

Maryland (University of Maryland College Park) Annual Report - FY2021

Report Status: Approved as of 07/08/2022

Contributing Organizations

University of Maryland College Park

Executive Summary

Overview

By October 2020, the beginning of this reporting period, the University of Maryland was operating under Phase 2 Research Reopening guidelines allowing up to 50% occupancy and 1 person per 150 sqft space requirement. This policy remained in place during most of the reporting period and was transitioned to Phase 3 Research Reopening in August 2021, allowing for the return of all researchers to campus laboratories and to operate at full capacity. Campus fully reopened thereafter in the fall of 2021. Reopening plans were made in response to directives given by State of Maryland Governor Larry Hogan and specific guidelines set by the University of Maryland System.

A few researchers conducting laboratory experiments reported that the university's COVID-19 restrictions had hampered their activities because of limitations in space occupancy and problems in hiring students. In contrast, field experiments continued uninterrupted because social distancing was easily implemented and field technicians were already on board to assist researchers. Day-to-day activities in the farms, as well as in the labs, were carefully planned so that staff were rotating in smaller groups in case some individuals got infected with the virus or were exposed to COVID-19 and were required to quarantine for several days.

Restrictions were relaxed by the university for human subjects researchers that addresses community-based and other human subjects-based research including clinical research only in May 2021.

University of Maryland Extension continued to serve the Marylanders through different models of program delivery- virtual, in-person, and hybrid. The UME educators were resilient and quickly adapted to the changing COVID scenarios and its impacts, especially when the COVID restrictions were in place and after they were lifted. Informed by stakeholders' inputs and by the findings of a 90-day rapid response task force created by UME senior administrators, the educators continued with their programming despite several challenges. Based on a statewide Extension faculty needs assessment survey results, a 12-week 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. Subsequently, 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.

During this reporting period, the College of Agriculture and Natural Resources embarked on a rigorous exercise to review its policies and current practices, and in April 2021, renewed its commitment with a Diversity, Equity, Inclusion and Respect (DEIR) Plan to incorporate DEIR efforts in all AGNR college-wide and the unit level strategic and operational efforts so that it becomes a seamless and a common element in planning, programming, and employment. This Plan serves as our guiding principle for all research and Extension programming activities.

Following the creation of AGNR's DEIR vision, a task force was formed in UME around September 2021 to systematically understand the multifaceted need of our stakeholders. Initial draft for consideration was developed by UME Senior Administration, a representative of Area/City Extension Directors, and the AGNR Compliance Officer. Now, the DEIR vision of UME has been finalized and is gearing towards accomplishing DEIR goals.

Critical Issue: Climate Change (CP)

A number of research projects and Extension programs aligned closely with addressing critical issues associated with climate change. Climate change critical area maps aptly to our AGNR College's strategic initiative "**Advance eco-system health in a changing world, specifically agro-ecosystems affecting the health of the Chesapeake Bay**". UME and MAES have developed research and education

programs that generated knowledge to develop agricultural systems that maintain high productivity in the face of climate change and variability and ensure the protection and health of the Chesapeake Bay.

The research project that we highlighted in this report, entitled, **Waste management and cover cropping systems to enhance soil health, nutrient cycling, waste to energy, water quality and climate adaptation**, exemplifies the 'adaptive practices for effective nutrient management under changing climate conditions' recommended by the researchers based on their findings, to the state and local policy and decision makers. The researchers in this project are members of various state advisory councils and committees in the fields of soil health and waste management.

From the Extension side for this reporting period, we have chosen to highlight three projects: 1- **Bay-Wise Landscape Management, 2- Farm Solar, and 3- Watershed Stewards Academy**. All these three programs fall under the “Big P” Environment and Natural Resources (ENR) program. Our extension educators have been heavily involved with addressing climate change issues in Maryland and beyond.
Critical Issue: Climate Change - UMES

Not applicable.

Critical Issue: Environmental Stewardship (CP)

The AGNR Strategic Initiative “Optimize Urban Environments through Design, Green Technology, and Community Engagement” closely aligns with the Environmental Stewardship Critical area. This initiative addresses the improvement in healthy environments, urban resilience in conditions of climate change, social justice, impacts of built environments on community health, maintenance of human dignity, equitable access to nutritious food, and access to formal/informal agricultural and environmental design. The health of non-tidal waters and the Chesapeake Bay depend on improved land use practices.

Many of our research projects under this Critical Issue also address the Critical Issue on Climate Change. Projects we chose to highlight in this report are: **1- Mechanistic Drivers of Nutrient Transport in Maryland Agroecosystems; 2- Wetland management, engineering, and restoration: Understanding soil, microbial, biogeochemical, plant, geomorphological, hydrological, and ecosystem processes; 3- Assessing Impacts of Anthropogenic Activities on Aquatic Ecosystems; 4- Water Quality and Economic Incentives for Conservation Practices; 5- Costs and Benefits of Natural Resources on Public and Private Lands: Management, Economic Valuation, and Integrated Decision-Making.**

We chose to highlight two UME programs **Backyard Farming and Thriving Naturally** for this reporting period.

Critical Issue: Environmental Stewardship - UMES

Not Applicable

Critical Issue: Family & Community Resiliency (CP)

AGNR-UME’s Strategic Initiative 4-H Youth Development maps to the Family & Community Resiliency Critical issue. Maryland 4-H provides safe, welcoming, and affirming environments where young people engage in age-appropriate, meaningful educational programs and experiences that allow them to build positive life skills, supportive adult and peer relationships, and understanding and connections to their communities. For this reporting period, we chose to highlight four programs namely, **Strengthening the Capacity in Rural Maryland to Address Opioid Misuse, 4-H Health Rocks! Mentoring Program, Ag Innovators Experience-Curbing Our Carbon Appetite, and Career AGsperience.**

Critical Issue: Family & Community Resiliency - UMES

Not applicable

Critical Issue: Food and Agriculture (CP)

Food and Agriculture critical issue is very closely aligned with our AGNR college’s strategic initiative “**Advance Innovative, Profitable, and Sustainable Agricultural Production Systems**”. Maryland has a strong traditional agriculture base with grain crops, dairy, poultry, vegetables, fruits, and aquaculture. This critical area focused on topics such as agricultural production emphasizing soil health and water quality, and training the next generation of farmers and agricultural professionals. Researchers and extension educators have been trying to resolve several issues by providing state of the art solutions to this critical area.

Research projects that we are highlighting are: **1-Using cover crops as a biculture intercrop to manage weeds in vegetables; 2- Improving strawberry reproduction through genome editing and mutagenesis; 3- Genome assembly and functional annotation the rainbow Trout fish; 4- Using clover and wildflowers to improve ecosystem services in edamame, and 5- Engineering for food safety and quality.**

1-Using cover crops as a biculture intercrop to manage weeds in vegetables: Farmers were taught new pest management techniques, trained next generation agricultural personnel, and helped mitigate community's food insecurity by sharing produce from the research plots.

2- Improving strawberry reproduction through genome editing and mutagenesis; 3- Genome assembly and functional annotation the rainbow Trout fish: A common thread in these basic research projects was that undergraduate and graduate students, and postdocs were trained in laboratory research procedures specifically in genetics. They also gained experience in sharing findings through publications and presentations at virtual conferences.

6- Using clover and wildflowers to improve ecosystem services in edamame. Farmers are beginning to adopt the project's biodiversity-friendly practices, such as floral supplementation methods to help the sustainability of production systems and increase yield.

7-Engineering for food safety and quality. This project is both **multistate and integrated**. 12 university-member institutions of NC-1023, the University of Maryland-CP being one of them, developed courses in By-Product Utilization, Engineering for Health, and Engineering and Processing for Sustainable Systems that were offered online during the pandemic and attended by graduate students. Our faculty representative to this multistate project led the development of one of these online courses.

We chose to highlight three programs in Extension for this reporting period. They are: **Agriculture Literacy, Commercial Poultry Education, and IPM of Forage and Agronomic Pests**. We chose these three programs to show the breadth of our expertise and how we have capabilities to cover a broad range of areas.

Critical Issue: Food and Agriculture - UMES

Not applicable

Critical Issue: Human Health, Nutrition, & Wellness - UMES

Not applicable

Critical Issue: Human Health, Nutrition, & Wellness (CP)

AGNR's strategic initiative "One Health: Improve Human, Animal, and Environmental Health", maps the critical issue of Human Health, Nutrition, & Wellness. Our aims are to (1) Improve animal and human health by reducing disease transmission between animals and humans; (2) Advance community health in a changing world; (3) Reduce chronic diseases in animals and humans; (4) Analyze environmental, agricultural, and health policy and inform decision makers; and (5) Promote and support healthy and livable communities through education of all ages.

Our college takes pride in helping Marylanders stay healthy and ensures that they have access to all the resources to do so. UME's Family & Consumer Sciences has several programs offered to prevent and manage chronic diseases through healthy food and physical activity choices, having basic financial literacy, and safe and healthy places to live, work, play, and learn. We chose to highlight two Extension programs **DASH Plus 2021 and Financial Wellness** from extension side for this reporting period.

For Research, we are highlighting the following projects that have significant implications on research related to COVID-19. **1- Mucosal delivery of universal influenza vaccine antigens.** The project aims to design an intranasal vaccine based on a model influenza virus hemagglutinin antigen. This research will essentially, "*fill the gaps left by standard intramuscular vaccines and stop the spread of COVID-19 at its source—in the nose*". **2-DIVA Vaccine Development Against Porcine Reproductive and Respiratory Syndrome Virus.** This project intends to develop an improved vaccine that can differentiate infected from vaccinated animals. [Note that this project is also classified under Critical Issue: Safe, Secure, Abundant Food Supply (CP)]

During this reporting period, results from these studies were preliminary, and hence, were too early to report. However, we would like to underscore these important research projects that are partly funded by USDA and are being conducted in our institution.

We also chose to highlight research project: **3- Applying transgenic insect pathogens.** The team designed engineered mosquito pathogen (Metarhizium) that can rapidly kill insecticide resistant mosquitoes. They are studying the risks of using a transgenic approach to alleviate the suffering caused by malaria in West Africa where the study is being conducted.

Critical Issue: Renewable Energy Resources (UMD College Park)

Not applicable

Not applicable

Critical Issue: Safe, Secure, Abundant Food Supply (CP)

AGNR's strategic initiative "Establish a Healthy Food System and Ensure Global Food & Nutritional Security" is aligned with the Safe, Secure, Abundant Food Supply Critical Issue. AGNR has the expertise to identify issues pertaining to inequality in food and nutritional security and the ability and creativity to explore innovative solutions. Our research, academics, and Extension programs are educating the next generation of food systems researchers, professionals, and educators. Our healthy food systems initiative encompasses all the processes that are required to produce and deliver food in a socially, economically and ecologically sustainable manner to promote and protect human health.

Research projects that we like to highlight are **1-Using cover crops as a biculture intercrop to manage weeds in vegetables; 2- Improving strawberry reproduction through genome editing and mutagenesis; 3- Genome assembly and functional annotation the rainbow Trout fish; 4- Mitochondrial Origins of Metabolic Diseases; 5- Pluripotency and lineage differentiation in stem cells and early embryos; and 6- Using clover and wildflowers to improve ecosystem services in edamame, 6-DIVA Vaccine Development Against Porcine Reproductive and Respiratory Syndrome Virus; 7-Improving Quality and Reducing Losses in Specialty Fruit Crops through Storage Technologies; and 8- Engineering for food safety and quality.** These projects also fall under the Critical Issue: Food and Agriculture, but the current NIFA system does not allow projects/programs to select more than one Critical Issue.

We chose to highlight two Extension programs under this critical issue namely, **Maryland Crabmeat Quality Program, Food Safety and Nutrition.**

Critical Issue: Safe, Secure, Abundant Food Supply - UMES

Not applicable

Merit and Scientific Peer Review Processes

Updates

None

Stakeholder Input

Actions to seek stakeholder input that encouraged their participation with a brief explanation

During pandemic and soon after some of the restrictions were lifted, our research and extension personnel were able to connect with the stakeholders to get and incorporate their feedback in the planning and delivery of programs. Previous successful programs that received accolades also encouraged us to continue with several programs. With virtual delivery mode, 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. The feedback received from the stakeholders during these programs also encouraged us to continue with the programs.

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. We are also in the process of strengthening the plan by tacking our goals.

Methods for collecting stakeholder input and brief explanation

Due to pandemic restrictions, stakeholder input were collected mainly through online technology and using social media tools. However, with some of the COVID restrictions being lifted, in-person, hybrid, and online methods of data collection resumed in few instances.

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 takes input from the stakeholders very seriously and has tried incorporating those into all our programming. We will continue to use stakeholder input in setting priorities for Extension and research activities as well as the way we operate. Our stakeholders wanted us to continue with our activities and modify it to cater to different stakeholders through several modes of delivery. In the process, an important thing that we learned 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.

Highlighted Results by Project or Program

Critical Issue

Climate Change (CP)

Farm Solar

Project Director

Debasmita Patra

Organization

University of Maryland College Park

Accession Number

7002024



Farm Solar

In 2-3 sentences, briefly describe the issue or problem that your project addresses.

Maryland has become one of the fastest-growing solar energy producers in the country with aggressive policies requiring 14.5% of the state's electricity to be generated from solar energy and GHG emissions to be reduced by 40%. However, only 7.25% of farms in the state currently have solar panels installed with many communities lacking the knowledge, technical expertise and experience necessary to facilitate on-farm solar development. Despite the risk of agricultural land being taken out of production, rural areas of the state are increasingly targeted for larger solar developments due to the reduced risk of neighborhood opposition and lower land rental costs. Interest in on-farm solar has increased dramatically across Maryland with over 40 utility-scale projects proposed since 2017. A needs assessment survey of UME faculty and staff indicated that grid-tied solar PV (13%) and land leasing for renewable energy systems (12%) were top priorities for those clientele currently seeking information regarding clean energy technology.

Briefly describe in non-technical terms how your major activities helped you achieve, or make significant progress toward, the goals and objectives described in your non-technical summary.

The Farm Solar program has been under development since 2019 to help target clientele (e.g., agricultural producers, agricultural service providers, local government, landowners, solar developers, and other stakeholders) increase on-farm energy production, minimize energy expense, and decrease greenhouse gas emissions by addressing the socioeconomic, legal and technical issues associated with on-farm solar PV and its BMPs on a farm. An online webinar series was offered in 2020; with additional hands-on solar training being facilitated through an online video series and in-person workshops. Relevant programming efforts in this area include 1 grant received, 9 workshops/presentations, 8 educational videos, and 5 one-on-one consultations for a total of 114 individuals reached in-person, and an additional 1,296 individuals through recordings. Outputs also include 6 website articles; 5 newsletter articles; 9 slide decks developed; and 3 factsheets reaching a total of 2,549 individuals.

Briefly describe how your target audience benefited from your project's activities.

In 2020, participants have reported the following learning outcomes: understanding Maryland's solar market (n=11; 22.58%-increase on mean); PV basics (n=19; 20.83%-increase on mean); planning and design (n=19; 34.69%-increase on mean); regulations and zoning (n=12; 31.03%-increase on mean); installation and maintenance (n=12; 68.18%-increase on mean); financial options (n=6; 61.54%-increase on mean); community solar options (n=6; 40.00%-increase on mean); utility-scale

leasing (n=11; 75.00%-increase on mean); and battery storage (n=6; 42.86%-increase on mean). The following intentions were reported after program participation: seek additional information (46.75%), educate others (24.85%), assess implementation options (23.08%), explore land leasing opportunities (9.47%), purchase/install solar (8.88%), consult attorney/specialist (7.69%), contact installer (7.10%), apply for grant/loan (5.92%), sign a contract (2.96%), and take other actions (1.78%). This represents an average increase of 52.75% in terms of learning outcomes. Based on the documented intentions to implement energy-related measures (46.75+24.85%), potential annual savings have been identified as: 299,683 kWh in electricity and 3,151 MTCO_{2e} GHGs.

Briefly describe how the broader public benefited from your project's activities.

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Describe and explain any major changes or problems encountered in approach. Additionally, note opportunities for training and professional development provided, how results have been disseminated to communities of interest, and any new details regarding what the project or program plans to do during the next reporting period to accomplish the goals.

The activities are impacted by COVID pandemic.

Watershed Stewards Academy

Project Director

Debasmita Patra

Organization

University of Maryland College Park

Accession Number

7002026



Watershed Stewards Academy

In 2-3 sentences, briefly describe the issue or problem that your project addresses.

