulative total of 1,561 Maryland Master Naturalists, taught using UME curriculum in one of 80 trainings, have volunteered a total of 162,286.48 hours. According to the Independent Sector, this time is valued at$4,427,469.74. In the words of some 2018 trainees, "Everyone in the state should take this class, it'd be an eye-opener.", "While the course was recommended to me by an informed acquaintance, I did not anticipate it would be as diverse and complete, as well as providing a basis to contribute to our environment. It also pleased a personal trait of enjoying learning things about which I was previously clueless.", "As a former Biology Teacher this program was invaluable to me. This class put all the pieces of my training together with a global view of our interaction with the environment around us and the important mission we have to protect it.", "The Maryland Master Naturalist Program has opened my eyes to the natural world around me and connected me to my surroundings in ways that I hope will only grow and deepen over time.", "I am so glad I found the Maryland Master Naturalist Program. It combines my desire to learn more about the natural world with an opportunity to lend a hand in preserving these important resources. It also gets me outside, which is fabulous! I highly recommend the program for anyone wanting to learn about nature and help others gain an appreciation for it too.", "The MD Master Naturalist program gave me a better framework to tell the story of	

		our local environment. It enhanced my passion for the outdoors and gave me tools to share my excitement with others." By the end of 2020, 133 new interns (from 8 volunteer trainings) representing 10 sites, brought the total number trained to 1,587 since 2010. There are currently 42 Master Naturalist volunteer training sites in the coastal plains, piedmont, and mountain regions of the state. Based on 2019 figures (2020 figures are unavailable until the end of the first quarter, 2020), a total of 786 have reported achieving Certified Master Naturalist status since 2010. Volunteer service provided by Certified Master Naturalists and Interns in 2019 totaled 31,506.38 hours, valued at $929,753.27 by independentsector.org.	
25.	**Horticulture Education**	Issue and activities: Americans are persistently worried about the environment. 56 percent rate the overall quality of our environment as fair or poor according to Gallup's annual environmental survey conducted March 2 to 13, 2020. 43 percent say they worry about the environment "a great deal." Among the issues they cite are global warming and pollution. 46% say they worry "a great deal" about global warming and 64 percent say that we are to blame, not natural environmental changes. Local horticulture consultation questions mirror those concerns. One in three inquiries are about invasive species, organic pest controls, wildlife management, growing food organically or other techniques designed to support a healthy environment. When a client calls or e-mails or visits our offices with a gardening question, they get research-based answers that emphasize solutions that are kind to the environment. In-person and online gardening talks offer sustainable techniques and encourage stewardship. Bi-monthly newspaper columns, monthly blogs and weekly Facebook posts give readers/viewers	Environmental Stewardship

		ideas that work and techniques that build a healthier environment and community. Outcome: In 2020, 860 people got answers to their gardening questions through horticulture consultations at our office, online or through the eXtension Ask an Expert program, more than double the number of the previous year's inquiries for six months of the year. Another 163 people learned environmentally smart techniques through in-person and online educational presentations. 24 horticulture columns in a local newspaper extended teaching beyond the tristate with a daily print readership of 25, 000 and 23 million page views monthly on its digital platform. Additional online gardening education was offered through 2,900 page views of 8 blogs on the University of Maryland Extension Maryland Grows blog.	
26.	**Watershed Protection and Restoration Program**	Issue: Water quality in the Chesapeake Bay region is considered impaired by the US EPA and is caused by excessive amounts of nutrients (nitrogen and phosphorus) and sediment that have resulted from increasing human population, changes in land use, and poor land management. Sources (sectors) of nutrient and sediment pollution are broadly classified as agriculture, wastewater treatment facilities, septic systems, and urban stormwater. Although there has been improvement in reducing nutrient loads from the agriculture and wastewater sectors, there have been increases in loads from the septic system and urban stormwater sectors. According to the Maryland Department of the Environment's *2014 Integrated Report of Surface Water Quality*, from 1985 to 2013, the urban stormwater sector reported a 17% increase in nitrogen loadings to Maryland's portion of the Chesapeake Bay. To restore Bay water quality to an acceptable level, *Watershed Implementation Plans* (WIP) were developed based on *Total Maximum Daily Loads* (TMDL) intended to reduce nutrient and sediment loads throughout the Bay's watershed. The WIPs require counties and	Environmental Stewardship

