

FY 2020 Annual Report of Accomplishments and Results

North Carolina
North Carolina State University (NC State)
North Carolina A&T State University (NC A&T)

I. Report Overview

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

<p>1. Executive Summary (Optional)</p>	<p>This report reflects the accomplishments of Research and Extension programs at North Carolina State University (NC State) and North Carolina Agricultural and Technical State University (N.C. A&T). These programs and activities are designed to discover and develop new knowledge and technology that allow North Carolinians to lead prosperous, healthy lives. They largely emanate from the College of Agriculture and Life Sciences (CALs) at NC State and the College of Agriculture and Environmental Sciences (CAES) at N.C. A&T.</p> <p style="text-align: center;">NC State Research & Extension</p> <p><i>Despite disruptions caused by the COVID-19 pandemic in 2020, the research and extension faculty and staff of North Carolina State University maintained their commitment to our state and nation. The standard ways of doing their work were out, and new protocols shifted sharply over time. Still, these professionals, largely based in the College of Agriculture and Life Sciences (CALs), didn't stop working to help people lead prosperous, healthy lives. They found creative ways to carry out the college's and university's strategic plans on time and on target. As the university continued building a new strategic plan, the North Carolina Agricultural Research Service (NCARS) and NC State Extension prioritized efforts aimed at solving the complex challenges facing food, agriculture, and other areas of life. The Plant Sciences Initiative is a good example. Through the initiative, CALs researchers and Extension agents and specialists are working together and reaching out to their colleagues in all colleges on campus and throughout the state. Their goal: to gain the kind of interdisciplinary traction needed to solve the challenge presented by a growing world population that needs more food, fiber and fuel produced in ways that are economically, environmentally, and socially sustainable. Construction on a new plant sciences building is nearing completion, platform directors have been named, and interdisciplinary teams are hard at work on ambitious, problem-solving endeavors. This report reflects just a fraction of the accomplishments made by NCARS and NC State Extension faculty and staff members during an extremely difficult year.</i></p> <p>Improving Plant and Animal Agriculture Systems. Agriculture and agribusiness – food, fiber, and forestry – is North Carolina's number one industry, contributing \$92.7 billion in income and about 772,000 jobs annually. In the crops area, NC State researchers conducted genetic research, developed new varieties, and came up with a damage-reducing curing method to invigorate the production of sweet potatoes, the state's number one vegetable crop. They also discovered novel non-GMO plant editing techniques with broad industry applications; completed the first stages of creating 3D-printed plants to create more nutritious and stress-resistant plants; and laid the groundwork for promising crop preservation efforts by sequencing and analyzing thrips, an invasive insect that causes billions of dollars of damage to a range of food, fiber and ornamental crops. In addition, researchers partnered internationally to better understand and combat a devastating virus that causes severe loss of vegetable crops in the United States and staple crops in the developing world; launched an inexpensive camera monitoring system that allows</p>
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farmers to remotely track drought stress in corn and soybean fields; identified factors in plant ozone tolerance and screened soybean germplasm for ozone tolerance; and conducted patent-producing algae research with promising insights for the production of a range of consumer products, including biofuels from camelina, a canola-like plant that can grow on poor land with little soil. Meanwhile, their groundbreaking tree-related research spun off a company to revolutionize the forestry industry by exploiting CRISPR-based genome editing to build healthier forests and reduce paper production costs by about 6.5%.

Extension educators offered an array of online programs, including popular field days, and followed CDC guidelines for in-person meetings and consultations. Their goal: to help farmers make a profit while sustaining and improving the environment. As a result of these programs, over 76,700 crop producers adopted best practices for nutrient management, conservation, production, pest management, variety selection, business management, marketing, and more. One field day welcomed four times as many participants than expected. Through herbicide-related training, cotton and peanut producers gained new knowledge and tools to reduce the environmental and economic impact of herbicide resistance. In peanut-producing counties, agents conducted maturity clinics to help growers pinpoint the best time for harvesting their crop, providing timely and practical information to increase yields and profitability. For example, if a farmer digs peanuts one week early, they might have yields 10% lower than if they'd waited, and if they dig 14 days too early, they might realize just 80% of the yield potential. When they made 4,000 on-farm consulting visits, Extension agents followed CDC protocols to protect themselves and their clients. These visits allowed farmers to optimize yields, secure high-quality crops, and increase profitability. For example, by using Extension advice, growers on just three farms were able to sell their wheat for an additional \$1.50 per bushel, increasing their total income by approximately \$337,500.

In the area of animal agriculture, researchers and Extension specialists worked to support an industry that accounts for 67% of North Carolina's agricultural income and jobs. Research laid a foundation for improved swine production through the development of the world's largest database on intestinal health and growth potential in nursery pigs, a major factor in pork producers' success. In the area of poultry production, researchers found that dietary supplementation with an alternative trace mineral source reduced nutrient emissions and maintained or improved growth, animal welfare and profitability; many poultry companies have adopted these new feed supplements. And with cattle production, Extension encouraged the use of truckload cattle sales that resulted in premiums of \$50 to \$200 per head. Also, Extension teamed with NC State's College of Veterinary Medicine to conduct cattle breeding soundness exam clinics that helped farmers identify infertile or marginally fertile animals, which allowed them to improve conception rates. In aquaculture, NC State research led to smart breeding techniques to bring low-cost, hormone-free, locally sourced hybrid striped bass to North Carolina markets, while Extension conducted fish health assessments at carp and trout farms to identify and correct fish health issues. Extension also produced free downloadable enterprise budgets allowing producers to assess the impact of the COVID-19 pandemic on their farms' economic future, to understand the scale of trout farming needed to be economically viable, and to examine their relative costs and returns.

Protecting Environmental and Natural Resources. Conservation and sustainable agriculture and timber production practices are critical to maintaining and improving the quality of life that North Carolinians depend on for their health and prosperity. Researchers found ways to convert swine waste and other agricultural leftovers into sustainable energy and organic fertilizer; to use porous fabric and vegetation to build low-cost windbreaks that are pending cost-share approval from USDA-NRCS to reduce air and odor pollution from swine farms; and to better manage on-farm water usage to reduce nutrient losses from farms into streams, estuaries and the ocean. They also made progress on better understanding the impact of saltwater intrusion on coastal wetland ecosystems and farms; the processes that control the fate, transport, bioavailability and human exposure to trace organic contaminants; and the dynamics of flow, concentration of pollutants, and cumulative loads from stream restoration. In addition, they used real-time remote systems to monitor drinking water quality for hundreds of thousands of North Carolinians; these systems protected people's health and saved one city more than \$1 million.

Meanwhile, Extension agents and specialists provided thousands of animal waste operators with virtual and in-person training and education enabling them to maintain required permits, implement best management practices, and avoid fines. They also helped protect water quality by partnering with government agencies

and others to install sites for demonstrating best management practices mitigating stormwater runoff, monitor water contamination caused by runoff, develop stormwater plans for schools and community colleges, and educate thousands of wastewater operators, erosion control professionals, environmental health specialists, septic system installers, engineers, soil scientists and others. In addition, their training programs helped more than 1,000 applicators of two important herbicides, paraquat and auxin, meet new requirements to safely use these chemicals.

Enriching Youth, Family and Community Well-Being. NC State professionals found creative ways to enrich youth, family and community well-being by delivering Extension programs online or with minimal contact that complied with CDC guidelines. For example, a health and safety program helped raise farmers' COVID-19 awareness and distributed 1 million masks to farmworkers. County agents helped with mass testing updates, launched a program to distribute pet food to struggling families and led the way in helping communities meet needs related to the rise in food insecurity. In addition, over 350,000 people accessed programs to support family economic well-being.

Meanwhile, 4-H made 161,638 educational contacts that helped young people gain knowledge and skills to make a difference in the world. 4-H reached them through individual study; family learning; and virtual club activities, educational enrichment, camping programs, and animal husbandry events. By participating in a 4-H opioid abuse education program, participating middle school-aged youth and their caregivers their improved knowledge and attitudes about healthy lifestyles, family communication and abuse of opioids. Meanwhile, Extension Master Gardener Volunteers not only helped people learn to grow food at home, but they also donated food to local agencies, ministries, and food pantries and organized no-contact food deliveries to families in need.

Enhancing Food Safety, Nutrition and Health. In 2020, through its research and Extension education efforts, NC State encouraged consumption of healthy foods, developed such foods, and helped protect the safety of food across the entire supply chain. Through research, it also laid the groundwork for important advances benefiting human health. For example, in response to statewide dining room closures during the pandemic, Extension worked with public and private partners to develop a food-safety program that delivered science-based best practices to 16,400 restaurant workers. Its SNAP-Ed program Steps to Health empowered youths and adults with limited resources to embrace nutrition, healthy living and effective food management strategies; the program made 28,364 direct educational contacts across the state and reached thousands of others through social media. Extension Master Food Volunteers reached more than 7,000 community members in 2020, providing food safety and nutrition to individuals with limited incomes, providing the public with nutritious recipes, educating people on food safety, and providing them with cooking skills. Close to 11,000 high school students gained knowledge from the food systems and local foods curriculum. And nearly 900 people participated in the Eat Smart, Move More, Prevent Diabetes program, which helped 84% lose weight and 43% achieve healthy A1c test results.

Through research, scientists investigated alternative vaccine methods to prevent diseases like those caused by the COVID-19 virus; one involved engineering an immune-system-boosting beneficial bacterium used in foods such as yogurts. Such vaccines could be delivered by mouth or nose and don't require ultra-low temperatures for storage. Researchers also found a way to use CRISPR technology to reduce C. diff infections, which causes diarrhea and colon inflammation, and are working with a startup company to test the effectiveness of using a gene-edited virus to search for and destroy the harmful pathogen. And to help farmers reduce public health risks associated with Salmonella, researchers discovered that the most important pathway for the bacterium to contaminate cucumbers is through blossoms.

While it was a challenging year, it is clear that NC State Extension and North Carolina Agricultural Research Service faculty and staff members worked hard under adverse conditions to advance knowledge and creatively deliver programs that met the changing stakeholder needs.

N.C. A&T Research and Extension

Fiscal Year 2020 was another highly productive year for researchers within the College of Agriculture and Environmental Sciences (CAES) and for the College's outreach efforts through Cooperative Extension at N.C. A&T. The work summarized here presents accomplishments from research projects involving 22 research scientists. Additionally, our Extension professionals at the county and campus levels worked to provide educational programs by way of hands-on learning experiences and educational materials that help the audiences we serve.

Cooperative Extension at N.C. A&T delivers educational programs and technology that enrich lives, land and economy in North Carolina. The mission is to provide educational programs to inspire North Carolina's underserved farmers, families, individuals, youth, and communities to make informed decisions to improve their lives. Extension at N.C. A&T uses a continuous long-range planning and evaluation process designed to allow the organization to adapt programs rapidly in response to emerging needs and issues. Due to the corona virus pandemic in 2020, the delivery of educational programs shifted to a virtual format. Using Zoom, Facebook, and other social media platforms, we were able to reach our clientele and offer educational workshops, conferences, etc. We also expanded our website ([COVID-19 Resources for the Public](https://www.ncat.edu) (ncat.edu)) to include COVID-19 resources. Despite the impact of COVID in 2020 and the significant decreased number of face-to-face contacts, CAES is proud to report on a number of accomplishments in the four areas that make up the College's four target integrative research clusters as well as accomplishments with community-based education through our Extension outreach programs.

Improving Plant and Animal Agricultural Systems. Research projects in this integrative cluster area focused on plant/crop production and animal systems. Research relating to plant/crop production included work on developing a local cultivation protocol involving micropropagation for producing ginger plants (which grow tropically outside the continental United States); determining cold- and heat-tolerance in green leafy vegetables; investigating the ways to extend the season using plastic film layer(s) for enhanced production and quality in North Carolina; increasing production and diversity in sweet potatoes; developing and understanding best management practices to grow tuber borchii truffles in North Carolina; using integrated non-toxic pest management techniques to improve crucifer production; and using commodity pricing analyses for assisting in policy planning to help guide the direction of agricultural enterprise and production. Researchers also worked with Extension faculty to advance the emergent hemp industry. Scientists focused on best management practices for several varieties of industrial hemp to share with North Carolina growers, N.C. A&T hosted a hemp conference on Feb. 11, 2020, which attracted more than 250 attendees. Research relating to animal systems focused on improving the physical and reproductive health of pigs by identifying feed supplements, such as moringa; identifying prevention and mitigation strategies to protect pigs against respiratory disease; characterizing the immune's system response to disease pathogens in ruminants to help determine ways to control and prevent disease; and using agricultural residue and crop extract (onion peel) to produce antibiotic free poultry.

In addition to our research activities, Cooperative Extension disseminated information gathered from Extension applied research and field demonstrations to assisted small-scale farmers in improving their crop and livestock production through several programs. For example, to make plasticulture production more accessible, in 2018 NC A&T created the Plasticulture Rental/Cash Back Program. Equipment is provided at county Extension centers across NC strategically located to reach as many farmers as possible. Rental net cost to the farmers is \$25/day. This program was updated in 2020 in response to COVID restrictions and in an effort to prevent the potential spread of disease for shared use equipment. Extension at A&T also continued to provide small farmers with the latest information on hemp production, including state and federal regulations, up-to-date research results, production techniques and challenges, and information on hemp's changing market and economic potentials. Six hemp workshops, one hemp webinar and one hemp conference reached more than 310 farmers, Extension professionals and hemp enterprises. The Extension horticulture unit conducted applied research and demonstration projects in high tunnels on cool-season vegetables (kale, swiss chard, lettuce, bok choy and carrots), warm-season vegetables (tomato, bell paper, eggplants, cucumber, melon and watermelon), and ginger. Two field guides, one on field fruiting vegetables, and another on high tunnel tomatoes, were developed and distributed. A comprehensive high tunnel field guide was developed for final design and publishing.

In response to COVID-19, Extension staff created and published a wide range of fact sheets and videos designed to help the public understand and cope with the pandemic and continue their farm operations safely. The website "COVID-19 Resources for the Public" (<https://www.ncat.edu/caes/cooperative-extension/covid-19/index.php>) includes 16 fact sheets and videos related to small-scale farming and community gardening.

Protecting Environmental and Natural Resources. Research in this integrative cluster area addressed the development of waste based biorefinery for the recovery of energy, nutrients, and water from agricultural and food waste for sustainable agricultural production. Additionally, Extension staff worked with landowners in Columbus and Bladen counties on forest management and establishment programs to improve their timberlands' economic viability through wood fiber production and outdoor recreation. Although COVID-19 delayed some of these efforts, one landowner along the Waccamaw River has prepared his 90 acres for production and recreation using herbicidal chemicals to control vegetation. His long-term plan is to improve the recreational value of the land and increase his income by establishing nature trails, campsites, and areas for hunting.

Enhancing Food Safety, Nutrition and Health. Research projects in this integrative cluster area included development of a low fat frying process involving a coating that retains less oil from the frying process and provides a healthier coating batter (sweet potato starch vs. corn starch); development of local strains of *L. bulgaricus* as new sources of yogurt creating bacteria; investigation of the use of non-toxic natural products (essential oils, grape seed extract, phenolic extract) as alternatives to replace toxic fumigants in post-harvest storage of corn; and identification of dietary compounds that can be obtained from parts of food plants typically discarded that have the potential to prevent obesity.

Extension programs targeting food safety, nutrition and health included the Expanded Food and Nutrition Education Program (EFNEP) and SNAP-Ed, both of which reach low-income parents and families with education on nutrition, health and food safety. Due to the pandemic, social distance guidelines, and in-person gathering restrictions, programming efforts were extremely limited. The Speedway to Healthy program visited only one county (Alexander), reaching 318 youth. All other 2020 scheduled and/or new bookings were canceled. These include scheduled activities in Burke, Hertford, Rutherford, Stanly, and Swain counties. Plans are underway to move Speedway to Healthy to a virtual environment which will allow 24/7 access to children and families within their homes, schools, and youth organizations. The pandemic also created a need to reach out to North Carolina residents coping with food insecurity, whose challenges were made even more severe by job losses, market shutdowns, and a lack of support services such as school lunch programs. County food drives held for Small Farms Week 2020 helped to feed needy families and senior citizens. Extension staff at the University Farm donated more than 800 pounds of produce grown in high tunnels to Greensboro area nonprofits and 4-H members in Mecklenburg County assembled and distributed more than 400 starter garden kits so families could learn to grow their own food. The website, "COVID-19 Resources for the Public" included 11 printable fact sheets related to nutrition and wellness and staying healthy during the pandemic.

Enriching Youth, Family & Community Well-Being. Research projects in this integrative cluster area included the study of factors that influencing aging in place like housing, residential environment, and their physical activity levels; working with residents to improve their lifestyles and eating habits; and addressing the nutrition, well-being, and self-sufficiency of adults with disabilities through a mentoring program.

Extension programs in this area included a four-day leadership training, "Clover Night Live Edition", which was conducted virtually. The training was part of the Leaders in Training (LiT) program, which was created in 2018 to reach limited-resource 4-H members ages 13-18 with a structured leadership program that uses trained facilitators to teach leadership skills to teens. The Computer Science Pathways Program, supported by the National 4-H Council and Google, builds computer science skills in teens to prepare them for the 21st century workforce and allows teens to become computer science teen leaders in their communities.

COVID-19 also required the Extension 4-H program to find new ways to reach its audience. One successful program was the statewide "4-H Mystery Challenge" series. This series, which ran from March through May of 2020, was orchestrated to engage youth and families in learning opportunities while being quarantined.

II. Merit and Scientific Peer Review Processes

The NIFA reviewer will refer to your 2020 Plan of Work. Use this space to provide updates as needed or activities that you would like to bring to NIFA's attention.

Process	Updates ONLY
1. The <u>Merit Review Process</u>	No updates
2. The <u>Scientific Peer Review Process</u>	No updates

III. Stakeholder Input

The NIFA reviewer will refer to your 2020 Plan of Work. Use this space to provide updates as needed or activities that you would like to bring to NIFA’s attention.

Stakeholder Input Aspects	Updates ONLY
<p>1. Actions taken to seek stakeholder input that encouraged their participation with a brief explanation</p>	<p>NC A&T: The Strategic Planning Council (SPC) membership is comprised of 24 influential volunteers representing the broad diversity of North Carolina's population. Because of their knowledge as it relates to the local perspectives, council members assist with identifying, analyzing, and prioritizing issues which impact limited-resource individuals, families, and communities.</p> <p>The Small Farms Task Force is a group formed by Cooperative Extension at N.C. A&T that targets areas within the state to optimize the use of Cooperative Extension resources and the development of appropriate strategies to ensure the sustainability and success of small farms. The group solicits community input about relevant issues and challenges in sustaining rural communities and small farms. The input from the Small Farms Task Force helps to improve Cooperative Extension’s programming efforts within the targeted areas so that resources can be used most effectively, and broad-based strategies can be implemented to help sustain family farms and improve the quality of life and well-being for small farm families and rural communities.</p>
<p>2. Methods to identify individuals and groups and brief explanation.</p>	<p>NC A&T: The advocacy efforts of the CAES Advisory Board and the Strategic Planning Council helped to secure \$3M in state matching funds.</p>
<p>3. Methods for collecting stakeholder input and brief explanation.</p>	<p>No updates</p>
<p>4. A Statement of how the input will be considered and brief explanation of what you learned from your stakeholders.</p>	<p>Beginning March 2021, Extension will conduct a statewide needs assessment in 2021. The assessment will allow stakeholders an opportunity to share feedback about current and emerging needs and trends related to our four primary programmatic areas (4-H Youth Development; Agriculture and Natural Resources; Community and Rural Development; and Family and Consumer Sciences). The data collected during the need assessment project will be used to inform our strategic plan update, program development and research opportunities.</p>

IV. Critical Issues Table of Contents

No.	Critical Issues in order of appearance in Table V. Activities and Accomplishments
1.	Improving Plant and Animal Agricultural Systems
2.	Protecting Environmental and Natural Resources
3.	Enhancing Food Safety, Nutrition and Health
4.	Enriching Youth, Family & Community Well-Being
5.	
6.	
7.	