The Chesapeake Bay has significant economic value for Maryland and surrounding states. The Bay's value in current dollars would be in excess of \$1 trillion. This valuation includes shipping, the commercial seafood industry, tourism, forestry, recreational activities such as fishing and boating, real estate, and other economic categories. According to the Chesapeake Bay Program (CBP), since restoration efforts began in the past several decades, the health of the Bay has shown some improvement in certain areas but overall, "the ecosystem remains in poor condition." Despite the signs of improvement, the CBP states that "the Bay's water quality remains very poor," and can be attributed to excessive amounts of pollution entering the Bay from the many streams and rivers that drain to it. In tandem with the CBP's assessment, the US Environmental Protection Agency's (EPA) Office of the Inspector General (OIG) reported that one of the leading causes of impaired waters is urban/stormwater runoff, which transports excessive sediment and nutrients (nitrogen and phosphorus). As population in the watershed continues to increase, natural areas are converted to more impervious surfaces in order to accommodate the needs of residents, businesses, and industry, thereby increasing stormwater runoff and the transport of sediment and nutrients. The CBP estimates states that "increased development across the watershed has made stormwater runoff (also called polluted runoff) the fastest growing source of pollution to the Chesapeake Bay."

Briefly describe in non-technical terms how your major activities helped you achieve, or make significant progress toward, the goals and objectives described in your non-technical summary.

The Watershed Stewards Academy (WSA) trains and supports a diverse group of volunteers (“stewards”) conversant in stormwater issues who then use their training to educate communities and design, implement, maintain, and promote restoration projects focused on stormwater management and improving local water quality. Stewards enroll in a 12 to 18 month program where they receive 40+ hours of classroom and field training and project implementation experience, and also complete a Capstone project that includes a site assessment, community engagement, implementation activities, and a maintenance plan. Support is provided for the stewards in the form of additional resource materials and access to a Consortium of Support Professionals with experience in landscape architecture, permitting, grant writing, engineering, and more. The Anne Arundel WSA officially started in 2009 as a non-profit 501(c)(3) and is managed by an Executive Director and a Board of Directors. The second WSA to form was the National Capital WSA in 2011, which is an initiative of a coalition of watershed protection groups administered by Anacostia Watershed Society in partnership with University of Maryland Sea Grant Extension. The Sea Grant Extension Specialists, in cooperation with county partners, led to creation of the Howard County WSA in 2012, the Cecil County WSA in 2014, the St. Mary’s County WSA in 2016, the Harford County WSA in 2017, and the Calvert County WSA in 2020.

Briefly describe how your target audience benefited from your project's activities.

Through education, oversight, or support from the Sea Grant Extension Specialists throughout 2021, there were 33 new Watershed Stewards Academies graduates and the Specialists and their County partners continued with both in-person and online classes and provided assistance to previous program graduates on various activities. Their combined efforts of class, capstone, and community projects resulted in the completion of 11 new projects totaling 1,460 square feet of best management practices (BMP) treating 4,695 square feet of impervious surfaces. In all, they planted 978 native plants, held 18 educational events, educated 1,640 individuals, and engaged 88 volunteers to install and/or distribute 93 rain barrels, complete 3 rain gardens, and 4 conservation landscapes. Volunteer hours in 2021 totaled 2,464 resulting in an estimated value3 of \$70,322.56.

Briefly describe how the broader public benefited from your project's activities.

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Bay-Wise Landscape Management

Project Director

Debasmita Patra

Organization

University of Maryland College Park

Accession Number

7002023



Bay-Wise Landscape Management

In 2-3 sentences, briefly describe the issue or problem that your project addresses.

According to Maryland’s Department of Planning, Maryland lost 1,009,698 acres of resource land to development between 1973 and 2010 (latest figures as of 1/2022). Of that, 845,978 acres (83.8%) were converted to residential use. Many residents, planners, and developers do not recognize the urban and suburban landscape as part of the greater ecosystem, and they have generally failed to incorporate environmental and ecological concepts into their landscape plans. This failure has led to very

unhealthy and unsustainable communities, and has been linked to climate change. Today, climate change is causing increased flooding during summer and higher temperatures during the winter, wreaking havoc on how we live. An educated public should be able to minimize the impacts of climate change, thus staunching such deleterious effects.

Briefly describe in non-technical terms how your major activities helped you achieve, or make significant progress toward, the goals and objectives described in your non-technical summary.

The University of Maryland Extension Bay-Wise Landscape Management program helps residents in rural, suburban and urban settings reduce their negative impact on the environment through efficient use of nutrients and pesticides, water management, composting, alternative use of pesticides (IPM), native plants, rain gardens and other related landscape management techniques. MD Master Gardeners teach homeowners in their community about sustainable landscape practices and certify landscapes as conservation landscapes.

Briefly describe how your target audience benefited from your project's activities.

In 2021, 52 (40 new and 12 returning) Master Gardeners learned how to share Bay-Wise best management practices (BMPs) with community members during a hybrid (virtual and in-person), synchronous Bay-Wise advanced training in September. This brings the total of trained Bay-Wise- trained Master Gardeners to 1,537, with 386 of them currently active on their local Bay-Wise Committees, where they reached 287 Maryland residents. The Bay-Wise Program kicked off its 25-year anniversary in November by hosting a one-day conference for 109 Bay-Wise Master Gardeners from 10 counties. When surveyed to rate their strength in a set of skills, attendees indicated they were above average in engaging with the public (29.1% far above average, 43.75% somewhat above average, n=96). When asked about sharing scientific information with the public in a way that is easy to understand, 21.9% rated themselves far above average while 45.8% rated themselves somewhat above average (n=96). Since 1997, Bay-Wise Master Gardeners have created and maintained 701 residential demonstration sites throughout Maryland. They have also certified 2,475 residential and 265 non-residential sites around the state. In 2021, Master Gardeners certified 18 demonstration, 121 client, and 15 non-residential landscapes and volunteered 3,646.60 hours in Bay-Wise projects, reaching 287 Maryland residents. This time is valued at approximately \$114,102.11 by independentsector.org. The program generated \$3,886.50 in fees in 2021. This income is used to support the program's operating expenses.

Briefly describe how the broader public benefited from your project's activities.

The University of Maryland Extension Bay-Wise Landscape Management program helped residents in rural, suburban and urban settings reduce their negative impact on the environment through efficient use of nutrients and pesticides, water management, composting, alternative use of pesticides (IPM), native plants, rain gardens and other related landscape management techniques. MD Master Gardeners taught homeowners in their community about sustainable landscape practices.

Describe and explain any major changes or problems encountered in approach. Additionally, note opportunities for training and professional development provided, how results have been disseminated to communities of interest, and any new details regarding what the project or program plans to do during the next reporting period to accomplish the goals.

Note: the statistics are low this year due to COVID-19 restrictions, which prevented a lot of face to face activities.

[Waste management and cover cropping systems to enhance soil health, nutrient cycling, waste to energy, water quality and climate adaptation](#)

Project Director

Raymond Weil

Organization

University of Maryland College Park

Accession Number

1014496



In 2-3 sentences, briefly describe the issue or problem that your project addresses.

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. Another objective of this study was to assess effects of climate change and adaptations on nitrate loss, microbial respiration and soil organic carbon.

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 develop improved cover cropping systems that can both protect water quality and improve farm productivity and profitability. Similarly, waste-to-energy systems are needed to make effective use of organic by-products from agriculture and other industries. Animal manures are rich sources of nutrients but difficult to handle and have high biochemical oxygen demand. These organic waste products are inherently rich in energy as well. Anaerobic digestion is a means by which the energy content of these wastes can be captured as combustible methane gas and used for electricity and heat generation. In addition, these nutrient containing wastes can be used to remediate degraded urban soils and improve urban land use and vegetation. 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 adaptive practices that will allow effective nutrient management under changing climatic conditions.

Briefly describe in non-technical terms how your major activities helped you achieve, or make significant progress toward, the goals and objectives described in your non-technical summary.

Three journal articles were published on environmental and nutritional aspects of soil nutrients. Hirsh et al. (2021) described just how much nitrogen is left over after corn, soybeans and other major crops have finished taking up nutrients before harvest. The benefits of multi-species cover crops that include a legume and a brassica were demonstrated, including avoidance of N tie-up in spring as often occurs with a cereal cover crop.

Sarah M. Hirsh, Sjoerd W. Duiker, Jeff Graybill, Kelly Nichols, and **Ray R. Weil**. 2021. Scavenging and recycling deep soil nitrogen using cover crops on mid-Atlantic, USA farms. *Agriculture, Ecosystems & Environment* 309:107274. <https://doi.org/10.1016/j.agee.2020.107274>

Rushovich and Weil (2021) demonstrate for the first time that sulfur deficiency in soils not only reduces soybean yields, but reduces the nutritional value of this major source of plant-based protein because the relative amounts of essential amino acids methionine and cysteine are reduced. Furthermore, the research showed that managing sulfur fertility could enhance the amino acid profile of this grain legume.

Dana Rushovich and **Ray Weil**. 2021. Sulfur fertility management to enhance methionine and cysteine in soybeans. *Journal of the Science of Food and Agriculture*. 101 (15) 6595-6601. <https://doi.org/10.1002/jsfa.11307>

A simple, cost-effective test for active or easily oxidized soil organic carbon was originally developed in the Weil Soil Quality Lab. Now used by thousands researcher and farm advisors around the nation and globe, this test is often called permanganate oxidizable carbon (POXC) and is a leading indicator of soil health dynamics. Lucas and Weil (2021) showed that crops grown on soils testing low in POCX are likely to benefit most from improved soil organic matter management practices such as cover crops.

Lucas, S. T., and Weil, R. R. (2021). Can permanganate oxidizable carbon predict soil function responses to soil organic matter management? *Soil Science Society of America Journal* 85:1 768-1784. 10.1002/saj2.20282 <https://doi.org/10.1002/saj2.20282>

The Lansing Lab published a paper based on, and a patent was issued for, 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). Laboratory and field studies were conducted on food waste digestion and how nutrients

change during this process, with a DOE grant received on food waste utilized (\$2.5 million) as well as municipal solid waste production, including the large food waste fraction treated using anaerobic digestion (\$4.3 million) A Phase I and Phase II grant (\$250k total) was received from Maryland Industrial Partnership (MIPS) to study the effect of adding poultry litter-derived biochar on bedding plants and turf grass growth. Finally, a manuscript was published on enhancing biogas production of cassava wastewater using zeolite and biochar additives and manure co-digestion.

Regarding the climate change objective, the Hill Lab published a paper in which models predicted that future nitrate loss increased by 40–80% and was lower with biochar and under C4 than C3 crops; carbon was higher under C4 crops and with biochar. Inclusion of C4 crops in rotations and biochar use under wetter climate scenarios will allow to reduce nitrate loss and increase soil organic carbon.

Taras E. Lychuk, Robert L. Hill, Roberto C. Izaurralde, Bahram Momen, Allison M. Thomson. 2021. Evaluation of climate change impacts and effectiveness of adaptation options on nitrate loss, microbial respiration, and soil organic carbon in the Southeastern USA. *Agricultural Systems* (193) 103210. <https://doi.org/10.1016/j.agsy.2021.103210>

Briefly describe how your target audience benefited from your project's activities.

The target audiences include farmers, livestock producers, local and state agencies, extension agents, commodity groups, and environmental groups.

An anaerobic digestion extension website has been developed and updated (<https://enst.umd.edu/extension/anaerobic-digestion>) with more information available on Dr. Lansing's personal website as well (<https://agmr.umd.edu/about/directory/stephanie-lansing>). These websites include numerous anaerobic digestion FactSheets, Case Studies, and a full 100+ page Technical Guide to Anaerobic Digestion published to help farmers understand anaerobic digestion technologies.

Determining the effect of waste to energy (WTE) technologies on solids and nutrient concentrations, transformations, and subsequent crop nutrient uptake. Farmers, policy makers, and digester industry experts were better informed on anaerobic digestion and how digestion affects nutrient cycling from manure. A graduate student research grant was received from NE SARE to study the effect of algae from algal turf scrubbers added to anaerobic digestion system co-digested with dairy manure, poultry litter, and food waste, with the effluent from each digester used as fertilizer to growth lettuce.

Briefly describe how the broader public benefited from your project's activities.

Climate change presents a challenge for agriculture with implications to environmental quality. Findings from these research activities are used by decision/policy makers working on technologies to mitigate climate change impacts on agriculture and the environment.

Here are specific examples.

Dr. Weil is a member of the Northeast Cover Crop Council – Founder and Board Member (2015-2022), member (appointed) Governor's Advisory Council on Health Soils, and member (appointed) of the Maryland Dept. of Agriculture Program Development Workgroup for new cover crop and soil health program. As a result, MDA's cover crop program has been modified several times to harmonize with the results of Weil lab's research on the benefits of multi-species mixtures, early planting, and late termination (Hirsh et al. 2021 and Sedghi and Weil, 2022). Dr. Weil also serves as board member representing Maryland on the Northeast Cover Crop Council (2018-2022) and has had input, including research results from this project, in developing their cover crop species selection and management tool available online at <https://northeastcovercrops.com/decision-tool/>

Co-PDs, Dr. Lansing and Dr. Toor, are part of the Phosphorus Management Tool Advisory Panel for the State of Maryland, with Dr. Lansing representing Advanced Manure Technologies and Dr. Toor representing the University of Maryland, which has impacted nutrient policy in the state of Maryland. Specifically, Dr. Lansing serves as the Alternative Manure Technology Specialist on this committee.

Describe and explain any major changes or problems encountered in approach. Additionally, note opportunities for training and professional development provided, how results have been disseminated to communities of interest, and any new details regarding what the project or program plans to do during the next reporting period to accomplish the goals.

Critical Issue

Environmental Stewardship (CP)

Backyard Farming

Project Director

Debasmita Patra

Organization

University of Maryland College Park

Accession Number

7002020



Backyard Farming

In 2-3 sentences, briefly describe the issue or problem that your project addresses.

The COVID-19 pandemic continues to limit extension's ability to provide in-person training to livestock and poultry owners. Additionally, during this same time, more people were purchasing farm animals, particularly smaller ones, as a potential source of food and to take advantage of the extra time spent at home due to business closures and canceled events. Many of these livestock and poultry owners were looking for more information on how to properly raise them as they do not possess a farming background.

Briefly describe in non-technical terms how your major activities helped you achieve, or make significant progress toward, the goals and objectives described in your non-technical summary.

A series of webinars was put together and titled "Backyard Farming." These webinars were broken down into the following subject areas: Backyard Poultry, Small Ruminants, Hay, Cattle and Bees. Each subject area had a set day of the week and time for its webinar and consisted of 2-5 webinars. Each subject area ran a series in spring 2020. There was an additional series in fall 2020 for the Backyard Poultry and Small Ruminants sessions. In 2021, 2 poultry series, 1 small ruminant series and a farm management series were held. Each webinar was scheduled for one hour and topics included how to raise poultry and livestock, nutrition, health, diseases, preparing for cold weather and biosecurity.

Briefly describe how your target audience benefited from your project's activities.

Approximately 1,728 adults and youth participated in the webinars in 2020. In 2021, there were 475 participants. Following the Backyard Farming series, a Qualtrics™ survey was developed and sent to participants. The purpose of the survey was to determine the success of this type of online programming for livestock producers in Maryland. The survey consisted of 21 questions asking participants about their reasons for participation, if COVID-19 played a role in their attendance, whether the information learned would keep their livestock healthier and make their operations more productive, and if any behavioral changes occurred as a result of the sessions. The survey was completed by a total of 118 respondents across the various industries. For example, in Spring 2021 sessions 22 participants responded to the survey:

- 100% of participants thought the hour-long format was perfect, 95% experienced no technical difficulties

- 36% stated that the COVID-19 shutdowns affected their decision to participate

- 100% watched the sessions live

- 90% indicated that the information would help them keep their animals healthier, 10% answered maybe

- o 55% answered yes when asked if the information will help them save money or make their operation more productive; 40% answered maybe
- o \$2,750 was the estimated amount of money saved as a result of participating in the sessions
- o 56% changed the ways they managed their animals while 17% planned to 95% found the information valuable
- o 95% were likely to participate in future sessions
- o 28% ranked “the additional free time from COVID 19 shutdowns” as the number 1 reason for participating

Briefly describe how the broader public benefited from your project's activities.

Overall, the sessions were a success. Most survey participants were able to join with no technical difficulties and thought the format was perfect. These sessions resulted in positive behavioral changes and a significant amount of money saved. Availability to watch was the main driver of participation throughout the past year; however, the desire to grow food and know what’s in it is becoming a more important reason to participate. The Backyard Farming series has filled a significant role for many small and beginning livestock producers. As people return to normal working schedules, it will be important to make these sessions available for participants to view as their schedules permit.

Thriving Naturally

Project Director
 Debasmita Patra
 Organization
 University of Maryland College Park
 Accession Number
 7002034



In 2-3 sentences, briefly describe the issue or problem that your project addresses.

