Virginia (Virginia Polytechnic Institute and State University, Virginia State University Combined) Annual Report - FY2021

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Contributing Organizations

Virginia Polytechnic Institute and State University
Virginia State University

Executive Summary

Overview

Virginia Cooperative Extension (VCE), a partnership between Virginia Polytechnic Institute and State University (VT) and Virginia State University (VSU), and the Virginia Agricultural Experiment Station (VAES) and the Virginia State University Agricultural Research Station (VSUARS), enables people to improve their lives through research and education using scientific knowledge focused on the issues and needs of all Virginians. Audiences are involved in designing, implementing, and evaluating needs-driven programs. VCE is a dynamic organization that stimulates positive personal and societal change leading to more productive lives, families, farms, and forests, as well as a better environment in urban and rural communities. The overall educational goal is to bring about change in people's knowledge, understanding, abilities, or behavior related to an issue and/or broader changes in economic, environmental, or social conditions. Progress towards these goals is recorded by programs at the individual and team levels. The primary, overall research goal for Virginia is to develop relevant basic and applied research data to help solve the problems, anticipate transformational needs, and seek opportunities for the agricultural and food system, and its supporting constituencies, and to support the economic, environmental and social health of the Commonwealth of Virginia. Through the combined efforts of VCE, VAES, and VSUARS, we aspire to create and deliver dynamic, responsive, and progressive research and cooperative extension programs throughout Virginia.

VAES, VSUARS, and VCE PROGRAMMATIC GOALS:

VCE's goals are to: 1) develop and transfer new knowledge in applied and basic life sciences, 2) perform relevant, objective, and timely research, 3) improve the quality of life for communities and citizens in the Commonwealth, 4) use a systems approach to programming, with task-oriented work teams that respond to the needs of individuals, groups, and organizations, 5) work with at-risk, underserved, and underrepresented audiences who need specialized attention, 6) fully integrate a culturally diverse paid and volunteer staff in planning, implementing, and evaluating programs, and 7) recruit and collaborate with public and private partners to better utilize resources, heighten impact, and reach a more diverse audience.

In particular, VSU's Extension program goals are to: 1) improve local and state economies by helping small and limited resource farmers and citizens garner resources to own, operate, and sustain small businesses, 2) educate and empower socially disadvantaged farmers to produce, distribute, and market organic, locally grown, and ethnic foods to feed Virginia's citizens, 3) ensure safe food supplies by teaching small-scale growers and farm families effective food safety practices, 4) address health issues and nutrition practices that confront limited-resource urban and rural citizens, 5) help youth, families, and seniors manage money to survive during challenging economic times, and 6) enable parents and families to leave their children in high quality and safe child-care environments.

VAES is committed to developing and implementing research that addresses society's needs and expectations. The College creates, integrates, and shares knowledge to enhance: (1) life sciences, food, and agricultural systems; (2) the economic prosperity and life quality of the greater community; (3) the stewardship and health of land, water, and air for future generations; and (4) workforce development through academic and constituency education including hands-on experiential opportunities. In pursuit of research excellence and translational value, research focuses on: improving human and animal health and nutrition; enhancing climate resiliency, quality of the environment, and energy solutions; reducing the effects of major infectious diseases and invasive species; developing value-added food processing, products and reducing agricultural and food waste; building viable communities supported with social, economic, health and wellness and reduced disease risk; and developing resilience and productivity through innovations through advances in digital agriculture and security strategies. Research programs are conducted on the main campus as well as at the 11 Agricultural Research and

Extension Centers (ARECs) located across the Commonwealth. The research focus of VSU's Agricultural Research Station includes the following: developing production systems that conserve natural resources; crop diversity and alternative crops; economically competitive and sustainable small-scale agricultural systems; bio-based energy production; improving food safety and quality; and value-added plant and animal products.

PLANNING:

VAES, VSUARS, and VCE address a broad range of problems and issues facing citizens of Virginia through focused research and educational programming. The foundation for Research and Extension programs are built on the identification and prioritization of strategic issues through situation analyses, which are accomplished through the examination of trends and emerging issues identified by local advisory groups in Unit offices (Extension Leadership Councils), AREC Advisory groups, and individual Extension specialists. In 2018 every Unit office completed a local situation analysis. Unit profiles were created based on data gathered from a variety of sources such as US and Agriculture census data. This data was supplemented with community input collected via issue forums, focus groups, key informant interviews, and community surveys. In Spring 2022, we held the Virginia Agricultural and Natural Resources Summit to gather perspective and information from constituencies throughout the state, including private individuals and small, moderate, and large agribusinesses, state agencies, commodity groups, and tangential supporting enterprises. Unit situation analyses will become the background and rationale for deciding which problems and issues will be addressed and reported on by VAES, VSUARS, and VCE.

State level VCE Program Teams that are aligned with Strategic Plan objectives are comprised of agents, specialists, and others. These teams meet on a regular basis to coordinate state level programming, including situation analysis, program planning, program development, evaluation, and reporting for the Strategic Plan objectives and evolving community needs. State Program Leaders guide and assist Program Teams, and also serve as liaisons between Program Teams and the Associate Directors. District Program Leadership Teams made up of experienced agents representing all program areas provide training and mentoring to new agents on development, delivery and evaluation of programs. These efforts are enhancing the capacity of Virginia Cooperative Extension to deliver quality programs and document the impacts of those programs. Researchers at Agricultural Research and Extension Centers and academic departments support research priorities and initiatives and share information with VCE agents and specialists to provide developing knowledge and translational evidence for informing, guiding, and supporting VCE programs.

REPORTING:

Beginning in 2016, all Virginia Tech College of Agriculture and Life Sciences and Virginia State University Extension and research faculty report through a new University-based activity reporting system. This system includes annual program reports focused on faculty goals, outputs, outcomes, and other data for each planned program for teaching, research, and Extension at an individual, unit, college, and organizational level. All research faculty are required to propose peer-reviewed Experiment Station projects submitted to USDA/NIFA, and entered into REEport; transition to reporting into the new National Reporting System (NRS) was initiated in 2022. Researchers prepare annual progress and termination reports reviewed by the VAES associate director before being submitted to REEport/NRS. Extension impacts are shared with partners and stakeholders through efforts at multiple levels. VCE annually produces professional quality Unit office level brochures detailing Extension impacts and return on investment information. This information is shared with local and state officials and stakeholders. Selected research and VCE impacts are shared publicly through the national Landgrant Impacts website.

Critical Issue: Agricultural Viability, Profitability, and Sustainability

The vigorous growth in demand for edamame in the U.S. over the past two decades has driven the increased domestic edamame production, but at least 70% of edamame consumed in the U.S. is still imported from southeast Asia countries. The significant barrier to increasing domestic edamame supply is suitable cultivars. Even if the U.S. produces the most grain soybean in the world annually, most American soybean varieties are not desirable for edamame production due to their limitations in physical, chemical, or nutritional properties. Compared to Asia customers, U.S. customers tend to favor brighter seeds with larger size and sweet flavor. Currently, U.S. growers used soybean varieties for edamame product, which is the number one drawback in edamame production because of diminished consumer preference for current domestic edamame varieties, plant structure and uniform pod maturity not quite suitable for mechanical harvest. Furthermore, edamame is a non-transgenic crop and thus lack of effective weed management plan due to the absence of herbicide-tolerant traits. Therefore, developing new edamame varieties with improved appearance and flavor to satisfy consumer expectations, desirable plant architecture and growth habits for efficient machine harvest, and rapid canopy closure to suppress weed competition (particularly in an organic production system) will effectively resolve the main issues that the U.S. edamame industry faces.

Response:

The breeding groups in VA, MO, AR, and MS coordinated closely to conduct breeding and phenotyping work on edamame breeding populations, lines, and Plant Introductions. We have communicated to develop entry lists, coordinate experimental design, and standardize data collection and sample shipment. Activities for the reporting period included crossing, yield testing, and pod/seed phenotyping. The entire group has been kept apprised of planting and field updates throughout the reporting period. The food scientists evaluated the varieties harvested from three breeding locations, conducted sensory evaluations of edamame from extension lines to understand the consumer perceptions on different edamame varieties, measured sugars (glucose, sucrose, and fructose) and alanine to quantify the sweetness of edamame samples, and provided recommendations, based on the sensory information, to breeders to assist with breeding decision. At Virginia tech, the phenomics team employed new phenotyping technique for phenotyping and conducted drone tests to collect aerial imagery for edamame fields to evaluate canopy closure. The new phenotyping methods are based on machine learning using the drone images as training data points. In the extension trail, we selected around 20 large-seeded soybean varieties for edamame yield in Arkansas. At two locations in Virginia, we assessed 23 large-seeded soybean varieties for edamame yield, growth characteristics, pest incidence, and pubescence on pods. We also provided edamame pod samples of these varieties from all locations to the Food Science and Phenomics labs at Virginia Tech for chemical analysis, taste evaluations and image process.

Results:

This project has a wide-range impact to diverse audience including stakeholders, scientists and consumer community. The breeding team led by Virginia Tech released one edamame cultivar 'VT Sweet' with superior agronomic performance, food quality and consumer acceptance. It is an ideal cultivar for growers who are interested in commercial edamame production in the mid-Atlantic region of the U.S. We have published six papers on peer-reviewed journals, and one numbered VCE extension publication. We also made 36 presentations at National, Regional and Local conferences and extension meetings. During Virginia Tech CALS Dean's Advisory Council Tour, Virginia tech edamame team was led by Dr. Duncan to present a showcase of our edamame project with five concentrations including breeding, entomology, SmartFarm technology, food processing and sensory quality and economics. In addition to disseminate our own research findings, I also worked with Dr. Jeremy Ross to establish a special issue for Frontiers in Plant Science Frontiers in Plant Science, Nutrition and Sustainable Food System entitled "Everything Edamame: Biology, Production, Nutrition, Sensory and Economics", and have published 6 articles.

More than ten students at undergraduate and graduate level were trained through this project. The Food science sensory analysis has provided students experience in setting up surveys and evaluating edamame sensory characteristics. A set of edamame breeding lines was planted at four states in 2020 to evaluate agronomic performance and pod characteristics for release purposes. Canopy closure and plant architecture studies have allowed students to learn about phenomics. Field research has led to learning opportunities for students and staff to improve phenotyping skills and learn breeding technologies. Presenting at conferences and extension meetings also gave students opportunities to interact with peers, growers, etc., and to build up their professional speech skills.

Critical Issue: Biotechnology, Biomaterials, and Bioenergy

The mission of the Virginia Cooperative Extension Sustainable Biomaterials program is to serve Virginia citizens and businesses that work with and use wood and other sustainable biomaterials. Extension and outreach faculty in the Department of Sustainable Biomaterials work with individuals and groups through education in the efficient manufacture and sustainable use of a variety of products in the business and management realm, in Lean manufacturing of many different products, and in sustainable enterprise, particularly associated with the region and the countries' sustainable biomaterials and forest resources. Specific areas of emphasis for Extension specialists include: wood drying, wood processing and manufacturing, wood identification, wood performance, wood flooring, manufacturing systems engineering, lean manufacturing, business benchmarking, competitive strategy, globalization, continuous improvement, organizational innovation, international marketing, supply chain management, and business process management. Additional focus areas include the efficient utilization of agricultural byproducts, renewable energy project analysis and resource assessment, integrating nutrient management technologies with renewable energy generation, and providing technical information on bioenergy conversion technologies including anaerobic digestion, biodiesel and thermal conversion processes.

Critical Issue: Community Viability

The Virginia Tech research and Extension programs reported over 185 impact statements associated with community viability and one Smith-Lever Extension Capacity Fund project is approved within the NIFA Reporting System. Virginia Cooperative Extension partners with governments and organizations to solve systemic challenges and find real solutions in a way that benefits all Virginians. The commonwealth counts on us for their immediate land, health, and community needs to fix problems as they arise. Extension thinks ahead about community needs at state and local levels while prioritizing challenges like social justice, land protection and restoration, malnutrition, and pandemic response efforts. By training county elected officials, educating entrepreneurs, facilitating collaborative projects, and enhancing community leadership skills, Extension empowers communities to address critical local needs. Extension

engages with diverse audiences and partners with volunteers to lead transformational change that promotes community and economic prosperity. Extension nurtures relationships through civil dialogue that promotes listening and connection of people from all walks of life to foster justice, equity, and respect for all. By teaching decision making, fostering connection, and promoting youth voice to influence community change, Extension prepares youth to be well-informed community leaders. Extension utilizes partnerships that help solve systematic issues across the commonwealth for all Virginians.

Virginia Cooperative Extension programs that serve Virginia families include: Certified County Supervisor Program, Coming together for Racial Understanding, community planning, emergency preparedness, Energy Masters, Innovative Leadership, Master Gardeners, Master Naturalists, recidivism, strategic and project planning, Strengthening Your Facilitation Skills, the Virginia Geospatial Extension Program, and volunteer development. Community viability programming promotes continuing prosperity and financial security for all Virginians through educational strategies that:

- Transform traditional and at-risk local economies through entrepreneurship, small business development, and community-based local and regional food systems and enterprises
- Empower traditional and at-risk communities through individual and community leadership development, facilitation, and conflict resolution skills
- Develop tools and resources to support best management practices that foster volunteerism
- Enhance representative civic engagement, including youth and adult involvement in community decision-making
- Minimize losses to agricultural operations, individuals, families, and communities resulting from natural disaster or other emergencies

Critical Issue: Food, Nutrition, and Health

Among adults in Virginia, just 12.2% and 9.6% met fruit and vegetable recommendations, respectively. 21.8% did not engage in physical activity outside their job.