		municipalities to reduce pollutant loads from all sectors by 60% in 2017 and completely meeting the goals by 2025. Along with efforts by the state, counties, and municipalities to meet WIP deadlines, meeting the reduction goals and timeline will require action from communities and individuals. Activities: To address the communities' needs, the *University of Maryland Sea Grant Extension* employs 5 Regional Watershed Restoration Specialists that work in specific regions of the state to extend research-based information. They assist in developing partnerships among state and local governments and organizations, help identify and prioritize nonpoint-source pollution challenges, assist partners in implementing on-the-ground projects that result in measurable improvements in water quality, and assist in realizing funding opportunities to achieve these efforts. One Sea Grant Extension Specialist is assigned to work in the Mid and Upper-Eastern Shore counties to identify needs and opportunities and provide research-based information to individuals, organizations, and local governments to aid in the decision-making process to assist in WIP implementation, as well as provide educational programs focused on helping local and county governments and watershed groups to plan, develop, implement and monitor projects and programs that lead to quantifiable reductions in nonpoint sources of pollution as outlined in WIPs. Outcome: The grant assistance provided by the Specialist resulted in 8 grants being approved totaling $261,056 for water quality restoration projects on the Mid and Upper Eastern Shore. These projects will result in an annual reduction of 5.1 pounds of Total Nitrogen, 0.4 pounds of Total Phosphorus, and 264 pounds of Total Suspended Solids. In 2020, Master Watershed Stewards with the Cecil County WSA completed 3 new projects totaling 470 square feet treating 940 square feet of impervious surfaces. The projects are estimated to have annual load reductions of 0.14 pounds of Total Nitrogen, 0.02 pounds of Total	

		Phosphorus, and 37.85 pounds of Total Suspended Solids. Additionally, they planted 423 native plants. There were no volunteer or community engagement activities in 2020 due to COVID-19 restrictions.	
27.	**Public Speaking 101**	Issue: Public speaking skills are ranked number one among the desired skill sets of professionals. Maryland 4-H recognizes this need and strives to provide public speaking experiences to youth at the county and ultimately at the state level as well. 4-H members practice by giving talks to project groups and at community club meetings, sharing information about the skills they learned in a project, and observing other people giving presentations. These presentations and public speaking opportunism help youth develop life skills. In preparation, youth learn how to research a subject, organize ideas in a logical order, share knowledge with others, set and meet goals, receive constructive feedback and evaluation, and much more. When youth share knowledge and skills in a public speaking and communicative format, it demonstrates advanced skills and a deeper understanding of what was learned. The COVID-19 pandemic might have cancelled programs but 4-H did not stop. 4-H youth still actively learned, created, cultivated, and did in 2020. Because the pandemic affected in-person Maryland 4-H programming, the State 4-H Public Speaking Contest and public speaking experiences could not be held in their normal context. Public speaking programming and opportunities shifted to a virtual format in 2020. Activities: Three Public Speaking 101 virtual workshops and presentations were held across the state reaching over 100 youth. The presentations, hosted on Zoom and Facebook, were held for youth in Frederick, Garrett, Howard, and Montgomery Counties, as well as all Eastern Shore counties, at the invitation of 4-H faculty and/or volunteers in those areas. The	Family & Community Resiliency

		workshops focused on the basics of public speaking, including the exploration of Maryland 4-H public speaking categories and both formal and informal opportunities. Outcome: Youth shared the following about the public speaking presentations:-"This was a great presentation. Thank you for the awesome ideas, information, and advice."-"I loved all the tips and suggestions. I now feel encouraged and ready to try a public speaking contest."-"This was so fun and helpful!" -"I never knew that learning about public speaking can be fun. It makes me want to try harder to overcome being nervous and shy. "Participants increased their knowledge and skills in why public speaking is important, how to overcome fears about public speaking, how to adequately prepare for formal and informal 4-H public speaking experiences, and much more. They learned tips, how to's, and strategies for effective communication to use in their daily lives.	
28.	**Google & 4-H Pathways to Computer Science**	Issue: Starting 2017, Google partnered with National 4-H in order to increase youth interest in STEM and to help youth learn technical skills to help fill significant gaps in national Computer Science (CS) employment. The US Bureau of Labor Statistics, for example, accurately predicted that in 2020, only 400,000 qualified CS job candidates will exist to fill 1.4 million CS-related jobs (National 4-H Council 2017). Locally, there are over 20,000 CS jobs in Maryland, but the state of Maryland identified that it needs to triple the number of STEM teachers and increase the number of STEM college graduates in order to retain Maryland's global competitiveness (Governor's STEM Task Force 2009). 4-H, in Maryland and nationally, has made it a priority to encourage more youth to engage in STEM programming, specifically related to topics such as Engineering, Math, Physics and CS, so the Google partnership was pursued in effort to do this.	Family & Community Resiliency

