

2019 Annual Report of Accomplishments and Results

North Carolina

North Carolina State University (NC State) – 1862 Institution

North Carolina A&T State University (N.C. A&T) – 1890 Institution

I. Report Overview

1. Executive Summary

This report reflects the accomplishments of research and extension programs at North Carolina State University (NC State) and North Carolina A&T 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.

NC State University

In 2019, CALs prioritized three initiatives aimed at solving complex challenges facing agriculture. Through a plant sciences initiative, teams of researchers and extension agents and specialists have been working together representing not just CALs but also engineering, sciences, textiles and other colleges to address key problems related to food, fiber and fuel. The final beam of a large, state-of-the-art plant sciences building was recently placed, and the building is expected to be complete in 2021. A food manufacturing and processing initiative led to the 2019 opening of a pilot plant, the NC Food Innovation Lab, at the North Carolina Research Campus, and NC State faculty members are an integral part of that effort. In addition, a food animal initiative – a CALs partnership with the College of Veterinary Medicine – progressed, prompting collaborative investigations into the health of swine, cattle and poultry.

Global Food Security – Plant Production Systems and Health. North Carolina is one of the nation’s top three states when it comes agricultural diversification. Our scientists and educators work with dozens of crops, ranging from traditional row crops to high-value specialty crops. Highlights of their work in 2019 include the evaluation of colorants from purple carrots that hold promise as commercial dyes; ongoing use of a user-friendly online cotton variety performance calculator that has led to an estimated \$68 million benefit for North Carolina producers since 2016; hemp research and extension efforts that have supported growth of this emerging industry to nearly 8,000 acres statewide; and lab- and field-based experiments and training programs that are helping growers manage the guava root-knot nematode, which poses a significant threat to the state’s \$350 million sweet potato industry.

Global Food Security – Animals and Their Systems, Production and Health. About 67% of North Carolina’s agricultural income and jobs stem directly from food animal systems. NC State efforts to enhance the industry included the development of management strategies that resulted in an increase of about \$5,000 gross income per sow by lengthening the sow’s reproductive life; maintenance of a county group purchasing program that reduced farmers’ costs and helped their cattle get enough minerals in their diets; and delivery of educational programs that helped producers manage 4 million tons of animal waste produced in North Carolina. In addition, new feed milling and feed formulation recommendations reduced feed manufacturing costs; improved feed conversion, nutrient utilization, and poultry health; and lowered litter moisture and ammonia emissions.

Climate Change. Major hurricanes that have caused massive flooding and agricultural damage are occurring more frequently in North Carolina. In addition to causing dramatic losses, it’s suspected that climate change is taking a subtler, but nonetheless significant, toll on agriculture through temperature changes

that influence crop growth and the emergence of new pests and diseases. CALS faculty members are conducting research and developing practices to help individuals, communities, and others cope and to protect the environment. Examples include a comprehensive educational program on economical, environmentally friendly gardening and landscape management practices that encouraged 75% of participants to implement best practices; a two-day training event on data science that led to an investigation of the use of UAV imagery to assess forage crop quantity and quality, an examination of digital approaches to quantify yield variability in cotton variety trials, the development of videos for a new sixth-grade STEM training curriculum and an ongoing Advanced Ag podcast; Extension workshops that helped stabilize streambanks and curb stormwater runoff, reducing soil loss by an estimated 290 tons per year and removing nutrients that cause stream pollution; and research that led to next-generation water control structures to save farmers' time, mitigate flood damage, conserve water, and enhance water quality.

Sustainable Energy and Biotechnology. Finding sustainable energy solutions is critical for North Carolina's future. Through research and extension efforts, CALS supports expansion of production systems for biofuels and biobased products, including nonpetroleum-based fuels, forest biomaterials, power sources and chemicals. These efforts included the development of a model that could boost investment in farm-based sustainable energy projects by allowing investors to more accurately predict whether a project will be profitable; a wide range of research investigating productivity, environmental sustainability, and economic viability of high biomass-producing perennial grasses such as miscanthus; research that's laying the groundwork for a new animal feed supplement made from low-value glycerol leftover from biodiesel production; and the discovery of a way to isolate micro-organisms from the guts of wood-eating insects so that they can be used convert biomass into biofuels and other high-value chemicals.