Teen Cuisine reached 700 limited resource teens (6 hours): cooking/food preparation, nutrition, health, and fitness. Post-tests indicated 73% plan to drink recommended water daily, 76% plan to stay physically active, and 63% plan to prepare healthy foods/snacks. 81% learned knife safety, 81% washed hands before cooking, 73% cooked more often, 74% ate more fruits/vegetables, 67% were more physically active and 64% drank less soft drinks.

41 faculty were trained to teach GEM, a stress management program for youth 10> with 5 weekly lessons: Intentions/Goal Setting, Awareness/Attention, Self-care: Stress Reduction/ Relaxation, Communication/Relationships, and Gratitude/Acceptance. 100% understood mindfulness and relation to health/wellness. 90% can use mindfulness to reduce overall stress. 53% indicated they had implemented mindfulness strategies with program audiences and 95% personally implemented strategies.

153 adults participated in the FitEx program, logging over 56 million steps and consuming 29,000 cups of fruits/vegetables.88 people completed the LIFT Program in 27 counties in Arkansas, North Carolina and Virginia. 1 hour strength training sessions, 2x/week for eight weeks consisted of warm up, 8 strength exercises, and cool down. The pre and post program strength/endurance measurements showed improvement in lower/upper body strength, flexibility, agility, balance and aerobic endurance. Participants were significantly more connected with friends, family and community. Fruit/vegetable consumption significantly increased from 4.12 to 6.22 cups per day.

The monthly *Buzz, Body, & Bites* newsletter covered cancer prevention/screening, financial management, hypertension, stress management and healthy grilling. They were distributed to 110 Area Agencies on Aging, senior centers, and AARP's, 52 individual subscribers, and to 1800 individuals. Community leaders strongly agreed the newsletter helped them serve their clients and was beneficial to their mental and physical health. 87% felt it contains useful information. 63% indicated they gained ideas for meals, and helped to keep their mind active.

Nutrition programs for SNAP-Eligible youth: 12,125 youth completed the comprehensive programming. Grades 3-5 significantly increased fruit and vegetable (MT1) and milk consumption, decreased sugar-sweetened beverage (SSB) consumption, and increased their frequency of participation in physical activity (MT3) from pre to post-participation. Grades 6-12 significantly increased their fruit and vegetable (MT1), healthy snack, breakfast and low-fat or nonfat dairy consumption and reported drinking fewer SSBs, increased physical activity frequency (MT3), and improved hand washing before eating or preparing food (MT4).

Nutrition programs for SNAP-Eligible adults: 2,007 adults completed six lessons. 523 child caregivers who completed pre-post evaluation showed statistically significant improvements in food resource management behaviors and in consumption of fruit and vegetables (MT1); whole grain, dairy and lean protein consumption; decreases in SSB consumption; improvements in frequency of physical activity and

increased limiting of sedentary behaviors (MT3). Perceptions of accessibility and affordability of foods and places to be physically active increased.

FNP Talks were developed to deliver short lessons by phone/Zoom. Nutrition assistance programs and emergency food systems information was shared. Topics included: Older Adults – Staying Safe and Connected during the Winter Months;Cooking and Physical Activity Activities for When Kids at Home; Shopping with Limited Options and Using Shelf-Stable Foods; What You Need to Know about Online Shopping; How to Start a Container Garden at Home; and Food Storage and Safely Freezing Foods. 823 FNP talk lessons were delivered to 915 unique participants.

Volunteer-Led Nutrition Education: The number of trained volunteers was 1,249 and volunteer hours were 5,633. 5,244 youth were served (with 3,164 graduating).

Partnered with Food Bank of Southeastern Virginia and the Eastern Shore to pilot use of quick response (QR) codes as a client outreach strategy. 3 food pantry sites and two food hubs participated, each receiving 100 magnets to distribute to clients and A-Frame boards displaying the QR code information. The QR code directed clients to a website, Nourish, with nutrition education, physical activity resources, and community speci?c information. During the 3-month pilot, there were 251 visits with 150 being unique users (35% were from the QR code).

Safe, High Quality Food from Field to Table Program: 150 food entrepreneurs and food businesses were educated in food safety and food product development resulting in the production of 360 new value-added food products safely reaching the retail market to be sold.

The Produce Safety Rule (PSR) is the first to regulate the produce industry. Growers selling to larger or widely distributed buyer channels are required to obtain a GAP certification audit, as well as complying with FSMA's PSR. Producers must receive training authorized by the PSR. Access to food safety education leads to adoption and implementation of best practices that reduce microbial risks and strengthen a prevention-based food safety culture. Training is tailored to meet marketplace and regulatory requirements.

"Enhancing the Safety of Locally Grown Produce" workshops targeting farmer's market growers, were delivered reaching 460 producers and market managers. 968 people were trained in accessing markets, navigating on-farm and market food safety risks, and implementing worker health, hygiene, and handling practices to satisfy buyer policies.

54 agents conducted introductory and advanced level agent/grower training to increase agent capacity and the number of growers implementing on-farm and marketplace food safety principles, GAP, and/or safely operating produce packing facilities (total 922). Of those, 46 agents and 128 growers have been mentored in the GAP certification process, with 44 growers passing their third-party audits (a 100% success rate). Developed and revised USDA GAP/GHP, HGAP, and HGAP Plus manual templates and guides to support growers and agents.

49 programs were delivered to 989 growers, 27 agents, and 45 elected officials to raise awareness about the FSMA Produce Safety Rule (PSR). 27 agents/specialists, and 13 VDACS Produce Safety Program personnel attended a Produce Safety Alliance (PSA) train-the-trainer workshop allowing them to assist in PSA Grower Training courses; 2 specialists and 1 postdoc became lead trainers.

873 producers were trained in PSA. One PSA Train the Trainer course was held (28 new PSA trainers). VCE partnered with VDACS to assist Produce Safety staff in FSMA PSR education, training, and outreach. 17 specialists/agents were trained to assist VDACS during OFRR, with 70 OFRRs performed. This is a joint program between extension and state government from 2018-2021, with VCE taking full supervision in 2022.

Post-tests indicated increased knowledge in identifying on-farm risks, implementing GAPs, and documenting food safety procedures.Growers intended to provide more worker food safety training; test quality of irrigation water; improve worker hand washing/toilet facilities; improve cleaning/sanitizing methods; incorporate ways to control/monitor animals; use safe methods for storage/transport of product to marketplace; and document food safety practices. There was a 100% pass rate for growers.

A comprehensive produce food safety website (https://ps.spes.vt.edu), with guidance/resources for agents, growers, and consumers, was launched in late 2018. Since its launch, there have been 16,038 web-page views, providing vital resources for trainers and clients.

Critical Issue: Natural Resources, Environment, and Climate Change

Virginia Cooperative Extension programming supports the commonwealth's agriculture and forestry industries which are Virginia's number one private economic driver with an annual economic impact of more than $91 billion. Extension develops workplace readiness, delivers high-quality continuing education, and supports economic development through research-based information. A trusted resource, Extension offers educational programming and diagnostic services that strengthen agricultural profitability and sustainability.

Interdisciplinary teams of Extension faculty collaborate to address complex issues in agribusiness management and economics, agronomy and horticulture, animal production, emerging pests and pesticide management, environmental and agricultural literacy, and natural resources management. With specific regard to natural resources, Virginia Cooperative Extension programming serves a wide range of audiences. These audiences include residents, homeowners and landowners, agricultural producers, industry representatives, and natural resource professionals. VCE assists these groups in better understanding, valuing, sustainably using, conserving and managing natural resource capital for the benefit of human health, environmental health and the economy. VCE's efforts to sustain Virginia's natural resources and environment include the following objectives, among others: to support the management, use, and sustainability of Virginia's natural resource capital for the benefit of future generations; provide natural resource and environmental education; provide educational resources to address urban/rural interface issues; provide education to conserve and protect Virginia's surface and groundwater resources, including the Chesapeake Bay; to enhance natural resource and environmental literacy, and; to develop and deliver programs in green energy/bioenergy.

Active research and Extension activities are evident in the 257 annual impact statements and 14 capacity funded projects. The capacity funded projects include 6 Hatch, 7 Hatch MultiState projects, and 1 Smith-Lever Extension project. Science-based research and education strategies addresses critical issues of natural resource and environmental enhancement, protection and conservation.

Critical Issue: SmartFarm Technology and Security

With over 215 impact statements involving technology and five capacity funded projects (3 Hatch and 2 Hatch Multistate), Virginia Tech is contributing to the transformation of agriculture. Using transdisciplinary research and education strategies, we anticipate, develop, and advance the discovery and translation of technologies, including decisions through data analytics, artificial intelligence and machine learning, incorporating cyberbiosecurity, and address the biosecurity challenges of the food and agriculture system, such as:

- Characterizing efficiencies and economics of technology applications for crops and green industries and animal agriculture
- Identifying and characterizing risks and strategies for protection at the interface of digital, biological, and cyber physical systems in the food and agriculture system
- Integrating technology for providing security against plant, animal, and food pests, diseases, and other biological threats
- Developing workforce for meeting the future technology and security needs for the food and agriculture system

Feeding the world in the future requires innovations and technologies with greater efficiencies, automated management, enhanced decision support based on data analytics and artificial intelligence, and improved security for this advanced digital agriculture. Virginia Tech is contributing to the rapid progress in digital agriculture through the SmartFarm Innovation Network. This network of 12 agricultural testbed sites across Virginia, equipped with integrated technologies, data collection, talent, and capacity for working directly with stakeholders. We have elevated our capacity with the recent hiring of 20 new research, extension, and teaching faculty and infrastructure upgrades to increase wifi and wireless connectivity on these crop and animal agriculture farm testbeds. Fundamental and translational research has contributed to innovations with potential for reducing disease risk, anticipating invasive pests and providing control measures, reducing the effort needed for management, and identifying the value and importance for protecting the digital data and cyber-based systems to provide security of our food supply. Example 1: The impacts of reducing the incidence of costly diseases like dairy cow mastitis cannot be understated. Despite the importance of reducing disease prevalence, challenges like mastitis and acidosis are prevalent in today's dairy production systems. To address these prevalent animal health challenges, a team of Virginia Tech researchers studied the application of sensor networks to preemptively identify health challenges like mastitis and acidosis in cattle. This work leverages existing sensors at the Virginia Tech dairy but also tests how novel sensors can contribute to animal health monitoring. Their sensor networks were able to differentiate between different pathogens causing mastitis and can help detect mastitis in advance of clinical symptoms. The team continues to refine detection algorithms, which will be beneficial to producers, helping dairy producers to identify treatment options earlier, resulting in fewer days of lost milk and reduced veterinary and drug costs. Feeding algorithms designed to influence animal feed efficiency through maintaining rumen health improved the income over feed costs of dairy farms, without negatively influencing milk outcomes. Real-time sensor networks for livestock monitoring currently are limited by durability of sensors, battery life, and network accessibility. The developed algorithms can be deployed within commercial dairy systems to detect clinical mastitis in advance of normal symptoms. The team has developed and published open-source designs for animal sensor networks, which can be used by individuals across the industry to advance the accessibility and affordability of precision animal agriculture technologies. Algorithms developed by the team helped save the Virginia Tech dairy $0.45 to $0.70 per lactating cow per day in a short-term, preliminary evaluation. If applied over the 250 cows, which lactate for 305 d, these daily savings add to considerable values.

Critical Issue: Strengthening Virginia Families

Balancing Life Series: A virtual series was developed to provide "rapid responses" to the most pressing current challenges, including financial issues, remote working and schooling, child and older adult impacts, family dynamics, and stress management. In 2021, audience size averaged 100 with a reach of 2750 distinct participants from an array of agencies/organizations primarily in Virginia and North Carolina. A post-webinar survey with 476 responses revealed webinars were very useful and participants were likely to apply something they learned, either personally or professionally. Local governments, mental health providers, schools, colleges, human resources departments, non-governmental organizations, faith-based groups, correctional facilities, and non-profit groups attended, and regularly replayed/reposted recordings.

The webinar recordings were professionally captioned and added to the VCE YouTube page (playlist here) https://www.youtube.com/playlist?list=PLsPrMF2hUwAaTaUe1V8RYnxfoiGLs9lYg as well as on the VCE website: https://www.pubs.ext.vt.edu/tags.resource.html/pubs_ext_vt_edu:balancing-life

Given the response and demand, the team designed, piloted and implemented a 6-week series titled; Resilience: Applying the Lessons Learned. The 6-hour program built upon the resilience-focused sessions of the Balancing Life series and is co-led by VCE and the Virginia Department of Behavioral Health.