V. Activities and Accomplishments

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

No.	Project or Program Title	Outcome/Impact Statement	Critical Issue Name or No.
1.	Invasive Insect Genome Sequencing Lays Groundwork for Targeted Pest Management (NC State)	<p>The western flower thrips is an invasive insect that causes billions of dollars in damage to a broad range of food, fiber, and ornamental crops each year. Thrips is a major pest in the Southeast U.S. and California, but it can cause substantial damage in any area of the world that produces large fruit and vegetable crops. Thrips damage plants by laying their eggs on them and infecting them with viruses, including tomato spotted wilt virus, which is notorious for infecting more than 1,000 plant species and being difficult to control.</p> <p>NC State has partnered with researchers worldwide to sequence and analyze the western flower thrips genome. Researchers have identified sets of genes that contribute to thrips’ development, reproduction, and ability to survive natural threats and pesticides.</p> <p>Current research efforts are focused on identifying the way in which thrips spread viruses, which could lay the groundwork for promising new crop preservation methods. This research also represents the first genome sequence and analysis for</p>	Improving Plant and Animal Agricultural Systems

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		<p>Thysanoptera, an order that includes over 7,000 species of small insects with fringed wings. Thus, it represents a groundbreaking contribution to broader pest and disease management efforts. This project’s results exemplify the progress being made through the North Carolina Plant Sciences Initiative; a major interdisciplinary effort designed to address the biggest challenges facing agriculture today.</p> <p>See https://cals.ncsu.edu/news/insect-insights/ for more information.</p>	
<p>2.</p>	<p>New Sweet Potato Curing Technique Prevents Multimillion-dollar Crop Losses (NC State)</p>	<p>North Carolina is the nation’s leading sweet potato state, with the crop valued at \$350 million annually. The Covington variety of sweet potatoes represents approximately 90% of that crop. Although Covington sweet potatoes are high yield, nutritious, and easily stored, they are susceptible to internal necrosis, a process caused by pests or pathogens that results in black spots and patches on the inside of the root. Because these spots are formed only at the end of the root closest to the vine, it is impossible to determine if a root has internal necrosis without cutting into it. According to a 2010 and 2011 survey conducted by an NC State task force, 90% of sweet potato storage rooms surveyed contained roots with internal necrosis. In most cases, less than 10% of the sweet potatoes examined had signs of internal necrosis, but some producers had more than 30% of their roots affected, often to the point of being unmarketable.</p> <p>By comparing roots grown under different commercial growing conditions and stored in different commercial facilities, it became clear that the curing conditions immediately after harvest had a pronounced effect on internal necrosis incidence and severity. In response, NC State researchers have developed a heat treatment curing process that supports root healing and greatly reduces the incidence and severity of internal necrosis in Covington sweet potatoes.</p> <p>These new curing conditions have prevented millions of dollars in damages from crop loss and preserved the viability of a high-value sweet potato variety. Identifying these solutions was enabled not only by the efforts of the interdisciplinary research team but also by the collaborative efforts of Extension agents, research station personnel, and partner farms. Such an interdisciplinary approach is key to the North Carolina Plant Sciences Initiative, a major effort designed to address the biggest challenges facing agriculture today.</p> <p>See https://cals.ncsu.edu/psi/news/nc-state-team-finds-solution-for-sweetpotato-problem/ for more information.</p>	<p>Improving Plant and Animal Agricultural Systems</p>

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<p>3.</p>	<p>NC State Researchers Discover Novel Non-GMO Plant Editing Techniques with Broad Industry Applications (NC State)</p>	<p>Genetically modified organisms (GMOs) have been a source of frequent controversy and confusion for consumers, with many preferring non-GMO products. According to the USDA and the FDA, the defining characteristic of a GMO crop is the presence of DNA from other species in the finished product. In addition, GMOs must undergo a rigorous evaluation process that renders GMO crops more expensive and complex to bring to market. However, given rising demands for more efficient and sustainable crop production, and given the looming threats of climate change, scientists need effective ways to introduce plant DNA changes that enhance crop resilience.</p> <p>NC State researchers have discovered a promising new non-GMO method for delivering beneficial genetic content directly into plant cells, without introducing any foreign DNA. This allows for precise genetic deletions or replacements without inserting foreign DNA; therefore, the end product is not a genetically modified organism, or GMO.</p> <p>This novel approach could be applied to deleting or turning down a gene, such as the one responsible for turning sliced apples brown. Similarly, a sweet potato variety could be made more pest resistant by altering its genes using non-GMO methods. In addition, this non-GMO technique could be significantly more attractive to consumers. Researchers are continuing to refine this method and develop new non-GMO gene editing techniques with promising applications, particularly in enhancing nursery crops and sweet potatoes. With its potential for helping transform agriculture, this project aligns well with the goals of the North Carolina Plant Sciences Initiative, a strategic university effort to advance agriculture and the biological sciences.</p> <p>See https://cals.ncsu.edu/news/crispr-plants-new-non-gmo-method-to-edit-plants/ for more information.</p>	<p>Improving Plant and Animal Agricultural Systems</p>
<p>4.</p>	<p>NC State Brings Revolutionary 3D Bioprinting Technology to the Quest for Hardier, More Nutritious, and More Sustainable Crops (NC State)</p>	<p>The first functional 3D printer was developed in 1984, and the technology has come a long way since then. Everything from replacement parts to prototypes to human organs have been 3D printed. NC State researchers are the first to begin applying this breakthrough technology to plants. Traditional 3D printers construct an object by laying down successive layers of materials, all under the control of a computer. 3D bioprinting applies the same principles. But instead of printing with materials like metals or plastics, a bioprinter creates patterns using living cells as its ink. By applying the basic principles of 3D-printing, bioprinting enables the creation of biological tissues. Bioprinting has already yielded promising results for human healthcare and veterinary science.</p>	<p>Improving Plant and Animal Agricultural Systems</p>

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		<p>Plant scientists and mechanical and aerospace engineering researchers at NC State have successfully completed the first stages of creating 3D-printed plants. By isolating and precisely distributing stem cells layer by layer, scientists can form a living “blueprint” that can develop into a fully formed plant with carefully selected genetic traits. This research has the potential to revolutionize agriculture by allowing scientists to create more nutritious, more stress-resistant plants, thus enhancing the industry’s ability to meet constantly increasing global demands for food, biofuel, and fiber. This project’s lead researchers are helping pave the way forward for the North Carolina Plant Sciences Initiative, with its goal of solving significant agricultural challenges.</p> <p>See https://news.ncsu.edu/2019/08/3d-printing-plant-science/ for more information.</p>	
5.	NC State Researchers Partner Internationally to Combat a Devastating Crop Virus (NC State)	<p>Geminivirus disease poses a serious threat to vegetable crops in the U.S. and causes severe losses of staple crops in the developing world. A better understanding of geminivirus infection and evolution, as well as the genes that provide resistance to it, will greatly facilitate the development of resistant crops.</p> <p>NC State researchers have played a key role in illuminating the processes by which geminiviruses infect and harm plant cells. These experiments have led to new plant DNA research areas and laid the groundwork for ongoing studies aimed at developing crops that are resistant to geminivirus infection. NC State scientists are currently working with Tanzanian researchers to understand how two particular DNA sequences enhance viral disease processes and overcome viral resistance in cassava, an important staple crop in the developing world.</p> <p>NC State scientists are also working with other U.S. scientists and African partners in Kenya and Tanzania to understand what drives geminivirus evolution, and they are collaborating with researchers in the United Kingdom and Tanzania to develop instruments that can rapidly detect infected cassava plants shortly after infection. All of these insights have the potential to transform agriculture in the U.S. and in Sub-Saharan Africa. By addressing some of the biggest challenges facing agriculture today, this project’s success is consistent with the goals of the North Carolina Plant Sciences Initiative at NC State,</p>	Improving Plant and Animal Agricultural Systems
6.	NC State Pairs Breakthrough Genetic Research with New Variety Releases to Invigorate the Sweet Potato Industry (NC State)	<p>Sweet potatoes are the most important vegetable crop in North Carolina. The state produces roughly 60% of the nation’s crop, valued at \$300 million annually. To remain competitive, the state’s growers need new varieties to address production needs and changing market opportunities. However, sweet potatoes have six copies</p>	Improving Plant and Animal Agricultural Systems

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		<p>of each gene, or three from each parent. This makes it very complicated to pinpoint the genes associated with desirable traits.</p> <p>To meet this challenge, NC State researchers have created complex genetic maps that illuminate sweet potato genes associated with high yield, disease resistance, and other desirable traits. This represents the first successful sorting and mapping of genetic inheritance for a plant as genetically complex as the sweet potato. Using sophisticated computational tools and algorithms, researchers have written a groundbreaking study on the sweet potato genome. Scientists have also been working with the International Potato Center to support food security in Sub-Saharan Africa through sweet potato breeding.</p> <p>NC State’s sweet potato breeding program has released over 20 varieties of ornamental sweet potatoes in the last several years in collaboration with Proven Winners, a corporate partner. NC State’s ‘Sweet Caroline,’ ‘Illusion,’ ‘Bewitched,’ and ‘Medusa’ ornamental sweet potatoes have become breakaway industry leaders and have generated an estimated \$94 million for a wide range of greenhouse, nursery, and floricultural businesses.</p> <p>NC State’s sweet potato breeding program is also developing varieties that produce higher-quality chips and fries, which could eliminate the need for expensive added production steps for these highly popular snacks. Two clones are in large-scale commercial testing and will likely be released in 2021. Processors are already considering product launches based on these new clones, which could increase sweet potato consumption and opportunities for North Carolina growers. Scientists working on this project continue to advance the sweet potato industry, and agriculture generally, through their leadership in the North Carolina Plant Sciences Initiative, a major effort aimed at solving grand agricultural challenges.</p> <p>See https://cals.ncsu.edu/news/sweetpotato-genome-map/ for more information.</p>	
7.	<p>Low-Cost Remote Crop Monitoring System Could Yield Big Gains for Farmers and Researchers (NC State)</p>	<p>Early identification of crop problems is key to preventing losses, but high-tech solutions can be unaffordable, particularly for smaller farming operations. An interdisciplinary team of NC State researchers are launching an inexpensive camera monitoring system for crops. This system costs less than an average smartwatch (~\$200) and can be used to remotely track drought stress in corn and soybean fields.</p> <p>The StressCam system is based around a Raspberry Pi, a tiny, inexpensive, and easily programmed computer. StressCam connects a WiFi-enabled Raspberry Pi with a camera for taking field pictures and a timer that turns the system on in the morning and off in the evening. In addition, every 15 minutes the camera sends an SMS</p>	<p>Improving Plant and Animal Agricultural Systems</p>

		<p>message with information about the crops’ water stress levels and the status of the camera. The angle of the camera and the timer can be adjusted to suit the needs of different crop fields. The system is also solar-powered, with a back-up battery for cloudy days.</p> <p>After the photos are taken, the tiny computer runs an algorithm to analyze the photos for indications of drought stress. It then sends the information to a web platform for researchers, breeders, or farmers. Researchers have also worked with a team of NC State seniors to design a cloud-based web platform to manage StressCams and monitor fields. This platform allows users to check the StressCam for overheating, change photo scheduling, and look at previously captured images and drought stress scores, which saves time and increases the precision of drought data collection.</p> <p>In addition to providing farmers with a smarter method for reducing crop losses, these low-cost sensors can help researchers conduct studies to design more resilient agricultural systems and breed more drought-tolerant varieties. These sensors may eventually be able to alert farmers when their fields need irrigation. This project exemplifies the kind of results being made possible through the North Carolina Plant Sciences Initiative; a strategic university effort aimed at solving grand agricultural challenges.</p> <p>See https://cals.ncsu.edu/news/low-cost-cameras-could-be-sensors-to-remotely-monitor-crop-stress/ for more information.</p>	
<p>8.</p>	<p>NC State Researchers Close in on the Genetic Key to Ozone Tolerance in Plants (NC State)</p>	<p>North Carolina is one of many areas in the U.S. that experience elevated ground-level ozone concentrations. Although ozone pollution is often perceived as an urban issue, the problem is regional in scope and includes agricultural areas. Electrical power generation facilities and automobiles can generate emissions that move as plumes into rural areas, where they interact with heat and sunlight and produce ozone. In addition to its negative effects on human health, ozone has been shown to reduce the growth, yield, health, and appearance of vegetation.</p> <p>To address ozone pollution vulnerability in crops, NC State researchers are identifying and comparing ozone-sensitive and ozone-tolerant plant varieties to determine the biochemical, physiological, and genetic basis for ozone tolerance. Critical factors in plant ozone tolerance have been identified, and 30 soybean ancestors representing 92% of the pedigree of modern U.S. cultivars have been screened for ozone tolerance, yielding a promising groundwork for the future development of ozone-tolerant breeding lines.</p>	<p>Improving Plant and Animal Agricultural Systems</p>

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<p>9.</p>	<p>Tissue-cultured ginger for N.C. growers (NC A&T)</p>	<p>Since the demise of tobacco as North Carolina’s major cash crop, farmers have been searching for a high-revenue, high-demand crop to replace it. Ginger, which enjoys consumer demand, high price per pound, and increasingly well-known health benefits, has the potential to be a profitable niche crop for N.C. growers. The aim of this project is to study the feasibility of growing ginger in North Carolina using ginger plants grown from tissue-cultures.</p> <p>Research and Extension faculty at N.C. A&T have grown seven varieties of ginger under varying conditions, including high-tunnel and greenhouses, and evaluated them for such variables as shade tolerance, yield, resistance to disease and cold-hardiness. In the lab, the researchers are perfecting protocols for growing micropropagated ginger.</p> <p>The micropropagated ginger shows great promise, demonstrating better resistance to disease, significantly more vigorous and healthier growth, higher yield per cultivar and an overall better consistency than seed-sprouted ginger.</p>	<p>Improving Plant and Animal Agricultural Systems</p>
<p>10.</p>	<p>Research and education related to industrial hemp production (NC A&T)</p>	<p>Hemp is a multipurpose crop that delivers seeds, fibers, and bio-active chemicals and has the potential for a number of uses and markets. The legalization of hemp production in North Carolina and the continued interest in growing hemp by small farmers has created a need for both research related to hemp and Extension outreach activities. To legally grow hemp in the state, THC concentrations must be below .3 %. To meet this requirement and produce industrial hemp varieties that have high cannabinoid (CBD) levels, optimum growing conditions (soil type, fertilization rate) and best management practices for cultivation need to be established. N.C. A&T is conducting research to determine optimum soil conditions for the production of industrial hemp for CBD. Two industrial hemp varieties treated at four different fertilizer rates were tested in the field during the 2018, 2019, and 2020 growing seasons. Chemical analysis of the two tested hemp varieties (Spectrum and Therapy) indicated that the project’s production methods yielded high concentrations of CBD (~8% - 10%) in both varieties while staying within the legal limit of THC concentration.</p> <p>In addition to the continuing hemp research, Extension continues to work with researchers to help farmers understand the potential value of growing hemp and decipher state and federal regulations that many small farmers find confusing. N.C. A&T hosted a hemp conference on Feb. 11, 2020, which attracted more than 250 attendees. Presenters shared information about hemp production, marketing and economics, licensing, the latest research, post-harvest processing, and federal and</p>	<p>Improving Plant and Animal Agricultural Systems</p>

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		<p>state regulations. Extension at A&T continued to provide small farmers with the latest information on state and federal regulations, up-to-date research results, production techniques and challenges, as well as the changing market and economic potential of hemp. In addition to the hemp conference, six hemp workshops and one hemp webinar were organized. Two hemp field guides, one for fiber and grains and another for CBD, were developed and distributed. The workshops, webinar and conference reached more than 310 farmers, Extension professionals and hemp enterprises. Feedback from farmers and agents revealed that participants had become fully equipped with the latest state, USDA and FDA regulations on hemp, hemp production techniques, and the latest research findings. Additionally, a comprehensive hemp guide was drafted by the end of 2020.</p> <p>Industrial Hemp Program (ncat.edu)</p>	
<p>11.</p>	<p>Plasticulture Rental/Cash Back Program for NC Small Farmers (NC A&T)</p>	<p>Plasticulture production has been proven to increase yields and extend the growing season for small farmers. However, plasticulture equipment is expensive and beyond the reach of many. Due to the high initial cost of purchasing plasticulture equipment, small farmers do not routinely take advantage of the benefits plasticulture production offers. Among them are earlier harvests, better weed control, enhanced watering efficiency, and better plant nutrition through targeted nutrients applied through the drip irrigation lines. Adopting plasticulture production has the potential to increase yields and profits for NC small farmers.</p> <p>A blog post on the USDA website recognized the impact of 1890 land-grant universities and calls out the Extension at A&T plasticulture program as an effort that helps small farmers extend their growing seasons, control weeds, and enhance water efficiency, all while saving money. To make plasticulture production more accessible, in 2018 N.C. A&T created the Plasticulture Rental/Cash Back Program. Equipment is provided at strategically placed county Extension centers across North Carolina. Rental net cost to the farmer is \$25/day.</p> <p>Low-cost rental has expanded the use of plasticulture production across North Carolina. In 2020, despite operating under restrictions due to the COVID-19 pandemic, the equipment was rented by 12 individual small farmers. Of those, eight reported being first time users of the N.C. A&T plasticulture program and two reported being first time users of plasticulture as a production method. Savings for NC small farmers in 2020 totaled \$23,405 when compared to the cost of purchasing new equipment. Total savings for small farmers since the program began in 2017 is \$90,985. Farmers in 14 North Carolina counties have used the equipment.</p>	<p>Improving Plant and Animal Agricultural Systems</p>

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		<p>Without this low-cost rental program, it is doubtful many small scale, limited resource farmers would be able to take advantage of the increased production plasticulture offers. This would erode their potential for profitability and could potentially accelerate the loss of farmland in North Carolina.</p> <p>Beginning in March 2020, there was much uncertainty as to the feasibility of continuing to operate the plasticulture program during the pandemic. Governor’s directives, travel restrictions, farmer and employee safety, and limited operations at the rental locations, including the University Farm, forced a hard look at the viability of moving forward.</p> <p>A task force consisting of administrators, specialists, and associates in consort with University Legal drafted and adopted additional rules which allowed the program to continue operating during the COVID-19 pandemic. Specifically, additional checkpoints were implemented requiring farmers to certify they were not currently sick; they had not to their knowledge been exposed to COVID-19; they would practice social distancing in their plasticulture operations; they would wear face masks when engaged in plasticulture operations; and they would clean and sanitize the plasticulture equipment prior to returning it to the pickup location.</p> <p>To further ensure the safety of all involved in the rental process, agents at the return locations were required to clean and sanitize the equipment upon return.</p> <p>These additional safety precautions have allowed the plasticulture program to continue to operate during these difficult times. As a result, the 12 farmers who utilized the rental program were able to expand and diversify production on farms ranging from six to 400 acres. These farmers employed plasticulture on 20 acres of production area, producing a variety of crops including vegetables, hemp, cut flowers, herbs, and berries. Without the continued operation of the program, it is doubtful that these farmers would have taken advantage of the increased production plasticulture offers due to the high initial cost of purchasing plasticulture equipment.</p>	
<p>12.</p>	<p>Smart Breeding Techniques Bring Low-Cost, Hormone-Free, Locally Sourced Fish to North Carolina Markets (NC State)</p>	<p>Americans lack easy access to high-quality seafood products and must rely heavily on imports, while local seafood producers struggle to balance efficiency, cost demands, and increasing concerns about the health effects of the hormones used to breed sea animals in captivity. These obstacles have resulted in a \$16 billion seafood industry trade deficit. Currently, there is no appreciable aquaculture of white-fleshed marine fishes in the country, due to the limited number of candidate species. A candidate species has a premium price, high consumer demand, and adapts well to localized</p>	<p>Improving Plant and Animal Agricultural Systems</p>