Childhood Obesity. CALS provides nutrition education programs to provide individuals, families and communities with the knowledge they need to make informed choices about food and healthy lifestyles. Extension's Expanded Food and Nutrition Education Program reached nearly 2,700 families and over 17,500 youth, with 96% improving their diets and about 50% increasing their physical activity. In Columbus County, for example, young people who took a cooking class are making more home-cooked meals and cutting back on high-fat fast foods. Children who took part in NC State Extension's Steps to Health program, designed for those who rely on the federal Supplemental Nutrition Program, have started drinking more water, are more willing to try fruits and vegetables and are more active. Steps to Health also encouraged 93% of food pantries and small retail stores to promote improved use of SNAP benefits and thus improve access to healthy foods for limited-resource residents. A new program called Eat Smart, Move More, Prevent Diabetes helped participants eat better, lose weight, increase their physical activity, and lower their A1c levels.

Food Safety. To reduce cases of foodborne illness, NC State conducts research and delivers training programs to keep the entire food chain safe. 2019 accomplishments included keeping certified food protection managers up to date on food safety techniques and regulations and a social media campaign that reached 350,000+ people with science-based consumer food safety information. Environmental health inspectors and regulators learned about retail HACCP regulations at a workshop with over 210 participants in seven states and the District of Columbia. And food producers gained a better understanding of the Food Safety Modernization Act and Produce Safety Rule, readying them for food safety audits and site inspections.

Human and Community Development. Some of CALS' most impactful human and community development programs in 2019 involved young people. Through clubs, camps and other educational programs offered across North Carolina, Extension's 4-H program helped 261,000 youth gain confidence and knowledge to make a difference in the world. Research has shown that children involved in 4-H programs are five times more likely to graduate from college, and that translates into economic benefits. The programs also helped prevent substance abuse among teens and informed young people about careers involving horticulture and livestock. Vulnerable youth also had the chance to attend camp for the first time, an experience they found to be safe and inclusive. N.C. A&T researchers are studying the need of senior renters to age in place. Many elderly renters face challenges relating to their health and

financial conditions and obstacles to independent living including unaffordable housing. Study is going on to know how indicators like residential environment and health of rural senior influence the aging in place. Another project focused on adults with disabilities. Researchers are developing a curriculum and mentoring program to promote their knowledge in nutrition and self-efficacy.

Human Health. Scientists from many CALS disciplines and departments are making basic and applied discoveries that have implications for human health. A food scientist and CRISPR pioneer has, for example, identified genomic hotspots in a beneficial gut bacterium and is using that knowledge to develop a COVID-19 vaccine. A poultry scientist has developed and tested a now-patented vaccine that's proven 100% effective in mice in preventing a common, and sometimes deadly, foodborne illness. Food scientists developed technology that concentrates healthy proteins and fruit compounds and modifies proteins so they don't trigger allergic reactions; as a result, a company is using leftovers from farm and food processors to make protein-packed gummies and another is looking at ways to use the patented ingredient technology to create healthier protein bars, beverages and other products. And a cell biologist discovered an atypical activity of some immune system components that may be a key factor in the complex interplay between oxidative stress and inflammation in a severe neurological disorder called Rett syndrome.

N.C. A&T Research and Extension

For research and Extension faculty within N.C. A&T's College of Agriculture and Environmental Sciences (CAES), 2019 was another highly productive year. Research conducted by 23 scientists led to accomplishments with wide-ranging impacts of importance to agriculture, environment, sustainable energy, food safety and nutrition, human and community development, and health. Additionally, our professionals at the county level and campus-based specialists worked to provide programs that translated that research into 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 decisions to improve their lives. N.C. A&T Extension 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. In 2019, Extension made hundreds of thousands of face-to-face contacts with North Carolinians in half of the state's 100 counties and the Eastern Band of Cherokee Indians.