Preventing Opioid Abuse in Rural Virginia: Virginia families and communities are grappling with the impact of opioid and other substance misuse on newborns, children, adults, seniors, schools, health and social service systems, the workforce, and communities. VCE responded by engaging 26 communities with the evidence-based PROSPER delivery system. Agents, teachers, and community leaders were trained to use PROSPER, Botvin®LifeSkills and Strengthening Family 10-14. This program has a parental component that has been adopted by other communities to overcome the scheduling challenge experienced with the Strengthening Family program. The scope of the work related to opioids has expanded beyond prevention to support treatment, harm reduction, stigma reduction, and drug courts.

Results include improved youth life skills; enhanced parenting skills; increased family cohesion and well-being; reduced exposures to substance use; reduced gateway and illicit substance initiation; long-term reductions in substance use— e.g., 40% reduced likelihood of having been drunk by 10th grade; reduced youth behavior problems— e.g. 40% fewer aggressive and destructive behaviors by 10th grade; and long-term effects on school engagement and academic success (e.g., higher GPA).

Rural Opioid Technical Assistance project funded by the Substance Abuse and Mental Health Services Administration (SAMHSA): The project addresses misuse of opioids and stimulants and provides training and technical assistance using evidenced-based universal prevention curricula targeted youth in 3 - 9 grades and their families in 26 rural counties. 5 regional Extension project coordinators are facilitating implementation and supporting local community groups/coalitions that focus on substance use disorder. VCE serves as a cornerstone of the community to connect schools, coalitions and other community stakeholders. Training, technical assistance and direct programming for evidence-based programs including the Botvin LifeSkills®Training school and parent programs and Mental Health First Aid are part of the program. In addition to working with school systems, preschools and Head Start programs, parenting classes are offered for foster and incarcerated parents. Teens are being trained as life coaches for younger students. Regional project coordinators are fully engaged in coalitions, providing opportunities to connect groups with complementary missions/goals and to provide tailored technical assistance for community-driven initiatives. 38 localities have been served with 180 teacher volunteers trained reaching 7200 youth with the Botvin program. 34 parent program facilitators have been trained reaching an additional 82 students. The program has supported 32 local coalitions.

CDC funded High Obesity Prevention (HOP) Project in Petersburg, VA: This program fosters efficient, sustainable use of resources to provide evidence and practice-based community programs to reduce obesity. The project targets policy, systems and environmental changes to address three overarching strategies: healthy nutrition standards, improving the local food system for access to healthy foods, and access to safe places for physical activity. Technical and direct assistance for program activities and evaluation are provided by VCE Specialists and Family Nutrition Program staff along with students from Virginia Tech and Virginia State University.

In partnership with River Street Market (the only farmers' market in Petersburg), VCE designed a mobile market with a refrigerated truck and established a satellite market location at the Petersburg City Library. Both increased fresh produce access in high priority areas. SNAP sales increased dramatically in 2021. Walkability audits are in progress, and work with local corner stores and food pantries related to healthy food standards is ongoing. https://cphpr.publichealth.vt.edu/phops/team.html

EXCITE Vaccine Education Project (Virginia Tech and Virginia State): Target audiences for this project in 12 locations across Virginia include rural/Appalachian, agricultural workers with emphasis on migrant workers, Black and Latinx residents, and military personnel. Formative evaluation is underway: meetings with Extension staff in targeted locations, hiring local community members to conduct semi-

structured interviews, and development of tailored presentations for each target locality. A Subject Matter Expert team of university faculty in public health, health communication, professional and technical writing and virology and Extension agents in FCS, ANR, and 4-H provide guidance for project activities.

Youth Financial Management: Junior Achievement/The Allstate Foundation reported that 72% of teens look to their parents for money management information and 50% of youth have a goal of creating a savings plan while 43% are concerned that they do not have the skills to manage their money. VCE uses several approaches/programs to educate youth about sound money management skills, the financial planning process, and to help them begin to develop positive behaviors necessary to attain financial maturity and achieve a secure future. VCE offers Reality Store simulations, Kids Marketplace simulations, Real Money Real World simulations, and Reading Makes Cents. In 2021, VCE conducted 8 Kids Marketplace simulations engaging 150 youth (Covid-19 had a negative impact on reach). Of those surveyed, 90% learned more about using money, 92% learned that different jobs pay different amounts of money, 72% reported gaining new ideas on handling money, and 85% planned to talk with their parents about money; VCE conducted 37 Reality Store programs engaging 1962 youth. Of those surveyed, 92% stated the program increased awareness of making smart financial decisions, 97% reported that having insurance and a savings account would help plan for emergencies, and 78% reported there is a clear relationship between my performance in school, my participation in community activities, and my future occupation; VCE conducted 5 Real Money, Real World programs engaging 223 children. Of those surveyed, 85% indicated they will think through how spending impacts other opportunities and choices and 78% stated this program helped them decide to seek more training/education after high school.

Critical Issue: Youth Development

Teen Summit: Empowering Youth Voice. To ensure future commitment to diversity and inclusion, it is important to engage teens in a movement towards an inclusive, civil society for all. Teens express a lack of safe places to discuss issues that weigh heavy on their minds, such as racial and gender inequality, environmental justice, and the opioid and vaping epidemics. With issues facing the country around social justice related topics, youth are interested, empowered, and want to help solve these problems in their communities.

In response, Virginia 4-H developed a webinar series and both spring and winter Teen Summits to provide teens an avenue to discuss issues important to them and inspire them to take charge by empowering them with needed skills to turn ideas into action. Anchored in the InclusiveVT mission and its diversity strategic plan, these programs prepared participants for service (consistent with Ut Prosim) through an understanding of issues of identity, the human condition, and life chances. The program's purpose is to educate and make teens aware of what social justice is, teach them to advocate for issues they are passionate about, and allow them to consider effective ways to make a positive difference in their communities.

125 youth engaged in one of the Teen Summit events during 2021. Of these, 25 participated in the Spring Weekend Event, and 55 teens participated in the Winter event. The events were planned and created for teens by teens.15 teens and 5 adults planned the events: organized speakers, panelists, and workshops. All participants completed evaluations. Participants in the webinar series noted that as a result of their participation, they are extremely likely to take action on an issue that they are passionate about and they feel empowered to do so. Qualitative data received included: "This was the most enlightening series of zoom meetings that I have ever been to! I loved it so much. Thank you guys for putting this together!" "Keep up the great work! I cannot wait for the next event, and wish to see the same hyped energy that was presented within your previous events!"

At the Spring Summit, 95% felt like they learned something they could use in their community, 98% felt like they belonged, and 95% said that the speakers/panelists inspired them to make a difference in their community. One teen participant responded when asked how the weekend impacted you, "Learning from incredible teen leaders; observing in a space that truly felt open & honest....dialogue was held respectfully & with some very intense, real, and insightful conversation. I was humbled to listen to this generation and learn from the incredible ideas they were lifting up. We need to teach adults how critical these spaces are and that anytime a decision is made about programming for youth, there should be youth representation at the table guiding those decisions. Outstanding conference!"

During the Winter Teen Summit, the passion areas among the teens that were most highly noted were: Mental Health (89%), LGBTQ+ Rights (83%), Women's Rights (78%), Racial Justice (72%), Inclusivity in 4-H (72%), and Environmental Justice (61%). As a result of participation in the event, 94% somewhat or strongly agreed that they learned something new and felt like they belonged. 89% somewhat or strongly agreed that they learned something that they can use in their community and feel motivated to make a difference. 83% indicated they learned something new about themselves and felt inspired to make a difference in their community. 94% were interested in continuing their participation in teen summit work and would like to attend future events. When asked what one experience impacted them over the weekend, comments received included: "Literally everything. This was amazing and just what I've been needing."; "It was just an amazing experience and it is so welcoming and a safe space."; "The conversations I was able to have because I

felt safe and heard." "The implicit bias workshop really impacted me and how I see biases. I think to recognize that it lies in everyone, allows for greater empathy." There was consensus that the one change they would like to make in their community as a result of their participation in Teen Summit is to work to make 4-H more inclusive.

4-H Diversity and Inclusion Task Force: Equity is an issue for every aspect of society. Though not everyone directly experiences the effects of inequity, many youth feel excluded from the 4-H program or have to work much harder than others to participate and fit in with their 4-H peers. All youth, especially those who are part of underserved or underrepresented groups, need a safe, caring environment to create opportunities for growth and development. LGBTQ+ youth, youth of color, and other minority groups are everywhere. 4-H isn't inclusive until every 4-H club, group and event is inclusive. Inclusion starts from the top, and all of VA 4-H must work together to make 4-H a more inclusive place where all feel valued and welcomed, living up to our commitment to providing opportunities for all.

Creating safe, places where youth can be authentically themselves, is a key for youth thriving. To address this need, a teen-led task force was developed to assess issues related to equity in 4-H and to design and implement solutions to foster an environment where youth can feel safe and welcomed. The task force has a focus on education, communication of ideas and information, and looking at policy and opportunities for policy changes.The 18 member teen-led task force developed a mission statement and goals focused on working with administration to affect policy change within the organization to help create a safer, more inclusive environment for all youth. The task force delivered educational workshops at State 4-H Congress, iCongress, State Fair, Teen Summit, and to the State 4-H Cabinet, regarding the role of youth voice in social justice and community engagement. They received charter status recognizing the task force as an official 4-H group, and facilitated an implicit bias session at the National True Leaders in Equity Institute conference, resulting in two states Indiana and Minnesota reaching out to learn to replicate a similar process.

Teen Leadership Councils: The Positive Youth Development Program Team recognized a need for empowering teens to encourage more statewide participation. In the last 10 years, teen led programs have seen a decline in applications and participation. Cabinet members acknowledged that an in-between leadership opportunity would better prepare them and increase their confidence to apply for more state level opportunities. Agents were seeking teen opportunities that did not have the travel and time commitments that some of the state level programs have.

In 2021, a team of agents, camping faculty/staff, and specialists worked to lay the groundwork for 4-H center based Teen Leadership Councils. Six, Teen Leadership Councils were formed offering a stair step strategy to teen leadership programs. The councils formed direct pathways to teen opportunities beyond the county/city level. A statewide kickoff event was planned to introduce different pathways as well as leadership and action planning for their own center's needs.

50 youth applied for their respective Teen Leadership Council. Each center selected 4 to 12 teens from their region to design teen led activities and provide programming ideas. The Statewide Kickoff Event provided 40 of these teens an introduction, development of leadership skills, and the opportunity to speak with teens represented by other statewide groups. A post survey showed 100% of the respondents learned about a new 4-H Teen opportunity, 80% could see themselves applying for a state level position, and 100% were excited about the opportunity to be on the team.

Merit and Scientific Peer Review Processes

Updates

None

Stakeholder Input

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

In addition to the methods described previously, plans were put in place to hold an ANR Summit requesting input from stakeholders and key state leaders on programming for VCE and VAES. The summit is to be held in the spring of 2022.

Methods to identify individuals and groups and brief explanation

NONE

Methods for collecting stakeholder input and brief explanation

In addition to the methods described previously, we are instituting a broader approach of CLD3 (Community Learning through Data Driven Discover) at the local government level to better understand issues and what VCE can do to contribute to solutions and programs. This process is done in collaboration with the University of Virginia Social Data Analytics Lab. This is expected to continue to gain acceptance and utilization.

A statement of how the input will be considered and brief explanation of what you learned from your stakeholders

Stakeholder input at the local level helps determine the specificity of programs needed and desired. Significant input from this past year during the pandemic has indicated that current and potential clientele are open to and sometimes prefer virtual offerings as well as hybrid offerings in delivery. We also see as a result of the pandemic a growing demand for our family and consumer sciences programs.

Highlighted Results by Project or Program

Critical Issue

Agricultural Viability, Profitability, and Sustainability

Addressing Underserved Farmer Needs: Empowering Women in Agriculture

Project Director

Nicole Martin

Organization

Virginia Polytechnic Institute and State University

Accession Number

7000175

2021 Farmer Needs

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

In Virginia, the number of women reporting as the principal operator on their farm has increased. The United States Department of Agriculture's (USDA) National Agricultural Statistics Service (NASS) reported 7,653 farms, totaling 780,688 acres, were run by a female principal operator in 2012. These numbers have increased to 16,456 farms in 2017, farming 2,043,877 acres. This is an increase of 115% in farms operated principally by women in 5 years. Women make up 36% of all operators and 56% of farms have at least one female producer associated with the operation based on the 2017 Census of Agriculture. Female producers are also the backbone of many farm families where men are the principal operators. Most programs, although not excluding women, are not designed to provide a female friendly environment to foster learning and to improve and build upon basic skills that may be overlooked in most programming.