		<p>production environments. Research conducted over several years shows that striped bass meets all of these criteria.</p> <p>Hybrid striped bass are the fourth most farmed fin fish in the U.S., behind only catfish, salmonids, and tilapia. In North Carolina this industry accounts for approximately 3.5 million pounds of annual production with a farm-gate value of nearly \$14 million. While hybrid striped bass is a successful freshwater aquaculture species, particularly in the South and Midwest (\$50 million farm gate value in 2018), there is an untapped demand for pure-strain marine striped bass by consumers in coastal states. To address this problem and meet the significant demand for marine striped bass, NC State researchers have developed a hormone-free method to farm striped bass more efficiently and less expensively than ever before. This method has allowed the NC State team to produce five million captive striped bass offspring—the equivalent of an entire season’s yield—from a single spawning event.</p> <p>This is the first time that researchers have reported successful breeding of captive striped bass without hormones, and it has massive implications for the \$50 million dollar hybrid striped bass industry. The new breeding method has the potential to seed the entire industry with as few as six or seven spawning events annually, all while reducing costs and producing farm-raised striped bass that reach twice the weight of domesticated hybrid striped bass.</p> <p>See https://cals.ncsu.edu/applied-ecology/news/farmed-striped-bass-without-hormones-or-the-price-tag/ for more information.</p>	
<p>13.</p>	<p>New Poultry Feed Fortification Approaches Enhance Sustainability and Animal Wellbeing (NC State)</p>	<p>Many poultry producers attempt to increase their profitability by fortifying their feed. Over-fortification of poultry feed can cause nutrients and trace minerals to leech into the environment. Alternative mineral sources, although more expensive, are more easily absorbed by the body and can therefore be used to supplement feed much more efficiently.</p> <p>NC State researchers have demonstrated that dietary supplementation with an alternative trace mineral source (organically complexed trace minerals) can reduce nutrient emissions by over 75% while still resulting in equal or superior growth performance, animal welfare, and production profitability. Another study demonstrated an effective method for reducing nutrient supplementation levels by 70% without adverse effects on growth performance and with the added benefit of improved gut health.</p> <p>The results of this research were published in peer-reviewed and popular press journals and distributed via Extension education programs. In addition, many poultry</p>	<p>Improving Plant and Animal Agricultural Systems</p>

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		companies have adopted new practices based on this research, patents have been awarded based on the findings, and a commercial company is currently developing a marketing plan for a novel technology based on the research.	
14.	NC State Researchers Develop World's Largest Database for Studying Intestinal Health and Growth Potential in Nursery Pigs (NC State)	<p>The intestinal health of young pigs is a major factor in the success of pork producers. However, there is no clear understanding of the relationship between intestinal health and growth in pigs. To address this problem, NC State researchers have collected and analyzed intestinal samples from over 2,000 nursery pigs to create the world's largest database for specialized information on key intestinal health markers and their relationship with growth performance in nursery pigs.</p> <p>This research has laid a critical foundation for enhancing pork production through improved intestinal health. This database is based on over 17 peer-reviewed research papers in scientific journals and six research abstracts from NC State's Kim Lab. Research publications from Kim Lab were cited over 2,000 times since 2020 (or 13,700 times total). In addition, the head researcher behind this effort has had meetings with five industry-leading companies and five academic symposia across two countries.</p>	Improving Plant and Animal Agricultural Systems
15.	Crop Production Meetings Increase Profits (NC State)	<p>Research conducted by NC State University helps growers produce field crops more efficiently. It is important that educational information addressing these issues reaches growers across the state. With assistance from NC State Extension specialists, NC Cooperative Extension agents hosted a number of virtual crop production meetings for growers across the state in 2020. Producers received the latest research-based information to use on their farms, and many also received pesticide license continuing education credits at these events.</p> <p>During one of the meetings, growers were surveyed and asked to place a value on this education and on impacted acres. Survey results indicated that 201 producers representing an estimated 64,850 acres would use information gained from these production meetings to increase profitability, an average of \$23.33 per acre. This represents an educational value of \$1.5 million for the meetings in one county.</p> <p>In each of the last 49 years, farmers representing the Blackland Farm Managers Association have worked with Extension agents and specialists to host the annual Blackland Farm Managers Tour. Due to COVID-19 meeting restrictions, the 50th anniversary of the event was changed to a virtual format. Only around 700 participants were anticipated, but the move to a virtual format attracted over 3,291</p>	Improving Plant and Animal Agricultural Systems

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		<p>people. This effort provided almost 2.75 hours of unbiased, research-based information to growers in a way that was not previously possible.</p> <p>As a result of NC Cooperative Extension programs and services, 76,745 crop producers adopted best management practices, including those practices related to nutrient management, conservation, production, cultivars, pest management, business management, and marketing. In addition, 8,119 producers gained skills or knowledge to increase production for local markets. NC State Extension’s leadership in experiential education equips agricultural producers to effectively transfer knowledge and skills into practical application.</p>	
<p>16.</p>	<p>NC State Extension’s Integrated Weed Management Training Reduces Environmental and Economic Impact of Herbicide Resistance (NC State)</p>	<p>Herbicide-resistant weeds are increasing in prevalence throughout the U.S. In North Carolina, the most difficult to control include common ragweed, horseweed, and Palmer amaranth. These weeds can reduce crop yields and quality and interfere with harvesting. They can also increase weed control costs. The presence of herbicide-resistant weeds in cotton and corn alone represents an approximately \$50 million threat to North Carolina producers. In addition to the increased herbicide costs, some growers have resorted to hand-pulling Palmer amaranth at an approximate cost of \$23 per acre.</p> <p>NC State researchers have developed an integrated approach to managing common ragweed, Palmer amaranth, and horseweed. This approach includes cultural, mechanical, and chemical tactics that preserve yields while decreasing herbicide usage and associated costs and reducing stress on the environment. In 2020, researchers evaluated the effectiveness of new cotton cultivars in controlling common ragweed and Palmer amaranth.</p> <p>Control recommendations for each weed were delivered to stakeholders via field days, Extension publications, and professional meetings, including the 2020 Virtual Cotton Field Day and three Extension cotton and peanut agent trainings. The results of this research were also used to update North Carolina and regional weed management guides. North Carolina Cooperative Extension’s Hoke, Robeson, and Scotland Centers partnered with NC State’s Cotton Extension Program to hold an educational meeting for 83 participants to emphasize tools to better manage production risks. Through this program, 92% of participants increased knowledge of the Cotton Seed Quality Program, 65% increased knowledge of the cotton variety selection tool, and 65% increased knowledge of economic pest thresholds.</p> <p>As a result of the program, 78% of the participants stated they intended to use NC State’s Cotton Variety Calculator to assist them in making the right seed selection,</p>	<p>Improving Plant and Animal Agricultural Systems</p>

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		<p>72% stated they intended to use auxin herbicide technology to help manage problematic weeds, and 67% stated they plan to use the NC State Thrips Flight Predictor Tool to reduce damage caused by the insect. Growers and crop consultants who attended the program represented 23,450 acres of cotton. Financial indicators revealed the average benefit to participants was \$4.65 per acre. The total economic program benefit was valued at \$109,042. NC Cooperative Extension has significantly influenced cotton production by giving producers valuable tools to help manage risk. NC State Extension, transfers research-based knowledge to North Carolinians.</p>	
<p>17.</p>	<p>Produce Safety (NC A&T)</p>	<p>Farmers are always in need of the latest information on produce safety, and COVID-19 made that need even greater.</p> <p>Online platforms have allowed Extension specialists to deliver educational programs to farms to understand how COVID-19 affects those involved in fruit and vegetable production. The programs provided information on properly cleaning, sanitizing, and disinfecting work areas, and applied guidance issued by the CDC, the FDA, and the U.S. Department of Labor at the farm level. Extension specialists continued to deliver produce safety training for small-scale farm owners and their workers, including good agricultural practices, audits and certifications required by buyers, and assistance with general product safety and COVID-19 related information.</p> <p>During early 2020, three workshops were offered that discussed approaches to treating water on the farm; approximately seventy (70) growers participated in the training. Two hands-on workshops discussing cleaning and sanitation practices at produce farms were offered in Eastern and Western NC. The content of these workshops was timely and critical as the COVID-19 pandemic unfolded. Fifty (50) producers called Extension offices for information on food safety. The produce safety specialist has participated in numerous webinars to help farmers address COVID-19 concerns. Educational materials such as video and fact sheets that address produce safety and COVID-19 were produced and disseminated to farmers.</p> <p>N.C. A&T jointly organized and conducted the NC Produce Safety Professionals Session for Extension agents across the state via Zoom. Sixty (60) participants attended this event. The topic of this event was cleaning and sanitation for produce operations. Nationally renowned speakers were in attendance from academia, industry, and trade associations.</p>	<p>Improving Plant and Animal Agricultural Systems</p>

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<p>18.</p>	<p>Helping to Empower Community Gardeners (NC A&T)</p>	<p>Many rural and limited-income communities have little access to fresh and healthy foods. Community gardens can give them an affordable source of fresh food while beautifying the community and building community partnerships.</p> <p>A three-year, \$206,000 grant from the Blue Cross and Blue Shield of North Carolina Foundation will enable Extension at A&T to strengthen the state’s network of community gardens, build the leadership capacities of community gardeners, and connect community gardens to local, regional, and statewide food system transformation efforts. The project brings together Extension at A&T and the North Carolina Community Garden Partners (NCCGP), a grassroots initiative that supports gardens across the state, to provide technical support to gardens and leadership training to gardeners so they are able to influence food policy and address the problems of food deserts and food inequities.</p> <p>The program is being launched this year.</p>	<p>Improving Plant and Animal Agricultural Systems</p>
<p>19.</p>	<p>Production of Specialty Crops (NC A&T)</p>	<p>Small farmers are continually looking for ways to increase production and profits without incurring excessive costs. Techniques that help them in this endeavor lead to small farms that are more profitable and sustainable.</p> <p>Specialty crops such as vegetables and small fruit are high value crops for small farms. Season extension with the low-tech structures, such as high tunnels, are proven tools that help small farmers increase on-farm profitability. In 2020, extension horticulture unit conducted applied research and demonstration projects in high tunnels on cool-season vegetables (kale, swiss chard, lettuce, bok choy and carrots), warm-season vegetables (tomato, bell pepper, eggplants, cucumber, melon and watermelon), and ginger. Two field guides, one on field fruiting vegetables, and another on high tunnel tomatoes were developed and distributed. A comprehensive high tunnel field guide was developed for final design and publishing.</p> <p>Farmers now have comprehensive literature on specialty crop production that answers their questions and could allow more farmers to increase on-farm profitability.</p>	<p>Improving Plant and Animal Agricultural Systems</p>
<p>20.</p>	<p>NC State Extension Provides Critical Support to Trout and Carp Farms (NC State)</p>	<p>With sales approaching \$7.9 million annually, North Carolina ranks second in the U.S. in commercial trout production, behind Idaho. However, the trout industry faces major challenges in fish health, waste management, and general farm management. Drought and related low flows and high-water temperatures increase the prevalence of disease in fish. Bacterial cold-water disease, which is the number one fish health issue, requires additional time and expense to address. External parasites are also a</p>	<p>Improving Plant and Animal Agricultural Systems</p>

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		<p>concern during the summer months. Early detection and effective control measures are essential to preserve fish health.</p> <p>NC State Extension conducted 89 fish health assessments at trout and carp facilities and provided 34 carp ponds, three trout fee-fishing ponds, and 22 trout farms with tailored guidance on identifying and correcting fish health issues. This assistance had an estimated direct economic impact of over \$678,000.</p> <p>As with many forms of agriculture, trout farming in North Carolina has been severely impacted by the COVID-19 pandemic. But without fully understanding the economics of trout production, producers are unable to adequately assess the impact of the pandemic on their farm's economic future. A rational, comprehensive enterprise budget analysis can help with that assessment and identify the items that contribute to profit or loss in fish farming operations. Working with collaborating economists, NC State researchers developed and published enterprise budgets for trout production that can be used to demonstrate the scale of trout farming required for economic viability while providing producers with tools to analyze their relative costs and returns. The enterprise budgets have been published through the Southern Regional Aquaculture Center and can be downloaded free of charge. NC State Extension's trusted research-based programs and technical assistance provide solutions and empower clients to make better-informed decisions.</p>	
<p>21.</p>	<p>Truckload Cattle Sales Increase Profits (NC State)</p>	<p>The average cow herd size in North Carolina is 30. This makes marketing to receive a premium price challenging. To save on the cost of freight, calf buyers prefer to purchase and transport calves in groups large enough to fill a commercial cattle truck. Cattle that are sold in load lots (49,500 pounds) will almost always bring more profit than calves sold one at a time at the local sale barn. A producer would have to have about 200 cows in order to take advantage of this type of value-added marketing. Calves that are sold in truck load lots are consistently sold at \$10 to \$30 per hundredweight higher on sale day than calves that are sold individually. Local Cooperative Extension efforts to co-mingle cattle for truckload sales provided a means for producers to maximize the value of their calf crop.</p> <p>Partnerships between NC Cooperative Extension and local cattle alliances, cattleman's associations, and cattle buyers helped bring local producers together to co-mingle calves for sale in truckload lots in counties across the state, increasing profits for cattle producers. In one truckload sale, over 20 producers sold 15 loads of cattle (approximately 1,125 head) valued at \$975,000. These calves were sold at premiums ranging from \$100 to \$200 per head, securing \$169,000 in additional</p>	<p>Improving Plant and Animal Agricultural Systems</p>

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		<p>profits. Another truckload sale included 41 steers and 43 heifers averaging 590 pounds. Producers made \$94 more per head on steers and \$89 more per head on heifers. Another truckload sale with 17 loads of value-added calves yielded an average increase in profit of \$60 per head, or approximately \$80,400 total over 1,340 calves sold. Finally, 1,009 head were marketed through a truckload sale in which producers profited \$50 per head more by marketing through the alliance when compared to selling their calves at the local sale barn. The total premium received from this sale was \$50,450.</p> <p>As a result of NC State Extension translating knowledge into practical applications, 4,274 animal producers increased their knowledge of farm business management, business planning, financial management, marketing, or estate planning, and 1,929 producers adopted Extension-recommended practices related to planning, marketing, and financial management.</p>	
22.	Breeding Soundness Exam Provides Valuable Information and Potential Savings (NC State)	<p>One of the major issues facing cattle producers is reproductive efficiency. Low conception rates in beef cattle can often be attributed to low bull fertility. Cattle producers rely on fertile bulls to produce a good crop of calves each year. Producers are encouraged to perform breeding soundness exams (BSEs) on their bulls prior to the breeding season. If bulls go unchecked and are not capable of successfully breeding cows, it can result in a total calf crop failure. However, the number of veterinarians that have the equipment to perform a breeding soundness exam is limited, and many producers do not have the appropriate set-up for on-farm BSEs.</p> <p>North Carolina Cooperative Extension agents partnered with the NC State Veterinary School and local veterinarians to conduct breeding soundness exam clinics at four locations across the state. During testing, vaccination, and deworming clinics, producers from 13 counties had 144 bulls evaluated, identifying infertile and marginally fertile animals that could then be replaced prior to the breeding season, yielding an estimated value of \$45 to \$100 per bull. Beef producers are strongly encouraged to utilize breeding soundness exams in their herd management program due to the significant impact on farm profitability. NC State Extension provides provide high-tech, high-touch expertise to serve the unique needs of diverse clients.</p>	Improving Plant and Animal Agricultural Systems
23.	Peanut Pod Blasting Increases Profitability of Peanut Production (NC State)	<p>U.S. peanut production was estimated at 6.69 billion pounds in 2020. North Carolina production was estimated at 451.5 million pounds, up slightly from 2019. Timing of peanut harvest greatly impacts the quality and quantity of harvest. With 2020 weather and the pandemic impacting farmers' harvesting capacity, it was critical for farmers to maximize their resources and harvest. Farmers need to understand how to</p>	Improving Plant and Animal Agricultural Systems

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		<p>evaluate optimum peanut maturity while considering field conditions and the weather forecast. Poor timing with digging peanuts can cause significant pod shed and a reduction in quality and profit for growers. In 2020, peanuts varied in their maturity timelines due to germination lags from wet planting conditions, with several growers having to replant 50% of their acreage.</p> <p>NC Cooperative Extension held peanut maturity clinics in peanut growing counties for growers and consultants to bring samples to be field tested for maturity. This procedure is done by pressure washing to remove the outer layer of the peanut, allowing agents to see the pods' color and determine maturity on a color scale. Peanut maturity clinics are likely the single most important contribution a county agent can make to peanut growers. The information provided to peanut farmers at these clinics helps them pinpoint digging which can have a major impact on their bottom line. If a farmer digs peanuts one week early, they might have yields that are about 10% lower than if they waited one more week. If they dig 14 days early, they might only realize 80% of the yield potential. By holding peanut pod blasting clinics NC State Extension Agents provided peanut farmers with timely and practical information to make decisions to increase yield and the profitability of their harvest.</p>	
<p>24.</p>	<p>On-Farm Consultations Transfer University Research to the Farm (NC State)</p>	<p>To achieve successful harvests and optimize the value of their crops, producers need evidence-based guidance on best practices that are tailored to their crops, growing conditions, and market opportunities. Extension serves as a critical bridge between researchers and farmers, leveraging farm and field visits to translate data into hands-on guidance.</p> <p>To assist growers in their wheat production, NC State Extension agents made numerous farm and field visits throughout the growing season. Along with these visits, growers were provided with crop management and production recommendations that they could then put into action to optimize yield and secure the highest quality wheat for their operation.</p> <p>Through farm visits and subsequent conversations with growers about their wheat management strategies, several Union County producers were able to increase profitability for their operations. Three local producers representing over 7,500 acres of wheat disclosed increased yield averages across their farms as well as higher quality wheat in terms of test weight and falling number, resulting in greater profitability for their operations. These three farms noted that their overall yields were between eight and 10 bushels higher than the previous year, test weight was up two to four pounds per bushel, and falling numbers for grain quality were above 300.</p>	<p>Improving Plant and Animal Agricultural Systems</p>

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		<p>All of these parameters resulted in these growers selling their crop for an additional \$1.50 per bushel. A rough calculation for these three farms demonstrates an increase of \$112,500 in revenue per farm, with a total additional income of \$337,500 for the three reporting farms.</p> <p>Statewide, Cooperative Extension agents made 3,947 on-farm consultations to provide technical assistance to crop producers in 2020. As a result of Cooperative Extension programs and services, 76,745 crop producers adopted best management practices, including those practices related to nutrient management, conservation, production, cultivars, pest management, business management, and marketing. In addition, 8,119 producers gained skills or knowledge to increase production for local markets. NC State Extension delivers research directly into the hands of North Carolina’s farmers, helping them to translate knowledge into practical solutions.</p>	
<p>25.</p>	<p>Saltwater Algae Research Yields Promising Insights for Renewable Energy and Improved Consumer Products (NC State)</p>	<p>The scarcity and harmful environmental impacts of fossil fuels create an urgent demand for green, renewable energy sources. NC State researchers have been studying <i>dunaliella</i>, a group of saltwater algae, with the aim to use this algae to produce biofuel, or a fuel that is produced directly from living matter and has the potential to generate less pollution and greenhouse gas emissions.</p> <p>This research has resulted in a biofuels patent application and a paper in the journal <i>Nature</i>, which shares the results of a large, international collaborative study on plant evolution, comparing the genes of over 1,000 different species of plants.</p> <p>The NC State team’s patent application focuses on using saltwater algae to produce extremozymes, or enzymes that work under extreme conditions and have useful applications in a broad range of industries. NC State researchers have studied the extremozymes used for making cheese and those that can degrade sarin, an extremely toxic nerve gas.</p> <p>The algae research has also led to the engineering of <i>Camelina sativa</i>, a canola-like plant that can grow on poor land with little water, for biofuel production. Efforts are underway to create <i>Camelina sativa</i> plants that produce more oil while requiring less water and fertilizer.</p> <p>See https://cals.ncsu.edu/news/salty-algae-leads-to-sweet-success/ for more information.</p>	<p>Protecting Environmental and Natural Resources</p>
<p>26.</p>	<p>Linking Small Farmers to Federal and State Resources in Southeastern North Carolina (NC A&T)</p>	<p>Many small farmers face challenges in searching for alternative enterprises and opportunities to help diversify their farm operations. Due to the lack of formal education, many small farm families do not know what federal or state agricultural</p>	<p>Protecting Environmental and Natural Resources</p>