		Activities: Maryland was one of the first states to apply for the first round of funding from Google through National 4-H Council in 2017. This resulted in Maryland being awarded curriculum, 30 Chromebooks, and 2 Google Expeditions Virtual Reality kits in order to start new CS programming opportunities across the state. The estimated reach of the MD 4-H CS programming by the end of 2020 was 6000 youth and 200 adults. Outcome: After educators got trained in 2019, MD 4-H CS programming started primarily in the fall with the beginning of the 2019 4-H STEM Challenge "Game Changers." CS programming during the Fall of 2019 reached over 2000 youth, primarily through the STEM Challenge events. Programming in 2020 was planned to include significant in-school opportunities, particularly in Caroline, Baltimore, and Anne Arundel counties, but when COVID-19 impacted 4-H, in-school programming had to be cancelled. One of the programs educators were trained on was MIT's Scratch, an introductory block-based browser-ran coding platform that could be taught to youth aged 5 on up. Educators and volunteers ran Scratch sessions with youth at camps, during virtual club meetings, at 4-H's virtual camp, and during outreach efforts. Some counties, such as Allegany, dedicated the entire summer to STEM and CS programming, such as with their Summer robotics challenges, which reached over 20 youth and trained parents and volunteers on how to use Scratch so they can share such with others. Garrett 4-H led a series of virtual workshops to train educators and volunteers on the platforms and rules for the Maryland 4-H Robotics Challenges, which reached 25 adults and 11 youth over 6 sessions. Statewide CS events included a large outreach initiative with the Capital Area Scouting Council, meant to garner interest in 4-H with local scouting groups in the capital and southern clusters, reaching an estimated 250 youth and a similar number of adults. State STEM leadership also was asked to help with larger National 4-H events, including the National 4-H STEM Summit (97 youth, 25 adults), the National 4-H CS Education Week Conference (112 4-H educators), and with	

		marketing of the 2020 4-H STEM Challenge: "MarsBase Camp." All told, 5163 youth and 361 adults were reached through Maryland 4-H's CS efforts during the course of the grant. The higher-than-anticipated adult reach is particularly noteworthy, as it is anticipated this will mean higher CS programming efforts in the coming years as a result of more trained volunteers and educators that can lead such.	
29.	**4-H Health Rocks! Mentoring Program**	Issue: Maryland's opioid epidemic has become so widespread that Gov. Larry Hogan declared a state of emergency in February 2017. The state of emergency will increase first response, public health, and treatment funding related to the opioid epidemic. According to new data released in 2018 by the Maryland Department of Health, the number of drug and alcohol-related intoxication deaths occurring in Maryland increased 9 percent between 2016 and 2017, reaching an all-time high of 2,282. It marks the seventh straight year of increases in the overall rate of substance-related deaths. Illegal and prescription opioids continue to be the largest contributing factor. 2016 statistics showed that Allegany County Emergency Services (EMS) administered roughly $40,000 of Narcan, and see an average of one overdose per day in the county. 2019 data from Prescribe Change Allegany, found 58% of non-fatal overdoses in Allegany County during 2019 were opioid related. Activities: The Allegany County Task Force on Child Abuse and Neglect, hoping to provide services for a rising number of area children placed in foster care due to the region's opioid epidemic. In fiscal 2017, 117 children were placed in out-of-home care, a 74 percent increase from the previous year. In 2018, the local hospital labor and delivery reported a record rate of 20% of babies were born there were born with a substance (exposure). Allegany County falls within the Appalachian region, which are at high risk for youth impacted by opioids/substance abuse problems. According to	Family & Community Resiliency

		the Appalachian Overdose Mapping Tool, Allegany County has 57.2 deaths per 100k population. Outcome: 56 sessions, 130 youth with pilot grant (2019-2020)-72 sessions, 155 youth with Year 1 grant, as a three-county cluster (2020-2021)Mid-point surveys found:-100% felt 4-H was a place adults cared about them-100% felt 4-H was a safe place-83% felt 4-H was a place where it was okay to make mistakes-78% felt most of the time they liked themselves-33% of youth said they always worry-36% of you said they can always control their temper. Surveys show the program is creating a positive environment for youth to participate, however also showed the mental stress these at-risk youth are under. Mentoring research shows that it commonly takes more than one year to see an impact of creating positive environments and relationships. In a study by the National Mentoring Partnership, young people who were at risk for falling off-track but had a mentor were 55% more likely to enroll in college; 78% more likely to volunteer regularly; and 130% more likely to hold a leadership position. Utilizing a nationally recognized curriculum, Health Rocks!, we can assume youth completing the Health Rocks! mentoring program are achieving the same successes.	
30.	**Passport to Success**	Issue: Too many young people face barriers to opportunity and success based on factors beyond their control. Challenges are especially acute for youth living in poverty, youth with disabilities, racial or ethnic minorities, and young mothers. Too many become detached from school, work, and civic systems. (IYF, https://www.passporttosuccess.org/barriers-opportunity)Prince George's County has a poverty rate of 9.3% and the majority of homes with the lowest income are located inside Interstate 495 Beltway. The groups with the largest demographic living in poverty are females 18 - 34 and males 18-24. Lower income can be linked to a variety of reasons one being the lack of training and education. In PGC graduation rates at two evening high schools, also located along the Beltway, are	Family & Community Resiliency