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 group of female ANR Agents began meeting regularly via Zoom to evaluate programming for women in agriculture in Virginia. Many agents had in the past held programming specific to women in their own area. However, there was no statewide program. The group created the Virginia Women in Agriculture (WIA) Program, which was added to the Agribusiness Management & Economics (AME) program team as an action plan, Addressing Underserved Farmer Needs: Empowering Women in Agriculture. The group started the Women in Ag Networking (WAN) due to COVID-19 meeting restriction across the state. Monthly Women in Ag Networking online event sessions took place with sessions that focused on time for participants to discuss topics and issues. Another program is the Women in Ag Gatherings (WAG). WAG had been held in previous years by one group of agents. Working together the group sought to offer more WAGs across the state. In 2021, there were two WAGs held with one being in the Northern District and one in the Southwest District in the month of November. These in-person programs focused on a variety of topics within agriculture including agriculture photography, small ruminants, and ag myths. Another program created in 2021 was Cattle WISE (Women Increasing Skills and Education). The event was held on October 29th in Buckingham County. The day-long program focused on hands-on skills with female instructors. Areas covered included reproduction, equipment, and BQA Certification. Funds were secured from the Virginia Cattle Industry Board and the Virginia Beef Industry Council to support this program. Lastly, Annie's Project, a national program, was previously brought to Virginia in 2017 but is just beginning to gain popularity here. In late winter of 2021, agents were able to attend virtual

facilitator training sessions and were able to add 11 newly certified Annie's Project facilitators in Virginia. Annie's is a six-week course taught to empower women in agriculture focusing more on the business side of farming operations. One of the newly trained facilitators set-up an Annie's Project course for December 2021 into early 2022. Efforts will be made in 2022 to get more Annie's Project courses happening across the Commonwealth. Members of our team established both a Facebook page and a Google Site (website) as a home for all of our women in agriculture programming efforts to be advertised. In addition, a listserv was set up for Women in Agriculture with 276 women signed up to receive emails about programming.

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

Women in Agriculture Programs were evaluated throughout each program. The Women in Agriculture Network utilized polls during the sessions to increase participation and gather data regarding the program. For the May session, the topic focused on skills for critical conversations such as farm transition and farm stress. Nineteen participants answered the poll with 57.9% saying that they did not feel they had the skills to have difficult conversations on sensitive topics related to their family's farm or land. Following the session, 63.2% shared that they felt they had increased their skills to have these conversations and three shared that they felt they may have gained skills. For Women in Agriculture Gatherings, there were a total of 69 women who completed evaluations at both locations. From those who attended the specific session, 92.9% said they would be implementing a practice from the pasture assessment session and 95.2% women said they would implement a practice from animal health. Cattle WISE had 47 participants with 90% reporting their confidence in the low-stress cattle handling skills had increased and 92.5% reporting they would be using the low-stress cattle handling skills taught on their farm. For the 2021 Women in Agriculture Programs, a follow-up survey was sent to the Women in Agriculture listserv. Fifty-seven women answered the survey with 12 attending Women in Ag Network Meetings, 23 attending Women in Ag Gathering, 17 attending Cattle Wise, and one attending Annie's Project. Of these responses, 63.2% said they had increased hands-on skills, 84.2% said they had increased their knowledge, and 66.1% said they had increased their confidence through the programs they had attended. When asked if the programs being predominantly female were an influence on their decision to attend, 57.9% confirmed that it had affected their decision. Comments from the survey included "I was introduced to some of the value-added opportunities in which other farms were engaged that I pursued to further diversify my farm." Another comment was "I have become a voice in our cow and calf operation and my husband is listening to my opinion. We work as a team versus just him."

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

Women in Agriculture programming efforts increase the profitability, sustainability, and diversity of farming enterprises enhancing the strength of the food supply chain that in turn provides benefits to all Virginian's.

Farm and Forestland Legacy Planning

Project Director
Nicole Martin
Organization
Virginia Polytechnic Institute and State University
Accession Number
7001795

2021 Legacy Planning

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

Forestland owners 65 years and older own 41% of Virginia's 10 million acres of private forestland. High land values and taxes force many heirs to sell land to meet financial obligations; a major force behind the loss of nearly 300,000 forested acres since 1977, and the increasing parcelization and fragmentation of family woodlands. Virginia, is on the cusp of the largest intergenerational transfer of family forests ever and landowners need to know how to protect their land. A common barrier to estate planning is using planning tools and having confidence in knowing where to start.

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 generate awareness of this issue, previous landowner programs have included brief conservation planning sessions and mass media informed the general public. Two webinar series consisting of four 1.5-hour sessions were held, in April and September. In 2021, an estimated 78 individuals participated, representing 44 family units and over 9,700 acres of farm and forest land. Program design draws from national curricula and utilizes local experts to develop new material and initiate participant planning.

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

Following short-course participation, landowners can better articulate their land transfer goals and have begun planning. Participants indicated the program would increase the likelihood of their property, staying intact (85%), in the family (73%) and in woodland (70%). By the conclusion of the workshops, over 72% of the participants had already initiated or enhanced their estate planning and after 3-6 months, 85% of 2020 participants had initiated one or more estate planning actions. Approximately half have explored conservation options to protect their land from development. As these landowners continue executing their plans, they will be empowered to conserve their rural lands and family heritage.

A Participant Testimonial:

The class helped me see how important woodlands are to all of us, not just to my own family. And now I see that there are people who are ready to help me execute the legal and financial plans to successfully pass the land to family members.

- 2021 webinar series participant

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

Keeping farms and forests intact and in production provides benefits to the general public related to aesthetic beauty, cleaner air and water, and improved quality of life.

Evaluating the economics of U.S. shellfish aquaculture: enterprise budgets, addressing challenges and assessing opportunities to improve profitability and commercial viability

Project Director
Jonathan van Senten
Organization
Virginia Polytechnic Institute and State University
Accession Number
1021441

10/01/20 - 09/30/21

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

Major Goals:

The goal of this research program is to develop model enterprise budgets for U.S. shellfish aquaculture using primary data that can be utilized for business planning, decision making, and evaluating the economic effects of adopting new technologies or management strategies on farm profitability. The specific objectives are to:

1. Develop standardized enterprise budgets for various scales of U.S. shellfish production informed by commercial microeconomic data;
2. A comparative analysis will be performed across production costs, marketing costs, and sales for shellfish farms of different production scales, located in different regions, and selling products through different marketing outlet;
3. Assess the effects and challenges presented by user conflicts on the shellfish industry and their impact on expansion of the industry;
4. Evaluate opportunities presented by new technologies and management practices to improve profitability of shellfish aquaculture.

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.

Objective 1: Development of the first standardized enterprise budget for oyster and clam farming, based on Pacific coast shellfish data, is complete for the medium scale and small scale Pacific coast shellfish aquaculture industry. The enterprise budgets for the "extra-small" scale of the industry have been developed, and the pro-forma cash flow statement is under development. Additional data was collected from Atlantic coast shellfish producers over the course of 2020-2021. There were challenges contacting the industry resulting from the ongoing COVID-19 pandemic. The shellfish industry was particularly hard hit by the impacts of COVID-19; given the overlap of shutdowns and market disruptions with the traditional peak marketing season for shellfish. Nonetheless, there was data obtained from the Atlantic coast shellfish industry (79 completed observations). Those data have been entered and undergone a process of cleaning and standardization of units, and are now ready for further analysis to develop financial statements for the Atlantic coast.

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

During this reporting period, the primary target audience has remained shellfish aquaculture producers, aquaculture industry associations, and fellow researchers. Contact was established with over 80 aquaculture operations to gather input and relevant information to inform model development.

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

Results from this project are not yet available to disseminate to stakeholders. The "medium" scale Pacific coast enterprise budget has been presented to several stakeholders for their review and input but has not been widely distributed or issued for public release. Based on the feedback from industry, additional refinements were made to the model.

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.

Changes/Problems: As noted in the previous report, COVID-19 has presented a challenge to this project for data collection activities. In response to the pandemic, a new effort was launched to assess the impacts of COVID-19 on the U.S. aquaculture industry, including the shellfish sector. A quarterly assessment of COVID-19 impacts was performed during 2020, and results were summarized and shared with industry associations.

Opportunities: Project personnel had opportunities to practice survey interview techniques and in light of the challenges brought on by the pandemic had to develop a new research interview protocol to allow for safe practices for survey interviews.

Next Period: Additional data has been collected to develop a standardized enterprise budget for the Atlantic coast shellfish aquaculture sector, although these activities were very much disrupted due to the COVID-19 pandemic and related shutdowns. As such,
the project has experienced some delays in advancing objectives. A new research associate has been hired (starting August 2021), who will assist with data cleaning and preparation of data for comparisons as outlined in Objective 2. Objective 2 of the study is now underway.

Products:

Two peer-reviwed journal articles were published.

Data and Research Material was developed. Primary data set of farm-level financial data for U.S. shellfish aquaculture production.

Critical Issue

Biotechnology, Biomaterials, and Bioenergy

Virginia Forest Landowner Education Program
Project Director
Nicole Martin
Organization

Virginia Polytechnic Institute and State University
Accession Number
7001792

2021 Forest Landowner

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

Forests cover more of Virginia than any other use. Because 68% of the Commonwealth's forests are privately owned, private forest landowners (PFLs) are an important link to meet the Commonwealth's goal that "Virginia's natural resources will be enhanced." Regionally, "private forestland stewardship" is a priority issue in the Northern District Forestry and Natural Resources Situation Analysis. Extension's Northern District holds 3.5 million acres of these woodlands. Traditionally, PFLs have been difficult to reach because of their sheer numbers and short ownership tenure. As land continues to be sold and divided into smaller pieces, forestland ownership is turning over. On average, a given piece of woodland will have a new owner every seven years or less. As a result, there is a continual need to educate new landowners and acquaint them with professional assistance availability. Research into landowner decision making highlights the importance of planning, professional assistance and peer influence to increase stewardship while meeting society's demands.

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 variety of educational offerings target forest landowners with learning and networking opportunities, both directly and indirectly. The annual Landowners' Woods and Wildlife Conference and Forestry Wildlife Bus Tour showcase good management practices and connect landowners with local natural resource professionals. Virtual programming is delivered through real-time scheduled meetings and YouTube postings with #FifteenMinutesIntheForest and has reached 8257 individuals since 2020. Peer-to-peer learning is increasingly facilitated through the Virginia Master Naturalist (VMN) Program. Forest management related trainings are offered to several chapters through the Northern District for basic and continuing education training. Another indirect response to meet landowner needs is through real-estate professionals who represent a first point of contact for new landowners. Real Forestry for Real Estate (RFRE) equips real-estate professionals with basic forestry knowledge and material to share with new landowners. Additional efforts target landowners through online and printed media such as the On-line Woodland Options Course. Due to rapid turnover of landowners in the region, traditional means alone of educating landowners is implausible. Certified Virginia Master Naturalists serve as ambassadors of the Northern District Extension Forestry program reaching several hundred landowners a year through guided walks, exhibits and peer connections. As a result of real-estate professional training, approximately 400 new landowners are reached each year and connected with local resource professionals.

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

An average of 500 landowners, representing approximately 20,000 forested acres, participates in at least one educational offering each year in the Northern District. Participants of management related programs indicated an increase in knowledge and an intention to put practices into place. Follow-up evaluations reveal various implementations such as, completed management plans, controlled invasive plants, improved wildlife habitat and successful timber sales. Approximately 30% of program participants contact a natural resource professional following educational events. This work influences that fact that in 2020, over 703 management plans covering 29,403 acres were developed for and with landowner input and over 12,300 acres received active management in the Northern District.

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

Literature shows that keeping forests intact and in production provides a continuous flow of wood products that citizens rely on every day. In addition, the general public benefits from enhanced ecosystem services such as aesthetic beauty, cleaner air and water, and improved quality of life, among others.

Critical Issue

Community Viability

Community Leadership and Decision Making

Project Director
Nicole Martin
Organization
Virginia Polytechnic Institute and State University
Accession Number
7001793

2021 Community Leadership

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

“People have the inherent capacity to solve their own problems and that social transformation is within the reach of all communities" (Kellogg Foundation, 2009). However, there is a need to prepare volunteers, civic leaders, and elected and appointed officials to be the force for positive change within their communities. Research supports this notion that community leaders need to be involved in the decision-making process and problem solving to help organize and develop their communities. Yet, there is often a lack of formal leadership training that equips community leaders with the skills necessary to effectively meet community needs (Tackey, Findlay, Baharanyi, & Pierce, 2004). Educational programs focused on leadership and civic engagement can build the capacity of youth and adults to effectively participate in community planning and decision-making. The Unit Situation Analysis and Issues Reports revealed a clear need for community leadership through more representative civic engagement, especially as it relates to youth involvement in their communities, growing future leaders who give back to their communities, educating youth and adults on civic matters to foster greater participation in decision-making, and providing employment opportunities that entice youth to remain in their communities as adults.

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 Community Leadership and Civic Engagement (CLCE) Program Team offers VCE professionals an opportunity to "buy-in" to the associated action plans. For calendar year 2021, a total of 50 agents and 19 specialists bought-in. The CLCE Program Team supports those agents in their work through professional learning and regular formative evaluation. Areas of work are organized into the following sub-groups: Civic Engagement: Enhance the capacity of youth and adults to engage in civic activities locally, regionally, statewide, and globally through providing science-based educational tools, resources, programs, events, and hands-on learning experiences. Community Leadership: Enhance leadership by improving communication and development of an effective decision-making process among individuals, both youth and adults.