Charles County youth, like many youth across the nation wrestle with both mental and physical well-being. The Charles County Health Needs Assessment published in 2021 outlined several key health issues in the county. The greatest health needs in Charles County were identified as mental and behavioral health, substance abuse, obesity (particularly in children) and related conditions such as diabetes and high blood pressure. **Obesity-** Maryland childhood obesity rates are the 8th highest in the nation. The 2021 Charles County Community Health Needs Assessment highlighted childhood obesity as a challenge facing Charles County; despite a 2018 goal to reduce childhood obesity it continued to rise between 2018 and 2021. Over 2/3 of the Charles County population is either overweight or obese, greater than levels across the state. **Mental Health-** Results of the 2018 Maryland Youth Risk Behavior Survey highlight these issues in Charles County youth. 26.3% of Charles County’s middle school students and 32% of high school students report experiencing depression symptoms for more than two weeks during the twelve months prior to survey completion. The costs of these mental health challenges are staggering. ADHD in the United States are estimated between \$143 billion and \$266 billion/year, with the costs of depression estimated at \$210.5 billion/year. (workplacementalhealth.org). **Natural Solutions-**Research indicates that nature-based experiences can mitigate each of these issues. More and more doctors are “prescribing” nature as treatment for common issues such as obesity, high blood pressure, ADD/ADHD, anxiety, and stress (Park Rx). However, Charles County does not have a nature center for public use and environmental exploration. Only 7 of the 40 Charles County Public Schools are designated as green schools. **2021 Considerations** The COVID pandemic struck in March, 2020. This reality exacerbated the challenges in Charles County. “A new survey commissioned by National 4H Council, and conducted by the Harris Poll, finds that 7 in 10 teens are struggling with their mental health in the wake of COVID-19. More than half of those surveyed shared that the pandemic has increased their feelings of loneliness, with 64 percent believing it will have a lasting impact on their mental health.”

Briefly describe in non-technical terms how your major activities helped you achieve, or make significant progress toward, the goals and objectives described in your non-technical summary.

The Thrive Naturally program has been continually implemented since June, 2019; reaching an average of 197 youth and 181 adults annually through a variety of programs and practices. This program takes approximately 750 hours annually to implement.

In 2020, the COVID-19 pandemic mandated an alteration in plans. However, our efforts continued.

Program, and # Reached

- Outdoor Discovery (10 sessions) 15 youth, 12 adults

- Nature in your Backyard State-wide Summer Camp (5 sessions) 80 youth

- Nature Begins Outside your Backdoor State-wide Virtual Activity Club (6 sessions)

14 youth

- Living Clean and Green (7 sessions) 22 youth, 19 adults

- Professional Development Presentations and Posters (6 venues) 204 adults

- Written Educational Materials (2) 359 adults

- Partnership Development and Collaboration 31 adults

In 2021 Program, and# Reached

- Oyster Discovery during State-wide Virtual Camp (2 sessions)

- 100 Youth

- Nature Begins Outside your Backdoor State-wide Virtual Activity Club (6 sessions)

20 youth

- Algae Academy (4 sessions) 18 youth

- State-wide Forestry program (15 sessions, development of a State Contest, and team participation in the National Contest) 14 youth

- Nature Begins at your Backdoor (3sessions) 35 youth and 8 adults

- Insect Apocalypse Activity Club (6 sessions) 7 youth and 10 adults
- Malcolm Elementary Green Club (4 sessions) 9 youth and 1 adults
- Professional Development Presentations (8 venues) 138 adults
- Funding Streams Developed \$70,000

Briefly describe how your target audience benefited from your project's activities.

2021 was the first year of data collection for the program. In 2021, 52 youth completed the Thrive Naturally survey. Responses indicate that...

- 87% of participants were inspired to spend more time in nature after participating in this program.
- 91% of participants indicated that the program was a very high quality developmental experience based on the Thriving Model Context indicators.
- 94.5% of participants learned new things about science.
- The program resulted in a 24-44% increase from pre to post survey in youth wishing to pursue college and/or career pursuits in the environmental science field.
- 90% of participants reported that this 4-H program inspired them to volunteer in their community.

Anecdotal highlights reflecting the success of the program include:

From youth participants

- "I enjoyed learning about algae because I had never seen algae as something useful to society. It was really cool to learn about all the things algae is used for."
- "The guest speaker seemed like she really loved the topic and it was nice hearing about her passion for algae."

From a Forestry field instructor

- "I enjoyed assisting the students. I thought that they did a great job working on identifying the species marked and they also conversed much more regarding their work than I had anticipated!"

From parent/guardians of participants

- o “My daughter LOVED this virtual club. It held her interest even with 1.5 hours of learning each time. The experiments and craft activities were appropriate and fun. We would repeat this and recommend it to others in a heart beat!”
- o “Something about the way you presented the “create your own park” challenge inspired me. We built a bird park in the back yard. The boys and I have installed 5 new bird feeders and a bench for viewing. I just ordered a plaque commemorating my aunt and uncle who’s parklike backyard inspired me.”

What do you see as the longest lasting impact of this program for your child?

- o “Opening up a new career path as well as interacting with others with a similar interest.”
- o “A love of, or at least a caring for Nature.”
- o “Prior to this program, our son did not have a career plan. Now he would like to go to school for forestry.”

Reflecting on the successes evidenced above, youth participants in the Thrive Naturally program are inspired to spend more time in nature. People with access to nature have increased resilience to trauma and stress. They experience improved attention span, better quality of sleep, and increased levels of serotonin and vitamin D. “Time spent outdoors boosts concentration (even in those with ADHD), improves creative thinking, decreases negative thinking and stress”, “Green outdoor spaces foster creative play, improve children’s access to positive adult interaction, and relieve the symptoms of ADD.”

Briefly describe how the broader public benefited from your project's activities.

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Mechanistic Drivers of Nutrient Transport in Maryland Agroecosystems

Project Director

Kenneth Staver

Organization

University of Maryland College Park

Accession Number

1020435

★ Year round measurement of nutrient losses in two watersheds planted with corn and rye cover crop, to better understand nutrient transport mechanism and help reduce losses

In 2-3 sentences, briefly describe the issue or problem that your project addresses.

Agriculture in Maryland and around the country is under pressure to reduce nutrient losses to receiving waters. The problem for agriculture in Maryland is how to achieve nutrient reductions targets set for the restoration of Chesapeake Bay while maintaining productivity and profitability. This project helps clarify the mechanistic drivers of cropland nutrient losses, which is an essential first step toward developing strategies to reduce those losses.

Briefly describe in non-technical terms how your major activities helped you achieve, or make significant progress toward, the goals and objectives described in your non-technical summary.

Surface runoff losses of sediment, nitrogen and phosphorus were measured continuously in 2021 from two adjacent watersheds planted with corn in the summer and rye cover crops in the fall. Groundwater elevations also were monitored and soils were sampled to determine the distribution of nutrients, especially phosphorus. Both corn and cover crop nutrient uptake were measured to determine field phosphorus budgets and the deposition of phosphorus on the soil surface. Collectively, these activities helped improve the understanding of annual nutrient losses in real world conditions in one of the most common crop settings in Maryland and the country.

Briefly describe how your target audience benefited from your project's activities.

Dr. Staver is actively involved in the Chesapeake Bay restoration effort as an advisor to the modeling group that is the primary accounting tool for determining progress towards meeting the Bay nutrient TMDL. The information from this project also helps inform watershed managers responsible for developing the local Watershed Implementation Plans (WIPs) throughout the watershed. Information from this project contributes to development of coefficients used to estimate nutrient reductions for different practices via Dr. Staver's participation on Bay Program expert panels. Output from this project also is used to inform Maryland's Cover Crop Technical Advisory Committee, which spends approximately \$20 million annually to promote cover crop planting on MD cropland, and also helps inform the USDA NRCS Conservation Effects Assessment Program (CEAP) via a cooperative agreement. Farmers benefit from this project as it has helped provide information useful for helping them meet public pressure to reduce nutrient losses.

Briefly describe how the broader public benefited from your project's activities.

The broader public in Maryland and throughout the country is highly interested and invested in restoring Chesapeake Bay water resources. Overall agriculture plays a critical role in water resource quality and this project has helped agriculture become more protective of water quality and has identified the most cost-effective approaches so that publicly funded incentive programs return results. The public also is invested in agricultural systems that are sustainable so food will be available in the future. In researching no-till and cover crops, this project is helping design production approaches that are known to enhance soil resources while protecting water quality.

Describe and explain any major changes or problems encountered in approach. Additionally, note opportunities for training and professional development provided, how results have been disseminated to communities of interest, and any new details regarding what the project or program plans to do during the next reporting period to accomplish the goals.

Overall, this project has proceeded as planned with some minor delays in sample preparation and analysis due to COVID-19 restrictions at the Wye Research and Education Center. Lab work cannot be done via teleworking. With restrictions lifted, the backlog should be addressed in the coming months. Virtual participation in Chesapeake Bay Program and Maryland Department of Agriculture Cover Crop Technical Advisory Committee meetings continued largely uninterrupted throughout the pandemic so there was no major disruption of information dissemination. Tours of the Wye Research and Education Center were largely halted during the pandemic but several are now on the schedule later in 2022 so in person information dissemination will resume.

Costs and Benefits of Natural Resources on Public and Private Lands: Management, Economic Valuation, and Integrated Decision-Making

Project Director

Erik Lichtenberg

Organization

University of Maryland College Park

Accession Number

**In 2-3 sentences, briefly describe the issue or problem that your project addresses.**

Conservation subsidies have been the centerpiece of efforts to reduce environmental impacts of agriculture, including nutrient emissions into the Chesapeake Bay. There are, however, questions about their ability to achieve reductions in agricultural nutrient emissions sufficient to meet regulatory requirements current under development. For example, enrollment in programs like the Conservation Reserve Enhancement Program (CREP), which subsidizes installation and maintenance of streamside buffers, has been low and declining over time. Low participation rates raise questions about the adequacy of subsidy levels. Current incentives may not be adequate to ensure maintenance of best management practices like streamside buffers during CREP contract lifetimes, raising questions about the design of CREP contracts. And the cost-effectiveness of current subsidy programs is open to further questions raised by the prevalence of self-financing and spillover effects of subsidies onto related farming practices, including conversion of land in vegetative cover to crop cultivation.

This project will evaluate the performance of conservation subsidies under several scenarios. It will combine data from existing surveys of Maryland farmers to create a dataset that tracks individual farmers' use of conservation practices and participation in conservation subsidy programs over time. It will use econometric methods to estimate the impacts of conservation subsidies in the short run and the joint dynamics of conservation practice use and subsidy receipt over time. Those estimates will take into account the potential for self-financing, indirect effects, and conversion of vegetative cover to crop production. They will be used to construct counterfactuals that will permit estimation of the effects of subsidy receipt on conservation practice for both current program participants and current non-participants. They will also be used to estimate likely effects of introducing new programs like water quality trading that compete for participants with existing conservation subsidy programs. These estimates will be used to evaluate the performance of existing programs and to make recommendations for improvements in program design and targeting.

Briefly describe in non-technical terms how your major activities helped you achieve, or make significant progress toward, the goals and objectives described in your non-technical summary.

To date, this project has conducted two separate investigations of issues related to the design of CREP and similar conservation subsidy programs.

We have conducted a stated preference study using data from a survey of owners of farmland with riparian frontage to investigate the levels of upfront and annual payments needed to induce farmland owners' to enroll in a program like CREP. Data from that survey indicate that a large plurality of farmland owners have no interest in enrolling in such programs at any levels of upfront or annual payments that would be considered reasonable. That finding indicates that there are limits to the levels of nutrient emissions reductions a voluntary program like CREP can achieve. Statistical analysis of the data indicates that, among those that are potentially willing to consider enrolling in programs like CREP, the average subsidy level required to induce enrollment is substantially greater than current subsidy levels, raising questions about the cost-effectiveness of such programs. Statistical analysis of the data indicates that whether payment is front-loaded or provided gradually over the lifetime of the contract makes very little difference to landowners potentially willing to enroll in programs like CREP. Finally, statistical analysis of the data indicates that streamside buffers are considered to pose substantial risks to farming operations; the data are insufficient to identify the nature of those risks, however.

We have also conducted a theoretical analysis of how long term contracts for ecosystem services like reductions in agricultural nutrient emissions should be designed to ensure adequate performance. That analysis indicates that there are better ways to specify penalties for non-performance than the current approach, which requires repayment of all funds received. A numerical analysis using data from Maryland's Eastern Shore indicates that restructuring penalties for non-performance could improve net environmental benefits substantially.

Briefly describe how your target audience benefited from your project's activities.

The principal target audience of this project is scholars and policy makers working on design and implementation of programs aimed at reducing water quality impairments from farming activities, including subsidies for adoption of conservation practices and water quality trading programs. We are in the process of disseminating the results of the analyses described in the preceding section at national meetings of scholars working on design and evaluation of policies to protect

and improve water quality such as the Association of Environmental and Resource Economists, the Agricultural and Applied Economics Association. We have scheduled presentations of the results of these analyses to representatives of government agencies and nonprofits working on streamside buffer policies to occur in early fall 2022.

Briefly describe how the broader public benefited from your project's activities.

The Environmental Protection Agency is currently in the process of formulating regulations governing agricultural nonpoint nutrient emissions into the Chesapeake Bay. The studies conducted under the auspices of this project will help the Maryland Department of Agriculture and other entities design and implement programs to meet those requirements. The public at large will benefit from a cleaner Chesapeake Bay achieved at lower cost as a result.

Describe and explain any major changes or problems encountered in approach. Additionally, note opportunities for training and professional development provided, how results have been disseminated to communities of interest, and any new details regarding what the project or program plans to do during the next reporting period to accomplish the goals.

The research conducted under the auspices of this project has provided training for two doctoral students in the Department of Agricultural and Resource Economics at the University of Maryland. The stated preference study is a chapter in the dissertation of one of those students. The study of optimal design of conservation subsidy contracts is the core of the doctoral thesis of the other. Both students will gain additional professional experience by presenting research results at national conferences of two major professional associations.

Future work will proceed in two directions. First, the survey data will be used to conduct a revealed preference study focusing on the degree to which CREP contracts result in streamside buffer installation above and beyond those that farmland owners would have installed in the absence of subsidies. Second, the combined theoretical and numerical analysis will be extended to investigate efficient targeting of CREP contracts as designed efficiently as well as currently.

[Assessing Impacts of Anthropogenic Activities on Aquatic Ecosystems](#)

Project Director

Lenwood Hall

Organization

University of Maryland College Park

Accession Number

1016034



Identified stressors on aquatic ecosystems

In 2-3 sentences, briefly describe the issue or problem that your project addresses.

Since the beginning of the industrial revolution, human activities have caused adverse impacts on aquatic ecosystems. These adverse impacts have accelerated drastically in recent years. Multiple chemical and non-chemical stressors are responsible for causing these adverse impacts on aquatic ecosystems. This project was designed to identify these stressors.

Briefly describe in non-technical terms how your major activities helped you achieve, or make significant progress toward, the goals and objectives described in your non-technical summary.

The major activities in this project have helped us identify major chemical and non-chemical stressors that impact resident benthic communities. The major stressors were physical habitat metrics such as stream flow, hydrology, habitat diversity and substrate quality. The statistical analysis used for the data sets also provided valuable information on ranking the importance of various stressors to resident benthic communities.

Briefly describe how your target audience benefited from your project's activities.

The target audience benefited from this project because the results were important for making management decisions and formulating sustainable control solutions for reducing threats from both non-point and point sources to the aquatic environment and human health.

Briefly describe how the broader public benefited from your project's activities.

The broader audience benefited from this project because identifying specific stressors impacting aquatic ecosystems provided the information needed to develop impactful regulations and or mitigation strategies. Therefore, financial resources paid by the public (taxes) can be used wisely to address real world stressors that impact the aquatic environment.

Closing Out (end date 09/07/2023)

Water Quality and Economic Incentives for Conservation Practices

Project Director

David Newburn

Organization

University of Maryland College Park

Accession Number

1016264



Water Quality and Economic Incentives for Conservation Practices

In 2-3 sentences, briefly describe the issue or problem that your project addresses.

Agricultural nonpoint source pollution accounts for a large share of water quality impairments in the United States. Policies aimed at reducing nonpoint source pollution have largely involved subsidy payments to farmer to encourage the adoption of conservation practices.

Briefly describe in non-technical terms how your major activities helped you achieve, or make significant progress toward, the goals and objectives described in your non-technical summary.