Global Food Security – Plant Production Systems and Health. Research projects in this NIFA focus area 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; increasing production and diversity in sweet potato use so it will increase income and the nutritional well-being of farm families and rural communities; applying commodity pricing analysis for assisting in policy planning to help guide the direction of agricultural enterprise and production; developing and understanding best management practices to grow tuber borchii truffles in North Carolina; and reducing pest damage to organically grown apples and vegetables using natural (non-synthetic) pesticides and certain agronomic treatments. Researchers also worked hand-in-hand 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, both Research and Extension hosted workshops, field days, and a mini conference. Thanks to the work of Extension professionals in the field, 1,669 crop producers adopted best management practices, including those practices related to nutrient management, conservation, production, cultivars, pest management (weeds, diseases, insects), business management, and marketing. For example, Extension at N.C. A&T provided support to the largest peach grower in Rowan County after the crop had been decimated by late winter freeze events in 2014 – 2018. By learning

new marketing strategies and using social media promotions, the grower was able to sell 95% of his crop in 2019 and saw a 40% increase in foot traffic. The increase in retail sales translated into \$6,000 in additional revenue. Cooperative Extension at N.C. A&T also helped North Carolina farmers save \$70,000 in 2019 by renting equipment that they can't afford to buy so they could implement yield-increasing, season-extending plasticulture production on their farms.

Global Food Security – Animals and Their Systems, Production and Health. Research led to the development of a protein marker approach to identifying the immune's system response to disease pathogens in ruminants, a step forward in controlling and preventing disease in these animals. Other research focused on improving the physical and reproductive health of pigs by identifying feed supplements, such as moringa. Researchers also helped identify prevention and mitigation strategies to protect pigs against respiratory disease and incorporated pig-based spray-dried plasma (SDP) supplements to boost the immunocompetence in broiler chicks. Workshops offered by N.C. A&T for cattlemen covered herd health, nutrition, genetics, and artificial insemination. In Yancey County, Extension helped cattlemen form the Yancey County Cattlemen's Association, which now has 40 members. Before the coronavirus pandemic, the group was meeting once each month and each meeting featured an educational component offered by Extension at N.C. A&T.

Sustainable Energy and Biotechnology. Research in this NIFA focus area addressed development of an environmentally positive system (reducing CO₂ emissions) for creating biochar-based materials—the carbon-rich solid that comes from organic matter—from biomass. The researchers produced biochar from biomass sources that can be converted into the raw material used to produce low-cost, high-performance materials for production of supercapacitors. Research is also underway to develop an efficient system for recovery of energy, nutrients, and water from agricultural and food wastes for sustainable agricultural production. The system in development will address the processes involved in converting biogas, which is naturally produced from the decomposition of organic waste, to synthetic gas, production of biochar from anaerobic digestates, and conversion of biochar into fertilizers. The researchers have a prototype anaerobic digestion process that uses a two-stage thermophilic anaerobic co-digestion process that extracts biogas/methane from corn stover.

Childhood Obesity. Workshops and programs were provided to address a wide range of issues that impact childhood obesity, including healthy food selection and preparation, adding fresh produce to the diet, restricting the use of sugar and salt, and the role of macronutrients in the diet. Participants also were trained to use high-tunnel technology to produce high-value vegetables. Programs included: 1) The Expanded Food and Nutrition Education Program (EFNEP), which provided education to 50 SNAP-eligible adults and 1,500 family members, resulting in better diet practices among 90 percent of participants. 2) Try Healthy, a program developed at Cooperative Extension at N.C. A&T that encourages healthy eating and physical activity. The program reached 10,889 youth in 2019 and about half reported increasing their knowledge about nutrition and the benefits of exercise. 3) Speedway to Healthy, a 1,200-square-foot, walk-through exhibit that teaches K- 5 youth about nutrition and its effects on the body. In 2019, 3,273 students from eight counties participated in the program in their schools. In addition, another project examined the potential of faith-based settings as a connection portal for health promotion among older African American adults where the researchers and staff involved in the program observed changes in the ability of participants to recognize the importance of healthy food (growing, shopping, preparing, eating), physical activities, and the relationship between spirituality and healthy eating. And another group of researchers is working to identify the dietary compounds from food by-product that have the potential to prevent obesity.