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

Community leadership, civic engagement continues to be large and critical areas for Virginia Cooperative Extension programming. In calendar year 2021, educational contacts reported under the Community Leadership, and Civic Engagement (CLCE) Program Team action plans spanned six planned program areas (Agriculture Profitability and Sustainability; Community Viability, Food, Nutrition, and Health; Natural Resources, Environment, and Climate Change; Strengthening Virginia Families; and Youth Development). The work of the CLCE Program Team supports the mission of VCE, helping people put scientific knowledge to work through learning experiences that improve economic, environmental, and social well-being. Agents across the state encourage leadership through interactions with Civic Clubs, Master Gardener trainings and programs, emergency preparedness planning, and addressing mental health issues. Of the eight counties responding to the survey, a combined total of 453 people were reached in person and 2,931 participated in online events.

Personal stories:

During the Shenandoah Co. Board of Supervisors meeting, one of the Board members addressed the 4-H'ers at the conclusion of their presentation. He spoke for 10 minutes on how impressed he was with their public speaking skills and how valuable he thought the life skills that are being taught through 4-H are for all youth. He mentioned the financial planning that goes into livestock projects, the work ethic that is taught, and the communication skills he has witnessed. He owns a business and he said these are the skills he looks for when he hires employees. After he finished speaking, every other Board member shared a personal experience they have had either in 4-H themselves, or through the 4-H'ers they have seen. Between the 4-H'ers presentations and the Board member responses, they talked about 4-H for about 30 minutes during their meeting.

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

Formal training for community leaders helps localities with decision-making, problem solving, and enhances the ability of governing bodies to effectively meet community needs, improving the quality of life for all Virginians.

Critical Issue

Food, Nutrition, and Health

Prevention and Management of Chronic Disease

Project Director
Nicole Martin
Organization
Virginia Polytechnic Institute and State University
Accession Number
7000100

2021 Chronic Disease

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

Research shows that people with prediabetes who participate in a structured lifestyle intervention can cut their risk for developing diabetes in half. Prediabetes is a condition of slightly elevated blood sugar that increases risk for diabetes and that often goes undetected. Over 88 million people in the U.S., and 1 in 3 adults in Virginia adults have prediabetes. The National Diabetes Prevention Program (National DPP) is a public private partnership led by the CDC that is working to build a nationwide delivery system for a proven lifestyle change program to prevent or delay type 2 diabetes in adults. It brings together community, healthcare, and faith-based organizations, employers, private insurers and government agencies. As part of the National DPP, Extension leverages the National DPP systems to build a workforce to implement the program, ensure quality, create sustainability through accessing payer coverage, and establish participant referral systems.

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.

Virginia Cooperative Extension (VCE) joined the National DPP in 2017, and began building the systems and workforce to expand and sustain the lifestyle change program in underserved communities throughout Virginia. We have collaborated with the Virginia Department of Health, Virginia Diabetes Council, and the UVA Center for Diabetes Prevention and Education to train family and consumer science Extension Agents as lifestyle coaches for the 12-month lifestyle change program, support its conduct through distance learning and in-person, and to meet the quality standards necessary to become recognized by the Centers for Disease Control and Prevention (CDC) as a National DPP provider. We adapted the program to the online setting, developed marketing materials for print and social media, and established the systems for data collection and reporting.

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

Virginia Cooperative Extension has twenty family and consumer science Agents trained as lifestyle coaches. These agents serve thirty-five counties in all four VCE districts throughout the state, including in counties with the highest prevalence of diabetes. Seven new VCE diabetes prevention programs were started in 2021, and 3 previously started programs completed their final session. These programs served a total of one-hundred and seven Virginia residents with prediabetes. We reached a diverse audience that ranged in age from 33 to 81 years, were 86% female, and had a racial composition of 16% black and 74% white. The average weight loss for participants that attended at least 9 sessions was 5%, and over one third of participants (35%) reached the program goal of at least 5% weight loss. Increasing physical activity to at least 150 minutes per week is another goal of the program. Participants increased their physical activity to an average of 220 minutes per week, and 47% of participants consistently achieve the 150 minute/week goal.

In addition to these tangible goals, participants also increased their practice of behaviors that will allow them to maintain their weight loss and improved health. These included significant increases in monitoring their food intake and making healthful food choices away from home. They achieved 150 minutes per week of exercise more often and balanced their eating and exercise. They also employed problem solving skills and stress management to a greater extent allowing them to maintain their motivation.

Participants told us their favorite part of the VCE Diabetes Prevention Programs:

“The leader of the program was so helpful to everyone. The information and advice from the program, and all the resources that she made available to us were extremely helpful, as were the tips and suggestions from other participants who shared their experiences.”

“Listening to others and how they dealt with their challenges-also often they had good ideas on meals and foods.”

“The sense of community among the participants made me feel I wasn't in this alone.”

And they told us about their success:

> “I lost 24 pounds and lowered my A1C.”
>
> “Learning to stand and walk more. I went from obese, to overweight!”

“Because of my weight loss and increased physical activity, I lowered my blood pressure and was able to discontinue my medicine.”

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

Key diet and physical activity behaviors are well known to maintain health throughout the lifecycle. Lifestyle behaviors are also key to support immune function and prevent and manage chronic disease. Many Virginians fall short of the consistent, evidence-based guidelines on healthy diet patterns and types and frequency of physical activity from national health organizations.

Ovissipour: A Systematic Approach to Address Food Safety Issues in Minimally Processed Foods, Using Novel Sanitizers and Edible Sensors

Project Director
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Organization
Virginia Polytechnic Institute and State University
Accession Number
1021077

10/01/20 - 09/30/21

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

The long-term goal of this project is developing tools for addressing the food safety concerns in fresh produce, seafood, aquaculture and aquaponics industry. This will be accomplished through a comprehensive and collaborative research plan to develop bio-based sanitizers and non-living edible surrogate for sanitation verification in seafood and food industry. Our main hypothesis is that the bio-based antimicrobial compounds will be activated by applying UV-A light, and will reduce bacteria in water, plant and fish products surface. We hypothesize that the non-living surrogate such as DNA, will respond to certain sanitizers similar to live bacteria, and we will be able to measure and quantify the response to develop predictive models for sanitizers concentration and bacterial reduction.

Major Objectives:
Objective 1: Develop bio-based antimicrobial strategies to reduce foodborne pathogens.
Hypothesis: Development of bio-based antimicrobial interventions will reduce foodborne pathogens on seafood and fresh produce.
Approach: Different approaches will be used to answer the scientific questions by developing plant-based antimicrobials such as gallic acid, and ferulic acid, in combination with mild physical stressors such as UV-A light, to reduce pathogenic microbes on seafood and fresh produce.

Objective 2: Reduce the fish water-borne disease using plant-based antimicrobial strategies.
Hypothesis: Development of plant-based antimicrobial interventions will reduce fish pathogens in recirculating aquaculture system water with high organic load.
Approach: We will apply Obj. 1 approaches for inactivating water-borne pathogens including clinically isolated Aeromonas hydrophila which is important for fish aquaculture and aquaponics.

Objective 3: Develop edible surrogate as a rapid tool for sanitation verification.
Hypothesis: Spectroscopic approaches will detect oxidative damage in surrogate edible particles and the response will be similar to the oxidative damage induced in target bacteria and can be correlated to inactivation of target bacteria
Approach: Vibrational spectroscopy such as Raman will be used to determine the oxidative damages in bacterial cells and in edible surrogates such as DNA. The responses will be quantified using chemometrics and mathematical modeling, which result in developing predictive model for identifying the sanitizer concentrations and bacterial log reduction. Edible DNA-based surrogate will be prepared according to our previous study (26). Briefly, pure DNA will be deposited on Anodisc and will be used as a surrogate. As an alternative approach, we will use inactivated yeast or phage particles as edible surrogate.

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.

More than 50% of foodborne illnesses in the United States (U.S.) are related to raw and minimally processed fresh produce and seafood, causing 48 million cases, 128,000 hospitalizations, and 3000 deaths per year, with more than $15.6 billion U.S. economic burden. Thus, washing of fresh produce and seafood is a critical process that can reduce the microbial load including the inactivation of potential pathogens. Lack of optimal sanitation conditions in the wash water can increase the risk of foodborne illnesses. Despite significant progress in developing and implementing innovative technologies for reducing the risks of foodborne pathogens, the current trends of food safety outbreaks reflect the unmet needs for developing novel technologies for sanitation. The current practices are depending on a high amount of chemicals application resulting in antibiotics resistant bacteria, quality deterioration, chemical residue and environmental issues. Furthermore, many of these chemical sanitizer's applications can be limited due to rapid depletion in concentration and activity upon reactions with organic matters, and food surfaces structures. Current practices are not capable to induce more than 4 log cfu reduction on the surface of food materials, and biofilms. Thus, to address the challenges in raw foods and contact surface sanitation, we developed innovative approaches based on photosensitizers and nanobubbles technology. Our results demonstrated that these developed and innovative technologies significantly reduced bacteria in cell suspension, on food surfaces, and on biofilms. The results of this study can provide clean sanitizers technologies with significantly higher efficacy for the industry.

Objective 1: We have finished the first objective during the first year.

Objective 2: The antimicrobial efficacy of novel photodynamic inactivation technology was evaluated against Vibrio parahaemolyticus and Aeromonas hydrophila as two important aquatic microbial pathogens. Photodynamic inactivation results showed that LED (470 nm) and UV-A (400 nm)-activated curcumin caused a complete reduction in V. parahaemolyticus at 4 and 22 °C, and a greater than 2 log cfu/mL reduction in A. hydrophila, which was curcumin concentration-dependent ($p < 0.05$). Furthermore, the photodynamic approach caused a greater than 6 log cfu/mL V. parahaemolyticus reduction and more than 4 log cfu/mL of A. hydrophila reduction in aquaponic water samples ($p < 0.05$).

Objective 3: Our results with the nanobubble technology showed that the nanobubbles alone did not significantly reduce bacteria ($p > 0.05$). However, a greater than 6 log cfu/mL A. hydrophila reduction and a greater than 3 log cfu/mL of V. parahaemolyticus reduction were achieved when nanobubble technology was combined with ultrasound ($p < 0.05$). The findings described in this study illustrate the potential of applying photodynamic inactivation and nanobubble-ultrasound antimicrobial approaches as alternative novel methods for inactivating fish and shellfish pathogens. Removing foodborne pathogens from food surfaces and inactivating them in wash water are critical steps for reducing the number of foodborne illnesses. In this study we evaluated the impact of surfactants on enhancing nanobubbles' efficacy on Escherichia coli O157:H7, and Listeria innocua removal from spinach leaves. We evaluated the synergistic impact of nanobubbles and ultrasound on these two pathogens' inactivation in the cell suspension. The results indicated that nanobubbles or ultrasound alone could not significantly reduce bacteria in cell suspension after 15 min. However, a combination of nanobubbles and ultrasonication caused more than 6 log cfu/mL reduction after 15 min, and 7 log cfu/mL reduction after 10 min of L. innocua and E. coli, respectively. Nanobubbles also enhanced bacterial removal from spinach surfaces in combination with ultrasonication. Nanobubbles with ultrasound removed more than 2 and 4 log cfu/cm2 of L. innocua and E. coli, respectively, while ultrasound alone caused 0.5 and 1 log cfu/cm2 of L. innocua and E. coli reduction,

respectively. No reduction was observed in the solutions with PBS and nanobubbles. Adding food-grade surfactants (0.1% Sodium dodecyl sulfate-SDS, and 0.1% Tween 20), did not significantly enhance nanobubbles efficacy on bacterial removal from spinach surface. We have submitted four proposals, and one proposal was funded.

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

High-Tech Companies:
AquaOx: AquaOx is a company based in California, developed novel sanitizers including Electrolyzed water. Our team has been working closely with this company to optimize the sanitizer application in food industry. We have been supported with this company by in-kind supports, including solutions, and generators.

Moleaer Inc.: Moleaer is a California based company. This company was approached during the first phase of this experiment, and a of nanobubbles generator was provided as an in-kind support for this project. Mr. Warren Russell the founder of the company, visited our facility once, and we discussed all the results and outputs from this study.

NanoGas: NanoGas is a large company in Texas, mainly focusing on petroleum industry. However, this company also approached our program to develop novel sanitizers for seafood and fresh produce industry. Seafood industry: Several seafood companies were approached and our results were disseminated through conferences and webinars. Hispanic and African American audience were among the participants. Shellfish industry and Recirculating Aquaculture Systems were also approached, and the benefits of the technologies were discussed with them.

Aquaponics industry: Through several webinars, and conference presentations, the results of this study were shared with aquaponics companies all around the U.S. and instructions were provided for them. We also visited aquaponics system in a Correction Facility in Virginia and met with offenders who were working in aquaponics system.

Fresh produce industry: We approached fresh produce industry and provided our results regarding biofilm removal and bacterial inactivation for them.

Researchers, extension specialists, and extension agents: We have organized several webinars around nanobubbles and their applications for food safety.

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

Nothing 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.