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		<p>programs are available or do not understand some of the eligibility requirements. They're also constantly searching for farm programs to keep their land valuable, sustainable, and profitable.</p> <p>In 2016 and 2019, Bladen and Sampson Cooperative Extension Centers in partnership with the USDA Office Advocacy and Outreach conducted workshops on linking small farmers with USDA agencies, such as Farm Service Agency, Natural Resource Conservation Service, and Rural Development Agency along with the NC Forest Service. The workshops were designed to assist farmers and landowners with information on programs that can provide financial assistance to their farms.</p> <p>A total of 67 farmers attended the two workshops. Eighteen months after the completion of the first workshop, follow-up evaluations and interviews were conducted with 31 participants. Several of the participants stated that they had applied for and were approved for at least one USDA program. Those programs included NRCS-EQIP cost share grants, FSA (Farm Service Agency) farm programs, and other USDA services. Ten of them received cost share grants for high tunnel greenhouses and an irrigation system which totaled \$74,800. Families also benefited from receiving information on FSA programs being offered to help recover from losses caused by Hurricanes Matthew and Florence. Many of them were able to receive assistance that helped them recover some of their losses. With this knowledge of agricultural programs provided by USDA, these farm families have a new opportunity to make their farms more profitable and sustainable. Future plans are to conduct at least one meeting each year to provide farmers with updates on government programs.</p>	
<p>27.</p>	<p>A Waste-Based Biorefinery for a Resilient Food, Energy, and Water Nexus (NC A&T)</p>	<p>Sustainable agricultural production requires an uninterrupted supply of energy, fertilizer and water and proper management of food and agricultural waste. However, managing agricultural and food waste has been a huge environmental and economic challenge. Researchers aim to develop a waste-based biorefinery to enable the production of energy, fertilizers, and clean water from agricultural and food waste.</p> <p>N.C. A&T researchers have treated various agricultural (cattle manure and swine wastewater) and food wastes (corn stover) to enhance anaerobic digestion and investigate the interaction of systems that can facilitate biogas and methane production. The agricultural and food wastes are used to manufacture high value fertilizer (nitrogen, phosphorus).</p>	<p>Protecting Environmental and Natural Resources</p>

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		<p>The project has produced a process to recover nutrients and recycle clean water from agricultural waste, which includes a computational tool to access and manage a waste-based biorefinery for the resilience of food, energy and water (FEW) nexus in agricultural production.</p>	
<p>28.</p>	<p>Swine Waste Yields a Promising Source of Sustainable Energy and Organic Fertilizer (NC State)</p>	<p>Anaerobic digestion is a process during which bacteria break down animal waste in the absence of oxygen. This process is known to produce a reliable renewable energy source in the form of biogas. It also captures and reduces greenhouse gas emissions and supports farm environment sanitation, and it has the potential to recycle nutrients for the production of organic fertilizers. The technology is maturing and currently enjoys a worldwide emerging market. However, there are two major obstacles to developing a commercially viable process for converting animal waste into sustainable fuels and organic fertilizers. First, it is highly expensive and complex to build and operate the large, centralized digester systems that this process requires, making it cost-prohibitive for small and medium-sized farms. Second, more effective waste treatment techniques are needed to safely discharge the large volume of wastewater produced by farms and digesters.</p> <p>NC State researchers have developed a new system that has successfully converted chopped corn stalks or switchgrass into biogas energy and high-quality organic fertilizer using what is referred to as thermophilic (or high-temperature) digestion. This system has the potential to be housed in a single compact, efficient, low-cost, and user-friendly structure that can accommodate approximately 2,000 hogs, which will facilitate the elimination of wastewater from hog farms while generating additional income from biogas and bio-organic fertilizer.</p> <p>A pilot system was constructed at NC State’s Swine Educational Unit, where it successfully processed 401 liters of manure daily from 60 finishing pigs, producing an average of 1,933 liters of biogas per day and retaining nitrogen, phosphorus, potassium, and other crucial nutrients derived from hog manure. Research is ongoing to further evaluate the sustainability and economic feasibility of this system, which has the potential to dramatically improve waste management on hog farms while increasing profitability and access to renewable energy and environmentally friendly fertilizers. A patent for the system is pending.</p> <p>See https://www.nationalhogfarmer.com/manure/co-production-bioenergy-and-organic-fertilizer-swine-waste for more information.</p>	<p>Protecting Environmental and Natural Resources</p>

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<p>29.</p>	<p>New Green Windbreak Technology Lowers Air and Odor Pollution from Swine Farms (NC State)</p>	<p>Odor and pollutant emissions from livestock barns can adversely affect the environment and public health and provoke expensive lawsuits against producers. To address this issue, NC State researchers have developed low-cost, retrofittable systems for reducing these emissions, including a windbreak system composed of porous fabric and vegetation that can be built using resources found on livestock farms.</p> <p>This system has been shown to reduce odor emissions from a swine house by nearly 80%. Research surrounding this system has resulted in the publication of three journal articles and presentations at two nationwide webinars. The USDA-NRCS is in the process of approving this low-cost, environmentally friendly technology for cost-share funding to producers, and an NC State researcher is facilitating a cost estimate to support this funding. With additional funding from the North Carolina Department of Justice, testing will begin later in 2021 on the effectiveness of this technology in reducing odor emissions from a broiler house.</p> <p>Another important environmental concern on swine farms is management of sludge, a layer of manure solids that settles at the bottom of lagoons. Sludge accumulation in lagoons can be associated with odors, since it reduces lagoons' treatment efficiency over time. Sludge buildup also reduces the lagoons' capacity to store extreme rainfall and increases risk of inundation. Producers say they need more avenues for sludge disposal to avoid falling out of compliance with environmental regulations.</p> <p>An NC State faculty member identified a facility that produces turf and lawn care products from compost and accepts swine lagoon sludge. Two tours to the Sampson County facility were arranged for consultants, producers, and agents, and an online communication was developed and posted on Extension's waste management portal. As a result, several producers have coordinated sludge removal from their lagoons and delivery for incorporation into the sludge composting facility. A group interested in establishing a similar centralized system of composting attended the tour and is currently lining up funding for that project.</p> <p>See https://www.youtube.com/watch?v=5W70zBTNOmc for more information.</p>	<p>Protecting Environmental and Natural Resources</p>
<p>30.</p>	<p>Animal Waste Education and Technical Assistance Supports Pork Production (NC State)</p>	<p>In 2020, Americans consumed 52.1 pounds of pork per capita. Surprisingly, to meet this demand, pork production is concentrated in only a small number of states in the Midwest and in eastern North Carolina. In North Carolina at any given time, there are about 9.5 million hogs on about 2,400 farms. The North Carolina pork industry provides 19,298 jobs, \$5.9 billion in direct sales, and \$10 billion in statewide economic impact. For every job in pork production, an estimated 2.2 additional jobs</p>	<p>Protecting Environmental and Natural Resources</p>

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		<p>are created; thus, the North Carolina industry supports over 44,000 jobs. However, each year the hogs produce over 10 billion gallons of waste. If not properly managed, this excess of waste can cause environmental and public health problems.</p> <p>Farmers depend on Cooperative Extension’s technical assistance to meet and maintain their animal waste permit requirements. NC Cooperative Extension provides animal waste management educational programs for over 2,500 operators in the state. Each farm operation is required to have a certified Animal Waste Operator in Charge (OIC). Each certified operator must receive six continuing education credit hours over the course of three years.</p> <p>Cooperative Extension also helped farm operations by offering technical assistance for sludge surveys, equipment calibrations, waste utilization plan development and revision, and instruction in general record keeping and reporting. In total, 248 sludge surveys or equipment calibrations and 187 waste management plans were developed or revised. Producers also received answers to questions on permits, necessary COVID-19 adaptations, sampling methods, inspections, and more.</p> <p>A total of 934 producers implemented NC State Extension recommended best management practices for animal waste management. Technical assistance to keep hog farmers up to date on regulatory changes helped minimize non-compliance and assisted farms in preventing fines ranging from \$500 to \$25,000 per incidence. It also reduced the environmental impact of animal production.</p> <p>Cooperative Extension provided education for Animal Waste Operators in virtual and in-person formats; 2,534 participating producers increased knowledge about permits, inspection preparation, and other topics. Operators earned 4,960 credits to maintain their certification. Post-session surveys of the training indicated that participants gained knowledge that will increase their ability to manage animal waste systems, improve the likelihood of permit compliance, and benefit their operations. NC State Extension’s trusted research-based programs and technical assistance provide solutions and empower clients to make better-informed decisions.</p>	
<p>31.</p>	<p>“Forever Chemicals” Measured in North Carolina’s Aquatic Food Web (NC State)</p>	<p>Per- and polyfluoroalkyl substances (PFAS) compounds, including GenX, have been detected in water, food, soil, and air throughout world, including in North Carolina. PFAS compounds are human-made chemicals that resist friction and heat and are in many products that we use daily, from furniture to food packaging. However, these chemicals, with non-stick and anti-stain characteristics, persist in the environment, posing a public health risk.</p>	<p>Protecting Environmental and Natural Resources</p>

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		<p>A study measuring real-time PFAS contamination levels along the entire food chain of a major river was conducted. The research team collected water, sediment, algae, plant, insect, fish, crayfish, and mollusk samples at five study sites along the length of the Yadkin-Pee Dee River, which begins in Blowing Rock, North Carolina and runs 230 miles to empty into the Atlantic Ocean at Winyah Bay, South Carolina. Samples were analyzed for 14 different PFAS compounds. PFAS compounds were found in every step of the Yadkin-Pee Dee River food chain, even though the river does not have a known industrial input of these compounds. The study identifies strong links between ecosystem groups that lead to the buildup of PFAS compound concentrations in humans and animals that sit higher on the food chain.</p> <p>NC State researchers designed another study to elucidate the processes that control the fate, transport, bioavailability, and human exposure to trace organic contaminants, such as PFAS. This critically needed basic research is broadly applicable to a number of environmental and agronomic research areas. For example, the ability of toxic metals—such as arsenic, chromium, and vanadium, as well as PFAS—to contaminate groundwater resources or enter the food chain is partially controlled by the interactions of these metals with minerals. NC State scientists have studied the way plants and microbes acquire metals and PFAS in soils and aquatic environments. Multistate collaboration with other scientists led to new methods of quantifying molecules released by plants and microbes to facilitate metal acquisition. Research has included the assessment of the ability of biominerals—solid phases produced by microbes—to bind and potentially sequester toxic metals. These biominerals may be useful in designing remediation systems to reclaim land and purify contaminated water. NC State efforts are helping to change the way scientists view the biogeochemical cycling of nutrients and contaminants. More accurate quantification of the effects of microbial processes and mineral surfaces on toxic metal and PFAS fate and transport will allow for the development of better predictive models of contaminant behavior and may lead to improved designed remediation strategies.</p> <p>See https://cals.ncsu.edu/applied-ecology/news/pfas-in-yadkin-pee-dee-river-food-chain/ for more information.</p>	
<p>32.</p>	<p>New EPA Regulations Result in New Requirements for Herbicide Applicators (NC State)</p>	<p>Federal requirements related to the pesticides paraquat and auxin led to the need for training. Paraquat is one of the most widely used herbicides for the control of weeds in agricultural and non-agricultural settings. It is also used to defoliate cotton, peanuts, and other crops before they are harvested and to help control many glyphosate-resistant weeds in grain crops. Paraquat is a restricted-use herbicide with known hazards due to its acute toxicity. Unfortunately, in recent years its misuse has</p>	<p>Protecting Environmental and Natural Resources</p>

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		<p>led to 17 accidental deaths—including the deaths of three children—in the U.S. As a result, the EPA enacted new labeling and training requirements that went into effect in 2020.</p> <p>NC Cooperative Extension offered online paraquat application training, but because many growers with poor internet connections or limited computer proficiency found it hard to complete the training and exam, Cooperative Extension also offered in-person training and exam administration.</p> <p>Other mandatory training was required of auxin applicators to limit the drift of the herbicides onto landscape plants and sensitive crops such as vegetables, tobacco, and non-tolerant varieties of soybean and cotton. Auxin has long been used in pastures, hayfields, and corn production, and it is considered one of the best, if not the only, effective product for decreasing herbicide-resistant weeds like pigweed. Soybean and cotton crops have been genetically altered to tolerate auxin herbicides, and the creation of these tolerant varieties has greatly increased auxin herbicide use in the landscape. Many native and landscape broadleaf plants are very sensitive to these products, so it is critical to prevent these herbicides from drifting off the site they are intended for.</p> <p>The in-person paraquat training reached over 550 growers, and the in-person auxin training attracted 1,668 growers. Those involved in the paraquat training learned how to safely use and handle paraquat-containing pesticides to prevent accidental poisoning. Many growers went on to apply paraquat over thousands of acres this year, with no incidents or accidents reported. If the paraquat training was not being offered, weed control would decrease, grower pesticide costs would increase, and handlers and applicators would be at an increased risk of exposure and accidental poisoning.</p> <p>The auxin training helped 851 pesticide applicators receive certifications to legally apply these herbicides to fight resistant weeds and greatly increase their yield. This training has also been shown to greatly decrease the issues of drift associated with auxin products and may have prevented countless crop insurance claims for pesticide drift damage. NC State Extension’s leadership in experiential education equips clients to effectively transfer knowledge and skills into practical application.</p>	
<p>33.</p>	<p>Multiple Delivery Methods Allow Pesticide Applicators to Get and Keep Certification (NC State)</p>	<p>Insect and weed pests cause major economic loss to crops and landscapes. Farmers, as well as commercial pesticide applicators, are required by law to meet specific knowledge requirements to obtain and retain a pesticide certification or license. Recent federal pesticide label changes have also mandated specific safety training</p>	<p>Protecting Environmental and Natural Resources</p>

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		<p>and certification for users of auxin and paraquat herbicides. In North Carolina the pesticide applicator license can cover many categories, depending on the area of pesticide usage and application method. In 2020, the coronavirus pandemic limited in-person gatherings. However, pesticide applicators were deemed essential and continued to work. Thus, these applicators still required continuing education to maintain their pesticide licenses and stay up to date on the latest pest issues and safety protocols.</p> <p>In some counties face-to-face classes could not be held, while in others class sizes were reduced. Other counties faced challenges where internet connectivity was an issue, and some clients did not have the webcam set-ups required to fulfill state testing requirements. To address the continued need to provide pesticide applicator training, Cooperative Extension delivered training in multiple ways. In some locations, small classes were held in classrooms set up according to CDC guidelines. Other trainings were held via Zoom or pre-recorded video formats. One county used a hybrid format to deliver in-person training to pesticide applicators and licensed landscape contractors. Participants were spaced out in a very large room to maintain social distancing. Meanwhile the same information was simultaneously broadcast to others across the state online via Zoom. All the while, both groups were being actively engaged. A group of counties took a regional approach. Each agent taught a portion of the course via Zoom. The training was recorded so it could be offered in person for any clients who couldn't watch the course online. Also, because the training was offered virtually, license holders who did not want to meet in a group setting due to fears of being exposed to COVID-19 could obtain credit from the safety of their own homes. All participating clients were able to receive the required pesticide credits for 2020 due to the flexibility this virtual training provided.</p> <p>Statewide during 2020, 18,225 pesticide applicators received continuing education credits, and 538 participated in respirator fit testing conducted by NC State Extension.</p>	
<p>34.</p>	<p>Improved Water Management Systems Increase Yields While Protecting the Environment (NC State)</p>	<p>Water management is crucial to cost-effective, environmentally friendly farming operations. For decades, farmers have used NC State-developed strategies for agricultural water management at the farm level, and these strategies are highly effective in reducing losses of nitrogen, phosphorous, and sediment from farms into streams, estuaries, and oceans.</p> <p>NC State University is testing two new technologies for water management. The first is a drainage water recycling system that involves draining excess water from a field</p>	<p>Protecting Environmental and Natural Resources</p>

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		<p>to a storage pond and then later using the water as a supplemental irrigation source during dry periods of the growing season. Early results showed that about 80% of the nitrogen and 50% of the phosphorous that escaped from the field were assimilated and recycled into the storage reservoir, which also reduced sediment loss by 90% and increased soybean yields by 30%.</p> <p>The second technology is a solar-powered water management system that automatically drains excess water and delivers water directly to the plants' roots based on real-time feedback from monitoring stations, where instruments measure water table depths as frequently as every 10 minutes. This system is designed to help farmers keep soil moisture at ideal levels for plant growth throughout the growing season.</p> <p>These technologies have the potential to shape agricultural water management for decades to come, providing farmers with a highly intuitive, cost-effective solution that reduces the financial and environmental pitfalls of a "trial and error" approach to agricultural water management.</p> <p>See https://cals.ncsu.edu/news/research-for-better-water-management-not-too-wet-not-too-dry/ for more information.</p>	
<p>35.</p>	<p>Stormwater Runoff Education Protects Local Water Sources (NC State)</p>	<p>North Carolina consistently ranks as one of the top 10 states in population growth. The North Carolina Department of Commerce estimates that over 250 people move to the state every day. With this rise in population comes an increase in construction, roads, housing, and businesses, which increases stormwater pollution in drinking water resources. Development also increases the number of impervious surfaces like parking lots, rooftops, and walkways, and when it rains, stormwater can quickly run over these surfaces, picking up contaminants on its way into creeks and watersheds. Stormwater runoff in developed watersheds has become a major concern to citizens and leaders throughout North Carolina, and as a result local and federal rules have increased. These rules affect over 150 municipalities throughout the state and require municipalities to implement stormwater education programs and install innovative treatment practices to treat runoff.</p> <p>Throughout 2020, demonstration sites installed throughout North Carolina were monitored for water quality and hydrology. These sites not only mitigate water contamination caused by stormwater runoff but also educate the public on the practice and how it works. This education goes a long way in garnering public support of future stormwater practice installations. The data from these demonstration sites are used to develop new design standards and assign pollutant removal credits.</p>	<p>Protecting Environmental and Natural Resources</p>

		<p>These updated standards and credits and the trainings provided will enable engineers to design the most effective practices to mitigate stormwater runoff and meet regulations.</p> <p>To help with stormwater control management, one North Carolina county worked with NC State Extension and developed stormwater control demonstration projects to focus stakeholders on the benefits of stormwater control and how to design residential and commercial construction emphasizing innovative stormwater management. A refurbished 45-room hotel and three new residences in Raleigh were built with innovative stormwater management in mind. Builders installed 10 stormwater control measures on the four sites that treat 27,000 gallons of stormwater for each 1-inch rain or 1.3 million gallons annually. The practices have served as the focus of numerous stakeholder educational events. Additionally, the hotel and one of the residences have won sustainability awards and have been highlighted in the City of Raleigh's stormwater rewards program.</p> <p>In addition, NC State has partnered with the NC Sea Grant and Sound Rivers Inc. to develop stormwater plans for 20 middle schools, high schools, and community colleges throughout the Neuse and Tar River basins. Top-ranking best management practices (BMPs) have been identified for implementation, and three demonstration BMPs have been implemented, including a cistern and constructed stormwater wetlands.</p> <p>Other water-related issues that increase the need for North Carolina training programs are waste management, nutrient management, and watershed protection. NC State's Department of Crop and Soil Sciences offered 50 short courses and conferences in 2020 for erosion and sediment control professionals, municipal and industrial wastewater operators, environmental health specialists, septic system installers and operators, professional engineers, soil scientists, well contractors, water quality specialists, government agency employees, and elected officials. In all, 2,641 participants received technical training for license renewal, professional development or both.</p> <p>In addition, Cooperative Extension agents provided certification training in best practices for stormwater system management, inspection, and maintenance to an additional 821 people. At the local level, Extension in Forsyth conducted an online workshop to begin to address their stormwater concerns. The erosion of land surfaces through stormwater runoff contributed to sedimentation for a lake and river, which provide over 91 million gallons of drinking water per day. The workshop</p>	
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		<p>covered erosion’s environmental impacts, the use of online resources to pinpoint potential erosion sources, and the use of pervious surfaces, turf management, rainwater harvesting, planting along stream banks, and rain gardens for erosion control. Attendees reported that they increased their knowledge of the workshop topics, and over 80% said they intended to use the services, resources, and best practices introduced during the presentation.</p> <p>After participating in Cooperative Extension programming statewide, 16,227 participants increased their knowledge of best management practices, including stormwater systems, septic system maintenance, erosion control, rain gardens, and forestry. NC State Extension provides trusted information to help people, businesses and communities solve problems, develop skills and build a better future.</p>	
<p>36.</p>	<p>Research and Application of Stream Restoration Methods Yield Positive Results (NC State)</p>	<p>Increasing stormwater flows in rapidly growing areas of North Carolina cause stream impairment, sedimentation, property loss, and investment loss, while excessive nitrogen and phosphorous runoff damages streams and compromises drinking water supplies. Streambank retreat and sediment transport can severely impact the stability and function of restored streams, affecting water quality and aquatic and riparian habitats. As the interest in stream restoration grows and as climate changes and watershed dynamics are altered by land-use changes, the need to strengthen our scientific understanding of how streams respond to restoration efforts has grown. NC State University conducts a variety of research and Extension education efforts to meet these needs. For example:</p> <ul style="list-style-type: none"> > NC State Extension agents collaborated with environmental advocacy groups and local and state partners to deliver hands-on educational workshops in areas impacted by streambank loss. Seven streambank repair workshops with over 176 participants were held across the state in 2020. Due to COVID restrictions, online resources were also created and accessed by hundreds more stakeholders. In addition, 900 linear feet of streambanks were repaired during workshops, and the streambank repairs installed in 2019–20 are projected to reduce soil loss by 345 tons per year, nitrogen loss by 567 pounds per year, and phosphorous loss by 198 pounds per year. The value of nitrogen and phosphorus removal was nearly \$3 million. In addition, realtors and property appraisers who completed surveys estimate that properties with stable streams are valued 10% higher than those with eroding streams; the value of properties where repairs were installed increased by an estimated \$900,000. > Researchers and extension specialists installed performance measurement stations for a 2-kilometer-long Claridge Nursery two-stream reach in Goldsboro, North 	<p>Protecting Environmental and Natural Resources</p>