Food Safety. In this NIFA focus area, a group of N.C. A&T researchers is focusing on developing a coating that will retain less oil from the frying process and provide a healthier coating batter (sweet potato starch vs. corn starch). Preliminary results show that the process produces an edible coating that reduced fat uptake by 85% in fish and 60% in chicken with no difference in color, flavor, or taste.

Human and Community Development. One project in this area, PowerPay Your Way to a Better Credit Score, helped people develop plans to manage and reduce their debt by learning to write SMART goals, and implement basic financial management strategies. Another program, Community Voices, was aimed at developing the leadership base of communities, targets those who often do not have a voice, who feel that their voices are unheard, or are unaware that they need a voice in community decision-making. One of the 2019 Community Voices graduates was inspired to run for the Henderson City Council and was elected to the 4th Ward at-large city council seat. Professionals with Cooperative Extension at A&T also played a role in developing 15 grant proposals by local organizations to support community and economic development in initiatives.

A number of Extension programs focused on developing leadership skills in youth that often have limited opportunities for leadership roles in their communities. The interactive No Soil, Just Water program helped middle school students understand basic science, such as biology and chemistry and introduced them to agricultural sciences, technology, engineering, and math fields and associated careers. The program partnered with the nonprofit BEST Mentoring to encourage at-risk and adjudicated males to explore life options through agriculture activities such as hydroponic gardening. In 2019, six adult mentors worked with 14 students to produce, harvest, and deliver 284 one-pound bags of produce to 28 families and provided 325 pounds of produce to four church ministries that distribute food to communities within food desert areas. The N.C. A&T creation Innovation Station – a 40-foot-long mobile STEM lab and makerspace – visited 29 counties, helping nearly 2,900 youth build skills in the engineering design process, design thinking, computer science, and digital literacy.

Human Health, Nutrition and Well-Being. In this NIFA focus area a group of N.C. A&T researchers is exploring the development of local strains of *L. bulgaricus* as new sources of yogurt creating bacteria which offers the potential of local (U.S. sourcing) yogurt making bacteria, development of yogurts that are more preferred by American consumers, and a financial benefit to the dairy industry if the project proves successful. Another group of researchers worked to identify the effect of reducing the enzymatic allergen in peanuts. Researchers found that the enzymatic treatment could enhance peanut storage stability with no change in nutritional value but could negatively affect flavor.