The main goal for the project is to evaluate the cost-effectiveness of agricultural cost-share programs. These programs are essential to incentivize rural landowners to adopt conservation practices that provide improved water quality and other environmental benefits. We used econometric analysis from farmer survey data to assess conservation practice adoption decisions and the estimate the effect of economic incentives on farmer behavior to provide additional conservation practice adoption as well as indirect program effects. The analysis focused on the cost-effectiveness of Maryland's cover crop cost-share program and the impacts on nitrogen reduction to the Chesapeake Bay. Furthermore, we examined the expected interactions between the proposed water quality trading program and the cover crop cost-share program.

Briefly describe how your target audience benefited from your project's activities.

We presented the main findings on the cost-effectiveness of Maryland's cover crop program and interactions with proposed water quality trading at several venues to key stakeholders. These stakeholders included the Maryland Department of Agriculture who administer the cover crop program, Maryland Department of Natural Resources, extension agents, Maryland Farm Bureau, and the United States Department of Agriculture. Our results show that Maryland's cover crop program has substantially increased acreage adoption of cover crops that would not occur in the absence of these subsidy payments. This state-level program has been the centerpiece of Maryland's efforts for nutrient abatement to achieve water quality requirements for the Chesapeake Bay. Our results also help stakeholders to understand the low participation in the water quality trading program. While water quality trading is often proposed as the most efficient approach to achieve the overall goal of water quality improvement at the lowest cost, the framework is typically conceived in the absence of other policies. However, most nascent water quality trading programs enter a landscape where existing cost-share programs dominate. We show that water quality trading often does not achieve high participation because many farmers are already enrolled in the existing cost-share programs. Moreover, the water quality trading program may actually make the cost-share programs less effective. The water quality trading programs will attract the most polluting farms by paying landowners per pound of nutrient reduction instead of the fixed payments per acre in cost-share programs. The interaction between cost-share and water quality trading programs is more realistic. Hence, our study was able to explain to stakeholders how the potential cost-effectiveness of water quality trading is often substantially reduced when it is implemented where cost-share programs are already present.

Briefly describe how the broader public benefited from your project's activities.

Agricultural nonpoint source pollution and lower water quality affect the environmental services that the public enjoy in local waterways and the Chesapeake Bay, such as recreational activities (fishing, swimming, boating), coastal property values, and other amenities. The broader public also provide the taxes to pay for the government cost-share programs and other approaches to achieve water quality improvement. Hence, the analysis of cost-effective approaches for conservation practice adoption aims to create the most environmental benefit for society at the lowest cost. Our project help to demonstrate that Maryland's cover crop program is a highly cost-effective program to reduce nutrients from the agricultural cropland. We also are the first study to analyze the interaction between water quality trading and cost-share programs. While water quality trading has been viewed as the most efficient approach to achieving pollution reduction, we help to explain that this is no longer the case when considering the more realistic scenario where trading programs compete with existing cost-share programs that predominate across the United States.

[Wetland management, engineering, and restoration: Understanding soil, microbial, biogeochemical, plant, geomorphological, hydrological, and ecosystem processes](#)

Project Director

Andrew Baldwin

Organization

University of Maryland College Park

Accession Number

1013805



Wetland management, engineering, and restoration

In 2-3 sentences, briefly describe the issue or problem that your project addresses.

Many wetlands have been degraded or lost due to human activities, and efforts to restore their functions have had mixed results. Our 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." We hypothesize that these processes singly and in combination strongly alter structure and ecosystem functioning of wetlands.

Briefly describe in non-technical terms how your major activities helped you achieve, or make significant progress toward, the goals and objectives described in your non-technical summary.

Vegetation dynamics, ecosystem functions, and responses to natural and anthropogenic variables (Baldwin): Activities related to this goal resulted in four refereed articles. These products contributed to emerging research on methane emissions and carbon accumulation from restored wetland soil and how nutrient supply affects invasive-native plant interactions.

Role of soil management and restoration practices in increasing tidal marsh resilience to sea-level rise and reducing marsh greenhouse gas emissions (Needelman): An article was published that was the first to propose and assess the use of vegetation and hydrology as proxies for estimation of methane emissions in brackish marshes for blue carbon accounting. The research and outreach program of the Deal Island Peninsula Partnership was continued; this is a transdisciplinary project working to increase the socio-ecological resilience of the coastal ecosystems and communities of the Deal Island Peninsula in Somerset County, MD to climate change and other stressors. Two presentations were given related to the work of the Methane Working Group of the Coastal Carbon Research Coordination Network in which we are creating and aggregating a national methane flux data set for public release and working on synthesizing data to improve understanding of factors controlling methane emissions.

Pedological and biogeochemical processes leading to distinctive hydromorphology and other soil ecosystem services (Rabenhorst): Our efforts have helped better elucidate approaches and technologies for demonstrating when restored wetlands contribute specific redox-related hydric soil function. The use of Mn-coated IRIS are particularly useful for evaluating and demonstrating whether and when reducing soil conditions develop early in the growing season when soil temperatures are low and when reduction of Fe oxides may be too slow to be easily observed. We have also been able to further demonstrate, both practically and statistically, the viability and usefulness of using pedological conceptual models in the process of conducting inventories of subaqueous soil resources in Chesapeake Bay estuaries. During this reporting period, this information has been communicated via three conference presentations and abstracts and two refereed journal articles.

Microbial community composition and function, specifically examining the role of microbial communities in carbon storage (Yarwood): Activities related to this goal resulted in four refereed articles. This research informs the mechanisms that drive methane production and added to our understanding of how plants regulate soil organic matter creation.

Briefly describe how your target audience benefited from your project's activities.

Target audiences included environmental managers, restoration practitioners, and policy and decision makers in both the public and private sectors. These included the Maryland State Highway Administration, the Maryland Department of Natural Resources, the NRCS, NGOs, local and regional municipalities, and environmental consulting firms. To ensure that research findings reach these target audiences, we communicated them via presentation at scientific meetings, workshops with stakeholders and agencies, and peer-reviewed and technical publications and reports. Where possible, we partnered with University of Maryland Extension to communicate findings and solutions to a wider audience.

Briefly describe how the broader public benefited from your project's activities.

The project team's activities increased understanding of the fundamental processes relating to sustainable management, engineering, and restoration of the ecological functioning of wetland ecosystems. Wetlands are highly productive ecosystems that support biological diversity, provide opportunities for hunting and fishing, protect against flooding and storm damage, improve water quality, and play a major role in global carbon cycling. Knowledge from this project helps improve wetland restoration outcomes and how wetlands can be managed sustainably to maintain and expand their valuable ecological services.

Describe and explain any major changes or problems encountered in approach. Additionally, note opportunities for training and professional development provided, how results have been disseminated to communities of interest, and any new details regarding what the project or program plans to do during the next reporting period to accomplish the goals.

Some of the activities involved graduate and undergraduate students, who conducted their research on these topics, attended and presented at scientific conferences, and published their findings. Dissemination of results of the activities has been primarily through publication of results and presentations at meetings.

One of the Co-PDs in this project has retired and so no activities were reported under those objectives.

Critical Issue

Family & Community Resiliency (CP)

[Strengthening the Capacity in Rural Maryland to Address Opioid Misuse](#)

Project Director

Debasmita Patra

Organization

University of Maryland College Park

Accession Number

7002030



Strengthening the Capacity in Rural Maryland to Address Opioid Misuse

In 2-3 sentences, briefly describe the issue or problem that your project addresses.

Maryland ranks in the top 5 for opioid-related overdose death rates with the largest increase attributed to cases involving synthetic opioids (mainly fentanyl). In 2019, Maryland had the fourth highest rate of opioid-related deaths in the United States. This epidemic disproportionately impacts residents of rural areas. The CDC reported that rural residents are twice as likely to overdose on opioids as urban residents. Opioid-overdose deaths increased in rural Maryland such as Cecil, Caroline, and Allegany counties. Youth, individuals, and families in rural Maryland are at risk for opioid misuse and OUDs.

Briefly describe in non-technical terms how your major activities helped you achieve, or make significant progress toward, the goals and objectives described in your non-technical summary.

Education curricula for adults

The MarylandROTA project is currently delivering nine evidence-based and evidence-informed education curricula that focus on preventative, treatment, and harm reduction strategies for opioid misuse. Among our most popular programs, we deliver the Regrounding our Response Series [ROR], Opioid Public Health Crisis [OPHC], GenerationRX, Removing the Shame and Stigma of SUD, Guide to Harm Reduction, CCAR Recovery Coach Academy, and the Stress Management Series to Extension members, Local Health Improvement Coalitions (LHICs), and adult rural residents. These hour-long sessions have been delivered online.

Mental health first aid

MarylandROTA currently provides the Mental Health First Aid (MHFA) training and the MHFA certified instructor training to coach and prepare candidates to be ambassadors of the program. The program teaches participants how to identify mental health problems and provide mental health first aid in different situations. Newly certified instructors receive access to the learning management system and all necessary instructional materials required to facilitate training events in their respective communities for the purpose of improving mental health literacy.

Education curricula for youth

MarylandROTA has delivered three evidence-based curricula for middle school and high school students. The Botvin LifeSkills program is a 5-8 weeks program designed to teach socio-emotional skills to middle and high school youth. It has been found successful in reducing substance use and increasing socio-emotional skills that can act as protective factors from maladaptive behaviors. The second program, This is Not About Drugs (TINAD), targets youth in middle and high school, and it aims to teach teens about the dangers of misusing opioids and how to seek help if they or someone they know is in danger. Due to COVID-19 restrictions, all programs were delivered online.

Partnerships and reach

The MarylandROTA project has utilized its existing partnerships network, website, social media, list-serv, and practitioner networks to implement the programs. We have shared the results at partners' meetings, website, e-newsletters, social media, and list-serv in an effort to inform local and state stakeholders such as OOC, state and health departments, health coalitions about our new and existing programs.

Briefly describe how your target audience benefited from your project's activities.

Total Adult Participants: 3813

- 3196 in Set Curricula Courses and Webinars (SAMHSA & RHSE)

- 588 in MHFA

- 29 in MHFA Instructor Trainings

Total Youth Participants: 649

- 649 in Botvin LifeSkills

Adult Education Curricula

- 3196 participants

- Courses offered:
 - Regrounding Our Response (58 classes)
 - Opioid Public Health Crisis (8 classes)
 - Guide to Harm Reduction (5 classes)
 - Removing the Shame and Stigma of Addiction (4 classes)
 - ODL Workshop (3 classes)
 - CCAR Recovery Coach Academy (4 classes)
 - Farm Stress (2 classes)
 - Stress Management (1 class)
 - ACE Interface (1 class)
 - Mind Body Skills (1 class)
 - ROTA Webinars (7 classes)

From the ROTA TTC Post Event Survey:

- 77.4% of respondents strongly agreed or agreed that they expected the event to benefit their professional development and/or practice
- 72.8% of respondents strongly agreed or agreed that they will use the information gained from the event to change their current practice
- 91.8% of respondents would recommend the event to a colleague

Mental Health First Aid

- 588 participants trained in MHFA (60 classes)
- 29 participants MHFA certified instructors (3 classes)

From the MHFA TTC Post Event Survey:

- ◦ 94.6% of respondents strongly agreed or agreed that they expected the event to benefit their professional development and/or practice
- 94.0% of respondents were very satisfied or satisfied with the overall quality of the event
- 98.5% of respondents would recommend the event to a colleague

Briefly describe how the broader public benefited from your project's activities.

Total Adult Participants: 3813

- 3196 in Set Curricula Courses and Webinars (SAMHSA & RHSE)
- 588 in MHFA
- 29 in MHFA Instructor Trainings

Total Youth Participants: 649

- 649 in Botvin LifeSkills

Adult Education Curricula

- 3196 participants
- Courses offered:
 - Regrounding Our Response (58 classes)
 - Opioid Public Health Crisis (8 classes)
 - Guide to Harm Reduction (5 classes)
 - Removing the Shame and Stigma of Addiction (4 classes)
 - ODL Workshop (3 classes)
 - CCAR Recovery Coach Academy (4 classes)
 - Farm Stress (2 classes)
 - Stress Management (1 class)

- ACE Interface (1 class)

- Mind Body Skills (1 class)

- ROTA Webinars (7 classes)

From the ROTA TTC Post Event Survey:

- 77.4% of respondents strongly agreed or agreed that they expected the event to benefit their professional development and/or practice
- 72.8% of respondents strongly agreed or agreed that they will use the information gained from the event to change their current practice
- 91.8% of respondents would recommend the event to a colleague

Mental Health First Aid

- 588 participants trained in MHFA (60 classes)
- 29 participants MHFA certified instructors (3 classes)

From the MHFA TTC Post Event Survey:

- 94.6% of respondents strongly agreed or agreed that they expected the event to benefit their professional development and/or practice
- 94.0% of respondents were very satisfied or satisfied with the overall quality of the event
- 98.5% of respondents would recommend the event to a colleague

4-H Health Rocks! Mentoring Program

Project Director

Debasmita Patra

Organization

University of Maryland College Park

Accession Number

7002031



4-H Health Rocks! Mentoring Program

In 2-3 sentences, briefly describe the issue or problem that your project addresses.

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. According to the Appalachian Overdose Mapping Tool, between 2015 and 2019, Washington County had 71.0 deaths per 100,000 population, which is 46.7% more than the state average, and 147.4% greater than the national overdose rate. Washington County has seen a 57.9% increase in drug overdose deaths from the 2014-2018 data, as compared to the 2009-2013 data.

Briefly describe in non-technical terms how your major activities helped you achieve, or make significant progress toward, the goals and objectives described in your non-technical summary.

The 4-H Educator and Program Assistant secured two partnering organizations where the 4-H Health Rocks! program and additional 4-H activities have been planned, delivered, and evaluated to 39 youth, through 22 weekly sessions (2021-2022.) Participate in monthly Western Cluster Health Rocks meeting and National 4- H Council monthly check-in meetings.

Programs sites in Allegany County: 93 – weekly mentoring sessions, using curriculum lessons and 4-H activities in Allegany County, supervised by Educator, taught by grant funded program assistant, reaching 218 youth; \$247,388 (\$98,521 Educator) – Grant funds secured (PI & Co-PI) to support Health Rocks! Educator has grant oversight of two other Health Rocks! Mentoring program sites in the western cluster (Washington County & Garrett County), reaching 72 youth with weekly mentoring sessions (54 sessions). Educator leads cluster program management, monthly fiscal management, quarterly program reporting, program assessments, and evaluations to National 4-H Council.

Briefly describe how your target audience benefited from your project's activities.

New partnership with the Ft. Ritchie Community Center in Cascade, MD has been obtained. This is a region of the county in which Washington County 4- H had not previously had a presence.

- o 96% of youth feel it is not ok for someone their age to consume alcohol. (n=25)
- o 100% of youth feel it is not ok for someone their age to smoke. (n=24) 92% of youth feel it is not ok to take drugs. (n=25)
- o 92% of youth encourage their friends to make responsible choices. (n=25) 92% of youth feel 4-H is place where adults care about them. (n=24)

Allegany County

- o 100% felt 4-H was a place adults cared about them 100% felt 4-H was a safe place
- o 83% felt 4-H was a place where it was okay to make mistakes 95% intent to avoid underage tobacco use

Through the Health Rocks! program weekly lesson implementation and cultivating an environment for mentor and mentee relationships where youth feel as though the adult cares about them youth are 55% more likely to enroll in college; 78% more likely to volunteer regularly; and 130% more likely to hold a leadership position (Mentor, 2021).

Briefly describe how the broader public benefited from your project's activities.

The project is not just helping fewer counties, but helping the state of Maryland as a whole to address the opioid epidemic.

Describe and explain any major changes or problems encountered in approach. Additionally, note opportunities for training and professional development provided, how results have been disseminated to communities of interest, and any new details regarding what the project or program plans to do during the next reporting period to accomplish the goals.

Covid Impact

Project Director

Debasmita Patra

Organization

University of Maryland College Park

Accession Number

7002032



Ag Innovators Experience-Curbing Our Carbon Appetite

In 2-3 sentences, briefly describe the issue or problem that your project addresses.

Earth's atmosphere performs several essential functions. It provides gases that organisms need for survival, plays a role in the water cycle, protects Earth's surface from harmful wavelengths of solar radiation, and carries sound waves. The atmosphere also keeps Earth's surface warm enough to support life. Unfortunately, human activity is causing the levels of greenhouse gases to increase and trap too much heat, contributing to climate change. Modern agriculture can play a key part in addressing these effects and has the potential to help reduce and sequester atmospheric carbon dioxide through adoption of more sustainable land management decisions. Consumers can also influence the carbon footprint through their food choices which in turn influence producers to adopt sustainable practices. Both the consumer and the producer have contributing to a healthy, sustainable food supply to feed a growing world.