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		<p>Carolina. These stations are at the upstream, middle, and downstream ends of the stream reach and provide information on the dynamics of flow, concentrations of pollutants, and the cumulative loads. After 24 months, preliminary results showed that the restoration of the stream has improved water quality greatly and that these benefits vary by season. They also shed light on the impact of restoration practices on stream dynamics and water quality.</p> <p>> NC State’s Stream Restoration Project organizes EcoStream, the Southeast Regional Stream Restoration Conference, which is one of five regional stream restoration conferences held every two years in the U.S. Over 400 practitioners and regulators attend the conference. It is one way the project is working to advance the science and practice of stream restoration by training students and professionals, carrying out research, and facilitating the transfer of information and knowledge.</p>	
<p>37.</p>	<p>Smart Monitoring Systems Protect Local Drinking Water (NC State)</p>	<p>North Carolina’s continued economic growth and the health of its citizens depend on high-quality water sources. However, the water quality of many drinking water sources is declining due to watershed development and the budgetary constraints that prevent the state environmental agency from monitoring potable water sources frequently. Aquatic resource managers have identified a critical need for consistently collected, high-quality data to enable accurate assessment of the efficacy of management and policy decisions in protecting and improving water quality. However, significant reductions in funding for state and federal environmental agencies over the last two decades have led to severely constrained or eliminated water quality monitoring programs. As a result, most major waters across the nation, including North Carolina, are now sampled infrequently, which prevents accurate assessment of water-quality changes over time.</p> <p>In partnership with local governments, NC State researchers are maintaining a network of real-time remote monitoring systems (RTRMs) in three major potable water supply reservoirs in the state’s Triad and Piedmont regions. The RTRM network in Falls Lake partners with the City of Raleigh to provide high-frequency data 24/7 as an early warning system to safeguard a drinking water source that more than half a million North Carolinians rely on. RTRMs in City Lake and Oak Hollow Reservoir, in partnership with the City of High Point, safeguard drinking water for about 250,000 more North Carolinians. Raleigh’s mayor stated that these efforts have saved the city more than \$1 million by enhancing the accuracy and efficiency of water treatment plans.</p>	<p>Protecting Environmental and Natural Resources</p>

<p>38.</p>	<p>Constructed Wetlands Used as a Low-Cost Alternative to Improve Wastewater Treatment (NC State)</p>	<p>Hundreds of smaller rural wastewater treatment systems dot the North Carolina landscape. These systems are important because they limit nutrient enrichment and high bacteria concentrations in water bodies. Many of these systems do not have high efficiency for pollutant removal and need repair or upgrades due to age, poor management, or increased amounts of wastewater generated by an increased population. Many towns lack the expertise and the budget to improve their wastewater treatment plants, but several low-cost and low-tech solutions are available. Constructed wetlands, for example, can provide additional polishing of wastewater before it is discharged, enhancing treatment to levels that help towns meet or surpass their permit requirements.</p> <p>In a multistate effort, faculty at NC State, Virginia Tech, and Clemson have partnered to improve the water quality treatment potential of constructed wetlands used in wastewater treatment. The effort uses a field demonstration in Walnut Cove, North Carolina, where constructed wetlands at the wastewater facility significantly improved the retention time of the wastewater by removing detritus. This led to improved treatment of ammonium-nitrogen and lowered the concentrations of these nutrients in the waters discharged from the system.</p> <p>It is estimated that once both wetland cells are upgraded and as new aeration in the lagoon system is continued, discharge of nitrogen to the Dan River watershed will go down by 2,000 pounds. Lessons learned from this demonstration help the project team work with other towns and facilities with constructed wetlands. In fact, the team hosted the Town of Marshville, North Carolina at the Walnut Cove site as they considered options for expanding their wastewater treatment capabilities. Documentation of the improved function allows other towns in need of wastewater expansion to consider using constructed wetlands to improve their wastewater treatment discharges. The project team is also advising the North Carolina Division of Public Safety about a maintenance project to reduce short circuiting due to detritus buildup of the treatment wetlands at Caledonia State Prison, and outreach to the Town of Aurora, which has a wetland system similar to Walnut Cove, provided its new operator with options to address some of the emerging issues with their older wetlands.</p> <p>In addition to helping small towns meet their wastewater discharge limits, the widespread adoption of this low-cost, low-tech solution could improve overall watershed health in many locations in the Southeast. To expand the reach of the project and share project outcomes, the team actively uses its Twitter account, @NCState_Wetland; town meetings; local, state, and national professional</p>	<p>Protecting Environmental and Natural Resources</p>
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		conferences; and Extension publications. NC State Extension provides trusted information to help people, businesses and communities solve problems, develop skills and build a better future.	
39.	NC State Lays Groundwork for Data-Driven Environmental Preservation in Coastal Regions (NC State)	<p>Saltwater intrusion and sea level rise (SWISLR) pose a major threat to water sources in North Carolina. Seventeen counties are situated along the tidal coastline, with over one million residents living in areas that are undergoing drastic environmental changes. Soil survey information in this critical coastal zone is lacking, which limits efforts to protect coastal ecosystems.</p> <p>In 2020, NC State researchers initiated four coastal zone soil projects related to SWISLR, with a focus on understanding the impacts of rising salt levels in coastal wetland ecosystems in the Albemarle-Pamlico region. A follow-up project targeting tidal marsh systems in the Outer Banks is underway, which will provide critical information about the role of these wetlands in protecting uplands from negative environmental impacts.</p> <p>Researchers are also examining the effects of coastal flooding and the impacts of rising salt levels on Tidewater farming operations, and they are partnering with Extension to support low-lying farms in Hyde County that are already experiencing the effects of saltwater intrusion. A lead researcher in NC State’s SWISLR initiatives has also been asked to serve on various state, regional, national, and international committees related to coastal soils.</p> <p>This promising research has also caused the USDA-NRCS to reassign the Coastal Zone Soil Survey team and the associated Special Projects Team, which is in charge of coastal and urban soil projects nationwide, to Raleigh. With these efforts, North Carolina is poised to develop the most comprehensive coastal soil database in the Southeast, which will be a vital resource for coastal environmental preservation.</p>	Protecting Environmental and Natural Resources
40.	NC State Researchers Found Groundbreaking Forestry Company to Support Sustainable “Smart” Forests (NC State)	<p>Forestry contributes over \$32 billion and 150,000 jobs to the North Carolina economy, producing fiber, timber, and energy for essential items. Foresters face a rising presence of invasive pests as well as severe and frequently changing weather patterns, and they have been slow to adopt new technologies, such as genome editing, to combat these challenges. In addition, breeding long-lived trees takes significantly longer than breeding annual crops.</p> <p>In partnership with NC State’s Office of Research Commercialization and Office of Technology Commercialization and New Ventures, NC State researchers have founded a company, TreeCo, that is designed to revolutionize the forestry industry by</p>	Protecting Environmental and Natural Resources

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		<p>exploiting new molecular breeding techniques, combining insights from tree genetics and non-GMO genome editing tools. At the core of these innovations is CRISPR-based genome editing, a quintessential tool that is deployed in the quest to build a healthier forest while avoiding the regulatory problems associated with other genome editing technologies. TreeCo is currently working on three proof-of-concept projects targeting different genetic traits for key forestry segments, including timber, fiber, and chemical production.</p> <p>The innovations TreeCo is currently exploring have the potential to produce trees with advanced traits that reduce the cost of producing a ton of paper by about 6.5% (from \$414 to \$387 per ton). Given the large scale of forestry companies, this and other innovations have the potential to generate massive cost savings for the industry and for consumers, all while developing more resilient forests with greater potential to produce not only standard staple products but also new sources of bioenergy and bioproducts.</p> <p>See https://cals.ncsu.edu/news/nc-state-spin-off-treeco-to-breed-a-better-forest/ for more information.</p>	
<p>41.</p>	<p>Forest Landowners Realize Substantial Savings Through Present Use Value Education (NC State)</p>	<p>North Carolina real estate values have significantly increased over the past five years, approaching \$50 billion in 2020. For forest landowners and farmers to afford to keep their land in production, the present use tax program allows them to defer a significant portion of the market value of their land. Forestry PUV is the value of a tract of land used as forestland, based solely on its ability to produce income from timber growth assuming an average level of management. Each year, a committee sets the value, and a county tax assessor calculates the associated property tax by applying the current tax rate to the use-value of the land. In this instance, the current use is producing timber, while the market value is based on the property’s highest and best use. The difference in the market value and the use-value is deferred until the property no longer qualifies or is removed from the program. In many counties, the tax savings from PUV program enrollment is substantial. According to data published by USDA, 89% of private land owners do not have timber management plans. As a result, many landowners are underutilizing the aesthetic and productive value of their land as well as missing opportunities to reduce the property tax cost of owning land.</p> <p>NC State Extension Forestry provides data for the use value for forestland based on the cost of land management and the land’s productivity and conducts training sessions for county tax administrators and landowners throughout the state. A new</p>	<p>Protecting Environmental and Natural Resources</p>

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		<p>landowner worked with the N.C. Cooperative Extension, the NC Forest Service, and the Pender County Tax Office as well as consulting with a private timber consultant to develop a timber management plan. In filing the timber management plan for this 37-acre section of land, the land owner will reduce her property tax by an estimated \$2,352 per acre per year. With a timber management plan spanning 25 years, the potential property tax savings is \$2.17 million. In 2020, \$33.8 billion in taxes were deferred through the PUV program. The sustainability of working lands, of which an estimated 60% are forested, grows from profits, public benefits, and the products that flow from them. Thus, the educational work of NC Cooperative Extension and Extension Forestry with the PUV program greatly impacts North Carolina's \$92 billion agriculture and \$32 billion wood products industries, allowing farm and forest lands to remain in production despite development pressures.</p>	
<p>42.</p>	<p>Landowners in Columbus and Bladen counties participated in forest management and establishment programs (NC A&T)</p>	<p>Adopting practices such as forest management can help farmers with timberland gain more profit from their land, while preserving open land and providing recreational activities to communities. Small farmers need to know about forest management programs and how to implement them.</p> <p>Several small-scale landowners contacted the Columbus County Extension office to seek advice about improving their timberlands' economic viability through wood fiber production and outdoor recreation. After consultation with the Extension Ag Technician, six of these landowners expressed an interest in using herbicidal chemicals for site preparation, pine plantation establishment, and understory vegetation control. Restrictions due to COVID-19 delayed these efforts, but three of the landowners decided to proceed with their plans. These three landowners each own property ranging from 10 to 90 acres. Since working with Extension, the landowner with 90 acres along the Waccamaw River and located less than a 30-minute drive to the beach decided to develop his land for recreational use by establishing trails and wildlife habitats for hunting. He has begun using the herbicidal chemicals to control the understory to create nature trails and paths for campsites along the river.</p> <p>The farmer's plans to begin clearing a new food plot area to promote wild turkey and deer populations for wildlife enhancement were delayed by flooding over the summer. Once he has implemented the full plans, the land's recreational value will improve along with increased income through camping visitors and hunters. The other two landowners are exploring plans to increase their income through longleaf pine straw production, harvesting timber, and replanting.</p>	<p>Protecting Environmental and Natural Resources</p>

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<p>43.</p>	<p>Agroforestry and Specialty Crops Demonstration Plots (NC A&T)</p>	<p>Small farmers have a need to increase their profitability and find new markets while protecting environmental quality. Agroforestry and specialty crops are two examples of practices that can help them achieve these goals.</p> <p>Demonstration plots established at the University Farm and in three NC counties will be used to show small-scale sustainable farming systems that produce specialty crops for culinary, medicinal, decorative and other purposes. During 2020, efforts were made to establish and expand small demonstration plots to include cut flower and mushroom production. Shiitake mushrooms are being produced in a semi-indoor environment of a high tunnel, utilizing a recirculating system. A sunflower and wildflower plot has been established to demonstrate cut flower production and seed production for cooking oil and animal feed.</p> <p>Due to COVID-19, farmer and staff trainings were canceled. The plots will be incorporated into future field day events and farm visits for school age children.</p>	<p>Protecting Environmental and Natural Resources</p>
<p>44.</p>	<p>New Bacterium-Based Vaccine Delivery System Could Eliminate Major Obstacles to COVID Vaccine Distribution (NC State)</p>	<p>The COVID-19 pandemic has caused an urgent need for vaccines, but the wide-scale delivery of these vaccines is complicated by logistical problems and public fears about the potential side effects of vaccination. To address this problem, NC State researchers have been investigating alternative vaccine delivery methods, including a method that involves engineering a beneficial bacterium (<i>Lactobacillus acidophilus</i>) to deliver the vaccine.</p> <p>This bacterium has a long track record of safe use and inclusion in food products (such as yogurts), it is able to survive passage through the gut, and it is a known immune system strengthener. It is also possible to administer via the mouth or the nose, making needle-free vaccination a possibility. Vaccines developed with this bacterium would also avoid the need for ultra-low temperature storage that has caused serious logistical problems and large financial costs associated with distributing the currently available COVID vaccines.</p> <p>NC State researchers have recently resolved a major obstacle to producing these microbe-based vaccines, and they are in the process of engineering bacterial strains that can provide immunity against COVID-19.</p>	<p>Enhancing Food Safety, Nutrition and Health</p>
<p>45.</p>	<p>NC State Researchers Leverage State-of-the-Art Greenhouse to Illuminate Salmonella Contamination (NC State)</p>	<p>Salmonella causes an estimated 1.35 million illnesses, 26,500 hospitalizations, and 420 deaths in the U.S. annually. Although most individuals who become infected with salmonella recover after a few days, salmonella infections can spread to the urine, blood, bones, joints, or immune system to cause severe disease, especially in vulnerable populations. Even mild and moderate cases collectively result in millions</p>	<p>Enhancing Food Safety, Nutrition and Health</p>

		<p>of dollars in lost revenue and health care costs, and outbreaks result in massive costs and reduce public confidence in food suppliers.</p> <p>NC State’s Phytotron is a secure greenhouse specially designed for the safe, secure study of bacteria and other pathogens, including those that cause foodborne illness. NC State researchers are using the Phytotron to conduct critically important research that will inform FDA and industry guidelines for food safety, with a focus on developing a clearer understanding of how fresh produce becomes contaminated.</p> <p>In response to a cucumber-associated Salmonella outbreak in 2015–2016 that sickened more than 900 people, NC State researchers are currently focusing on how cucumbers become contaminated with Salmonella. They have found that the most important pathway for Salmonella contamination is the blossoms of the cucumber, whereas contamination via the roots rarely reaches the fruit itself. In fact, when a highly diluted amount of Salmonella was placed directly on the blossom, about 30% of the plants developed contaminated fruit.</p> <p>NC State researchers have also begun studying how tomatoes and cantaloupe can become contaminated with Salmonella, and they are beginning to investigate other foodborne disease-causing microbes as well. The insights this research yields will result in highly targeted, efficient, and effective recommendations for farmers that will reduce public health risks and safeguard economic prosperity throughout the food production and distribution chain.</p> <p>See https://cals.ncsu.edu/news/securely-studying-salmonella-to-advance-produce-safety/ for more information.</p>	
<p>46.</p>	<p>CRISPR Technology Yields Promising Results in Combating C. diff Infection (NC State)</p>	<p>Clostridioides difficile, also known as clostridium difficile or C. diff, is a bacterium that causes severe diarrhea and inflammation of the colon. C. diff is a common side effect of antibiotics, resulting in almost half a million infections in the U.S. every year. C. diff is difficult to treat and highly contagious; it also carries a high risk of relapse. It is particularly dangerous to elderly, immunocompromised, and hospitalized individuals, for whom it can be life-threatening.</p> <p>CRISPR technology is based on a family of gene sequences found in certain organisms and is used to precisely alter genetic codes within bacteria. NC State researchers have discovered that CRISPR can be used to effectively target and eliminate certain gut bacteria, including C. diff. In a proof-of-concept study, NC State researchers demonstrated reductions of the C. diff pathogen both on the lab bench and in mice.</p>	<p>Enhancing Food Safety, Nutrition and Health</p>

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		<p>In addition, microbiologists from two NC State colleges worked with the NC State start-up Locus Biosciences to test the effectiveness of using a virus to carry a programmable CRISPR that will execute a search-and-destroy mission against <i>C. diff</i>. This approach is superior to antibiotics in that it targets the harmful pathogen without disturbing the healthy gut bacteria that provide many benefits, including to the immune system.</p> <p>See https://news.ncsu.edu/2020/03/crispr-kills-pathogen/ for more information.</p>	
<p>47.</p>	<p>New Technology Converts Raw Food and into High-Value, Health-Preserving Supplements and Food Products (NC State)</p>	<p>Fruits, vegetables, and tree nuts are particularly nutritious and have been shown to provide a diverse range of health benefits. These foods contain nutrients that can reduce the risk of long-term and debilitating health conditions, including neurological diseases, cancers, and cardiovascular disease. Certain herbs also produce natural compounds with the potential to safeguard consumer health. It is crucial to study these food sources to identify new approaches to fostering public health.</p> <p>NC State researchers have identified a technique for increasing the shelf stability of plant-derived antimicrobial and antioxidant compounds. With the application of a specialized protein, the active compounds can be “encapsulated” and protected from thermal damage and degradation, allowing them to retain their healthy bioactive properties over long-term storage.</p> <p>In 2020, NC State researchers demonstrated for the first time that this “encapsulation” method can also protect helpful plant-derived active compounds as they pass through the digestive tract, allowing them to reach the colon, where microorganisms transform them into a form that is more easily useable by the body.</p> <p>To put this discovery to use, NC State partnered with two NC State-related start-ups, Sinnovatek and Ripe Revival, to launch a new line of protein-enriched, low sugar gummies into supermarkets, and Ripe Revival opened new production facilities exclusively to promote the launch.</p> <p>In addition, NC State researchers completed a comprehensive review of natural colorants derived from fruits, algae, and herbs. This research resulted in a publication in the Annual Review of Food Science and Technology, and it lays a theoretical groundwork for future replacement of synthetic food dyes with healthier alternatives.</p>	<p>Enhancing Food Safety, Nutrition and Health</p>
<p>48.</p>	<p>Low-Fat Fried Muscle Foods and Human Health Enhancement: A Three-Prong Strategy (NC A&T)</p>	<p>Fried fish and fried chicken products make up a substantial percentage of the items sold at fast-food restaurants. However, consumption of deep-fat fried foods has been associated with coronary heart diseases, obesity, and Type 2 diabetes, because of the</p>	<p>Enhancing Food Safety, Nutrition and Health</p>