I. Merit and Scientific Peer Review Processes

Process	Updates
<p>1. The Merit Review Process</p>	<p>At NC State a thorough scientific and merit review of each proposed HATCH project is conducted at the departmental level before submission to the North Carolina Agricultural Research Service (NCARS). This departmental review consists of an informal review (PI's responsibility) and a formal review (Department Head's responsibility). HATCH projects must be aligned with one of the critical issues from the Plan of Work. Next, research projects undergo a budgetary review and are submitted to USDA/NIFA for approval. The merit of Smith Lever Extension programs developed by Extension Specialists is determined by the Department Heads, Extension Director, and State Program Leaders. Program merit is guided by emerging needs identified through needs assessments, Extension agents, state/local advisory councils, governmental officials, advisers, commodity group representatives, volunteers and other clients. At the state level, extension leadership and specialists identify broad areas and scope for Extension to focus its work. At the local level district directors, county directors, and field faculty review local needs to develop county level plans of work and individual plans of action. At the local level, District and County directors assess the merit of Extension programming.</p> <p>Evans-Allen projects are supported through the Office of Agricultural Research in N.C. A&T State University's College of Agriculture and Environmental Sciences (CAES). The research director in conjunction with the leadership team, faculty and staff determines the need, priority, and scientific feasibility of proposed Evans- Allen projects and the development and implementation procedure for project documentation, merit review, and selection. This process assures that research proposals are scientifically sound, relevant to society's food and agricultural needs, and no duplication of efforts undertaken elsewhere. Prior to proposal development, alignment of the research topic with the needs of the state and the direction of the program initiatives of CAES is determined. Upon agreement by the department chair, the associate dean for research, the research director, and the principal investigator, a proposal on the topic for submission through the Evans- Allen program is prepared. A merit review process is conducted that includes a review by 3-5 peer reviewers from both within and outside the University who are knowledgeable of or familiar with the area of research. Proposals are then reviewed by the associate dean for research, who determines if additional review and substantive revision is necessary. Upon acceptance by the associate dean for research and research director, proposals are transmitted to NIFA/USDA for approval. Upon NIFA approval, proposals are submitted to the Office of Agricultural Research for budgetary review.</p>
<p>2. The Scientific Peer Review Process</p>	<p>See above</p>

II. Stakeholder Input

<p>1. Actions taken to seek stakeholder input that encouraged their participation with a brief explanation</p>	<p>NC State College of Agriculture and Life Sciences is committed to seeking, receiving and using input from all stakeholder groups, including under-represented groups and the general public. NC State makes a concerted effort to involve and inform college partners and other stakeholders in planning efforts. The college is fortunate to work closely with a large number of North Carolina commodity organizations, biotechnology companies, service organizations and societies, agricultural advocacy groups and others to encourage their input and support. NC State Extension routinely reaches out to stakeholder groups including residents, governmental officials, advisory leaders, commodity group representatives, volunteers and other clients. County extension personnel interact daily with stakeholders in such a way that input is effectively gathered and communicated to administration and faculty. An Advisory Leadership System is functional in each of North Carolina's 100 counties and the Eastern Band of the Cherokee. The Advisory Council represents geographic, cultural and economic diversity within the communities we serve. This council provides the voice of the groups they represent. Extension county staff serve on local boards and committees to encourage stakeholder involvement in Extension activities. Local extension staff attend community meetings and events and as members of the communities they serve, engage stakeholders an actively seek input.</p> <p>The CAES Advisory Board provides advice and counsel on matters related to the College's strategic direction, priorities, and external relations, as well as advice on staying relevant and addressing the needs of its stakeholders. The Board is comprised of industry/commodity group leaders, alumni, students, partner agencies and small farmers. It provides eyes and ears into the communities served by N.C. A&T, offers a forum for CAES to hear from constituents, and communicates information relating to research and outreach. The Strategic Planning Council (SPC) is the advisory leadership group for Cooperative Extension at N.C. A&T. The 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. Council members help Extension reach more clientele, ensure the relevancy of programs and the delivery of Extension education, and interpret the value of Extension to stakeholders. The SPC meets three times per year, one of which is a joint meeting with NC State's State Advisory Council. Networking and collaboration between both councils are facilitated by two members who serve on both councils. With these organized groups emphasizing and providing significant stakeholder input into program direction, a planned and proactive process is operational that assures that programs are reviewed and overall needs assessed on a continuous basis, but no less than once every two years, with greater frequency encouraged. The Small Farms Task Force is</p>
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	<p>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 State is committed to identifying and giving stakeholders the opportunity to provide feedback and ensure that local programs meet local needs and priorities. Stakeholders are identified through commodity groups, community partners, the Advisory Leadership System, volunteers, staff participation and attendance at community events, other clients, public outreach efforts, and the needs assessment process. Stakeholders are also identified through outreach efforts using mass media, social media, and the Extension website. The Advisory Leadership System, functional in each of North Carolina's 100 counties and among the Eastern Band of the Cherokee is also used to identify groups and individuals from whom to collect input. The Advisory Council represents geographic, cultural and economic diversity within the communities we serve. The system provides a means to engage a comprehensive stakeholder group. This system is monitored administratively to assure that a diverse group of stakeholders are engaged.</p> <p>The College of Agriculture and Environmental Sciences (CAES) works with its College and departmental advisory boards to identify stakeholders. These boards are comprised of industry, commodity and organizational groups, as well as small farmers and alumni, who help the College, identify stakeholders and assist with obtaining input into CAES’ strategic direction and priorities. The Strategic Planning Council SPC organizes community forums, focus groups, listening sessions and a grassroots leadership conference, which helps to identify the stakeholder to collect the input. The input from diverse group of stakeholders are gathered via mail surveys, electronic/web surveys, focus groups.</p>
<p>3. Methods for collecting stakeholder input and brief explanation.</p>	<p>One source of stakeholder input comes from direct interactions between NC State research scientists and county-based extension personnel with producers, industry and other agribusiness representatives. NC State maintains close ties with state agricultural industry associations. The association boards identify high-priority research areas. NC State Extension conducts a formal needs assessment which includes collection of stakeholder input. Extension uses mailed surveys, electronic/web surveys, one-on-one interviews, and focus groups to collect stakeholder input for the needs assessment and subsequent program prioritization process. Stakeholder input is also collected from advisory leadership councils located in each county. Strategic planning efforts in extension and for the entire college benefit from concentrated efforts by college leadership to engage stakeholders through listening sessions, focus groups, and state-wide conferences and workshops. Many of the departments within the College of</p>