Changes/Problems: N/A

Opportunities:

- International Intern, from India, Currently seeking Ph.D. opportunity.
- Postdoctoral researcher, Virginia Tech, Current position: Food Safety Specialist, VDACS.
- Undergraduate researcher, current position: Masters student in Bioinformatics, University of Virginia.
- Training courses for industry
- Moleaer Inc.: Two days of on-site training.
- Aquaponics company: Zoom-based training for applying these approaches
- Several presentations and webinars for industry around nanobubbles and photosensitizer

Next Period:

We will be studying the impact of NB on multi-species biofilm removal from surfaces in next year which has been funded by the National Dairy Council.

Products:

- Four peer-reviewed journal articles were published.

- One patent filed entitled "Method to Develop Engineered Nanobubbles for Sanitation".

- Protocols developed: We have developed the protocols for nanobubbles applications for food safety for the first time. We have optimized nanobubbles and photosensitizers for aquaponics sanitation.

- Evaluation Instruments: We have evaluated several nanobubbles instruments in our lab and supported the industry to optimize the instrument.

Critical Issue

Natural Resources, Environment, and Climate Change

Virginia Master Naturalist Program

Project Director

Nicole Martin

Organization

Virginia Polytechnic Institute and State University

Accession Number

7001794

2021 Master Naturalist - Northern Neck

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

Americans' interest in nature is growing. There is a large constituency of people, both urban and rural, engaged in non-consumptive uses of natural resources such as birdwatching, and studies show this population is growing. Research also shows, however, that Americans still face a significant gap between their interest in nature and their ability and opportunities to pursue that interest. Individuals need opportunities to be actively involved in exploring, caring for, and observing nature in their local communities. Furthermore, because the most impactful experiences in nature are deeply social, opportunities to connect people with nature through social groups are needed. At the same time, the Commonwealth of Virginia is facing difficult natural resource challenges, such as loss of forestland, sea level rise, and invasive species impacts. State and local natural resource agencies need help to accomplish their missions, address these natural resource challenges, and reach more sectors of our population. Public engagement is critical to successful conservation and management of Virginia's woods, wildlife, and waters.

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 Northern Neck Master Naturalist program addresses these needs by having volunteers provide education, outreach, and service dedicated to the beneficial management of natural resources and natural areas. The program aims to extend the capacities of both state and local natural resource agencies and organizations to be able achieve their missions in new ways, engage new audiences, and work towards creating a citizenry more informed about and involved in natural resource conservation and management. The program, because of its chapter-based structure, also promotes learning about, exploring, and stewarding natural areas through social groups. In 2021, the Northern Neck Master Naturalist chapter welcomed 18 new trainees through the basic training class. The planning committee worked diligently to provide 15 virtual training sessions weekly, with 5 small group, in person field experiences following VCE Covid-19 protocols.

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

In 2021, the Northern Neck Master Naturalists had 81 active volunteers, completing a total of 7670 hours of community service. 832 hours of service were spent on projects with sponsoring agencies, 3157 hours were on education/outreach projects, and 2492 hours were with citizen science projects. Stewardship projects made up 1190 hours. Because of the stewardship projects completed, 26 sites were improved around the Northern Neck. Members spent 672 hours on continuing education, to make a greater impact in the Northern Neck community. The value of this volunteer service is $223,503. Through education and outreach programs, members of the Northern Neck Master Naturalists made 11123 direct educational contacts and 58902 indirect educational contacts in 2021. All of this was done while following Covid-19 safety guidelines.

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

Public engagement creates a citizenry that is more informed about, and involved in, natural resource conservation and management. This in turn enhances the conservation and management of Virginia's woods, wildlife, and waters, which provide public benefits to all Virginians.

Critical Issue

Strengthening Virginia Families

Improving Economic Wellbeing

Project Director
Nicole Martin
Organization
Virginia Polytechnic Institute and State University
Accession Number
7001807

2021 Financial Literacy

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

Covid-19 created both dramatic health and wealth shocks across Virginia, the United States, and the globe. Shortly after government forced shutdown were put in place in an effort to stem the tide of covid-19 infections, the unemployment rate spiked to 14.7% from historically low unemployment rates under 5%. Millions of households were ill prepared, financially, for long-term unemployment. Economic Impact Payments were received by the majority of households to help make ends meet. When these payments were passed in congress, it was thought this money would be enough to get households through the difficult time of covid-19. Further, housing and rent eviction moratoriums, extended and enhanced unemployment benefits, deferral of student loan payments were put into place in the spring of 2020 with original end dates of July 31st 2020. Towards the end of July, it became clear to most that for financial difficult would plague our country. Extensions of deferral programs and eviction moratoriums were extended several times into 2021. However, another round of COVID relief payments would not come until January 2021.

Pre-pandemic, only about 60% of households stated they had the financial resources to pay for a $400 emergency. For roughly half of the country, they faced a financial emergency much greater than $400 for which many could not prepare. At the national level, the 2018 Consumer Financial Literacy Survey prepared by Harris Poll found that 79% of adults would benefit from advice and answers to everyday financial questions and 73% are currently worried about their personal finances. The same survey revealed that 24% reported finding it difficult to reduce debt due to unexpected financial emergencies. Eight percent of all adults have debts in collection with Millennials (ages 18-34) having a greater percentage in collection – thirteen percent. The well-being of Virginians depends on individual and family financial capacity. Financial capacity will enable individuals to make informed choices, sound decisions, and avoid financial pitfalls, as well as obtain knowledge of strategies to implement during times of financial crisis. The process of developing financial capacities will provide individuals the appropriate tools to understand and apply financial products, services, and concepts in an effort to improve their financial situation. The well-being of Virginians depends on individual and family financial capacity. Financial capacity will enable individuals to make informed choices, sound decisions, and avoid financial pitfalls, as well as obtain knowledge of strategies to implement during times of financial crisis. The process of developing financial capacities will provide individuals the appropriate tools to understand and apply financial products, services, and concepts in an effort to improve their financial situation. These numbers reveal the urgent need for Virginians to receive education to improve their financial literacy to improve their money management skills and make wise financial decisions.

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.

FCS Agents and personnel collaborated with Master Financial Education Volunteers, Extension Leadership, and community volunteers to deliver financial literacy workshops, and one-on-one counseling sessions to Virginia residents. Due to Covid-19, nearly all of these educational pieces occurred virtually, rather in person starting in March. Virginia Cooperative Extension needed to be nimble, creative, and reactive in order to create and adapt content and delivery techniques in order to best assist residents of the Commonwealth of Virginia. VCE Agents collaborated with the Department of Social Services,

Department of Housing, community colleges, Volunteer Income Tax Assistance Sites, earned income tax sites, Financial Empowerment Centers, Virginia Tech Income Tax School, community organizations, correction facilities, as well as churches and businesses across the commonwealth.

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

1465 adults attended one of 205 sessions led by 12 VCE Extension employees in 2021. There was a dramatic increase in planned behavior based on surveys taken prior to the adult financial literacy programs and after them: we observed that 81% of participants plan on writing short term financial goals after attending our training while only 24% did so prior to coming to our training. We also see 84% of attendees plan on writing a spending and savings plan while only 16% did so prior to attending one of our trainings. The majority, 71% of attendees plan on paying themselves first for saving towards a financial goal; a stark improvement from the 12% who planned on doing so prior to attending one of our classes. After our training, we also report that 80% plan on saving towards their emergency fund, 83% plan on paying down debt, and 80% plan on checking their credit reports annually.

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

Family financial management programs help secure healthy financial futures for Virginia families. Financial literacy has a material impact on families as they try to balance their budget, buy a home, fund their children's education, or ensure an income for retirement. An investment in financial literacy programming is an investment in building thriving communities.

Critical Issue

Youth Development

Teen Empowerment

Project Director

Nicole Martin

Organization

Virginia Polytechnic Institute and State University

Accession Number

7001809

2021 Teen Empowerment

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

In 2020 the Positive Youth Development Program Team recognized a need for empowering teens to encourage more statewide participation. In the last 10 years, teen led programs like State Cabinet have seen a decline in applications and even left some positions empty due to a lack of applicants. Cabinet members in recent years have acknowledged that an in-between leadership opportunity would better prepare them and increase their confidence to apply for more state level opportunities. Agents across the commonwealth were seeking an opportunity for teens that did not have the travel and time commitments that some of the state level programs have.

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 2021, a team of agents, camping faculty and staff, and specialists formed to lay the groundwork for Teen Leadership Councils that were center based. Six individual Teen Leadership Councils were formed in the summer offering a stair step strategy to teen leadership programs across the state. The Teen Leadership Councils formed direct pathways to a multitude of teen opportunities beyond each unit. A Statewide Kickoff Event was planned in September of 2021 for teens to be introduced to the different pathways as well as leadership and action planning for their own center’s needs.

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

Over 50 youth across the commonwealth applied for their respective Teen Leadership Council—more than any other statewide group in recent years. Each center was able to select 4 to 12 teens to represent teens in their region and provide teen led activities and ideas for programming. The Statewide Kickoff Event at the Skelton 4-H Center hosted over 40 of these teens as an introduction to the program, a place to further develop leadership skills, and the opportunity to speak with teens affiliated with other statewide groups. A survey sent out at the conclusion of the event showed that 100% of the respondents learned about a new 4-H Teen opportunity, nearly 80% felt that they could see themselves applying for a state level position in the future, and 100% were excited about the opportunity to be on the team.

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

Youth empowerment programs have a significant impact on their communities by supporting students, increasing access to opportunity, removing barriers to education and achievement, and building leaders for a better future for all Virginians.

Virginia 4-H Camping Programs – 4-H summer camp experiences in a pandemic year

Project Director
Nicole Martin
Organization
Virginia Polytechnic Institute and State University
Accession Number
7001808

2021 4-H Camp

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

“Youth camps can play an important role in the lives of children, including supporting their social, emotional, and physical development. Camps provide opportunities for children to try new activities, develop relationships, develop social and emotional skills, and be physically active.” (CDC) The Center for Disease Control recognized the need to get youth back in camp, and with the help and support of the Virginia Department of Health and Governor Ralph Northam, Virginia 4-H did just that. Participation in overnight, residential 4-H camps offers an opportunity for youth to not only gain knowledge and learn new skills, but to grow socially and emotionally in a safe environment while interacting with caring and nurturing adults. After almost two years of pandemic-related cancelations and social distancing, the need to provide Virginia youth with opportunities for social and emotional growth was of the utmost importance.

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.

When the Governor of Virginia announced camps would be allowed to open in 2021, Virginia Cooperative Extension professionals leaped into action. The faculty and staff of the six 4-H Centers, in cooperation with unit 4-H extension agents and state office staff, began planning, preparing, and training for the summer. Following guidance from the CDC, ACA, and VDH, protocols were developed and implemented to keep everyone as safe as possible. This meant significant changes to how some programming at camp would be conducted, as well as reducing the number of participants by approximately 50% to allow for social distancing. Facilities, programs, activities, and even transportation procedures were developed to carry out these new guidelines. A major component to ensuring the safety of campers was requiring proof of a negative COVID test prior to entering 4-H Center grounds. The Virginia Department of Health provided assistance in the form of free COVID testing sites for those units coming directly out of school to ensure that as many participants as possible were given the opportunity to attend summer camp. Because of the collaborate efforts of 4-H camping professionals across the Commonwealth, thousands of youth had the chance to experience overnight 4-H camp, and thus the opportunity to grow and develop in a safe, caring environment.

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

During the summer of 2021, over 5,000 youth and adult volunteers cumulatively attended 4-H Junior Camp at our six 4-H Educational Centers. With eight to nine weeks of camp, totaling 50-55 days at each Center, there was only ONE positive case of COVID reported the entire season! The VCE’s 4-H camping program not only offered the opportunity for youth across the

Commonwealth to experience educational programming and engaging activities, make new friends, create relationships with caring adults, and build life skills, it provided a respite during the stress and fear of a global pandemic. Youth were able to learn more about themselves and their interests, and grow both socially and emotionally.

Post camp surveys were collected from over 2,700 respondents.

Highlighted results include:

- 92% felt the program provided opportunity to explore something they really care about
- 95% felt safe in the program
- 96% felt welcome in 4-H
- 91% felt they mattered in this 4-H program
- 87% felt caring adults invested time in them
- 38% of all respondents were first year attendees

These responses support the positive influence of the Virginia 4-H summer camp experience, especially during the challenges of COVID.

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

VCE's 4-H camping program plays an important role in the lives of children, to include: supporting their social, emotional, and physical development; developing relationships along with social and emotional skills, and; enhancing physical activity, among others. By benefiting youth as community members and future leaders, the enhanced development of these life skills has positive ramifications for all Virginians.

Type

Projects / Programs without a Critical Issue

Projects / Programs

5

Closing Out (end date 09/07/2023)

Assessing How Sediment Moves Through Watersheds and Floodplains to Improve Water Quality in Virginia Streams

Project Director

JONATHAN CZUBA

Organization

Virginia Polytechnic Institute and State University

Accession Number

1017457

10/01/20 - 09/30/21

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

Problem Statement: Sediment (and sediment-associated impairments such as phosphorus and heavy metals) is a major water quality problem in streams and rivers in Virginia and the U.S. Efforts to restore the Chesapeake Bay are limited by the legacy of
historical pollution on the landscape that may take hundreds to thousands of years to move in and out of floodplains

before reaching the Bay. Theoretically, if pollution and the delivery of excess nutrients from fields ends, it will still take many years to
see the full downstream improvement in water quality because of historical sediment, phosphorus, and heavy metals still moving downstream through the watershed. In order for restoration efforts that control sediment or reduce nutrient loads to be
successful in improving water quality, we must better understand sediment dynamics through watersheds because sediment-related processes are a large driver of water quality.