		between 22-52. Youth in evening high schools are often there due to factors beyond their control. They are youth that are working full time jobs, assisting their families, or may have children of their own. This group requires education and training to not only obtain but keep a job. Through a grant from the International Youth Foundation (IYF), PGC 4-H and FCS partnered with high schools to bring Passport to Success to students that are in evening school or are in career readiness programs in day schools. Activities: A 12 lesson curricula was used to offer experiential learning through real life scenarios, problem solving, and discussions. In-School sessions were offered during normal school hours once or twice a week for six weeks; evening school sessions were offered once a week for two hours for six weeks. Along with the workplace skills youth were afforded the opportunity to participate in a hiring fair in which transportation was provided, career exploration via faculty from the UMD Institute of Applied Agriculture (IAA) giving a presentation on the IAA Certificate, and a financial literacy class was offered. Outcome: From October 2019 - March 2020 this program reached 168 youth ages 16 -19. Fifty-six percent of participants that attended the hiring fair were offered a second interview. After that, IYF could not produce data as to how many were hired. Participants are asked to complete a Life Skills Retrospective Survey. Of those that completed the survey, 69.6% reported increases in life skills and 75% reported satisfaction with the training. Students inquired about continuing sessions and had further topics of interest such as resume writing and how to find job openings in their communities.	
31.	**Maryland RREA**	Issue: Maryland is a rapidly growing urbanizing state with changes in demographics, economic and political patterns that affect forest ownership and management. The University of MD, College Park will develop educational programs in cooperation with its 1890 institution, University of MD Eastern Shore, to develop educational programs to fill	Renewable Energy Resources

		these diverse needs and also help those underserved and minority forest landowners understand the value of their forest land, programs available to assist them and take actions to manage their land following sustainable forest stewardship techniques. There are 2.4 million acres of forest land in Maryland covering almost 43% of the total land area, with 75% being family owned covering more than 1.8 million acres. There are 130,800 private forest landowners in Maryland that own 78% of the forestland. Seventy five percent of these forest landowners own less than 10 acres, with an average forest holding of about 17 acres. These private forest lands protect and supply more than 2/3 of Maryland's drinking water. Maryland is a very diverse state consisting of forest landowners who are residents, absentees, private ownerships, incorporated, large & small ownerships, some engaged in management decisions and others not engaged in any management decisions, farmers, urban owners, political motivated, minority ownerships, ethnic diversity, hardwood vs. pine management, coastal plain vs. mountainous regions, and own for a variety of reasons (recreation, wildlife, timber resources, profitability). This poses a challenge to MD extension educators, for there is no one program that can fill all the needs of this diverse audience. Activities: In 2020, one-face-to-face, 4-part core course training was offered in Eastern MD for the Maryland Master Loggers with a total of 19 attendees. Due to the global pandemic, sessions were moved online with 39 participants completing the core courses through distance education experiences; 32 attended online courses and 7 completed classes by way of correspondence means via mailed materials. **Woods In Your Backyard Online Course** (50 participants and 1306 acres in 2020). In addition to the course and supplemental videos the course include evening chats with participants.	

		Training for Green Industry Professions (Landscapers and Arborists) to Provide Backyard Woodland Services. Leveraging grant funding from the Hughes Center for Agro-Ecology, University of Maryland Extension organized the Woods in Your Backyard Partnership, which includes Penn State Extension, Virginia Cooperative Extension, Alliance for the Chesapeake Bay, and Virginia Department of Forestry. The partnered effort developed two quality publications to be used to train green industry professionals on how to expand the services they provide to include woodland health practices that improve forest health on small acreage properties. In 2020, the Woodland Health Checklist and Woodland Health Practices Handbook were released and a four-part webinar series was offered to over 200 green industry professionals in the three states. **General Forestry & Wildlife Correspondence Courses.** Over 545 forest landowners and other interested persons have enrolled in the course since 2000. Students have participated from all over the world. Participants own over 27,000 forested acres and have implemented several forest management plans and practices as a result. Outcome: This program has provided training and professional development for landowners, loggers, wildlife and forestry professionals, "green" and forest industry professionals, bioenergy experts and several others through a variety of face-to-face and webinar programs reaching a diverse group of individuals while addressing the diverse needs of Maryland's forests.	