	<p>Agriculture and Life Sciences have formal advisory groups with stakeholder members that meet on a regular basis providing input and direction for research and extension programs.</p> <p>Each year, the SPC at North Carolina A&T hosts its annual Grassroots Leadership Conference (GLC), a forum which brings together a diverse group of local stakeholders throughout the three regions of North Carolina (Mountains, Piedmont and Coastal Plains). Their input helps to determine the theme, program structure/content, and location of the conference. The purpose of bringing this group together is to discuss real issues impacting the lives of the residents of those regions of the state. The goal of the conference is to provide attendees with an opportunity to engage in a purposeful dialogue about a specific identified issue which leads to exploring and identifying real strategies and solutions that will help to improve the quality of life for North Carolina residents, especially limited resource populations. Responses on the survey at the GLC provides feedback regarding topics of interest for future conferences. The 2019 conference theme was <i>“Shaping the Future of Communities Through Conversations that Matter.”</i> The conference presented best practices and strategies that community residents can use to identify priorities and opportunities and work together with others to foster positive change. In addition to Advisory Board, CAES uses mail surveys, electronic/web surveys, focus groups, and community forums to collect stakeholder inputs for the needs assessment and program prioritization process.</p>
<p>4. A Statement of how the input will be considered and brief explanation of what you learned from your stakeholders.</p>	<p>Stakeholder input is used to set program priorities, identify emerging issues, redirect extension programs, redirect research priorities, set staffing priorities and direct budget priorities. Because research and extension activities are directed toward the development and implementation of new knowledge and technology, faculty members are constantly relating industry and consumer needs to the discovery process. Stakeholder input is used in determining research and extension directions and gaining program support and advocacy for research and extension initiatives. For example, the commodity association boards provide information on high-priority research areas to be used in requests for proposals, and boards then decide which proposals to fund. This type of stakeholder input has a direct effect on research activities and subsequent extension programming. Our environmental scanning process identifies key issues of concern and needs of the community and allows us to translate these needs into science-based programs and services. Citizens, commodity association members and representatives, county commissioners, state legislators, and many other leaders and policy makers identify these emerging issues, program needs and priorities which inform program direction, budgets, staffing, and plans of action. This is a huge ongoing function that is ingrained in program planning and implementation for both Research and Extension. It is our intent to involve and serve the citizens of this state in the most effective ways possible to enhance the quality of their lives and economic well-being.</p>