Briefly describe in non-technical terms how your major activities helped you achieve, or make significant progress toward, the goals and objectives described in your non-technical summary.

In partnership with National 4-H Council and Bayer, in 2020-2021, a team of seven University of Maryland Extension 4-H youth development educators developed and implemented the National 4-H Ag Innovators Experience team challenge for 2021 titled Curbing Our Carbon Appetite for both virtual programming and in person programming. Curbing Our Carbon Appetite is a hands-on curriculum that focuses on teaching youth about climate change and actions that agriculture, business and industry, and families can take to reduce atmospheric carbon.

The primary program goal is to help students discover and apply strategies related to agriculture, food systems, and personal behaviors that can help to reduce atmospheric carbon and combat climate change. Students in grades 3 through 12 learn about the causes and effects of climate change and explore strategies that agriculture, businesses, and individuals can adopt to reduce atmospheric carbon. To better visualize the greenhouse effect and climate change, students construct and collect temperature data for three atmospheric models representing reduced carbon, current carbon, and increased carbon. Next, they complete a carbon-friendly lunch challenge by analyzing the carbon footprints of their food choices and planning carbon-friendly meals. Finally, they complete a carbon actions line-up activity that investigates more than a hundred carbon reduction strategies. Each student also receives three take-home activities designed to extend their learning at home: a carbon-friendly strategies family inventory, a carbon actions board game, and a carbon-friendly community service challenge.

Briefly describe how your target audience benefited from your project's activities.

The Ag Innovators-Curbing Our Carbon Appetite curriculum is the first National 4-H curriculum with a climate change focus. Curriculum development and implementation was sponsored by the National 4-H Council and Bayer and 183 trained teen facilitators reached 7,526 youth across seven states and seven different international youth audiences as of July 23, 2021. In Maryland, 21 trained teen facilitators taught 1,050 youth. The curriculum went through the National 4-H peer review process and is being sold nationally through Shop 4-H.

The *Curbing Our Carbon Appetite: An Ag Innovators Experience Addressing Climate Change among Youth Audiences* presentation was shared in person and virtually as part of the National Association of 4-H Youth Development Professionals Conference. The presentation was shared with conference attendees and abstract was share with conference registrants from across the United States.

Nationally Trained State Teen Facilitators:

- ■ ■ ■ ○ 100% of felt prepared to help lead a successful state facilitator training

- 100% were more confident that they can lead others through the Experience

- 100% were more capable of explaining how human activities affect atmospheric carbon

State Teen Leaders:

Leading the Curbing Our Carbon Appetite Challenge gave teens new perspectives and the opportunity to develop leadership skills, including group facilitation and public speaking.

Highlights from the 2021 teen leader survey included:

- ■ ■ ■ ○ 98% gained new knowledge about science
- 97% talked about how science is useful for solving everyday problems
- 89% are interested in educating youth about agriculture issues
- 79% are more interested in learning about food production
- 79% are more interested in advocating for agricultural issues that affect our world
- 59% are more interested in pursuing a career in agriculture

Youth Participants:

Five common key outcomes of the Ag Innovators Experience are measured every year. Below contains a summary of the 2021 participant survey results regarding these outcomes

- 71% answered yes and 25% answered kind of that I thought it was important to work in a group to complete the Challenge
- 66% answered yes and 27% answered kind of that my teammates and I used good communication to complete the Challenge
- 79% answered yes and 18% answered kind of that after completing the Challenge, I have a better understanding of how I can contribute to a healthy food supply
- 50% answered yes and 36% answered kind of that I am more interested in science and agriculture after participating in the challenge
- 71% answered yes and 24% answered kind of that after completing the Challenge, I have a better understanding of how science and engineering help solve real-life problems

Briefly describe how the broader public benefited from your project's activities.

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Career AGsperience

Project Director

Debasmita Patra

Organization

University of Maryland College Park

Accession Number

7002033



Career AGsperience

In 2-3 sentences, briefly describe the issue or problem that your project addresses.

Many times when youth are asked about agriculture careers, they only think about farmers and veterinarians. However, there are many agriculture related jobs. Although agriculture is a multi-billion dollar industry, which directly affects everyone in the world, employers still struggle to find qualified candidates to fill vacancies within the agriculture career sector. With the United States growing population of more than 6 million largely located in urban and suburban areas, and most of the population being several generations removed from direct work in farming, it is imperative to educate youth about agriculture as well as related agricultural careers and it is essential for agriculture workforce preparation. Exploring the vast array of career opportunities connected to agriculture will increase teens' pursuit of postsecondary training and degrees connected to agriculture as well as enhance their interest in and success at pursuing careers within agriculture fields.

Briefly describe in non-technical terms how your major activities helped you achieve, or make significant progress toward, the goals and objectives described in your non-technical summary.

The University of Maryland Extension AGsperience team has developed Career AGsperience, an agriculture career literacy program designed to increase participants' knowledge base about agriculture careers and required preparation for careers in Animal Science, Environmental Science, Agri- Business and Leadership and Agriculture Science and Technology. The team developed curriculum related to agriculture careers, career planning, resume development, internship acquisition, interviewing skills and business etiquette, supplemental materials and assessment tools for both virtual and in person programming. The program strives to increase the amount of youth pursuing post-secondary degrees and careers in agriculture related fields. The program is supported with a website page and YouTube channel via the AGsploration website.

Briefly describe how your target audience benefited from your project's activities.

In 2020-2021, the Career AGsperience team developed and piloted the curriculum and supplemental activities for both virtual programming and in person programming related to agriculture career preparation. The curriculum is currently going through the University of Maryland Extension peer review process. They also developed assessment and evaluation instruments. In fall 2020 and spring 2021, the team offered a 6-week virtual Career AGsperience program for career exploration and preparation. Participants from the Northeast “Unlocked the Mysteries and Learned the Untold Secrets of Preparing for a Successful Career in Agriculture” as they further expanded their knowledge and learned more in depth skills related to career planning and acquisition. Virtually, youth learned about agriculture careers, career planning, resume development, internship acquisition, interviewing skills and business etiquette. Two virtual sessions also included listening and interacting with individuals that are currently working in agriculture related careers. Four of the five panel participants were Maryland 4-H alumni and the fifth individual although not a 4-H alumna is a University of Maryland College Park College of Agriculture and Natural Resources Alumna and current faculty member. Twenty-five youth from the Northeast region participated in the intensive 6-week Career AGsperience program hosted virtually in 2020-2021. Career AGsperience post-survey of program participants indicated that the presenters were effective in communicating program content and 100% learned “a lot of” new information about workforce preparation. One Career AGsperience participant stated that “they learned so much and they wished that the 6 session program was not ending”. Twenty-six students were introduced to the resume, interview and internship lessons during an in-school program. Thirty-nine 4-Hers were introduced to an overview of the curriculum at the State 4-H Teen Leadership Summit in late June. Additionally in 2021, over 10,000 youth were reached via a Career AGsperience Virtual Booth for the Junior Achievement of Central Maryland Inspire program in February and November. Moreover, 205 youth and adults participants from 38 states and Puerto Rico participated in the Career AGsperience presentation at the National 4-H Youth Summit on Agri- Science. One of the main objectives is of the summit is to increase participants understanding of careers and career pathways in agri-science. The summit participant evaluation indicated, 98% of youth participants increased their knowledge of agri-science-related careers and 100% said the summit increased interest in pursuing agri-science careers. 73% of youth participants said that they identified one or more careers in agriculture that are a good fit. The Career AGsperience session entitled *Career AGsperience: Unlock the Secrets of Helping Youth Prepare for a Successful Career* was recorded and shared virtually as part of the National ESP conference. The presentation was shared with 100 extension conference attendees from across the United States.

Briefly describe how the broader public benefited from your project's activities.

In 2020-2021, the Career AGsperience team developed and piloted the curriculum and supplemental activities for both virtual programming and in person programming related to agriculture career preparation. The curriculum is currently going through the University of Maryland Extension peer review process. They also developed assessment and evaluation instruments. In fall 2020 and spring 2021, the team offered a 6-week virtual Career AGsperience program for career exploration and preparation. Participants from the Northeast “Unlocked the Mysteries and Learned the Untold Secrets of Preparing for a Successful Career in Agriculture” as they further expanded their knowledge and learned more in depth skills related to career planning and acquisition. Virtually, youth learned about agriculture careers, career planning, resume development, internship acquisition, interviewing skills and business etiquette. Two virtual sessions also included listening and interacting with individuals that are currently working in agriculture related careers. Four of the five panel participants were Maryland 4-H alumni and the fifth individual although not a 4-H alumna is a University of Maryland College Park College of Agriculture and Natural Resources Alumna and current faculty member. Twenty-five youth from the Northeast region participated in the intensive 6-week Career AGsperience program hosted virtually in 2020-2021. Career AGsperience post-survey of program participants indicated that the presenters were effective in communicating program content and 100% learned “a lot of” new information about workforce preparation. One Career AGsperience participant stated that “they learned so much and they wished that the 6 session program was not ending”. Twenty-six students were introduced to the resume, interview and internship lessons during an in-school program. Thirty-nine 4-Hers were introduced to an overview of the curriculum at the State 4-H Teen Leadership Summit in late June. Additionally in 2021, over 10,000 youth were reached via a Career AGsperience Virtual Booth for the Junior Achievement of Central Maryland Inspire program in February and November. Moreover, 205 youth and adults participants from 38 states and Puerto Rico participated in the Career AGsperience presentation at the National 4-H Youth Summit on Agri- Science. One of the main objectives is of the summit is to increase participants understanding of careers and career pathways in agri-science. The summit participant evaluation indicated, 98% of youth participants increased their knowledge of agri-science-related careers and 100% said the summit increased interest in pursuing agri-science careers. 73% of youth participants said that they identified one or more careers in agriculture that are a good fit. The Career AGsperience session entitled *Career AGsperience: Unlock the Secrets of Helping Youth Prepare for a Successful Career* was recorded and shared virtually as part of the National ESP conference. The presentation was shared with 100 extension conference attendees from across the United States.

Engineering for food safety and quality

Project Director

Rohan Tikekar

Organization

University of Maryland College Park

Accession Number

1025478



Online multi-institutional graduate course in food engineering was designed and offered during the pandemic

In 2-3 sentences, briefly describe the issue or problem that your project addresses.

Consumers expect the US food industry to develop and deliver safe, high-quality, nutritious, and healthy food products while also addressing several emerging sustainability issues such as resource consumption, food loss and waste, food waste management, and food safety. With these demands have emerged a need for food engineers to develop and deliver novel solutions to address these competing challenges. However, many key technical hurdles need to be overcome to meet these goals, such as (a) limited characterization of physical, chemical and biological properties of foods that influence their quality and susceptibility to spoilage and contamination; (b) the need for optimization of existing technologies or discovery and translation of new sustainable food processing and packaging technologies that can deliver safe, nutritious, healthy, and high quality foods; (c) the need for development of novel methods to collect and analyze big data and its utilization in product and process development; (d) development and refinement of mathematical models that can enhance the understanding of fundamental dynamics within food processing operations to enable accurate prediction of safety and quality attributes of foods; and (e) training of the next generation of food industry professionals that are equipped with science and engineering tools to address these issues facing the food industry. To solve these technical hurdles, there is a critical need for interdisciplinary efforts and collaboration among food engineers, food scientists, and food industry professionals across the nation.

Briefly describe in non-technical terms how your major activities helped you achieve, or make significant progress toward, the goals and objectives described in your non-technical summary.

The COVID-19 pandemic brought significant barriers to learning, but it also created new opportunities and receptiveness to innovate what and how we teach. The USDA multistate project NC-1023 (Engineering for food safety and quality), attempted to break these barriers and provide opportunities for students to interact with researchers from across the country through a new, online multi-institutional graduate course in food engineering. The online course provided unique opportunities for students to meet their peers and faculty from across the country, create a peer network of researchers and mentors to learn from their experiences, and build a sense of community.

Briefly describe how your target audience benefited from your project's activities.

The objectives of the online course, that was designed and offered by the multistate committee, were to: (1) provide graduate students general knowledge of emerging food science and engineering topics; (2) create a peer network of researchers and mentors in food engineering; (3) provide opportunity to connect students with top researchers in food engineering across the US; and (4) get examples of how to organize and transfer complex information to diverse audiences. The learning outcomes developed for the course were that upon completion of the course, students will: (1) become familiar with approaches used in by-product utilization and value-added processing in food and agricultural industries; (2) become familiar with the engineering and processing approaches for health; (3) learn recent developments in engineering and processing in sustainable food systems; and (4) apply insights gained from observing faculty presentations to improve student presentation skills.

Education program developed: In the development of this course, relevant topics were selected by a planning committee and grouped into 13 thematic areas. To develop a student-centered course, a survey was developed and disseminated to NC1023 member institutions to evaluate student interest and knowledge about the 13 thematic areas. 108 student responses were received from 18 institutions. Based on student responses, the thematic areas selected for the course were: By-

Product Utilization, Engineering for Health, and Engineering and Processing for Sustainable Systems. For each area, four speakers were selected from the NC1023 members. Many of the projects presented were funded by USDA-NIFA or HATCH. 12 universities concurrently offered the course in the spring semester/quarter (January - April) of 2021 (see participants list). Across these universities, there were 132 students enrolled in the course, with additional attendees from many institutions each week who were interested in the presentation topics. The course met for 90 min weekly on Zoom. Each week, there was a live, 50 min presentation followed by a moderated Q & A session. In the last 15-20 minutes each week, attendees were invited to break-out rooms with 3-5 people for networking with faculty and students from different universities. Presentations were recorded and were available through the UC Davis video-sharing platform to all students enrolled in the course, which gave them flexibility to overcome scheduling conflicts.

Method for evaluating impact& measurable outcomes: The course impact was evaluated through student feedback from the 12 participating universities and through quantification of attendees and video views. Student feedback was positive, and many students expressed interest in attending the course in the future as a professional development opportunity from their future careers in the food and agricultural industries. They also appreciated an opportunity to learn about research topics of other graduate students from diverse disciplines. Some student comments were: "Enjoyed the style of the course. The networking sessions at the end of the lecture helped to learn how to interact on a virtual platform." "I really appreciate your efforts to collaborate with this nation-wide course initiative and make it available to folks here". Attendance ranged from 86 - 163 attendees, with an average attendance of 139 attendees per week.

Briefly describe how the broader public benefited from your project's activities.

The online course made it possible for the students in food science and engineering to continue receiving quality education during the pandemic, that also allowed for networking opportunities, among the 12 participating universities. The food industry will benefit from these students who learned from various experts in the areas of By-Product Utilization, Engineering for Health, and Engineering and Processing for Sustainable Systems.

The presentation videos were viewed for >527 hours during the course from students across the country. The broad audience and large number of video views demonstrate scalability and a significant educational impact of this course. Plans are in place to offer the course each year with different thematic areas and speakers, and to increase course enrollment.

Describe and explain any major changes or problems encountered in approach. Additionally, note opportunities for training and professional development provided, how results have been disseminated to communities of interest, and any new details regarding what the project or program plans to do during the next reporting period to accomplish the goals.

There is a plan to develop the next iteration of the course for Spring 2022 with new speakers.

Closing Out (end date 09/07/2023)

Pluripotency and lineage differentiation in stem cells and early embryos

Project Director

Carol Keefer

Organization

University of Maryland College Park

Accession Number

1025210



Training undergraduates in stem cell research

In 2-3 sentences, briefly describe the issue or problem that your project addresses.

While decades of research have resulted in vastly improved in vitro culture conditions which allow researchers to approximate an appropriate environment for early embryonic development, in vitro produced embryos are less viable than in vivo derived embryos. Moreover, methods supporting in vitro propagation of pluripotent stem cells derived from domestic species are even less well developed, and techniques developed in the mouse system have not been fully replicated in other species, i.e., chimera production using embryonic stem cells (ESC) or induced pluripotent stem cells (iPSC), and in vitro spermatogenesis

using spermatogonial stem cells (SSC). In our studies, we hope to gain a better understanding of the metabolic mechanisms controlling pluripotency through the modulation of energy substrates and cytokine pathways during stem cell (ESC/iPSC/SSC) proliferation and early preimplantation embryonic development.

Briefly describe in non-technical terms how your major activities helped you achieve, or make significant progress toward, the goals and objectives described in your non-technical summary.

1. Due to COVID-19 shutdown and graduation of participating undergraduate students, the spermatogonial stem cell (SSC) cultures were not maintained. This summer new samples of pre-pubertal cat testes were obtained and frozen back for future use. Also new stocks of the feeder cells were made and frozen back.
2. A few initial cultures of SSC derived from frozen-thawed tissue were processed using a Qiagen kit for RNA in trial runs. RNA samples of sufficient concentration and purity were obtained. Newly obtained felid testicular tissues are being processed for SSC culture. These will be processed for RNA sequencing.