The overall goal of this work is to improve our understanding of how sediment (and thus sediment-associated pollutants) moves through watersheds and is temporarily stored in floodplains. This will be achieved through a combination of computer simulation
of water and sediment movement through streams and floodplains, comparison to measured water flow, sediment, and mercury data from field sites, and analysis of spatial data in a Geographical Information System (GIS).

Relevance to advancing Virginia, the Region, and the U.S.: This work can help protect the water, land, jobs, roads, and health of Virginia and the region. Nutrients (such as phosphorus) and contaminants (such as mercury and polychlorinated biphenyls (PCBs)) can adsorb to sediment; thus, understanding sediment movement also leads to an understanding of the fate and transport of nutrients and contaminants. These contaminants can be harmful to local populations and livestock that may be consuming water from these sources. Sedimentation can increase the risk of flooding and exacerbate river-channel migration, potentially affecting built infrastructure. These implications can create economic and infrastructure issues for agriculture, parks, cities, roads, and bridges with exorbitant costs in flood insurance and payouts, time lost, transportation issues, deterioration of infrastructure, safety of homes, and risk of loss of life. The cost of physical, chemical, and biological damages attributed to and associated with sediment in North America has been estimated at more than $20 billion annually (Gray and Gartner, 2009). Furthermore, restoration of the Chesapeake Bay calls for a 20% reduction in sediment (and 24% reduction in phosphorus) by
2025 (U.S. EPA, 2010). Specifically, this work will focus on field sites in Stroubles Creek (VA), the South River (VA), the Roanoke River (VA) and the Dan River (NC). Historical mercury contamination has accumulated in the floodplain of the South River. Eventually, this mercury-contaminated sediment will move downstream through the Shenandoah River to the Potomac River before reaching the Chesapeake Bay. This work helps inform where that mercury has accumulated and how it will be
released back into the river. While, only the South River is tributary to the Chesapeake Bay, the process-based understanding gained from the other field sites will help inform restoration of Chesapeake Bay watersheds and other watersheds throughout
the U.S. and across the world.

The overall goal of this work is to improve our understanding of the water-mediated transport of sediment through watersheds and floodplains. The proposed research consists of four objectives aimed at achieving this goal:

1. Surface-water exchange between streams and floodplains: Determine the controlling mechanisms driving the exchange of surface waters between streams and floodplains.
2. Sediment residence time in floodplains: Quantify sediment and legacy pollutant residence-time distributions in floodplains.
3. Sediment fingerprinting: Develop a protocol to distinguish if recently mobilized sediment is primarily sourced from uplands or from stream banks.
4. Sediment connectivity: Develop spatially-explicit, pathway-integrated metrics for assessing sediment transport/deposition potential along source to sink watershed pathways

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.

Major accomplishments:
In further analysis of our data collected in the Dan/Roanoke River basin, we have discovered that a certain combination of river channel characteristics (from recent sediment transport theory) can adequately predict the amount of silt and sand in the
pore spaces of a gravel streambed. This is important because the amount of silt and sand in a gravel streambed is one of the main predictors for habitat quality for aquatic organisms. While this has always been measured in the field before, this might
open the door to predicting habitat quality at watershed scales easily using freely available remotely sensed data. This is a research avenue we have been pursuing following the results from our earlier analysis. It has led to a rapid publication in the journal "River Research and Applications" and we are collecting additional preliminary data to support future proposals.

Progress on objectives:
1. Surface-water exchange between streams and floodplains: Determine the controlling mechanisms driving the exchange of surface waters between streams and floodplains.
For objective 1, we have completed model simulations from several different rivers and are waiting on further results from Stroubles Creek before finalizing the analysis. For Stroubles Creek, we have published a paper on "Estimating floodplain vegetative roughness using drone-based laser scanning and structure from motion photogrammetry" in "Remote Sensing". This paper has shown how data collected from a lidar drone can be used to better estimate vegetation roughness on floodplains for use in more accurate models of river flooding. We have continued to collect data at Stroubles Creek to help reduce some of the uncertainties from this initial publication/modeling for future modeling/publications.

2. Sediment residence time in floodplains: Quantify sediment and legacy pollutant residence-time distributions in floodplains.
For objective 2, we have finalized the model and finished model simulations. We have been analyzing the model results in various ways and comparing them against the existing data of mercury accumulation rates/floodplain sediment deposition rates. We have obtained a statistical model that explains over 60% of the variance of the measurements. This is a great improvement over previous estimates for the South River, which were only able to explain roughly 20% of the variance. Thus, we have our best estimates into specifically where, from a process-based perspective, the most mercury would have accumulated via sediment deposition.

3. Sediment fingerprinting: Develop a protocol to distinguish if recently mobilized sediment is primarily sourced from uplands or from stream banks.
For objective 3, we have collected physical sediment samples from the river bed, banks, and floodplains at our study sites in the Dan and Roanoke River basins. We have also recovered sediment from our passive in-stream sediment samplers at the ~15 of our 30 sites where they were deployed to collect more in-stream sediment. We have finished processing our collected sediment samples in the lab and starting in January 2022, we will begin data analysis.

4. Sediment connectivity: Develop spatially explicit, pathway-integrated metrics for assessing sediment transport/deposition potential along source to sink watershed pathways.
For objective 4, we have submitted our first paper showing that standard methods used to predict sediment erosion from upland fields and forests in the Dan and Roanoke River basins did not adequately predict the amount of suspended sediment or in-stream sediment conditions at our approximately 30 study sites. This suggests that sediment erosion from upland fields and forests may not be the major source of sediment transported by these rivers and instead, sediment eroded from river channel banks may be the source. This has implications for how and where managers should restore streams and in-stream habitat. Furthermore, new models are necessary to adequately capture sediment erosion at the watershed scale in these river basins. We are in the process of revising this paper.

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

1. Local Virginia landowners - conversations during fieldwork and later follow-up describing our findings
2. The scientific community - scientific papers and presentations at national scientific conference
3. Students

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

1. Local Virginia landowners - conversations during fieldwork and later follow-up describing our findings
2. The scientific community - scientific papers and presentations at national scientific conferences

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.

Change/Problem: COVID-19 limited the work that we were able to perform and our ability to disseminate our work to the communities of interest.

Opportunities: Given the COVID-19 pandemic, there were not as many high-quality opportunities for training and professional development. One of the graduate students who has worked on this project has presented their preliminary results at the American Geophysical Union's Fall meeting in Washington D.C.

Next Period:

1. We are in the process of further data analysis at Stroubles Creek and simulating how different restoration approaches (implemented roughly 10 years ago), have led to different surface-water exchanges at this site. This should lead to another
publication and a Master's student thesis at the end of May 2022.

2. Our next steps are to apply the statistical model to our spatial model results to look spatially at where we predict there to be more/less mercury accumulation on the floodplain and also to sum the mercury accumulation over the stretch of the floodplain
to come up with our best estimate for the total mass of mercury accumulated in the floodplain. We anticipate finalizing a manuscript at the end of January 2022 and submitting this work for publication by the end of February 2022 likely to the journal "Geomorphology".

3. Starting in January 2022, we will begin data analysis.

4. We are in the process of revising the paper that corresponds with this objective.

Products: Seven peer-reviewed journal articles and five conference papers.

Closing Out (end date 09/07/2023)

Molecular and neural modulation of mosquito-host interactions in Aedes aegypti and Aedes albopictus

Project Director
Clement Vinauger
Organization
Virginia Polytechnic Institute and State University
Accession Number
1017860

10/01/2020-09/30/2021

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

Major goal: Key features of mosquito biology remain understudied. For example, the molecular and neural mechanisms underlying the modulation of mosquito-host interactions have not been fully determined yet. In this proposal we will focus on the daily and circadian variations in mosquitoes' responses to host odors. The rationale that underlies the proposed research is that a determination of the molecular modulation of mosquito behavior is likely to reveal multiple targets of opportunity to selectively manipulate the competence of mosquitoes as vectors of diseases. Here, we will combine cutting-edge techniques including neural recordings from fixed- and tethered-behaving mosquitoes, behavioral paradigms, as well as genetic manipulations, in order to pursue the following Objectives:

Objective 1. Define the rhythmic modulation of responses to host signals.

We have all personally experienced that mosquitoes are not active all day long but, instead, display peaks in activity. The properties of their activity patterns have been described in major disease vector species such as Ae. aegypti (Taylor and Jones, 1969) and An. gambiae (Rund et al., 2011; Rund et al., 2012; Maliti et al., 2016). However, not much is known in terms of how their responses to odorant host signals (e.g. body odors and carbon dioxide) vary throughout the day. Here we propose to use experimental designs that will allow us a precise quantification of large and fine scale behavioral responses to host body odors. Targeted knockdowns of the expression of genes coding for central and peripheral biological clocks will be achieved by injection of dsRNA to interrogate the contribution of these oscillators in the observed behavioral rhythms.

Objective 2. Determine the circadian gating of sensory perception and integration.

Circadian variations in the levels of Odorant Binding Proteins (OBPs; Rund et al., 2013), or the down-regulation of odorant receptors themselves (Fox et al., 2001), have been shown to result in a periodically lower sensitivity to odors in An. gambiae. However, not only these mechanisms remain to be unraveled in Aedes mosquitoes, it is also not known whether the higher processing levels of olfactory perception and integration are modulated throughout the day. Our recent progress in this field (Vinauger et al., 2018)
places us in a unique position to overcome the technical limitations preventing recording from the antennal lobes

of mosquitoes and address this knowledge gap. Here we will define the temporal variations in olfactory perception and integration at the level of the antennal lobes. In addition, our ability to record electrophysiologically from tethered-behaving mosquitoes will enable us to correlate behavioral and neural responses to odors.

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.

Mosquitoes are often considered the deadliest animal on earth. The diseases they transmit (e.g. Zika, Chikungunya, yellow fever, West Nile, malaria) are responsible for more than one million deaths every year. At the scale of the United States of America, the mosquito-borne diseases represent a significant social and economic impact for the country by negatively affecting the health of its citizens, tourism and productivity. In the state of Virginia, every summer, thousands of citizens complain to their local and state government officials about the mosquito problems they have in their neighborhoods. The global strategy for management of vector-borne diseases involves controlling vector populations, to a large extent through insecticide application. However, vector-borne diseases are now resurgent, largely because of rising insecticide resistance in mosquito populations and the drug resistance of pathogens. Novel control strategies, informed by improved understanding of mosquito biology, are therefore urgently needed.

In this context, this project aims at understanding the mechanisms allowing Aedes aegypti and Aedes albopictus, the predominant mosquito species in the state of Virginia, to be such efficient disease vectors. The major goal of this application is to decipher the mechanisms that rhythmically modulate host-seeking behavior in mosquitoes. Results from this work can be leveraged by control professional to optimize the efficiency of odor-mediated control tools (e.g. baited traps, repellents) and to make recommendations to populations that are exposed to higher risks of contact with mosquitoes (e.g. agriculture workers).

Finally, the work detailed above contributed to the training of graduate and undergraduate students in the fields of biochemistry and medical entomology.

Objective 1. Define the rhythmic modulation of responses to host signals. (Year 1-3) - 70% completion
The goal of objective 1 is to characterize rhythms in the behavioral responses to host body odors by Aedes mosquitoes, and analyze the molecular mechanisms underlying these responses. In this third reporting period we have expanded our quantification of the responses of the yellow fever mosquito Aedes aegypti to the complex blend of human emitted chemical compounds. Specifically, we tested the response of female mosquitoes to human body odor extracts and used gas chromatography mass spectrometry to quantify the daily variations in the chemical composition of human body odors. In addition to the Y-maze olfactometry assays conducted in period 1 and 2, we have now performed free-flight assays in meshed enclosures. Our findings show that the abundance of individual volatiles vary throughout the day, in particular due to the application of soaps on human skin. We also found that mosquitoes' responses to human olfactory cues are affected by the time-specific composition of body odors, and significantly altered by the application of personal care products. This is significant as it provides a deeper understanding of the chemical cues mediating mosquito-host interactions at different times of the day.

Objective 2. Determine the circadian gating of sensory perception and integration. (Year 3-5) - 50% completion
Circadian variations in the levels of Odorant Binding Proteins (OBPs), or the down-regulation of odorant receptors themselves, are known to underlie rhythms in olfactory sensitivity of the nocturnal malaria vector Anopheles gambiae. The goal of objective 2, is to determine whether similar processes occur in species of Aedes mosquitoes that are invasive in Virginia. In the first reporting period, we had defined the temporal variations in olfactory sensitivity in Aedes aegypti, by performing electroantennogram (EAG) recordings on adult females, and in this second reporting period we had performed transcriptomic analysis (RNA-seq) of adult females' heads taken at the same times of day as in our electrophysiological assays. Results showed that variations in sensitivity levels are not only supported by rhythms in OBP genes expression, but also by rhythms in the expression of genes coding for odorant receptors (ORs). In this third period we have accumulated dissected antennae collected at the same time points to conduct antennal transcriptomic analysis, which will provide an even higher resolution of the daily rhythms in sensory gene expression. Additionally, we have established a colony of field-collected Aedes albopictus mosquitoes (another potent invasive in the state of Virginia) to begin comparative analyses in the next reporting periods. This represents a significant advancement for the field given that previous studies, relying on less sensitive methods (microarrays), had overlooked this component of the olfactory circuit. These results have been presented at the annual meeting of the international Vector Biology Seminar Series.