IV. Planned Program Table of Contents

No.	Program Name in order of appearance
1.	Global Food Security - Plant Production Systems and Health
2.	Global Food Security - Animals and Their Systems, Production and Health
3.	Climate Change
4.	Sustainable Energy including Biotechnology
5.	Childhood Obesity
6.	Food Safety - Food Production Systems: Development, Processing and Quality
7.	Human and Community Development Youth Development and Families
8.	Human Health, Nutrition and Well-being

V. Planned Program Activities and Accomplishments

No.	Title or Activity Description	Outcome/Impact Statement	Planned Program Name / #
1.	Research and Extension Grows North Carolina's Hemp Industry	<p>Industrial hemp, with over 25,000 uses spanning nine markets, has the potential to transform struggling farms into booming production centers. Hemp is a high value crop with a high expense between \$10,000-\$15,000 per acre but can return \$25,000-\$35,000 per acre. Hemp production regulations in North Carolina require that THC concentration levels remain below 0.3%. To meet this standard and produce industrial hemp varieties with high cannabinoid (CBD) levels, optimum growing conditions and best management practices for cultivation must be established.</p> <p>NC State has stepped forward as a leader in hemp research with its Industrial Hemp Program. NC State Extension Specialists are operating demonstration plots to explore optimal variety selection and growing practices, mulch studies, and analyses of planting density, planting and harvest dates, drying, and more. One trial tested 29 varieties on farms and field stations around the state to determine varieties that produce CBD oil but have low THC content. Other field studies have examined the proper water levels necessary to prevent spikes in THC levels. And studies have looked at drying processes and the amount of gas and electricity required as well as the ideal drying temperature and effect of drying temperature on product quality. Extension Specialists are also conducting research to pinpoint best practices for optimizing hemp crop profits while mitigating legal and business risks.</p> <p>NC State Extension held dozens of information sessions and field days to support rapid growth in industrial hemp production and providing growers with information to grow, transplant, fertilize and harvest hemp. They also offer help on the regulatory and legal challenges related to growing hemp.</p> <p>In addition, to the work being conducted at NC State, Hemp research is also being conducted at N.C. A&T State University. N.C. A&T researchers field tested two industrial hemp varieties treated at four different fertilizer</p>	Global Food Security - Plant Production Systems and Health/#1