Briefly describe how your target audience benefited from your project's activities.

Undergraduates gained experience in tissue processing, cell culture, and purification of mRNA. One returning undergraduate, Dorothea Strait, is learning how to culture feeder cells and will be trained to maintain SSC.

Briefly describe how the broader public benefited from your project's activities.

Due to COVID-19 issues, limited progress was made, therefore, other than providing STEM training to undergraduates, no broader public benefit at this time.

Describe and explain any major changes or problems encountered in approach. Additionally, note opportunities for training and professional development provided, how results have been disseminated to communities of interest, and any new details regarding what the project or program plans to do during the next reporting period to accomplish the goals.

All SSC cultures were stopped due to the COVID-19 shutdown and graduation of experienced undergraduates. Now that conditions have improved, the cultures have been started up again and training of undergraduates has resumed.

[Agriculture Literacy](#)

Project Director

Debasmita Patra

Organization

University of Maryland College Park

Accession Number

7001919



Agriculture Literacy

In 2-3 sentences, briefly describe the issue or problem that your project addresses.

Less than 2% of the U.S. population is directly involved with agriculture, and according to U.S. Census data, farmers comprise approximately 1% of the population (USDA NASS, 2017; U.S. Census Bureau, 2018). Over 40% of the U.S. consumer population is comprised of Millennials and Generation Z (U.S. Census Bureau, 2018), two groups that are overwhelmingly invested in learning how their food is produced and reducing their impact on the environment. For farmers, the disconnect between the consumer and food production is alarming, especially because consumer demands have recently manifested in changes in animal management and production systems that are often unsubstantiated by sound science.

The disconnect between farmer and consumer is even more substantial in Maryland, where farmers make up just 0.35% of the state's population (USDA NASS, 2017; U.S. Census Bureau, 2018). This statistic is startling and presents Maryland farmers with a host of challenges. However, the proximity of Maryland farmers to large population centers, like the Washington and

Baltimore Metropolitan areas, also presents them with unique opportunities to engage directly with consumers and lawmakers. This makes Maryland an ideal location to cultivate relationships between farmers and the non-farming public. The importance of developing direct relationships between farmers and consumers and lawmakers cannot be overstated.

Briefly describe in non-technical terms how your major activities helped you achieve, or make significant progress toward, the goals and objectives described in your non-technical summary.

In 2020, a series of three educational events were organized to help educate county officials on common agricultural practices related to crop and livestock production. Additionally, in 2020 the UME Agriculture and Food Systems Consumer Knowledge Committee laid important framework for developing a program designed to promote agriculture literacy and submitted a grant proposal to the Northeast Sustainable Agriculture Research and Education Professional Development Grant Program to support the program. Although this proposal was not funded, the concepts established by the effort provides guidance for the pursuit of additional funding and development of future educational materials. In 2021, efforts focused on the development of online modules that will be a resource for local government officials in their efforts to learn about basic agricultural production practices.

Briefly describe how your target audience benefited from your project's activities.

In 2021, efforts focused on the development of online modules that will be a resource for local government officials in their efforts to learn about basic agricultural production practices. This is a new and developing program, so impacts have not yet been realized. However, it is expected that the program will increase the non-farming public's knowledge of livestock production practices and increase the number of interactions that consumers have with farmers in the State of Maryland.

Briefly describe how the broader public benefited from your project's activities.

This is a new and developing program, so impacts have not yet been realized. However, it is expected that the program will increase the non-farming public's knowledge of livestock production practices and increase the number of interactions that consumers have with farmers in the State of Maryland.

Describe and explain any major changes or problems encountered in approach. Additionally, note opportunities for training and professional development provided, how results have been disseminated to communities of interest, and any new details regarding what the project or program plans to do during the next reporting period to accomplish the goals.

COVID Impact

IPM of Forage and Agronomic Pests

Project Director

Debasmita Patra

Organization

University of Maryland College Park

Accession Number

7002022



IPM of Forage and Agronomic Pests

In 2-3 sentences, briefly describe the issue or problem that your project addresses.

Despite declining pest populations, increasing concerns of insecticide resistance and field failures of these technologies necessitate monitoring programs and early warning systems to protect stakeholders from unexpected losses. Other changes in pest complexes, including invasive species, emerging pests, and evolution of pesticide-resistant populations present a serious threat to U.S. and MD crops. Appropriate use of these emerging technologies and successful management of hard to control pests requires extension education inclusive of demonstrations of the technology to demonstrate efficacy and to explain specific safety concerns.

Briefly describe in non-technical terms how your major activities helped you achieve, or make significant progress toward, the goals and objectives described in your non-technical summary.

Individual Consultations: Individual consultations and farm visits are essential for making diagnoses about problems in agronomic crops, which can have issues that manifest themselves at multiple different scales. Seeing the field in person and hearing from the farmer what practices were employed are often the best ways to determine the best IPM approach to take to correct any problems. A total of 25 individual consultations were made in 2021 on matters such as weed control, crop disease, and plant nutrition deficiencies. Many consultations resulted in plant samples being submitted for analysis at the Plant Diagnostic Clinic on campus in College Park, which is a resource that few local farmers are aware of.

Email Newsletter: An email listserv and physical mailing address list have been maintained for local farmers and agencies supporting local farmers. Email updates are provided on a regular basis to advertise upcoming extension programming locally and throughout the state, and to circulate relevant information in a timely manner. Over the year 2021, a total of 13 email newsletters have been distributed to a list of 219 subscribers.

Agronomy News: This is a statewide extension newsletter distributed online and in print. This newsletter covers topics directly related to production of agronomic crops in MD, including IPM strategies, fertility recommendations, disease forecasts, and results of variety trials among other topics. Articles contributed to this newsletter with content related to IPM of agronomic crops cover biology and management strategies of pest species, guidance for spray decisions, and timely pest updates.

Southern Maryland Crops Conference: This conference is a joint collaboration among all five Southern MD counties to provide farmers in the area with the latest research-based updates on crop management strategies. The conference is organized in coordination with B. Beale and R.D. Myers, and for 2021, this conference was held in-person and attended by 124 participants, including industry and agency sponsors.

Briefly describe how your target audience benefited from your project's activities.

As a result of this programming, 10 presentations have been given at workshops to 659 participants, one interactive poster display was presented at a meeting with 120 participants, one presentation was made at a field day event with 60 participants, six extension articles were published, and one segment was recorded for the public television program *Maryland Farm and Harvest*. Participants at these events learned the latest information about research on IPM practices that are most effective with modern farming practices. Data from a 2020 experiment on combinations of post-emergent herbicides to control Palmer amaranth and annual grass weeds was presented as a 12- minute talk at the Northeast Plant Pest and Soils Conference held virtually.

Briefly describe how the broader public benefited from your project's activities.

As a result of this programming, 10 presentations have been given at workshops to 659 participants, one interactive poster display was presented at a meeting with 120 participants, one presentation was made at a field day event with 60 participants, six extension articles were published, and one segment was recorded for the public television program *Maryland Farm and Harvest*. Participants at these events learned the latest information about research on IPM practices that are most effective with modern farming practices. Data from a 2020 experiment on combinations of post-emergent herbicides to control Palmer amaranth and annual grass weeds was presented as a 12- minute talk at the Northeast Plant Pest and Soils Conference held virtually.

[Commercial Poultry Education](#)

Project Director

Debasmita Patra

Organization

University of Maryland College Park

Accession Number

7002021



Commercial Poultry Education

In 2-3 sentences, briefly describe the issue or problem that your project addresses.

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. 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. The EPA's permitting rule for *Concentrated Animal Feeding Operation (CAFO)* was published on November 20, 2008. An operation must have a permit if it meets the definition of a CAFO. New poultry growers will need to obtain a permit prior to production. It is essential growers understand the management practices that should be implemented in order to demonstrate compliance with the regulation. 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. New poultry growers will need to obtain a permit prior to production. It is essential growers understand the management practices that should be implemented in order to demonstrate compliance with the regulation.

Briefly describe in non-technical terms how your major activities helped you achieve, or make significant progress toward, the goals and objectives described in your non-technical summary.

To help these growers we have developed programs to help educate them on management, health and compliance with regulations. Workshops were held in both MD and DE. However, because of COVID-19, in person programming continues to be limited. Programs include:

- Five Lunch and Learn webinars were conducted, each webinar was then transformed into a written document that was then sent to over 960 growers and allied industry personnel.

- Two workshops were held to help growers with their AIR reports. One on farm field day.

- one fact sheet "Avoiding Fires in Poultry Litter Dry Stack Sheds" was also published with Mississippi State University.

- Two workshops on vegetative buffers. Workshop on fly control and ventilation.

- Two workshops on cool cell maintenance. One virtual mortality composting workshop.

- Emailed poultry growers and allied groups to let them know of available assistance with mental issues.

Briefly describe how your target audience benefited from your project's activities.

Most growers (95%) found programming 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 programming. 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 trainings include:

- 100% reported a moderate or greatly increased in knowledge or skills, 98% had a better understanding of broiler production,

- o 83 %better understanding of poultry welfare, 88% better understanding of brooding,
- o 85% better understanding of composting,
- o 86% better understanding of basic poultry ventilation

Briefly describe how the broader public benefited from your project's activities.

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Closing Out (end date 09/07/2023)

Using clover and wildflowers to improve ecosystem services in edamame

Project Director

Maria Espindola

Organization

University of Maryland College Park

Accession Number

1023271



Biodiversity-friendly practices, such as floral supplementation methods, help the sustainability of production systems and increase yield

In 2-3 sentences, briefly describe the issue or problem that your project addresses.

Agricultural expansion has been shown to lead to reductions in biodiversity in the agroecosystem, with negative consequences in the ecology and yield of the crops and farms. In this project, we are seeking to understand whether a combination of clover and wildflower addition to edamame fields can lead to increased pollination and pest control services, and increased yield in the crop. Our end goal is to promote biodiversity-friendly practices that help the sustainability of the production systems and increase yield.

Briefly describe in non-technical terms how your major activities helped you achieve, or make significant progress toward, the goals and objectives described in your non-technical summary.

After planting our fields, we have now preliminary results that start to indicate that floral supplementation methods are indeed leading to increased quality and yield in the crop. Interestingly, this increase seems to not just be due to higher pollination, but rather to a combination of higher pollination and pest control.

We are also starting to have a better understanding of the floral visitors, pests, and potential pest control agents present in the different treatments, which will allow us to better target agents when recommendations for implementation are given.

Briefly describe how your target audience benefited from your project's activities.

We have now presented these results to some farmers, in particular organic vegetable farmers, who are extremely interested in adopting the method if it was shown to be effective and lead to higher high-quality yield.

Farmers are also now starting to consider the use of wildflower supplementation in their fields.

Briefly describe how the broader public benefited from your project's activities.

Through some of our publications in broader public media, they could be exposed to the idea of increasing biodiversity in farming lands, and how that is both sustainable overall, but also has clear economic impacts. The promotion of these ideas also impacts them directly, since they may start implementing such actions as well in their lives.

Describe and explain any major changes or problems encountered in approach. Additionally, note opportunities for training and professional development provided, how results have been disseminated to communities of interest, and any new details regarding what the project or program plans to do during the next reporting period to accomplish the goals.

- Major challenges: plantings were disturbed due to COVID-19, so some of the treatments had to be adjusted for 2021 and into the following years.
- Training: we trained two undergraduate and one graduate student in the use of agroecological practices, its communication and research.
- Dissemination: blogs in Spanish and English. Extension talks.
- Plans: apply new expanded sampling scheme (12 replicated plots) and perform sampling and analysis.

[Genome assembly and functional annotation the rainbow Trout fish](#)

Project Director

Mohamed Salem

Organization

University of Maryland College Park

Accession Number

1022805



[A new assembly of the rainbow trout transcriptome published](#)

In 2-3 sentences, briefly describe the issue or problem that your project addresses.

Aquaculture allows production of aquatic muscle foods to satisfy the increasing U.S. demand, but to enable the aquaculture industry to increase production and meet the growing demand for fish, we need fast/efficient growing and high-quality fish. However, a significant constraint to increasing production efficiency is the lack of genetically improved strains of fish for aquaculture. Rainbow trout, the most cultivated cold-water fish in the U.S. Aquaculture industry, needs applications of genomics in breeding programs to define genetic and phenotypic parameters that control complex traits such as disease-resistance and feed-efficiency.

Briefly describe in non-technical terms how your major activities helped you achieve, or make significant progress toward, the goals and objectives described in your non-technical summary.

A reference genome sequence is necessary for applications of genomics. A draft of the genome reference is available. However, significant improvements to the genome assembly and annotation are needed further to improve the utility of genomics applications in rainbow trout. The objectives of this project are to 1) Improving the reference genome assembly by using various DNA sequencing and genome mapping technologies. 2) Annotate the reference genome for the protein-coding and non-coding transcript-isoforms, by full-length DNA single-molecule sequencing. 3) Annotate the genome for chromatin histone-modifications, and chromatin accessibility across various tissues. The improved genome assembly and annotation will accelerate genetic and genomic analyses for improving important aquaculture production traits in rainbow trout and other closely-related salmonid species.

A new assembly of the rainbow trout transcriptome (Swanson clonal line) has been published allowing identification of alternative splicing associated with economically important phenotypes.

Briefly describe how your target audience benefited from your project's activities.

The target audience includes the aquaculture, fish, and animal science scientific community. A new assembly of the rainbow trout transcriptome (Swanson clonal line) has been published allowing identification of alternative splicing associated with economically important phenotypes.

Briefly describe how the broader public benefited from your project's activities.

The aquaculture industry will benefit by increasing their production efficiency by using genetically improved strains of fish that will be developed from this study. Economies of scale will then be passed on to consumers in terms of having abundant supply of high quality and affordable fish.

Describe and explain any major changes or problems encountered in approach. Additionally, note opportunities for training and professional development provided, how results have been disseminated to communities of interest, and any new details regarding what the project or program plans to do during the next reporting period to accomplish the goals.

The project helped in training 2 postdocs, 2 graduate and 1 undergraduate student. We made progress despite the pandemic.

Using cover crops as a biculture intercrop to manage weeds in vegetables

Project Director

Cerruti Hooks

Organization

University of Maryland College Park

Accession Number

1021814

★ Taught farmers new pest management techniques, trained next generation agri-personnel, and helped mitigate community's food insecurity by sharing produce from research plots

In 2-3 sentences, briefly describe the issue or problem that your project addresses.

Herbicides and cultivation are used routinely in sweet corn plantings. However, herbicides registered for sweet corn is dwindling because of no-reregistration of older compounds and suspensions over environmental concerns; and cultivation enhances fuel usage and production cost. Further, sweet corn is vulnerable to three yield reducing insects and although some GMO sweet corn cultivars are protected from these insects, similar to insecticides, resistance problems reduce their efficacy period. Thus, there is a need for additional practices that target weeds and insects concomitantly.

Briefly describe in non-technical terms how your major activities helped you achieve, or make significant progress toward, the goals and objectives described in your non-technical summary.

Training 2nd generation agri-personnel. Research and extension activities carried out in fulfillment of this grant exposed undergraduates, graduate students, agents and a Postdoc to novel research methods for manipulating insect and weed pests concomitantly without chemicals and provided them occasions to learn how to conduct quality research and impactful extension education. This provided them with valuable hands-on experience in conducting field work related to pest management science that goes beyond readings and standard classroom experiences. Students and others were also engaged in the design and delivery of extension programming in multiple formats, including written publications, field day events, and presentations at local and regional commodity meetings. These experiences have provided them with valuable experience for their future careers in science and/or extension education.

Information dissemination. Results were disseminated via a diversity of outlets to ensure that as many stakeholders as possible receive the information generated by this project. Vegetable farmers were presented directly with results at grower meetings via in-person and through virtual programming held online. Presentations were conducted at local and regional

venues. In addition, information was circulated in a timely manner through grower newsletters, delivered in print and digitally, and on the vegetable extension website. Several articles and updates provided information on using conservation tillage and cover cropping to suppress insect and weed pests that can be adopted in system other than sweet corn. A demonstration site that consisted of varying vegetables with differential susceptibility to pests was used to showcase a new pest management technique to farmers. A farm walking tour also provided direct guidance to farmers on pest management options in sweetcorn. These field events are especially helpful for farmers with limited or no internet access. Field day events also provided stakeholders visual assessments on how crop husbandry practices can be modified to mitigate pests.

Briefly describe how your target audience benefited from your project's activities.