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		<p>foods' high fat content. During deep fat frying, oil serves as a heating medium and is absorbed by the food, increasing its total fat content. The goal of this research is to create a preparation process using an edible protein-based coating batter that will retain the moisture and reduce the fat absorption during frying.</p> <p>Researchers at NC A&T have isolated proteins from chicken and fish by-products and successfully incorporated these solidified these proteins into a reduced calorie (compared to corn starch sourced batter) sweet potato starch-based batter to develop low fat edible coatings.</p> <p>The application of this edible coating and sweet potato batter has been found to reduce fat intake by 85% in fish and chicken without any change in the color, pH, and sensory properties of the food.</p>	
49.	Isolating novel probiotic strains of <i>L. Bulgaricus</i> for the dairy industry (NC A&T)	<p>Yogurt is a good source of several micronutrients and plays an important role in human nutrition. Consumption of yogurt has been shown to promote health benefits due to the presence of live bacteria or probiotics. Traditionally, yogurt has been produced using the lactic acid bacteria <i>Streptococcus thermophilus</i> (<i>S. thermophilus</i>) and <i>Lactobacillus bulgaricus</i> (<i>L. bulgaricus</i>). Only a few strains of <i>L. bulgaricus</i> are used in yogurt culture by the dairy industry and these are imported from Europe. The aim of this project is to identify viable strains of <i>L. bulgaricus</i> that can be cultivated for local production by the U.S. dairy industry.</p> <p>Researchers at NC A& T have isolated different non-commercial strains of <i>L. bulgaricus</i> from several source material like raw milk, traditional fermented dairy products and plant sources obtained from foreign sources and have developed an effective medium for the isolation, detection, and count the presence of <i>L. bulgaricus</i>.</p> <p>Isolation of strains of <i>L. bulgaricus</i> show potential promise of their development as alternative source for producing U.S. sourced culture for yogurt production. This probiotic strain could positively impact the dairy industry of North Carolina and USA with more beneficial characteristics including stronger taste and texture appeal to consumers, a reliable probiotic source, and a more accessible source for local production of yogurt.</p>	Enhancing Food Safety, Nutrition and Health
50.	NC State Researchers Shed Light on the Link between Nutrition and Respiratory Immunity (NC State)	<p>In the wake of the COVID-19 pandemic, there is a heightened need to understand how nutrients can enhance the innate immune system. This area of research yields insights that not only advance human medicine but also enhance the stability of animal production agriculture, which is frequently threatened by infectious disease.</p>	Enhancing Food Safety, Nutrition and Health

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		<p>Dietary fat is a particularly promising nutritional component because it is a source of essential fatty acids that could play a crucial role in immune function.</p> <p>Using a pig model, NC State researchers collaborated with researchers at the North Carolina Research Campus in Kannapolis, NC, to investigate the impact of omega-6 and omega-3 fatty acids on immune cell response to respiratory pathogens. When challenged with a bacterium-derived agent designed to provoke inflammation, pigs that were fed omega-6 fatty acids displayed a stronger inflammatory response that began to resolve more quickly. This suggests that enriching diets with omega-6 fatty acids may enhance the immune response to respiratory pathologies. This research resulted in publication of a peer-reviewed paper in the Journal of Animal Science and Biotechnology.</p> <p>This research lays the groundwork for further investigations of the relationship between nutrition and immunity. The insights generated from this avenue of research have the potential to yield major breakthroughs in the treatment of new respiratory pathogens in both humans and animals.</p>	
<p>51.</p>	<p>NC State Food Safety Programs Deliver Training and Knowledge During the Pandemic (NC State)</p>	<p>Foodborne disease affects about 17 percent of Americans annually and causes an estimated 48 million illnesses, 128,000 hospitalizations, 3,000 deaths, and over 1,000 outbreaks, resulting in millions in lost income, lost revenue, and health care costs. The COVID-19 pandemic has exacerbated previous concerns associated with safe food handling, leading to an even greater demand for effective food safety training for businesses and communities.</p> <p>In response to statewide dining room closures during the pandemic, NC State Extension food safety specialists have worked with public and private partners to establish the Count on Me NC training program, which has delivered science-based best practices for safe food handling to 16,470 restaurant workers representing 7,493 food and retail businesses in North Carolina. NC State Extension offers a wealth of educational programs that address public health issues, improve economic well-being, and help people make healthier, better-informed decisions.</p> <p>NC State Extension’s Safe Plates team is also participating in the FoodCovNET initiative, which focuses on food safety research and industry outreach. Funded by a \$1 million USDA-NIFA grant, FoodCovNET’s database includes over 160 resources for English, Spanish, Mandarin, and Haitian Creole speakers and has been distributed to 39 partner institutions and organizations nationally. This initiative has also reached over 496,000 individuals with over 850 COVID-19-related consumer messages on</p>	<p>Enhancing Food Safety, Nutrition and Health</p>

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		<p>social media. Safe Plates has also supported Extension throughout the pandemic with virtual forums, Q&A sessions, and new online versions of previous offerings.</p> <p>See https://cals.ncsu.edu/news/experts-you-can-count-on/ for more information.</p>	
<p>52.</p>	<p>NC State’s Steps to Health Program Empowers Limited-Resource Families with Healthy Lifestyle Education (NC State)</p>	<p>Many limited-resource individuals struggle to meet the nutritional needs of their families while balancing financial constraints and keeping their food safe. Social and geographic isolation combined with lost wages as a result of the COVID-19 pandemic have exacerbated existing challenges with nutrition and food safety. In North Carolina, 1,456,200 people are struggling with hunger, and one in five are children. Nearly 70% of adults and 3% of children in North Carolina are overweight or obese. Sixteen percent of adults and 41% of children eat only one serving or less of vegetables a day; 37% of adults and 30% of children eat only one serving or less of fruit a day, and 51% of adults and 78% of children do not get enough daily physical activity.</p> <p>Steps to Health is NC State Extension’s Supplemental Nutrition Assistance Program-Education (SNAP-Ed) Program, which empowers youth, adults, and communities to embrace nutrition, healthy living, and effective food management strategies. In 2020, Steps to Health reached 5,453 participants (4,893 youth and 560 adults) and made 28,364 educational contacts across North Carolina. Steps to Health also partnered with the Expanded Food and Nutrition Education Program (EFNEP) to distribute nutrition education materials to 264 emergency food distribution sites, and a total of 102,000 nutrition education card decks were provided along with donated food during the pandemic.</p> <p>Since the pandemic, Steps to Health has continued providing education online, reaching 390,063 impressions over Facebook, Instagram, and Twitter. The Steps to Health team also created virtual programming for two direct education curricula. Take Control, the adult curriculum, focuses on chronic disease prevention and highlights daily lifestyle changes in eight sessions to improve health. Topics include increasing physical activity, reducing sodium and sugar intake, and increasing the consumption of whole grains, fruits, and vegetables. Each video session was hosted by a different Steps to Health or Extension professional, recorded, and uploaded to YouTube. At least seven agents utilized Take Control between March and October of 2020 to reach over 70 participants. Delivery of the program was either entirely virtual, with links to videos and agent emails facilitating the program, or hybridized with agents offering live “office hours” in addition to providing links to lesson videos. After the program, 53% of adults reported using nutrition facts labels, 48% selected</p>	<p>Enhancing Food Safety, Nutrition and Health</p>

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		<p>food with less salt, 45% less sugar, and 46% less saturated fat. Almost half of the adults (47%) were more physically active after the program. Adults also reported eating more whole grains (51%), 52% increased their daily total vegetable intake, and 46% increased their daily fruit intake.</p> <p>Color Me Healthy, the pre-kindergarten/kindergarten curriculum, focuses on developmental skills and knowledge with nine interactive movement- and music-based lessons. Each lesson was filmed using a live-action narrative format (similar to PBS youth programs) and was available for agents to use in their counties before the 2020 holiday season. To improve retention and foster trust among students, a single educator hosted each lesson; however, taste tests and recipe demonstrations featured regular “video guests” and children ages four to five. Supplemental booklets for parents and students are available for agents to distribute to participating families. Booklets highlight recipes, art projects, and family activities for each lesson. Parents of children who participated in the program reported that their child was more willing to eat fruit (90%) and more willing to eat vegetables (93%) after completing the program. NC State Extension provides relevant, responsive, accessible and inclusive programs that result in positive changes in the lives of our customers.</p>	
<p>53.</p>	<p>Supporting North Carolina’s Families with the Greatest Needs (NC State)</p>	<p>Lack of access to healthy, affordable foods increases the risk of serious chronic illness. Many limited-resource families struggle to consistently meet the nutritional needs of their families. In North Carolina one in five children struggles with hunger. This is coupled with a population in which 68% (two out of three) of adults and 31% (three out of 10) of children between the ages of 10 and 17 are overweight or obese.</p> <p>The Expanded Food and Nutrition Education Program (EFNEP) targets key behaviors to help families and youth become more food secure, improve dietary intake, increase daily physical activity, improve food safety practices, and reduce the risk of overweight and obesity and related chronic diseases. Paraprofessionals who are peer EFNEP Educators utilize practice-tested curricula to deliver a series of six or more hands-on nutrition education lessons, and positive behaviors are reinforced through social media, including Facebook, Instagram, YouTube, and blogs. In 2020, NC State Extension EFNEP Educators utilized Zoom, Facebook Live, and Google sites to educate the public, and in areas without stable internet, phones were used to deliver lessons to participants. During 2020, 2,053 adults and 10,731 youth participated in the program using live, remote, and pre-recorded online lessons. In addition, 65,140 individuals viewed nutrition information via EFNEP state and county social media pages. A collaboration between NC State’s SNAP-Ed/Steps to Health, Local Foods, and</p>	<p>Enhancing Food Safety, Nutrition and Health</p>

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		<p>EFNEP resulted in 102,000 families receiving nutrition and food safety information through 264 emergency food distribution sites across the state.</p> <p>EFNEP in Ashe County took their cooking class one step further to help families prepare dinner together each Wednesday night via live Zoom classes. Each week participants were given a recipe and side dish recommendations in accordance with the five-food-group MyPlate method. They were given a shopping list to purchase what they would need for the class, an experiential learning exercise that allowed them to see how much easier, cost effective, and fun it is to meal plan, shop with a list, and prepare food at home. Participants reported that they saved an average of \$125 on groceries that month.</p> <p>As a result of participating in the NC State EFNEP program, 92% of graduates improved their dietary intake, 64% of participants reported eating vegetables more often each day, 66% reported eating fruit more often each day, and 51% reported drinking regular soda less often. In addition, 51% of graduates now practice daily physical activity. In addition, 90% of graduates improved their food resource management skills, and 45% showed improvements in food security. Finally, 91% of participants reduced their likelihood of foodborne illness by improving their food safety habits. NC State Extension offers a wealth of educational programs that address public health issues, improve economic well-being, and help people make healthier, better-informed decisions.</p>	
<p>54.</p>	<p>Eating Healthy: Med Instead of Meds (NC State)</p>	<p>One in four Americans has one or more chronic conditions such as heart disease, type 2 diabetes, or obesity. Chronic diseases are also responsible for seven out of 10 deaths each year. Treating people with these chronic diseases account for around 86% of our nation's health care costs. Research shows the Mediterranean eating pattern decreases the risk of type 2 diabetes, facilitates blood pressure management, and reduces the risk of cardiovascular disease by as much as 30–60%. As a result of COVID-19, many restaurants and food establishments temporarily closed their doors during 2020. In many households, a lack of home cooking resulted in greater consumption of processed foods, take-out, and fast food, all food choices that tend to be higher in sodium, sugar, fat, and calories and lack basic nutrients. There was a need for education in preparing healthy meals as citizens became more interested in preparing meals at home.</p> <p>North Carolina Cooperative Extension offers the NC State-developed curriculum Med Instead of Meds. This program educates participants on the science of eating the Med Way by helping individuals navigate the types of foods that promote health and</p>	<p>Enhancing Food Safety, Nutrition and Health</p>

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		<p>teaching them how to prepare delicious meals. Each of the six sessions includes multiple recipe demonstrations and taste test opportunities. The ability to offer virtual programming afforded agents the opportunity to work together across county lines and offer the Med Instead of Meds program via the Zoom platform. Over 80 Med Instead of Meds online classes were offered, providing nutritional education to over 1,600 participants.</p> <p>Evaluation results for the online programming were overwhelmingly positive. Participants stated that the program improved their quality of life during the pandemic. They enjoyed being able to participate in the program from the comfort and safety of their homes. They also enjoyed the helpfulness of the recipe demonstrations, having multiple instructors present the sessions, being able to access to the recorded sessions for later viewing, having the link to recipes on the website, and being provided with all the other resources for attending the sessions. Participants reported that they had increased consumption of whole grains, fruits, and vegetables; gained confidence in reducing their intake of added sugar, sodium, and saturated fat; and increased their adherence to the Med Way of eating as a result of the curriculum. A number of participants reported losing weight and improved health numbers. One participant was inspired to share recipes and helpful tips in her church newsletter. NC State Extension’s research-based programs address public health issues and help people make healthier, better-informed decisions.</p>	
<p>55.</p>	<p>Online Programming Helps Adults Lose Weight and Lower Diabetes Risk (NC State)</p>	<p>The issue of overweight and obesity continues to be the most pressing public health problem. An estimated 50% of adults attempt to lose weight or avoid gaining weight each year, yet most people do not follow recommendations for calorie intake and physical activity. To achieve North Carolina’s goals for preventing obesity and associated chronic disease, residents need access to affordable, family-based, culturally relevant, and interdisciplinary weight management services.</p> <p>NC State Extension offers the national Eat Smart, Move More, Weigh Less and Eat Smart, Move More, Prevent Diabetes programs to the public. Although the Eat Smart, Move More, Weigh Less program was originally designed to be delivered in person, it was approved for telehealth delivery in 2020 in response to the COVID-19 pandemic, and almost 300 participants enrolled. Of these participants, about 85% lost weight (between five and 25 pounds).</p> <p>In addition, the Eat Smart, Move More, Prevent Diabetes program continued to be offered in its standard online, real-time format, with access to a portal where participants can track their weekly progress and communicate one on one with an</p>	<p>Enhancing Food Safety, Nutrition and Health</p>

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		<p>instructor. In 2020, 865 individuals enrolled in this program; about 84% of them lost weight. By the end of the program, 43% of participants had healthy test results for A1c, a blood test that measures average blood sugar and is used to diagnose prediabetes and diabetes. This represents a 23% increase in healthy A1c tests among participants. NC State Extension provides provide high-tech, high-touch expertise to serve the unique needs of diverse clients.</p>	
<p>56.</p>	<p>Extension Master Food Volunteers Improve Access to Food and Nutrition Education (NC State)</p>	<p>Food insecurity and diet-related disease are major problems in North Carolina. An average of 13.1% of North Carolina households experienced food insecurity in 2019, compared to a national average of 10.5%. Research demonstrates that home food preparation reduces diet-related disease. Since 2016, the NC State Extension Master Food Volunteer (EMFV) program has been empowering Extension specialists and volunteers to deliver food and nutrition education to underserved populations.</p> <p>In early March, the COVID-19 pandemic put a halt to all in-person activities that the EMFV program previously used to provide food safety and nutrition education to individuals with limited incomes. In response, Brunswick County volunteers developed 14 fruit and vegetable fact sheets to be included in food pantry produce boxes, providing home-tested recipes and guidance for the selection, storing, and cooking of each produce item. Over 400 tip sheets were distributed through two participating pantries and five additional pantry locations. In addition, EMF volunteers partnered with staff and volunteers in the Extension Master Gardener program, the Expanded Food and Nutrition Education Program, and Family and Consumer Sciences to distribute food, share recipes and cooking videos via social media, moderate educational Zoom sessions, and cultivate community gardens.</p> <p>In 2020, the EMFV program also virtually trained 16 agents, established a monthly EMFV continuing education webinar series, launched an online teaching platform for new volunteers, and reached 10,894 high school students with its Food Systems and Local Foods curriculum. Additionally, FCS agents trained 25 new volunteers, for a total of 110 volunteers in the program. These efforts resulted in over 780 service hours valued at \$19,850 and engagement with 7,072 community members. Furthermore, a senior instructor with the Oregon State Extension Service completed the EMFV agent training in 2020 and plans to adapt and implement the program for her region. NC State Extension faculty, staff, partners and volunteers work together to create a healthier North Carolina.</p>	<p>Enhancing Food Safety, Nutrition and Health</p>

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<p>57.</p>	<p>Virtual Animal Husbandry Contests Keep Youth Engaged During COVID-19 Pandemic (NC State)</p>	<p>North Carolina transitioned to a majority urban state during the 1990s, yet the overwhelming majority of North Carolina counties remain rural. Many of these rural communities lack youth programs, making the annual 4-H Livestock Shows highly anticipated community staples. The COVID-19 pandemic threatened to halt the livestock shows and horse judging contests that have allowed countless 4-H’ers to cultivate their skills and engage with their communities. This was devastating to 4-H youth who had worked extremely hard to prepare for the shows and who were also dealing with life disruptions and social isolation. Thanks to 4-H families and the Extension professionals who support them, the events continued in 2020 and drew national attention. 4-H professionals and animal science educators from a dozen states reached out to NC State Extension for virtual event ideas, and the New York Times covered a 4-H’er’s participation in the first virtual version of Tyrrell County’s 71-year-old annual livestock show.</p> <p>Within days of learning that county fairs and other in-person events would be cancelled, the NC State youth livestock coordinator and an NC State student sprang into action, developing and advertising a dynamic, interactive, user-friendly, and completely free statewide virtual livestock show that allowed more than 100 4-H’ers ages 5 to 18 to show off their newfound skills. The virtual show used Google apps, Tik Tok, and Zoom to create an event that mirrored the two-part, in-person events that had taken place for decades, all while incorporating new activities. At the local level, Cooperative Extension also met the needs of youth in counties across the state. Hyde County put together a virtual livestock show that included curated videos and photos highlighting 4-H’ers work and shared them via Facebook, incorporating a digital pledge of allegiance, 4-H pledge, and auctioneer to lend authenticity to a virtual livestock show that reached over 13,000 people on Facebook. In addition, NC State Extension’s equine program put on a highly successful virtual horse judging contest that reached 155 participants across the state and secured a record-high participation rate in comparison to the past five years of in-person contests.</p> <p>Livestock shows and horse judging contests have been shown to help youth develop valuable life skills through unique experiential learning experiences. Statewide, 2,972 4-H’ers participated in virtual animal husbandry events in 2020. These events received an overwhelmingly positive response from participants and parents because they provided a sense of normalcy and community during an unprecedented crisis. Young people learn the skills to succeed through NC State Extension 4-H educational programs and camps.</p>	<p>Enriching Youth, Family & Community Well-Being</p>
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		See https://cals.ncsu.edu/news/the-shows-and-the-contests-go-on/ for more information.	
58.	Grow Boxes and Home Gardening Programs Enhance Youth Horticultural Education During COVID-19 (NC State)	<p>As demands for virtual education and recreation spiked during the COVID-19 pandemic, NC State Extension 4-H specialists needed to strike a balance between avoiding in-person events and encouraging youth to limit their screen time, explore the outdoors, and learn more about the natural world. To address this need, an NC State Extension 4-H specialist partnered with the children’s program coordinator at the JC Raulston Arboretum to develop Grow Box, an NC State program that delivers comprehensive, hands-on gardening kits to families. The family involvement component of the Grow Box is critical because research has shown that children learn from what is going on around them. When children see their parents take a break from using the computer to actively engage in outdoor activities, they are likely to imitate this behavior.</p> <p>One hundred Grow Boxes were sent to families in 32 North Carolina counties. The program received rave reviews for providing an easy, intuitive way for families to start their own gardens. Grow Box has helped increase youth interest in agriculture by bringing nature into homes and afterschool programs in the form of veggie and herb transplants, propagation instructions, an activity magazine, and more. In addition to the statewide Grow Box program, 4-H specialists and Extension agents in Mecklenburg, Brunswick, Edgecombe, Cleveland, and Onslow counties assembled and distributed over 2,560 starter garden kits consisting of seed packets and educational pamphlets. Individual county efforts to distribute starter garden kits have provided children and their families with the opportunity to grow delicious, healthy food in their own back yards while staying connected to nature and Extension educational resources during the pandemic. In addition, Henderson County was able to convert a popular special interest program, 4-H Mini Gardening, into an online format. The 4-H Mini Gardening program traditionally included in-person orientations, home visits/judging, and an awards supper. By transitioning Mini Gardening to an online platform and keeping youth accountable for their home gardens, 23 youth participants each grew their own fresh vegetables and documented their learning experience in photos or written garden journals. Seed sharing projects across 37 counties during COVID-19 have reached over 15,500 families, distributing seeds & seed kits through School Nutrition and other community partners. NC State Extension offers opportunities for youth to learn by doing.</p>	Enriching Youth, Family & Community Well-Being