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

The target audiences reached by our efforts during this reporting period are:
• Scientists: reached by means of 1 peer-reviewed publications, 1 book chapter, 1 pre-print, and 2 conference presentations.
• Students and educators: PI Vinauger gave 1 guest lecture, specifically highlighting work within the scope of this Hatch project, and was invited to present results from this Hatch project at the Virginia Tech Biochemistry Club.
• Public health professionals, and the general public: multiple interviews for local, national and international media highlighted work within the scope of this project (e.g. Virginia Tech News).

Our target audience also consists of graduates and undergraduate students developing careers in life and agricultural sciences, as well as in medical entomology, which lack thereof has been highlighted by the CDC as detrimental during the 2016 Zika outbreak. During this reporting period, 2 graduate students, 2 undergraduate students, and 1 postbaccalaureate student from an underrepresented minority have been trained.

Results have been disseminated by the PD and trained students, under the form of 1 peer-reviewed publications, 1 pre-print, and 2 oral presentations and 1 guest lecture. A book chapter has been accepted for publication by the Wageningen Academic Publisher. Media coverage and participation in events for the general public have disseminated our results beyond the scientific community.

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

Media coverage and participation in events for the general public have disseminated our results beyond the scientific community. Public health professionals, and the general public: multiple interviews for local, national and international media highlighted work within the scope of this project (e.g. Virginia Tech News).

Research sponsored by the present Hatch proposal was highlighted to the public at the 2021 Hokie BugFest, one of Virginia Tech's largest science literacy events.

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.

Changes/Problems: Nothing to report.

Opportunities: The second reporting period of the project has provided opportunities for the one-on-one training of 2 graduate student (1 MS and 1 PhD, who both graduated from the laboratory in May 2021) and 2 undergraduate students. Additionally, we pursued our increasing efforts to promote inclusivity and diversity in STEM by recruiting a postbaccalaureate student from an underrepresented minority. She will continue receiving training through the next reporting period. Students at the Virginia Maryland College of Veterinary Medicine have also been exposed to training in fundamental concepts of vector-borne diseases through lectures delivered by the PD.

Next Period: During the next reporting period of the project, we will pursue our research efforts on both objectives by analyzing olfactory rhythms in a second species, for which we now have established a colony: Aedes albopictus. We will extend our analysis of the neural and molecular processes contributing to the daily rhythms in olfactory behavior of these medically relevant mosquitoes. These plans will be pursued by training of graduate and undergraduate students. Results from this third reporting period, and results to come, will be further disseminated by scientific publications that are in preparation, and by increasing our efforts to reach the general audience (e.g., videos will be produced to summarize results and explain their significance to the general public).

Products: One peer-reviewed scientific article was published in a high impact journal. One book chapter was accepted for publication. Two conference papers and abstracts were presented/published, including an invited speaker invitation to the INternational Vector Biology Seminar Series. One other article was published. The research from this Hatch project was highlighted to the public at the 2021 Hokie BugFest. A guest lecture was delivered to veterinary students in the 'Neglected & Emerging Infectious Diseases' class. The PD presented results from this Hatch project to the Virginia Tech Biochemistry Club to encourage undergraduate student participation in academic research.

Nutrition, Money, and Time: An Empirical Assessment of SNAP Participants Combining Disparate Datasets

Project Director

George Davis

Organization
Virginia Polytechnic Institute and State University
Accession Number
1021020

10/01/20 - 09/30/21

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

The overarching goal is to determine the empirical profile, in terms of money and time, of Supplemental Nutrition Assistance Program (SNAP) households considered to be above and below some nutrient target and how the substitution of money and
time in food production may affect this profile.

For conciseness in communicating, let the money and time thresholds based on programming and simulation models be called the "model thresholds" and thresholds based on actual data be called "empirical thresholds".
The objectives of the project will be to answer the following questions:
1. What are the levels of money and time expenditures in home food production that are consistent with a nutritious diet for SNAP and non-SNAP participants based on actual data?
2. How do the existing model-based thresholds compare with the empirical thresholds in magnitudes?
3. How do the food expenditure poverty metrics differ using the empirical thresholds versus model thresholds?
4. Does the rate of substitution between money and time differ between SNAP and non-SNAP participants?
Obtaining answers to the four questions (objectives) will provide novel insights into the SNAP and help in designing more effective policies.

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.

Given the advent of COVID-19 and the policy responses, there was a great deal of immediate interest in the question: Are the temporary nutrition assistance levels being provided during COVID sufficient to address the intended goal of providing enough
money to reach the cost of a nutritious diet? Given answering this question certainly falls within this general research area, we pivoted during this time period to address this question and did so in the two publications listed.

In "The American Resouce Plan is a Great Start but More Increases in Supplemental Nutrition Assistance Program (SNAP) Benefits are Likely Dues to Implicit Hidden Reductions" I consider accounting for three omissions in the existing SNAP benefit
formula and show that the 20.3% increase during COVID in SNAP benefits did not fully address these limitations and in fact only accounted for about 1/4 of the needed adjustments.

Also, as part of the 2018 Farm Bill, the way SNAP benefits were calculated was going to be permanently updated in 2021 and the relevant policy question became was the update sufficient. This question was addressed in the article "An assessment of
recent SNAP benefit increases allowing for money and time variability." Food Policy (2021): 102175. In this article, we find that for single-headed households the temporary 20.3% and the permanent 21% increase both would have to be matched by an increase of about 9 hrs per week in food production in order to reach the full cost of a nutritious diet. This increase seems very unlikely based on historical time allocation patterns. More is needed to be done to increase SNAP benefit adequacy either through further increases to benefit levels and/or through education and outreach efforts designed to improve skills of home meal preparation and time management.

Regarding the specific objectives of the project, much has already been reported last year on the first three objectives. During this year we made progress on the fourth objective in the Ph.D. student Jinyang Yang dissertation chapter 2 where we developed a more flexible approach to estimate the elasticity of substitution between money and time in food production. While we have not yet partitioned the analysis into SNAP and Non-SNAP indications are that the more flexible approach leads to higher elasticities of substitution between money and time and this has important implications for policy. Most previous studies, using more restrictive models, have found it is very difficult to substitute money for time, which in turn means money- focused policies will have a smaller impact on nutrition than if the elasticity of substitution was higher. Our estimates imply that money-based policies may be more effective than thought.

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

Policymakers, health professionals, academics, and students benefited from the project's activities this year.

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

Through journal publications and workshop presentations.

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.

Changes/Problems

As indicated, given COVID-19, during 2020 there was immediate interest in the adequacy of nutrition assistance policies that were invoked, and since I have expertise in this area and it is related to this project it seemed warranted to pivot to answer
these immediate needs questions.

Opportunities

In the AAEA post-Conference workshop, the purpose of the presentation was to demonstrate how data from different sources could be merged or combined to answer relevant policy questions. There were about 70 people attending the "virtual"
workshop.

Next Period

We plan to prepare manuscript(s) for publication submission from the first three objectives and then continue working on the estimation of the elasticity of substitution between money and time, especially how it may differ between SNAP and non-SNAP households.

Products

Two peer-reviewed journal articles, a conference presentation, and educational aids/curricula to serve on a reivew panle for updating the SNAP benefit formula.

Closing Out (end date 09/07/2023)

Peanut Variety and Quality Evaluation for Development of Virginia-type Cultivars with High Oleic Trait, Flavor, and Rainfed Production

Project Director
SEAN OKEEFE
Organization
Virginia Polytechnic Institute and State University
Accession Number
1019136

10/01/20 - 09/30/21

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

The goal of our research is to develop standardized dry roasting procedures that allow precise control of roasting and to standardize procedures to better understand flavor in peanuts in the breeding program for Virginia peanuts. Flavor in peanuts is extremely complex, with more than 800 different flavor compounds identified and no one having been found to be the critical compound.

Major Goal of the Project: To find high oleic Virginia-type peanut lines with suitable flavor for development into cultivars, which are well adapted to the VC growing region.

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.

One student completed his MS degree (Jasim Khan) and his manuscript is being finalized for submission to the Journal of Food Science (Development of standardized dry roasting procedures for Virginia type peanuts).

Abstract:
Peanuts are grown around the world and in the United States where most are consumed as a confection. They are roasted to a specified color on L*a*b* scale as this measure is correlated with quality and roast optimization. Two batches of Virginia-type peanuts were acquired independently with one tested to be normal oleic and the other a high oleic variety. A surface response model using the Box Behnken design was developed for two roasting units, the Behmor 2000AB and GeneCafe coffee roasters, with normal and high oleic peanuts respectively. Peanut samples were roasted with sample size, roast time, and power/temperature as dependent variables and L* as a response variable. The overall model for Behmor roaster was not significant ($p>0.05$ and $R2 =0.87$) but with significant effect contribution of roast time while the GeneCafe model was significant ($p<0.05$ and $R2=0.98$) with multiple first and second-order effect contributions from temperature and roast time. The model was validated on each roasting machine, and Behmor roaster was found to be more consistent and predictable compared to GeneCafe. Both varieties of peanuts were roasted on each roaster and tested for volatile analysis using SPME GC/MS. The results had high variation within samples, which may be caused by uneven roasting between peanut kernels. The overall volatile results showed similar trends for seventeen compounds between normal and high oleic samples. The Behmor roaster is more effective at the predictable roasting of peanuts with sample size ranging from 50 to 100 g and more validation is needed on GeneCafe to improve its model. Furthermore, no clear difference existed between normal and high oleic roasted peanuts in volatile analysis. The results can help with quality testing of new varieties of Virginia-type peanuts quickly without relying on the large sample size typically used in other lab-scale studies.

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

The target audience for this work is students and peanut researchers who are interested in controlled roasting of Virginia (and other variety) peanuts.

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

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.

Changes/Problems: The main problem is finding funding for peanut-related research. Peanut companies are scale/cost-driven and not interested in R&D investments.

Opportunities: One MS student graduated.

Next Period: Finish publication. Further test the model developed to ensure that roasting will be accurate for a range of peanut varieties.

Products: N/A

Closing Out (end date 09/07/2023)

Peanut Variety and Quality Evaluation for Development of Virginia-type Cultivars with High Oleic Trait, Flavor, and Rainfed Production

Project Director
David Haak

Organization
Virginia Polytechnic Institute and State University
Accession Number
1019013

10/01/2020 - 09/30/2021

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

Global peanut production is nearly 29 million metric tons and the United States is the third largest producer of this important oilseed and food crop. As with most crops, losses due to drought stress are often high and in peanut they are compounded by a commensurate decline in food safety under drought. Because it is a high nutrient-density crop, peanut is third after potato and maize for dietary energy production per cubic meter of water. This means that efforts to improve drought tolerance in peanut are a large step toward local and global sustainability in the production of a safe and nutrient rich food supply.

(1) To find high oleic and drought tolerant peanut lines which are well adapted for rainfed peanut production in the VC encountering high temperature and unpredictable droughts.
(2) To develop a database for tested genotypes allowing knowledge-based selection for release of high oleic cultivars that will also meet all other criteria for market success within each state.

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 significant progress toward genotyping the RIL populations under investigation in this study. We have generated genotyping-by-sequencing libraries for all 700 RILs and progressed with sequencing with one entire RIL population. From this population, we have identified 1,589 genetic markers for mapping. We are now screening these populations for segregation distortion and will proceed with linkage map construction. Additionally, we have completed an analysis of multi-site, interannual phenotypic data.

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

Efforts to reach the targeted audiences include:

Fellow scientists, faculty: We have engaged other scientists directly in discussing results as well as indirectly through invited seminars and presentations.

Academic peers/researchers: We have engaged academic peers through presentations at national conferences.

Students: We have directly engaged students through training (Ph.D. student Naveen Kumar) and incorporating the data generated for this project in bioinformatics courses.

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

General public: The public has been engaged in this project through 'field days' under the direction of Dr. Maria Balota.

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.

Changes/Problems: Nothing to report.

Opportunities: A third-year graduate student Naveen Kumar is being trained as part of this project. In addition, we have started training an undergraduate researcher in the genetic analyses associated with this project.

Next Period: Over the next reporting period, we anticipate generating genetic maps for key drought tolerance traits identified from our phenotypic data, in the sequenced RIL population. We will also complete sequencing and genetic mapping on the two remaining RIL populations. These data should allow us to initiate work developing a RIL database for the identification of

lines, traits, and genotypes that contribute to drought-tolerant cultivars that retain other important market traits.

Products: Two conference abstracts have been accepted for presentation in the next reporting period.