Through the aforementioned extension activities, we have directly trained ~ 500 stakeholders between October 2020 – September 2021 alone and during the duration of the project have provided hundreds of more with increased knowledge of how to suppress weeds and manipulate natural enemies in sweet corn plantings. Articles were published in popular UMD extension newsletters and blogs. Vegetable and Fruit Headline and Agronomy News blog, to help promote ecological pest management knowledge, interest and conservation of beneficial arthropods. These newsletters and blogs were read by ~2,500 and 3,000 stakeholders, respectively. In summary, our extension activities have impacted MD stakeholders via environmental and economic gains, and has helped farmers via changes in knowledge, production practices and earnings.

Briefly describe how the broader public benefited from your project's activities.

During the summer of 2021, hundreds of pounds of fresh vegetables produced from the demonstration, sweet corn and applied research plots were donated to organization helping food insecure communities and individuals (e.g., UMD Campus Pantry, Upper Marlboro Food Pantry and Food Rescue US). One goal of the Hooks' lab, which is in parallel with organization helping mitigate food insecurity is to help alleviate food insecurities among community members in need by providing them emergency food at no cost and providing nutritious foods to those who would otherwise find it difficult to obtain or unattainable in hopes that it improves their lives. Our donations have resulted in enhanced food security and well-being of many Marylanders and their family members impacted by hunger and we have provided social service agencies fresh produce which has enhanced their ability to serve the food insecure. As a result of our efforts and an associated increase in cover crops being planted in Maryland there could be an environmental impact. An environmental benefit an increase in cover crop acreage is a reduction of pounds of nitrogen phosphorus from entering the Chesapeake Bay and its tributaries. This is important as "the bay provides countless opportunities and dollars in regards to its fishing, tourism, real estate, and shipping industries" in Maryland.

Describe and explain any major changes or problems encountered in approach. Additionally, note opportunities for training and professional development provided, how results have been disseminated to communities of interest, and any new details regarding what the project or program plans to do during the next reporting period to accomplish the goals.

Below are some extension activities associated with the project:

1. Yurchak, V., A. Leslie and C.R.R. Hooks. 2021. Using living mulch in reduced tillage sweet corn. Mid-Atlantic Fruit and Vegetable Conference. Hershey, PA February 08-11 (virtual poster session)
2. Hooks, C.R.R., G. Chen, H.M. Kahl, A.W. Leslie and V. Yurchak. 2020. Red clover: A memoir of a zealous cover crop, its friends and their battle with crop pests. Virginia Tech University, Department of Entomology Seminar Series. November 05, 2020. Blacksburg, VA. Attendance 45
3. Hooks, C.R.R., G. Chen, H.M. Kahl, A.W. Leslie and V. Yurchak. 2021. A fortuitous partnership: The tale of winter cover crops and strip tillage crusade against pests. Cornell University New York State Integrated Pest Management Academic Seminar Series. March 18, 2021. Attendance 31
4. Yurchak, V., and C.R.R. Hooks. 2021. "Creating an ecofriendly pest suppression program in sweet corn" Northeast Integrated Pest Management (IPM) Research Update Conference. Zoom Meeting, Northeast IPM Center. March 21, 2021. Attendance 36

5. Hooks, C.R.R., A.W. Leslie and D. Joseph. 2021. The critical period of weed control (CPWC): An underutilized concept. *Vegetable and Fruit News. Special Alert Edition: Weed Control.* May 06, 2021. pg. 1-8.
6. Hooks, C.R.R., G. Chen, H.M. Kahl, A.W. Leslie and V. Yurchak. 2021. *Workshop Title:* Beginning Farmers Training Program. *Presentation title:* Using cover crops and minimum tillage practice to influence insect and weeds pests in vegetables. Zoom meeting, Upper Marlboro, MD April 01, 2021. Attendance 20
7. C.R.R Hooks. 2021. Cover crops and conservation tillage research for managing insects and weeds in vegetable production. Vegetable Production and IPM Twilight Walking Tour. Mechanicsville, MD July 28, 2021. Attendance 100
8. Yurchak, V. and C.R.R. Hooks. 2021. Using living and dead cover crops to suppress weeds in sweet corn. Crops Twilight Tour and Ice Cream Social. Upper Marlboro, MD August 04, 2021. Attendance 72
9. Yurchak, V. and C.R.R. Hooks. 2021. Mixed vegetables interplanted with perennial clover. 2021. Crops Twilight Tour and Ice Cream Social. Upper Marlboro, MD August 04, 2021. Attendance 72
10. C.R.R. Hooks and A.W. Leslie. 2021. Using marigold as an insectary plant to enhance natural enemies of stink bugs and other insect pests. Crops Twilight Tour and Ice Cream Social. Upper Marlboro, MD August 04, 2021. Attendance 72

[Improving strawberry reproduction through genome editing and mutagenesis](#)

Project Director

Zhongchi Liu

Organization

University of Maryland College Park

Accession Number

1021445



Identification of two MYB genes that activate fruit formation without fertilization for high yield and improved quality of strawberries

In 2-3 sentences, briefly describe the issue or problem that your project addresses.

The project addresses two problems facing strawberry. First, lack of proper pollinators or poor pollen fertility, both due to the warming climate, adversely impact fertilization, which will cause poor fruit quality and low yield. We sought to solve this problem by identifying key genes whose activation will induce fruit formation bypassing the requirement of fertilization. Second, the buds in the axil of leaves in strawberry often alternate between developing into runners (daughter plants on a stem) and developing into branch crowns (flower forming shoots). While runners are important for strawberry propagation, branch crowns are important for yielding fruits. Therefore, identification of genes controlling this binary switch is highly desirable.

Briefly describe in non-technical terms how your major activities helped you achieve, or make significant progress toward, the goals and objectives described in your non-technical summary.

We have made important progress toward the first goal. By mining the RNA-seq data from prior studies, we identified two MYB transcription factors (MYB119 and MYB89), whose expression is induced by fertilization. We used genome editing to knockout these two genes at the same time. The double loss-of-function mutants of both genes failed to develop any fruit. Further analysis suggested that these two MYB genes activate fruit initiation by promoting plant hormone auxin synthesis. Since auxin is known to induce fruit initiation, we hypothesize that over-expression of MYB89 and MYB119, we may be able to induce auxin

synthesis and lead to fruit formation in the absence of fertilization. We generated MYB119 over-expression lines and found that MYB119-OE appears to produce parthenocarpic (fertilization-independent) fruit. We are currently characterizing further these transgenic lines further to confirm this important result.

We have not been able to make progress towards the second goal in that we have not done mutagenesis screen of U230 because U230 has a very low germination rate. However, we have made progress in investigating how environmental signals (high temperature and light quantity-specifically Far-Red light) on the lateral bud development, laying the foundation for future dissection of the molecular mechanisms that control the binary switch in the axillary buds of strawberry. In addition, we used mapping-by-sequencing to isolate a gene whose mutants exhibit a weak runner phenotype. While we were unsuccessful in identifying the causal mutation, we have narrowed down the causal gene to a small region of the chromosome.

Briefly describe how your target audience benefited from your project's activities.

While our work is basic research. The longterm goal is to benefit US strawberry growers and nurseries, which include the creation of strawberry varieties that are heat-resistant in producing high yield fruits and varieties that can be easily switched from runner-forming to fruit forming.

Briefly describe how the broader public benefited from your project's activities.

Our project provided training to students who will be the future leaders in horticultural and agricultural fields. The research results will be used to develop new strawberry varieties in the future in the hope to provide consumers with more superior varieties with higher yields and improved qualities.

Describe and explain any major changes or problems encountered in approach. Additionally, note opportunities for training and professional development provided, how results have been disseminated to communities of interest, and any new details regarding what the project or program plans to do during the next reporting period to accomplish the goals.

The COVID-19 pandemic has severely limited our ability to conduct research. In addition, we were unable to attend conferences that normally help to disseminate our research findings and provide professional trainings to our students and postdocs.

One PhD student and one postdoc participated in the research and were trained in transgenic strawberry generation, RNA-seq and DNA-seq data analysis, presentations, etc.

[Mitochondrial Origins of Metabolic Diseases](#)

Project Director

Nishanth Sunny

Organization

University of Maryland College Park

Accession Number

1017758



Remodeling of liver metabolism during embryonic-to-neonatal transition in chickens

In 2-3 sentences, briefly describe the issue or problem that your project addresses.

Inefficient embryonic-to-post-hatch transition in chicken is a significant source of mortality and economic loss to the poultry industry. Further, the liver mitochondria is a major integrator of energy metabolism during embryonic-to-post-hatch transition, and the understanding the mechanisms of mitochondrial function, will help us optimize healthy embryonic-to-post-hatch switch. This project investigates the mechanisms responsible for maintaining an optimal relationship between mitochondrial lipid-oxidation and new lipid synthesis in the liver. Our overarching goal is to provide novel insights towards 1) developing strategies to manage metabolic defects in fatty liver syndromes and 2) formulating nutritional strategies to optimize embryonic-to-post-hatch transition.

Briefly describe in non-technical terms how your major activities helped you achieve, or make significant progress toward, the goals and objectives described in your non-technical summary.

Towards the above objectives and towards understanding the adaptation and regulation of liver metabolism of embryonic and neonatal chicken, we conducted and published the findings from the following study in the past year.

Study title. Remodeling of liver metabolism during the embryonic-to-neonatal transition in chickens. Our objective was to characterize the metabolic phenotype of the embryonic and neonatal liver and explore whether these metabolic signatures are preserved in primary cultured hepatocytes. Plasma and liver metabolites were profiled using mass spectrometry based metabolomics on embryonic day 18 (ed18) and neonatal day 3 (nd3). Hepatocytes (liver cells) from ed18 and nd3 were isolated and cultured, and treated with insulin, glucagon, growth hormone and corticosterone to define hormonal responsiveness and determine their impacts on liver metabolism. Metabolic profiling illustrated the clear transition from the embryonic liver relying on lipid as a source of energy to the neonatal liver upregulating new lipid synthesis. This metabolic phenotype was conserved in the isolated hepatocytes from the embryos and the neonates. In summary, primary hepatocytes from the embryonic and neonatal chicken could be a valuable tool to investigate mitochondrial metabolism and new lipid synthesis in the liver.

Briefly describe how your target audience benefited from your project's activities.

The main avenue for the dissemination of our results to the scientific community and the poultry industry is through the publication of our scientific results in reputed journals. In this regard, our findings were published in the journal *Frontiers in Physiology*, section *Avian Physiology*. The title of our publication is “Remodeling of Hepatocyte Mitochondrial Metabolism and De Novo Lipogenesis during the Embryonic-to-Neonatal Transition in Chickens”, by Chaitra Surugihalli, Linda S Farley, Ronique C Beckford, Boonyarit Kamkrathok, Hsiao-Ching Liu, Vaishna Muralidaran, Kruti Patel, Tom E Porter, Nishanth E Sunny. These students and investigators involved with this project are currently involved in the dissemination of these results to a wider audience through presentations and seminars at multiple venues including the department seminars, local and national meetings and other conferences.

Briefly describe how the broader public benefited from your project's activities.

As described above, through student presentations and presentations at larger national scientific meetings, we are disseminating the results to a wider audience. We are hoping that our results can reach other investigators who can then build on and utilize them for future scientific discoveries. Further, aspects of our research, or their broad conclusions can be picked up by field extension agents or the poultry industry. They could be the harbingers for incorporation of our results in to protocols or procedures, which could benefit dietary formulation/nutrition or other management strategies implemented at the production level.

Describe and explain any major changes or problems encountered in approach. Additionally, note opportunities for training and professional development provided, how results have been disseminated to communities of interest, and any new details regarding what the project or program plans to do during the next reporting period to accomplish the goals.

We do not expect any major changes to our current strategy or approach. During this reporting period, one graduate student, a faculty specialist (research assistant) and two undergraduate students worked on the projects described above. Data from these experiments formed part of the dissertation for a doctoral student, who graduated in 2021 December. We are also currently in the process of recruiting a postdoctoral fellow to work on the objectives in this project. The fellow is expected to start in July 2022 and will be trained in profiling metabolism of the liver. Further, as mentioned above, manuscript detailing our findings was published in the journal *Frontiers in Physiology*, section *Avian Physiology*, for the dissemination of our results to the scientific community and the poultry industry. We are also investing resources to train the next generation of animal scientists at the undergraduate, graduate and post-doctoral levels, and the objectives of this proposal provide an excellent platform of their training in metabolism research.

Critical Issue

Human Health, Nutrition, & Wellness (CP)

[Applying transgenic insect pathogens](#)

Project Director

Raymond St Leger

Organization

University of Maryland College Park

Accession Number

1025551



Testing genetically engineered mosquito pathogen *Metarhizium* against insecticide resistant mosquitoes

In 2-3 sentences, briefly describe the issue or problem that your project addresses.

Around 46% of the World's population lives in risk of contracting a mosquito-borne disease. The increasing spread of insecticide resistance necessitates development of novel mosquito control strategies. We have designed engineered mosquito pathogens (*Metarhizium*) that can rapidly kill insecticide resistant mosquitoes.

Briefly describe in non-technical terms how your major activities helped you achieve, or make significant progress toward, the goals and objectives described in your non-technical summary.

We are testing whether selection for improved virulence of *Metarhizium* to a mosquito can be obtained by repeated passages through the host. This approach is designed to supplement the genetic engineering we have been performing. We are also testing whether we can force host range changes in these specialized fungi by passaging them through hosts they are not adapted to. This provides an opportunity to determine if *Metarhizium* adapts to a poor host within a few generations, which would indicate weak intrinsic limits to adaptation to new hosts on a microevolutionary timescale. This would suggest a risk to release of these fungi as they could evolve new host ranges. In which case we will test the genetic containment strategies that we have designed.

Briefly describe how your target audience benefited from your project's activities.

The principal beneficiaries have been in West Africa where we conduct most of our work. We are learning the risks of using a transgenic approach to alleviate the suffering caused by malaria. Dr. Etienne Bilgo, who did his PhD partly in my lab has leveraged some of our results to acquire additional funding. Hatch funding was acknowledged in St. Leger RJ (2021) From the Lab to the Last Mile: Deploying Transgenic Approaches Against Mosquitoes. *Front. Trop. Dis* 2:804066. doi: 10.3389/fitd.2021.804066

Briefly describe how the broader public benefited from your project's activities.

The ultimate aim of our work is to save lives by reducing the burden of malaria.

Financial Wellness

Project Director

Debasmita Patra

Organization

University of Maryland College Park

Accession Number

7002029



Financial Wellness

In 2-3 sentences, briefly describe the issue or problem that your project addresses.

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 (Allegany 5.2%, 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 Washington 19.9%) 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.

Briefly describe in non-technical terms how your major activities helped you achieve, or make significant progress toward, the goals and objectives described in your non-technical summary.

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 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, most programs were provided in a virtual format.

Briefly describe how your target audience benefited from your project's activities.

In 2021, the educator facilitated or co-facilitated 79 programs to 1,374 participants to increase basic financial literacy across all ages. Based on responses from 737 teacher effectiveness surveys, 93.5% indicated the presenter was well-prepared and 90.2% reported learning a lot from the workshop. Participants indicated effectiveness as a teacher at 93.3%.

Personal Finance Seminar

There were 122 attendees representing twenty-eight states in the 2021 PFS conference.

Participants reported a potential reach of 186,580 individual in PFS training in 2021.

PFS participants were asked to complete a pre- and post-survey and the results found that 98% plan to apply knowledge and/or skills gained and 98% have a greater ability to counsel and educate others.

YMYG

This educator hosted one YMYG training in 2021 and supported one additional workshop throughout the state. There were a total of 43 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 95% 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 100% 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 were 14 programs offered reaching 253 students. The Choices with a Financial Impact program was offered 4 times in the fall semester. Responses (52 pre/post surveys) indicate an 8.72% increase in confidence to make choices to increase income, 6.87% increase in confidence to make choices that will reduce my debt, and a 10.16% increase to set financial goals.

Understanding Credit Program

The understanding credit program was taught 4 times throughout 2021 by this educator. The pre/post survey indicates an increase in confidence to use/manage credit responsibly (6.9%). Of those that responded to the question I intend to request and review my credit report, 100% indicated an intent.

HILI

In 2021 this educator taught or co-taught, 7 Smart Choice Basics programs reaching 149 individuals, 3 Smart Use Smart Actions programs reaching 6 individuals, 2 Smart Use Understanding and Estimating Health Care Costs reaching 16 individuals, 3 Smart Choice Smart Use Healthcare in Your Senior Years programs reaching 34 individuals, 1 Smart Use Essential Health Benefits reaching 8 individuals, 1 Smart Choice Health Insurance Options for Farmers and Small Businesses reaching 9 individuals, and 6 Smart Use Managing Health Insurance and Resolving Conflicts reached 27 individuals. Evaluation data includes workshops provided by all educators.