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		<p>See https://cals.ncsu.edu/news/grow-box-gets-kids-growing-fall-vegetables-that-is/ and https://localfood.ces.ncsu.edu/local-food-farm-to-school/covidseedsharing/ for more information.</p>	
<p>59.</p>	<p>Master Gardener Volunteer Program Increases Equitable Access to Gardening Education (NC State)</p>	<p>Gardens help reduce negative environmental impacts, increase biodiversity, and enhance access to affordable, fresh, safe, and nutritious food. The NC State Extension Master Gardener (EMG) program pairs NC State faculty and staff with local volunteers to provide specialized training in research-based gardening practices and environmental stewardship. EMG rapidly adapted to the COVID-19 pandemic by moving program delivery online, taking advantage of virtual training opportunities provided by NC State, and adopting new best practices for limited in-person volunteer activities. EMG’s efforts included developing virtual botanical garden tours, providing free landscaping for low-income housing, developing local gardens to stock food pantries, and providing in-depth horticulture training to individuals with limited access to education.</p> <p>Mecklenburg County EMG partnered with the Mecklenburg County Sheriff’s Office to provide gardening training to adult and youth inmates with a high risk of reoffending. Inmates at a juvenile detention center grew and donated vegetables to community agencies and food pantries, and adult inmates grew vegetable plants for donation to community gardens. Because of the EMG program’s focus on fostering a sense of accomplishment and teaching practical vocational skills, participants reduced their risk of reoffending by 16% (in comparison to the national rate). In the future, the sheriff’s office plans to transform the EMG program into a culinary vocational training program that will serve as a direct employment pipeline for inmates.</p> <p>The pandemic disrupted traditional food distribution systems. By reaching out to Area Ministries early in the growing season, Master Gardener volunteers in Johnston County were able to adapt local community gardens and donate over 4,800 pounds of food to area ministries. In Craven County, Master Gardener volunteers organized a neighborhood network to provide no-contact food deliveries to food insecure families, ensuring that donations could continue being distributed despite social distancing protocols.</p> <p>Statewide, 2,723 certified EMG volunteers continued working with Extension agents to field phone and email questions from new gardeners, deliver online learning opportunities, and use community gardens to provide food to those in need. In total, EMG volunteers donated 109,610 service hours valued at \$2.98 million and reported</p>	<p>Enriching Youth, Family & Community Well-Being</p>

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		<p>over 70,000 direct educational contacts with an estimated 50,000 individuals during 2020.</p> <p>In addition to teaching new gardeners how to grow food at home, Master Gardener volunteers cultivated community gardens to grow food and distribute it to the hungry. Across North Carolina, Master Gardener volunteers contributed over 14,000 hours of service to nurturing community gardens. Master Gardener volunteers spent 25,952 hours maintaining demonstration gardens, which provided community members with education and enrichment. As a result of statewide consumer horticulture education programs, 41,328 people gained knowledge or acquired skills related to vegetable and/or fruit gardening, 29,511 people began growing food for home consumption, and 10,700 people started a new vegetable and/or fruit garden. NC State Extension provides relevant, responsive, accessible and inclusive programs that result in positive changes in the lives of our customers.</p> <p>See https://carolinapublicpress.org/41970/job-skills-grow-in-jail-garden-program/ for more information.</p>	
<p>60.</p>	<p>4-H Enrichment Programs Take Learning Online During the COVID-19 Pandemic (NC State)</p>	<p>4-H camps and hands-on enrichment activities provide thousands of youth with opportunities to socialize and learn practical skills spanning agriculture, animal husbandry, STEM, responsible and informed citizenship, career development, and more. After being forced to cancel all in-person youth programs during the COVID-19 pandemic, NC 4-H had to rapidly transition programming to an entirely online format in order to continue providing educational enrichment to students already coping with school closures.</p> <p>NC State Extension professionals developed new content, outreach strategies, and educational approaches to bring North Carolina’s 4-H curriculum to a virtual audience, resulting in interactive, hands-on programs. Twenty-one Extension professionals crossed county and program lines to create an entirely new program for young plant enthusiasts called Plant Geeks Unite, which provided 248 youth ages four to 17 with a self-guided, multi-media curriculum and frequent opportunities to collaborate with other students. Fifty-six percent of the participants were female, which demonstrates the program’s potential to increase the number of girls involved in STEM programs. Fifty-five percent of Plant Geeks participants were not previously enrolled in 4-H, demonstrating the potential of this program to recruit new members. The Plant Geeks site was visited over 1,850 times, with 75% of page views represented by returning visitors, indicating high levels of engagement.</p>	<p>Enriching Youth, Family & Community Well-Being</p>

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		<p>A more than 25-year-old 4-H embryology program also continued despite the pandemic thanks to the efforts of a Johnston County Cooperative Extension agent, who created a Facebook Live stream to demonstrate the incubation and hatching process in chicks. The stream reached over 90,000 individuals and was shared nearly 500 times thanks to promotion by teachers, Extension agents, and 4-H volunteers, providing students with an intuitive look at how life develops and supporting virtual classroom enrichment not only in science but also in the arts, as children were inspired to describe, illustrate, and discuss the chicks' development.</p> <p>In addition, NC 4-H offered Summer 2020 CAMP OUT!, a five-day virtual camping experience with three 30-minute daily sessions focused on North Carolina ecology education and socializing activities. CAMP OUT! reached 550 families across 79 North Carolina counties and 17 states. Ninety-six percent of participants reported a fun and engaging experience, and 99% indicated interest in attending 4-H camps in the future.</p> <p>NC 4-H also continued to participate in an annual national 4-H STEM challenge. This year's challenge, Mars Base Camp, provided youth with the opportunity to explore Mars while building skills in coding and other STEM activities, civic engagement, healthy living, and agriculture. Twenty afterschool sites and over 2,000 students participated in the 2020 STEM challenge.</p> <p>Statewide, over 315,000 youth participated in online 4-H enrichment programs in 2020. After attending 4-H programs, 60,110 youth increased their knowledge in science, technology, engineering, and math (STEM) areas, 33,273 youth improved knowledge of local food and agricultural systems, and 42,242 youth increased their knowledge of life skills. Young people learn the skills to succeed through NC State Extension 4-H educational programs and camps.</p>	
<p>61.</p>	<p>Program to Reduce Opioid Use Boosts Knowledge and Attitudes Among Youths and Caregivers (NC State)</p>	<p>Overdose deaths from opioids have been on the rise in the U.S. since at least 1999, reaching 50,000 deaths in 2019. Sadly, children were among those who died. To address the crisis, North Carolina 4-H developed and delivers an opioid prevention education program for middle school-aged youth and their caregivers.</p> <p>Goals of the NC State Extension Empowering Youth and Families Program were to reduce youth substance abuse in rural North Carolina, help caregivers improve parenting skills to help youths make healthy choices, to improve family relationships between youths and their caregivers, and to empower families to lead community change that leverages support for healthier lifestyles.</p>	<p>Enriching Youth, Family & Community Well-Being</p>

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		<p>Pre- and post-tests yielded positive program results. By the program’s end, 94.4% of participating youths indicated that they would probably or absolutely not take a drug or medication that was not prescribed to them, while 100% of caregivers felt they were better able to discuss difficult situations with their youth because of their participation. The program has expanded from three North Carolina counties to 16 counties in both North Carolina and Tennessee. NC State Extension offers provides relevant, responsive, and inclusive programs that address public health issues to help people make healthier, better-informed decisions.</p>	
62.	Computer Science Pathways (NC A&T)	<p>Computing has changed how we complete tasks, interact with each other, work and play. Given the rapid changes in technology, we are currently preparing young people for some jobs and careers that may not yet exist. Though technology changes constantly, a working knowledge of computer science (CS) is the foundation of almost all technologies being developed. CS is an essential component of the future workforce and the 4-H STEM team is heavily invested in ensuring that our NC 4-Hers are prepared to support future workforce needs in all areas of STEM.</p> <p>Through funding from the National 4-H Council and Google, the CS Pathways project was developed to develop CS skills in youth and teens. The program involves activities focused on computational thinking, algorithm development, and block-based coding.</p> <p>As a result of these efforts, more than 2,000 NC youth have been engaged with CS enrichment activities since the program began. Also, this engagement has generated a growing interest in advanced and text-based coding activities as youth continue to master fundamental CS skills and block-based coding. The team is currently investigating and preparing to introduce Java and/or Python as advanced levels of the CS Pathways project.</p>	Enriching Youth, Family & Community Well-Being
63.	Teen LEADS (Learning to Educate others About Doing STEM) (NC A&T)	<p>Computer science skills are key for young people today and will help them succeed in life and in their careers. Sometimes, teenagers learn best from their peers. Training teen leaders also builds the leadership skills of youth in limited income communities.</p> <p>Two teens from Bladen County were recruited as Computer Science (CS) leaders in their community as a component of the CS Pathways project. They have successfully led club meetings, workshops, and peer trainings. As one of the teen leaders transitioned from high school to her freshman year at NC A&T, the team saw a need to build upon the success of the initial two teen leaders.</p>	Enriching Youth, Family & Community Well-Being

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		<p>The 4-H Teen LEADS program was developed to integrate leadership, community service and STEM. Ten teens from eastern NC have been selected to serve as Teen LEADS. These teens have completed an application, interview and orientation to the program. Their monthly leadership and STEM training has begun, and they are looking forward to sharing STEM knowledge and activities with at least 50 younger youth in their communities.</p>	
<p>64.</p>	<p>Multistate 4-H Efforts Raise Awareness of Native American Culture and Combat Harmful Prejudices (NC State)</p>	<p>Many Native Americans are misunderstood, stereotyped, and experience racism. Although the Native American population in the U.S. consists of 574 federally-recognized tribes—each with their own rich, distinct culture and history—cultural stereotypes and misconceptions about a single, unified Native American culture are rampant. These stereotypes are partially caused by a lack of awareness of Native American culture and history. Research shows that 87% of state history standards do not mention Native American history after 1900, and 27 states do not include any reference to Native Americans in their K–12 curriculum. Other research has found that 62% of Americans have never met a member of a Native American tribe. In addition, 4-H youth members of the Eastern Band of Cherokee Indians (EBCI) were unprepared to answer questions about their culture and history when they were asked during 4-H activities.</p> <p>One of North Carolina Cooperative Extension’s local offices is located on the Qualla Boundary and serves the Eastern Band of the Cherokee Indians (EBCI). In April 2019, the EBCI Extension Center created a 4-H Cultural Presentation Team, which meets monthly to study various aspects of Cherokee history, language, and culture while creating workshops aimed primarily at non-Native youth. In March 2020, 10 EBCI youth from the cultural presentations team, one 4-H volunteer, and one 4-H agent took a trip to the University of Tennessee in Knoxville, Tennessee for leadership activities and to teach a class of first-year college students about Cherokee stories and legends. In addition, a workshop on Cherokee culture was held for the National Guard virtual summer camp hosted by NC 4-H, and a workshop on incorporating Cherokee cultural activities into 4-H meetings and programs was presented virtually at the National 4-H Volunteer Conference sponsored by the Southern States.</p> <p>All 35 of the first-year college students reported increased knowledge of Cherokee culture and expressed an interest in learning more about other cultures. Ten EBCI youth increased their knowledge of college accessibility, leadership, and public speaking. Through these efforts to increase awareness of Cherokee culture, Native American youth and non-Native American participants have enhanced their cultural competence and are making strides to prevent the spread of stereotypes. Young</p>	<p>Enriching Youth, Family & Community Well-Being</p>

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		people learn the multicultural skills to succeed through NC State Extension 4-H educational programs.	
65.	Mystery Challenge (Spring Series) (NC A&T)	<p>The onset of the pandemic presented many challenges. Youth and educators were faced with the uncertainty of learning using a different platform. Schools were forced to close, leading students to online facilitation at home. Although formal learning was being implemented, parents and youth needed opportunities to participate in informal educational activities.</p> <p>In response to the COVID-19 pandemic, 4-H at N.C. A&T created and facilitated the statewide "4-H Mystery Challenge" series. This series was orchestrated to engage youth and families in learning opportunities while being quarantined. The Mystery Challenge began in March of 2020 and concluded in May of 2020.</p> <p>These activities provided youth with fun, engaging and stimulating opportunities to connect formal learning with STEM and agriculture. The activities also encouraged family time, forcing youth and parents to work together to complete the challenges. Challenges were released each Monday, Wednesday and Friday via social media.</p> <p>There were 20 challenges released for participants to take part in. Through the mystery series, Extension was able to engage with over 300 youth and families. Offering the Mystery Challenge series not only allowed youth the opportunity to participate in problem solving activities, but also allowed families the opportunity to work together as a unit, promoting family time. During times of uncertainty caused by the pandemic, this opportunity assisted families with activities to keep them engaged and moving along while at home. As families were quarantined, the need for things to keep them occupied increased.</p>	Enriching Youth, Family & Community Well-Being
66.	Toybox Leadership (NC A&T)	<p>The need to provide leadership training for teens is necessary for their development and well-being. However, the need for adults to continue enhancing teens' leadership abilities is necessary for their development as professionals. Both teens and adults need to be continuously equipped with the tactics they need to lead in the community, at school and in structured 4-H clubs.</p> <p>Toybox Leadership was created as a secondary program to continue enhancing leadership skills and tactics for teen leaders. This program targeted not only teens, but also adults.</p>	Enriching Youth, Family & Community Well-Being

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		<p>Participants in the program were able to apply leadership best practices throughout county-based programming efforts and enhance programming productivity and creativity for other programs. The program focused on the following concepts:</p> <ol style="list-style-type: none"> 1. Lego Bricks: Relationships—Building Begins with Connecting 2. Slinky Dog: Vision—Pull—Then Be Patient 3. Play-Doh: Mentoring—The Mold Makes the Man 4. Yo-Yo: Creativity—It Only Happens When You Let Go 5. Mr. Potato Head: Mentoring—The Right Face for the Right Place 6. Rubik’s Cube: Ethics—Making the Right Turn 7. Rocking Horse: Efficiency—All Show and No Go 8. Little Green Army Men: Strategy—Success Is in the Set-Up 9. Lite-Brite: Message—Illuminate to Communicate 10. Weebles: Endurance—Staying Down Is Not an Option <p>In addition to increased leadership skills and abilities, the program also focused on expanding and elevating outreach efforts that enhance the well-being of people in North Carolina.</p> <p>To date, 22 teens have been trained to implement the program and 42 staff members have been trained to facilitate the program. Being that leadership opportunities are often limited in underserved communities, it was necessary to provide the program not only to teens, but also staff. This professional development program will continue to craft participants' expertise in leadership and the ability to lead.</p>	
<p>67.</p>	<p>Speedway to Healthy (NC A&T)</p>	<p>Obesity in youth often carries into adulthood and contributes to the development of many chronic illnesses such as heart disease and diabetes. The problem is worse in underserved and minority communities, where healthcare resources might also be limited.</p> <p>The Speedway to Healthy project was created as a resource to fight childhood obesity and poor health among children in North Carolina. The project features two learning experiences: 1) a creative educational exhibit that teaches students how the foods they eat affect their bodies and their health and 2) a series of experiential classroom activities. Children learn healthy lifestyle choices to avoid behaviors that have an adverse effect in childhood and continue into adulthood. The concepts learned through this interactive exhibit support or reinforce common core standards used in North Carolina public education. The activities conducted in the exhibit support the following standards associated with K–5th grade requirements:</p>	<p>Enriching Youth, Family & Community Well-Being</p>

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		<ul style="list-style-type: none"> • Understand wellness, disease prevention and recognition of symptoms. • Understand the importance of consuming, in moderation, a variety of nutrient dense foods and beverages. • Understand body systems and organs, their functions, and their care. • Compare unhealthy and healthy eating patterns, including eating in moderation. • Understand the benefits of nutrition and fitness for disease prevention. • Explain how nutrition and fitness affect cardiovascular health. • Infer the benefits of limiting the consumption of foods and beverages high in fat and added sugar. <p>Due to COVID-19 social distance guidelines and in-person gathering restrictions, Speedway to Healthy programming was limited in 2020. Only one county (Alexander) was visited, reaching 318 youth. All other 2020 scheduled and/or new bookings were canceled. These included scheduled activities in Burke, Hertford, Rutherford, Stanly, and Swain counties. Plans are underway to move Speedway to Healthy to a virtual environment which will allow 24/7 access to children and families within their homes, schools, and youth organizations.</p>	
68.	4-H STEM Challenge (NC A&T)	<p>Young people need to understand science, technology, engineering and math (STEM) to succeed in the 21st century. However, it can be a challenge to keep youth interested in STEM. Making STEM education fun is one way to address that problem.</p> <p>The 4-H STEM Challenge is a signature annual initiative in STEM and is designed to help make STEM fun and accessible to young people everywhere.</p> <p>The 2020 challenge activities allowed youth to develop quantitative, observational and critical thinking skills while making discoveries and designing solutions to problems related to setting up a camp on Mars. A total of 45 4-H agents across the state were trained to implement the activities. The NC A&T staff completed the activities with 256 youth.</p>	Enriching Youth, Family & Community Well-Being
69.	Leaders in Training (LiT) (NC A&T)	<p>Recruiting and engaging limited-resource teens in structured, leadership programming initiatives is challenging. Organizations such as 4-H are in competition with a multitude of activities that tend to capture the attention of our teen audiences. Although it's important to encourage teens to participate in numerous experiences, it's imperative that they participate in leadership-driven opportunities to equip them with the skills they will need to thrive in a competitive society.</p>	Enriching Youth, Family & Community Well-Being

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		<p>What was done: A four-day leadership training, “Clover Night Live Edition,” was conducted virtually in 2020. There were 45 duplicated participants and 13 non-duplicated participants. The training focused on STEM, Ag in the Bag, Clover Clapback, and Snack Attack. Counties represented at the training include Bladen, Wilson, Gates, Hertford, Bertie, Forsyth, and Mecklenburg. This program, called Leaders in Training (LiT) was created in 2018 to reach new limited-resource 4-H members ages 13-18 and to offer a structured leadership program where trained facilitators communicate leadership skills to teens.</p> <p>This residential leadership program has graduated 57 LiT participants from 13 NC counties. Participants have assumed various 4-H leadership roles at the district and state level with one participant being elected as the Northeast District President. She is the first African American female to hold the role and the first from her county.</p> <p>If this program were no longer available, our teens would face a disadvantage because of a lack of leadership training. In addition to leadership training, the opportunity to expose them to a university setting would not exist. This exposure is equally important as providing them with leadership skills.</p>	
<p>70.</p>	<p>Bertie County youth to present at national meeting (NC A&T)</p>	<p>Two Bertie County 4-H members had planned to start a small-scale vegetable growing program using their high school’s greenhouse and Nutrient Film Technique (NFT) hydroponics system. COVID-19 changed that plan and also meant the students needed to get jobs to help their families deal with the financial impact of the pandemic.</p> <p>Undaunted, the two 2020 high school graduates put together a new 4-H Agriscience Community Action Plan (CAP), with help from the 4-H agent in Bertie County. They conducted research on growing microgreens hydroponically and tested their system with eight youth volunteers, many whose families were struggling with job losses and illness caused by the pandemic. Each tester received a kit with broccoli and radish seeds, trays, microgreen growing mats, a gallon of spring water, nutrients, natural pH adjusters and pH paper, and printed instructions.</p> <p>Their efforts resulted in a mini-grant from the National 4-H Council and an invitation to present their project at the National 4-H Youth Summit on Agriscience, which was held virtually March 5 – 7. The two youth now plan to recruit 15 families into their program and help them grow fresh broccoli and radish microgreens.</p> <p>Read more about the youths’ hydroponic greenhouse at Bertie Early College High School.</p>	<p>Enriching Youth, Family & Community Well-Being</p>