Briefly describe how the broader public benefited from your project's activities.

In 2021 this educator was involved in 16 programs that involved identifying farm stress, building resilience, or succession planning reaching 331 individuals.

Describe and explain any major changes or problems encountered in approach. Additionally, note opportunities for training and professional development provided, how results have been disseminated to communities of interest, and any new details regarding what the project or program plans to do during the next reporting period to accomplish the goals.

Limited data was collected on the programs and not available at the time of this report.

DASH Plus 2021

Project Director

Debasmita Patra

Organization

University of Maryland College Park

Accession Number

7002027



DASH Plus 2021

In 2-3 sentences, briefly describe the issue or problem that your project addresses.

Older adults are the fastest growing segment of the population; by 2040, about 22% of the US population will be aged 65 or older (Nwankwo et.al, 2013). With the aging of the population, the health status of older adults has drawn a great deal of attention from health professionals, since their health status can result in a significant impact on the U.S. health care systems and social services including tremendous health care costs (Jenson J). Among major chronic diseases, elevated blood pressure (BP) represents a primary risk factor not only for cardiovascular complications but also for cognitive decline and loss of autonomy later in life (Benetos et al., 2019). Two-thirds of older adults have hypertension (HTN) and this group has the lowest BP control rate (Hyman & Pavlik, 2001). If not managed properly, deteriorating health conditions of older adults will consume enormous resources over the next decade. To tackle this prevalent and persistent disease, an integrated approach at the system level through collaborative partnerships will be effective and essential.

Briefly describe in non-technical terms how your major activities helped you achieve, or make significant progress toward, the goals and objectives described in your non-technical summary.

Educators facilitated eight weekly sessions beginning in July and concluding in October of 2021 (depending on each educator's schedule). Each session lasted around 60 to 75 minutes. The team created three geographical regions (Group1: Western, Northern and Central cluster, Group 2: Central and Capital cluster, Group 3: Southern and Eastern cluster). FCS educators in each group paired up to co-teach 8 weekly sessions. So, a total of 24 weekly sessions were offered by 9 FCS educators. To assess the effect of the DASH Plus curriculum, pre and post surveys corresponding to each DASH-Plus module were used. Participants were expected to complete pre-surveys at the time of registration and complete post-surveys at the end of the module. Key constructs assessed in pre, post surveys include perceived benefits, self-efficacy, and readiness to change behaviors.

Briefly describe how your target audience benefited from your project's activities.

352 older adults registered the sessions, and 74 actually attended at least one session. On average, about 28 participants attended each session and about 15 completed both pre and post-surveys after each session.

Introduction to DASH-Plus and Hypertension

Hypertension knowledge score was significantly increased at post-survey ($p=0.021$). Other constructs such as perceived benefits and self-efficacy for managing hypertension were not statistically significant, but the scores tended to increase at post-survey.

Sodium

Perceived benefits of reducing sodium score was significantly increased at post-survey ($p=0.004$). Change in self-efficacy for controlling sodium intake was not significant at post-survey, but the score tended to increase after the session.

Grains

Perceived benefits ($p = 0.001$), and self-efficacy for eating whole grains ($p=0.012$) were statistically significantly increased at post-surveys. Also, readiness to change behavior was statistically significant ($p=0.011$) Fruit and Vegetable

Self-efficacy for increasing FV ($p=0.024$) score showed a significant increase at post-survey. Also, readiness to eat more FV ($p=0.046$) was significantly changed at post-survey.

Shopping

Knowledge regarding food date labels showed significant change at post- survey ($p=0.05$).

Meats and Protein

Perceived benefits of selecting lean meat ($p=0.034$) and self-efficacy for consuming healthy meat and protein ($p=0.035$) showed a statistically significant increase at post-survey.

Fats & Sweets

Self-efficacy for selecting healthy fats and sweets statistically significantly increased at post survey ($p=0.034$). For Group 3 cohort (Sept-Oct), 3 educators shared co-teaching responsibilities, reaching 69 participants. A qualitative survey comment indicates a participant's satisfaction with the Group 3 cohort online series: Great information and very helpful.

Briefly describe how the broader public benefited from your project's activities.

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Closing Out (end date 09/07/2023)

Mucosal delivery of universal influenza vaccine antigens

Project Director

Xiaoping Zhu

Organization

University of Maryland College Park

Accession Number

1019540



Nothing Significant to Report

Describe and explain any major changes or problems encountered in approach. Additionally, note opportunities for training and professional development provided, how results have been disseminated to communities of interest, and any new details regarding what the project or program plans to do during the next reporting period to accomplish the goals.

Results are preliminary and are too early to report during this reporting period.

Critical Issue

Safe, Secure, Abundant Food Supply (CP)

Maryland Crabmeat Quality Program

Project Director

Debasmita Patra

Organization

University of Maryland College Park

Accession Number

7002025



Maryland Crabmeat Quality Program

In 2-3 sentences, briefly describe the issue or problem that your project addresses.

Crab is the largest species by value in the United States with a total landing value of \$650 million in 2019 (NOAA, 2020). Blue crab (*Callinectes sapidus*) is a species of crab native to the waters of the western Atlantic Ocean and the Gulf of Mexico. The blue crab industry has been of significant culinary and economic importance in Maryland for decades. Maryland lands 28 million pounds of blue crab annually and account for nearly one fifth of the total blue crab landing volume and value in 2019 (NOAA, 2020). However, the Maryland crab industry is composed of numerous, small, independently operated companies. The majority of Maryland seafood processors are poorly positioned to adapt to globalization, changing markets and seafood supplies. Over the past ten years, the number of crab and oyster processing plants operating in MD has declined by approximately 45%.

Briefly describe in non-technical terms how your major activities helped you achieve, or make significant progress toward, the goals and objectives described in your non-technical summary.

The Maryland Crabmeat Quality Program has been developed to provide onsite education, technical support and outreach service to the MD seafood industry and help the industry remain current and competitive.

Briefly describe how your target audience benefited from your project's activities.

Through this program, the educator conducted plant inspection and sanitation monitoring, offered on-site service and training, generated industry reports, and provided technical supports to the industry. Almost two thirds of MD crabmeat processors belong to the program. Routine microbiological inspections conducted through MCQAP ensure compliance with FDA and state regulations. Reports of the inspection and lab test results are mailed to each participating processing plant, and include recommendations if findings warrant changes in sanitation procedures.

- Two third of MD crab processors joined this unique voluntary food quality management program.
- The crab industry are primarily located in MD Eastern Shore including Cambridge, Church Creek, Crisfield, Fishing Creek, Hoopersville, Madison, St. Michaels, and Woolford, respectively.
- The educator periodically visited all participating crabmeat processors located in Cambridge, Church Creek, Crisfield, Fishing Creek, Hoopersville, Madison, St. Michaels, and Woolford, provided technical support and recommendation related to seafood regulation, seafood quality and safety.
- Our educator oversaw the CBSIA contractor for biweekly plant visits and crabmeat sampling.
- A total of over 138 crabmeat samples were collected and tested that involved 552 test procedures.
- The educator prepared over 141 industry reports and mailed to participating processors detailing the microbiological status of their operations, implications, and recommendations.
- The program assisted the MD seafood industry to comply with federal and state food safety regulations and helped them remain current and competitive.
- This program helped all participating crabmeat processors eliminate the dangerous human pathogens E. coli from their crabmeat and processing environments by 100% (0% positive for E. coli in crabmeat, food and non-food contact surfaces). State regulation does not allow detectable levels of E. coli, that is a Most Probable Number (MPN) of 0.36 per gram of fresh crab meat.
- In addition, the program helped processors to control Listeria monocytogenes in both crabmeat. Federal and state health regulators do not accept this pathogenic bacterium at any level in ready-to-eat seafood, including crabmeat. The effective federal and state standards of zero tolerance for specific pathogens are extremely difficult to monitor and manage without the specialist's assistance. Any violative samples could result in seized product and other regulatory action which can prevent companies from operating and lead to additional costly restrictions on the entire industry.

Briefly describe how the broader public benefited from your project's activities.

The educator have provided extensive on-site education, technical support and outreach service to MD crabmeat processors so that the industry is able to comply with FDA and state food safety regulations, remain current and competitive in a changing world.



In 2-3 sentences, briefly describe the issue or problem that your project addresses.

Foodborne illness can sporadically strike an individual or occur as an outbreak. About 17% of Americans will domestically experience an episode of foodborne illness each year (Food Safety, 2019). Those more vulnerable are young children (5 years and younger), pregnant women, older adults (65 years and older), and immunocompromised people (e.g., diabetes, cancer, HIV/AIDS, organ transplant) (Byrd-Bredbenner, Berning, Martin-Biggers, & Quick, 2013). Unsafe food handling behaviors can manifest in a) poor equipment cleaning/personal hygiene; b) not cooking foods to a safe minimal temperature; c) not chilling foods when the situation is appropriate; and d) favorable cross-contamination conditions. It is important that Marylanders practice safe food handling behaviors to protect themselves and others from preventable infectious diseases. All programs besides Kitchen Kaizen were adapted to be delivered online to a virtual audience.

The percentage of overweight and obesity among adult Marylanders is 34.9% and 31.3% respectively (State of Obesity, 2019). Youth in grades 9-12 represent 15.2% and 12.6% of the overweight and obese Maryland population (CDC, 2019). In particular, the obese percentage of adults are between 30-33% in Baltimore County, Harford County, Carroll County, and Baltimore City (Northern cluster) (County Health Rankings & Roadmaps: Maryland, 2019). It is important that Marylanders work towards the health objectives set by Healthy People 2020, such as adults reaching a healthy weight, reducing the proportion of adults who are obese, and preventing inappropriate weight gain in youth and adults (Nutrition and Weight Status, 2019). Maryland did show that children enrolled in Women, Infants, & Children between the ages of 2-4 years had declining obesity rates between 2010-2014 (Obesity Among WIC Participants Ages 2-4, 2000-2014, 2018).

Briefly describe in non-technical terms how your major activities helped you achieve, or make significant progress toward, the goals and objectives described in your non-technical summary.

Grow it, Eat it, Preserve it!

- 1 Virtual workshops on drying with B. Jackey

- 5 canning lectures at Baltimore City Enoch Pratt Libraries 58 participants 8.5 hours of direct participant contact

- \$0 net revenue, online and in-person workshops and lectures were free 4 emails related to food preservation

- 4 pressure canner dial gauge checks 96 minutes in canning phone calls

Kitchen Kaizen

- 13 answered questions via eXtension's Ask-an-Expert

- food safety special audiences presentations (GMOs and food recalls for the library of the blind)

- food safety webinars 25 participants 5.1 hours of direct contact 820 Tweets made @FoodSmartUME

- o total blog posts (eXtension, FCS the Breathing room and SNAP-Ed) 3 Emails related to food safety

Produce Safety Rule

- o 1 virtual workshops for growers 23 participants
- o 45 minutes of direct participant contact, equating to 2 days of contact with participants
- o 1 invited talk to youth on garden food safety 1 hour of direct contact 20 youth participants at Lakeland ES/MS, Baltimore City

Preventive Controls for Human Food

- o 1 virtual workshops for industry 7 participants
- o 4 hours of direct participant contact, equating to 4 days of contact with industry
- o 1 consultation

Fresh Conversations

- o 10 workshops
- o 75 participants 10 hours of direct participant contact
- o Co-lead a train-the-trainer with M. Habibi for 5 trainees statewide

Lakeland Cooking club

- o AGNR seed grant
- o 9 sessions, 13.5hrs of in-class instruction and 52 youth (includes the same individuals)

Briefly describe how your target audience benefited from your project's activities.

All (100%) participants were certified as completing the program to ensure safe manufacturing/processing, packing and holding of food products for human consumption in the United States. Participants who attend the workshop should be able to help their employer/owner comply with federal food safety regulations. All Trainees successfully completed their training Data on the 2021-2022 Fresh Conversation is still being collected.

Briefly describe how the broader public benefited from your project's activities.

All (100%) participants were certified as completing the program to ensure safe manufacturing/processing, packing and holding of food products for human consumption in the United States. Participants who attend the workshop should be able to help their employer/owner comply with federal food safety regulations. All Trainees successfully completed their training Data on the 2021-2022 Fresh Conversation is still being collected.

DIVA Vaccine Development Against Porcine Reproductive and Respiratory Syndrome Virus

Project Director

Yanjin Zhang

Organization

University of Maryland College Park

Accession Number

1020924



DIVA vaccine development against PRRS

In 2-3 sentences, briefly describe the issue or problem that your project addresses.

Porcine Reproductive and Respiratory Syndrome (PRRS) causes devastating losses to swine industry. The causative agent is PRRS virus (PRRSV). Current vaccines provide limited protection and an improved vaccine is needed. This project intends to develop an improved vaccine that can differentiate infected from vaccinated animals (DIVA).

Briefly describe in non-technical terms how your major activities helped you achieve, or make significant progress toward, the goals and objectives described in your non-technical summary.

Innate immunity is the first line of defense against viral infection and plays a crucial role in activating adaptive immunity. PRRSV inhibits innate immunity, especially type I interferons and their downstream signaling. We have discovered an atypical PRRSV strain that induces type I interferons in infected cells. We have also defined the mechanism of PRRSV-mediated inhibition of interferon-activated signaling. Infectious clone of a high-passage of the atypical strain has been constructed. Further work of this project is to generate mutant clones with a weakened effect on interferon-activated signaling while maintaining the capacity of interferon induction with reverse genetics technology.

Briefly describe how your target audience benefited from your project's activities.

Swine producers, veterinarians, research scientists, and biotech industries working on animal vaccines will benefit from the discoveries of this research.

Briefly describe how the broader public benefited from your project's activities.

This project intends to develop a better vaccine to benefit the swine industry, which supply pork to the broader public. Controlling PRRS will help reduce cost of pork and provide food safety to the public.

Describe and explain any major changes or problems encountered in approach. Additionally, note opportunities for training and professional development provided, how results have been disseminated to communities of interest, and any new details regarding what the project or program plans to do during the next reporting period to accomplish the goals.

No major changes to the approach. A graduate student is working on this project. Results will be presented in scientific conferences and published in peer-review journals when completed.

Improving Quality and Reducing Losses in Specialty Fruit Crops through Storage Technologies

Project Director

★ Apple Index based on weekly fruit assessments helps farmers develop handling and storage methods and identify optimal harvest times for multiple varieties and markets

In 2-3 sentences, briefly describe the issue or problem that your project addresses.

The interactions between new apple cultivars, planting systems and warmer summer and fall weather have led to problems managing fruit maturity, planning for harvest, and maintaining fruit quality in stored apples.

Briefly describe in non-technical terms how your major activities helped you achieve, or make significant progress toward, the goals and objectives described in your non-technical summary.

Conducting weekly harvests of different commercially important apple cultivars throughout the later stages of development (ripening) has allowed us to evaluate maturity indices, in the laboratory, at different ripening stages of these different cultivars. These have been crucial in order to provide timely and weekly information to fruit growers and guide them in terms of ripening dates and potential optimum harvest dates, depending on their market objectives, preharvest practices/ environmental conditions and cultivar. We have also stored some of these fruits, harvested at different stages of development, and have been able to show how the incidence of physiological disorders in postharvest storage can increase or decrease according to the maturity at harvest. Many of these activities have started to be replicated by growers, as they have also started evaluating some of these maturity indices in their own fields and comparing their results with the guidelines that we are providing. All these activities have therefore helped in adapting or developing harvest, handling and storage technologies to improve fruit quality, increase consumption and most importantly reduce fruit losses and waste.

Briefly describe how your target audience benefited from your project's activities.

The target audience benefited from the project activities as they have increased their understanding on apple fruit harvest maturity indices throughout ripening, as well as on instruments used to assess fruit optimum harvest maturity. They have received weekly reports during the apple ripening season (July to November) indicating the assessments of different maturity indices in different apple cultivars harvested in Maryland, which has provided a guidance tool for them to know when is the optimum harvest time based on their target markets and preharvest management practices. The growers have learned and adopted these recommended postharvest handling practices and thus have been able to reduce losses and increase production efficiency by decreasing the incidence of physiological disorders as well as fruit abscission in the field. All the above have incremented their marketable yields and sustainability of the operations.

Briefly describe how the broader public benefited from your project's activities.

The broader public benefit from the project's activities as they were able to acquire information, through our extension publications, about how is apple fruit quality defined and the factors that affect it. As harvest practices have been improved and apples are being harvested at the optimum maturity, the broader public has been enjoying delicious apples and not having to be disappointed by apples that look great but have no flavor. Thus, this has promoted their apple consumption, increasing the profitability of the industry but also bringing health benefits to the broader public due to high nutritional value of apple fruits.