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<p>71.</p>	<p>Hands to Service Mask Project COVID Response (NC A&T)</p>	<p>COVID-19 left many North Carolinians hunkered down at home wondering when life would return to normal. They had time on their hands, and they desperately needed help coping with an unprecedented emergency.</p> <p>For Extension at N.C. A&T, the virus was a call to action; a full-throttle effort to help limited-resource families and farmers withstand the pandemic.</p> <p>As coronavirus cases increased and experts recommended wearing non-medical facemasks in public, 4-H Specialist Shannon Wiley, Ph.D., called on 4-H members and volunteers to take part in a Hands to Service facemask sewing project.</p> <p>Club members, volunteers, and Extension agents stepped up to sew masks and donate them to community groups. By late April, 12 volunteers had provided 212 masks to grocery store employees in Forsyth, Harnett, and Herford counties, bus drivers and cafeteria workers in Gates County, senior citizens in Harnett, Herford, and Mitchell counties, and foodbank employees in Mecklenburg County.</p> <p>The project was a chance for 4-H youth to step up and use their skills for a community cause. Despite all the restrictions on gathering and traveling, they made a real impact and their enthusiasm helped expand the project beyond the 4-H program to volunteers and staff in other programs.</p> <p>In Wilson County, the 4-H Teen Council found another way to serve their community during the pandemic. They launched an initiative to deliver video messages and write cards to older adults at the local senior center as a way to lift their spirits and help them feel connected.</p>	<p>Enriching Youth, Family & Community Well-Being</p>
<p>72.</p>	<p>Cooperative Extension Supports Emergency Response and Community Economic Wellbeing During the COVID-19 Pandemic (NC State)</p>	<p>As COVID-19 rates spiked in the spring of 2020, emergency preventative measures were needed to slow the spread of the virus. Meanwhile, emergency shut downs and social distancing protocols threatened the livelihoods of community members and farmworkers. NC State Cooperative Extension efforts played a key role in combatting the effects of the pandemic by supporting mass testing, organizing mass distribution of masks to the highly vulnerable farmworker population, and continuing to provide economic resources and education to farmworkers and the community at large.</p> <p>The Extension Farmworker Health and Safety Comprehensive Program helped safeguard farmers by adding a COVID-19 awareness piece to their training and delivering 45 training sessions to 937 farmworkers. Thanks to Extension partnerships and the contributions of county Extension agents and leaders, one million masks were distributed to North Carolina farmworkers.</p> <p>Extension partnered with other Wake County departments and the COVID-19 Emergency Operations Center to provide support and resources to residents in the</p>	<p>Enriching Youth, Family & Community Well-Being</p>

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		<p>form of mass testing, data entry and analysis, and crucial updates on guidelines and developments. Two Wake County Extension staff were assigned to facilitate mass testing, supporting the administration of 34,247 tests as of mid-November 2020 and helping Wake County meet COVID-19 testing goals established by the North Carolina Department of Health and Human Services. In addition, two members of the 4-H Public Health Team and the 4-H program manager volunteered to work in a COVID Hotline Call Center, where they helped field over 25,000 calls from community members, providing crucial information about state and local guidelines, safety measures, economic resources, and more.</p> <p>As North Carolina moved into Phase 1 of the COVID-19 shutdown, many residents faced income loss, forcing them to make difficult financial sacrifices and making it impossible for them to provide for their pets. In response, Lenoir County Extension launched No Empty Bowl, a program designed to collect and distribute pet food and cash donations to struggling families, including no-contact delivery for individuals without transportation. No Empty Bowl helped over 200 families continue to care for their pets in the face of unprecedented economic hardship.</p> <p>Through participation in Cooperative Extension programs, 353,153 people accessed programs and implemented strategies to support family economic wellbeing, and 9,143 adults increased their use of identified community resources. NC State Extension’s extensive partnerships with agriculture, business, industry, education and government create a unique culture of collaboration that builds resilient communities.</p>	
<p>73.</p>	<p>NC State Extension Takes Lead Pandemic Food Security Role (NC State)</p>	<p>North Carolina is rated the 10th hungriest state in America, with nearly one in five residents facing hunger on a regular basis. Because food insecurity and poor nutrition are associated with several chronic illnesses that put people at higher risk for severe COVID-19 complications, a surge in food insecurity will exacerbate the health disparities that already plague our most vulnerable segments of the population, including low-income people, children, older adults, and immigrants.</p> <p>The COVID-19 pandemic exacerbated existing food security problems throughout the state, including in Durham County, where an estimated one in five households and one in four children lack consistent access to healthy, nutritious food. During the pandemic, Durham food pantries and similar organizations faced a 50% to 500% increase in demand as unprecedented economic challenges forced families to choose between food and other essentials. In response, the county Extension director assigned an official county feeding coordinator and partnered with Public Health’s</p>	<p>Enriching Youth, Family & Community Well-Being</p>

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		<p>nutrition services and County Strategic Initiatives to develop and lead a COVID-19 Food Security Task Force of over 40 community partners. This task force has coordinated the distribution of over \$1 million in funding for food security initiatives, supported the delivery of school meals to approximately 7,500 children daily, and created a farmers market team to address COVID- and market-related food distribution challenges. The task force has also provided technical and logistical support for food distribution, including volunteers, personal protective equipment, and on-site support.</p> <p>To combat COVID-related disruption of food supply chains, Iredell County Cooperative Extension partnered with The Dairy Alliance, a dairy company, a local church, and the Iredell County Health Department to distribute 4,000 gallons of free milk and 800 cloth face coverings to 1,000 Iredell County citizens. At the request of a poultry producer, Extension also partnered with other agencies to distribute 160,000 pounds of chicken and to provide food safety materials on handling bulk chicken to 3,500 citizens of Iredell and surrounding counties.</p> <p>Due to COVID shelter in place orders, Orange County Health Services closed the county's three farmers markets, which reduced income for farmers and further reduced access to local food sources. Extension partnered with the Orange County government to use additional county funds to purchase produce, dairy, and meat from local producers and supplement federal food boxes being provided by the U.S. Department of Agriculture. These efforts served an average of 300 to 400 families monthly across Orange County, providing healthy local produce to food-insecure families and providing a new market for farmers.</p> <p>According to the USDA, 14% of American families with children were food-insecure before the COVID-19 pandemic. In Jones County, 46% of children live below the poverty line. To meet the needs of this food insecure population during COVID-19, Extension collaborated with USDA's Farmers to Families program and Military Produce out of Virginia to provide 1,300 boxes containing cooked protein, dairy items, milk, hard-boiled eggs, and an assortment of fruits and vegetables weekly to residents of Jones County. Each week for 21 weeks, approximately 3,500 community members who would have otherwise been food insecure received food through this program.</p>	
74.	Aging in Place Indicators for Rural Seniors: Focusing on Residential	Older adults living in rural areas face challenges when aging in place due to deteriorating housing conditions, lack of services, and financial and health issues. This population is also likely to be inactive because of reduced access to opportunities for	Enriching Youth, Family & Community Well-Being

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	<p>Environments and Physical Activities Participants (NC A&T)</p>	<p>physical exercise and social interaction. The aim of this study is to assess indicators that may contribute to rural seniors’ successful aging in place, focusing on their residential environments and physical activity (PA) levels.</p> <p>NC A & T researchers are using Aging in Place (AIP) indicators to assess seniors’ need and place satisfaction. 28 onsite interviews with service provider and 300 surveys with rural aging seniors and rural homeowners have been completed.</p> <p>The preliminary results shows that the rural community face the challenges like transportation to access the community services, internet access, availability of senior housing, delivery of hot foods, nursing home facilities. Also, the rural community is facing the lack of work force or young generation to take care of older adults.</p>	
<p>75.</p>	<p>Lifelong Improvement Through Fitness Together (LIFT) (NC A&T)</p>	<p>LIFT focuses on building strength, flexibility, and improved balance in older adults. At the start of the program, the instructor conducts a baseline functional fitness assessment to measure strength, balance, flexibility and nutrition habits. The aim is to show improvements in these areas by the end of the course.</p> <p>LIFT was offered to seniors at the Troy-Montgomery Senior Center from January to March 2020. Activities in the class include strength building exercises, such as arm curls, standing on one foot to improve balance, improving flexibility through toe touches and arm stretches, and education on nutrition. As a whole, the participants improved their ability to balance in a set position by two seconds. They upped their ability to do high steps from about 36 steps to more than 82 steps in two minutes. The group also recorded major improvements in flexibility, from being unable to do toe touches in early January to being able to reach beyond their toes by early March. When the pandemic made in-person classes impossible, virtual LIFT classes were offered in spring and summer for Montgomery County residents. The course was expanded in the fall to include Alexander, Anson, and Stanly counties.</p>	<p>Enriching Youth, Family & Community Well-Being</p>
<p>76.</p>	<p>Seniors Receive Support through Research and Extension (NC State)</p>	<p>Older adults make up 16.7% of North Carolina's population and have complex needs that no one provider type can meet. Older adults may experience undesirable health outcomes as a result of inadequate access to community resources, including effective hospital discharge planning, home visits, and social worker visits. The Governor’s Advisory Council on Aging’s Subcommittee on the Integration of Medical and Social Programs convened a diverse group of providers from health care, social service, human services, and aging networks to develop recommendations for how the state government can support seamless integration of medical and social programs across these key sectors. An NC State Extension specialist served on this</p>	<p>Enriching Youth, Family & Community Well-Being</p>

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		<p>committee and helped develop a new model focused on keeping people healthy and living at home. Using this model, better health and access to community support services is expected to extend older adults' capacity for independent living and reduce overall health-related expenses. The economic impact will be significant given that the number of Americans 65 years and older will more than double between 2020 and 2040.</p> <p>In addition to this state-level effort, NC State Extension works at the community level to safeguard the wellbeing of seniors by providing hands-on support for navigating the Medicare system. According to an AARP report, there are 44 million beneficiaries enrolled in Medicare, and these numbers are expected to rise. One in five Medicare beneficiaries describes Medicare as confusing, which causes beneficiaries to miss out on thousands of dollars a year in savings. Every year, Medicare-aged seniors are bombarded with confusing advertisements for medications, further complicating their ability to navigate an already difficult Medicare system. The Seniors Health Information and Insurance Program (SHIIP) operates through Extension to provide seniors with advice and guidance on choosing a plan and to connect them with resources for offsetting insurance and medical costs.</p> <p>In 2020, Washington County Extension's SHIIP provided phone counseling to 230 citizens to help them save \$306,299 in prescription drug costs. In Greene County, Extension SHIIP volunteers assisted over 3,900 Medicare beneficiaries in insurance enrollment, leading to over \$87,000 in prescription drug cost savings. In Currituck County, SHIIP volunteers helped 288 individuals save over \$186,152 in insurance premiums and drug costs. In Perquimans County, SHIIP and Extension volunteers contacted 2,800 individuals and provided insurance guidance to 517 seniors, with an estimated impact of \$220,000 in medical insurance savings. In Swain County, SHIIP assisted 163 clients for a total savings of \$190,462 dollars on their medication plans for an average savings of \$1,168 per client, which is excellent because most of the clients are on limited and fixed incomes. In addition, many of the clients that come into the Swain Extension Center for their SHIIP appointment have accessed educational information from agents and learned about other Extension educational programs, such as family and consumer science classes. NC State Extension offers a wealth of educational programs that address public health issues, improve economic well-being, and help people make healthier, better-informed decisions.</p>	
77.	Extension Extended (NC A&T)	COVID-19 made in-person Extension programs impossible by mid-March 2020. At the same time, North Carolinians, especially those with limited resources, needed help	Enhancing Youth, Family and Community Well-Being

		<p>and support in adapting their farm operations to the pandemic, keeping their kids engaged while schools were closed, and staying healthy and safe.</p> <p>Extension made an effort to adapt as many programs as possible to an online format and offered new programs that specifically addressed the challenges of COVID-19. Extension Extended (#ExtensionExtended) provides educational resources as well as activities for kids and families through Facebook and Twitter.</p> <p>Extension Extended began offering a virtual programming series in April 2020, with county agents and state specialists sharing their knowledge on a wide range of issues from budgeting to healthy eating to safe gardening practices during the pandemic. Social media has been used to spread the word about Extension’s online coronavirus resources, present 4-H Mystery Challenges on topics ranging from healthy eating to career exploration, share recipes and food safety tips, and offer MyPlate at Home, an online version of the MyPlate healthy eating program.</p> <p>Other examples of Extension Extended outreach include:</p> <ul style="list-style-type: none"> • A virtual Speedway to Healthy exhibit sent to all third-grade teachers in Stanly County and posted to the Stanly County Cooperative Extension Facebook page. • Online Expanded Food and Nutrition Education (EFNEP) programs. • A weekly program in Edgecombe County providing information to entrepreneurs about financial resources and COVID-19 safety precautions as a way to entice customers to continue shopping with them, both online and in person. • A three-day series on Zoom about financial resources conducted by the Guilford County Family and Consumer Sciences Program. • A virtual program for youth in Gates County that provided information on life and vocational skills as well as resources to help them express their emotions during COVID-19. • Social media campaigns in Nash County that provided information on how to safely purchase and prepare food, apply for unemployment, protect mental health, and connect as a family during social distancing. <p>Various programs for senior citizens were adapted for virtual presentations, including Eat Smart, Live Strong, and the Lifelong Improvements Through Fitness Together (LIFT) exercise class, which was offered through Facebook Live.</p>	
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<p>78.</p>	<p>NC Healthy Homes Initiative Provides Education to Combat Radon Contamination and Associated Health Risks (NC State)</p>	<p>Radon is a colorless, odorless, tasteless, and chemically inert radioactive gas. It is formed by the natural radioactive decay of uranium in rock, soil, and water. It can be found in all 50 states. Testing is the only way to measure how much radon is present. Radon is the leading cause of lung cancer among non-smokers and the second leading cause of cancer among all individuals. North Carolina has documented elevated levels of radon across the state, in particular in the western and piedmont areas.</p> <p>North Carolina participates in the Healthy Homes Partnership (HHP), a multistate effort to support research, education, and Extension programs that increase home health and safety, improve family health, and build stronger communities. Since 1999, the HHP has addressed multiple housing-related problems that affect the health of children and families. These efforts have mobilized individual actions and improved environmental decision-making skills among millions of consumers.</p> <p>As part of the NC State Extension Healthy Homes initiative, a radon webinar series was held for health professionals, housing professionals, and consumers. The initial plan was to offer four webinars in January in conjunction with National Radon Action month. The success of the January webinars resulted in the creation of an additional 10 radon related webinars with over 2,260 views and plans for a continuing education radon training program to be offered to real estate professionals in 2021. Webinar participants included not only North Carolina residents but also individuals from across the U.S. and Canada. NC State Extension provides trusted information to help people, businesses and communities make safe, healthy, and better-informed decisions.</p> <p>See https://healthyhomes.ces.ncsu.edu/radon/north-carolina-radon-webinars/ for more information.</p>	<p>Enriching Youth, Family & Community Well-Being</p>
<p>79.</p>	<p>Nutrition and Self-Sufficiency of Adults with Disabilities through a Mentoring Program (NC A&T)</p>	<p>Adults with intellectual and developmental disabilities (I/DD) have high level of obesity and inactivity when compared to the general population due to physical challenges, cognitive limitations developmentally appropriate community programs and segregation from the community. They often face many obstacles in their development of self-efficacy and community independence. Individuals with I/DD have chronic and severe impairments that are used to characterize the individual as having physical and mental deficiencies whereby limiting them from being independent. The research aimed to improve the nutrition knowledge and self-sufficiency of adults with I/DD.</p>	<p>Enriching Youth, Family & Community Well-Being</p>

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		<p>Graduate and undergraduate students were given a special mentor training to serve as mentors and educators. The training was focused on getting familiar with intellectual and physical disabilities, language, adjusting to personalities, leading with emotional intelligence, leadership, and effective teaching. Five days of summer camp was also conducted which helped mentee (adults with I/DD) to gather knowledge about exercise and fitness, safety, meal preparation, apparel construction and personal goal settings.</p> <p>A curriculum book was developed for adults with I/DD to support both mentor and mentee. The book covered the important life lessons like making my plate; what to wear, wear and proper fit; eating out/dinning in; relationships and dating; and laundry lowdown. More than half of mentees applied the lessons independently or in partnership with mentors. The mentees were also able to prepare a quick meal. Also, a training manual for mentors and a workbook for mentees was developed. The mentee workbook includes presentations, activities, worksheets, web resources and games, and assessments. Adults with I/DD will be able to use the workbook as a learning tool during the program or at home outside of the program.</p>	
<p>80.</p>	<p>Coming Together for Racial Understanding (NC A&T)</p>	<p>In 2020, our nation struggled with racial tension and continued frustration over longstanding issues around racial injustice. N.C. Cooperative Extension has continued to participate in the Coming Together for Racial Understanding (CTRU) Program Initiative, a joint effort between N.C. A&T State University and N.C. State University with the state training team comprised of team members from both institutions. Extension at A&T saw the value of building upon the first phase of this pilot program by focusing internally on Extension employees and providing them with the professional development opportunity to improve their capacity to engage in dialogue around racial issues. The state training team worked together to convert the dialogue process into an online training format.</p> <p>Based on staff feedback, 10 discussion circles were organized using the Coming Together for Racial Understanding discussion format. Each dialogue circle had an average of 13 participants, plus two to three facilitators. The groups followed a six-week, two-hour conversation circle format. All sessions were conducted virtually via Zoom between August and November 2020. A combined session was held with all participants in December. About 130 people participated in this process (consisting of Extension staff from 24 counties and campus faculty/staff who manage state-level programs). Discussions explored participants' earliest conceptions about human differences, engaged in activities that showed how challenges and opportunities are tied to racial and ethnic groups, and reviewed several viewpoints and different data</p>	<p>Enriching Youth, Family & Community Well-Being</p>

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		<p>points that revealed disparities by race in North Carolina and the country. Participants were able to talk about their feelings and experiences with these racial realities. Each group also brainstormed ideas about improving race relations and reducing gaps among people from different backgrounds in their community and within the Extension organization.</p> <p>The evaluation response rate was 35 percent. Using a Likert scale where 1 = “totally unsuccessful” and 5 = “very successful,” respondents were asked to rate how successful the dialogues were in helping participants in three areas:</p> <ul style="list-style-type: none"> • Expanding their understanding of how race plays a role in shaping what others experience in life (mean = 4.15). • Discovering common values and priorities across different racial identities (mean = 4.15) • Talking about an issue that is hard to talk about (mean = 4.15) <p>Participants were asked to rate the extent to which the dialogues change their knowledge in five areas:</p> <ul style="list-style-type: none"> • Understanding of how different identities and experiences have impacted their colleagues: Greater after dialogues (34%); much greater after the dialogues (14%); unchanged (2%). • Knowledge of how race impacts life in the U.S.: Greater after dialogues (34%); much greater after the dialogues (7%); unchanged (10%). • Knowledge of how privilege impacts people’s life outcomes: Greater after dialogues (28%); much greater after the dialogues (7%); Unchanged (13%) • Desire to influence change at the individual level: Greater after dialogues (22%); much greater after the dialogues (18%); unchanged (8%). <p>Desire to influence change at the organizational level: Greater after dialogues (25%); much greater after the dialogues (19%); unchanged (2.5%).</p>	
<p>81.</p>	<p>Grassroots Leadership Conference (NC A&T)</p>	<p>For rural communities and limited resource and minority communities to effectively address the issues that affect them and strategize on problem solving, grassroots leaders need to work together to develop strategies and successful programming efforts.</p> <p>The Grassroots Leadership Conference is an annual forum that brings together a diverse group of stakeholders throughout the state of North Carolina. The conference was held on October 22, 2020 and this year’s theme focused on “Creating Equitable Solutions for Stronger Communities.” Due to COVID-19 and the need for social-</p>	<p>Enriching Youth, Family & Community Well-Being</p>

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		<p>distancing, the Grassroots Leadership Conference was conducted virtually for the first time to protect the health and safety of staff and guests.</p> <p>The conference allowed grassroots community leaders and organizations to network, learn about new program initiatives, and identify possible strategies to support equitable solutions and planning and programming decisions in their communities. Breakout sessions provided an opportunity for participants to brainstorm solutions around important community issues. Approximately 150 people attended the event. The conference evaluation reflected an overall positive response to the program.</p>	
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