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		<p>concentration rates during the 2018 and 2019 growing seasons, yielding evidence that CBD levels increase with higher fertilization rates. These findings were shared with over 350 growers attending the N.C. A&T Hemp Conference and N.C. A&T Cooperative Extension Agrishop workshops.</p> <p>N.C. A&T also hosted six hemp workshops, two hemp field days, and a hemp mini-conference that collectively reached 800 farmers. The university’s first hemp conference brought together more than 250 farmers, industry partners, and Extension agents from across the state to learn about the potentials of growing industrial hemp. A panel comprised of members of the N.C. Industrial Hemp Commission, the board charged with overseeing the development of hemp as a viable crop statewide, discussed changes in regulations governing hemp cultivation. In Madison County, considered a hemp production “hot spot” because of the number of industrial hemp license holders, more than 130 people attended an informational session where they learned about hemp production methods, possible hemp end products, and how to complete an application for a license. Field and high-tunnel demonstrations for hemp CBD production, as well as a field demonstration for hemp fiber production, were conducted on the University Farm. Three in-service workshops were conducted to train over 125 agriculture and natural resource Extension agents, a hemp website and fact sheet were developed, and field and high tunnel demonstrations for hemp CBD production, as well as a field demonstration for hemp fiber production, were conducted on the university farm. Approximately one-third of farmer participants indicated that they planned to give hemp a try.</p> <p>Hemp is now grown on upwards of 8,000 licensed acres, with an additional 7,500 acres licensed for production and 6,9 million sq ft of licensed greenhouse space. As of October 2019, the state has 1,404 licensed growers and 755 registered processors spanning diverse industries.</p> <p>Additional information: https://industrialhemp.ces.ncsu.edu/ https://www.ncat.edu/caes/agricultural-research/industrial-hemp-program/index.php</p>	
2.	NC State Develops Improved Strawberry Varieties	<p>North Carolina is the third leading state in producing fresh market strawberries, which provide \$27 million in farm income. Yet strawberry growers have been planting the same cultivars for over 30 years, and there is a need for a series of alternative cultivars that have the same ripening season with improved horticultural traits.</p> <p>In response, NC State breeders developed ‘Rocco’ and ‘Liz,’ two new strawberry cultivars released in 2018 and first commercially sold in 2019. ‘Rocco’ ripens early, has excellent flavor, rich red color, and good yield. It is to be considered as an alternative to the early ripening standard ‘Sweet Charlie.’ The fruit of ‘Rocco’ is moderately soft and best suited for pick-your-own or local markets. ‘Liz’ has very high yield, large-medium, firm fruit and is considered to be an alternative to the current industry standard ‘Camarosa.’ As one of the leading research and extension entities for strawberries in the United States, NC State provides unique research and extension resources across the entire strawberry supply chain.</p> <p>Additional information: https://cals.ncsu.edu/news/ready-for-new-strawberry-choices/ https://doi.org/10.21273/HORTSCI14516-19</p>	Global Food Security - Plant Production Systems and Health/#1

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3.	Online Calculator and Associated Variety Trials Yield Big Results for Cotton Producers	<p>Variety selection can dramatically affect the yield and profitability of cotton crops. Agricultural extension researchers at NC State have developed the North Carolina Cotton Variety Performance Calculator to help producers accurately evaluate cotton variety performance before making potentially risky financial investments. This online calculator seamlessly integrates multi-year, multi-environment data from NC State research programs into a comprehensive, user-friendly platform that attracted 695 users and 2,207 pageviews in 2019.</p> <p>Based on grower and Extension agent feedback and official statistics from the USDA Cotton Varieties Planted Report and the North Carolina Department of Agriculture and Consumer Services Annual Cash receipts, the calculator and the associated North Carolina On-Farm Cotton Variety Evaluation Program have yielded a comprehensive statewide impact of \$68,500,654 to \$75,531,236 over the 2016 to 2019 seasons.</p> <p>Additional information: https://trials.ces.ncsu.edu/cotton/</p>	Global Food Security - Plant Production Systems and Health/#1
4.	Master Gardeners Donate 230,000+ Hours Valued at \$5M+ to Their Communities	<p>Mitigating the negative impacts associated with urban landscaping, such as water-quality degradation, reduced biodiversity, and loss of ecosystem services, is essential to preserving the quality of life in North Carolina. NC State Extension horticulture agents based in county centers across the state provide educational programs that teach residents how to create and care for resilient, sustainable landscapes and gardens, but the demand for programming far exceeds paid Extension staff's capacity. The Extension Master Gardener (EMG) program was created to increase Extension's capacity to engage the community through education and outreach that connects people with research-based information and provides practical solutions that help grow North Carolina.</p> <p>In 2019, 3,315 certified volunteers worked alongside Extension agents throughout the state to enhance Extension's outreach capacity and deliver research-based knowledge and technology to educate North Carolinians on sustainable home food production and landscape care. Volunteers donated 229,687 hours of service, valued at \$5.8 million and equivalent to the contributions of 110 full-time staff. Four hundred ninety-two new volunteers were recruited and trained. Volunteers reported a total of 380,000 direct client contacts and made \$1.5 million in additional in-kind donations for a total value of \$7.3 million in reported efforts and donations.</p> <p>Additional information: https://emgv.ces.ncsu.edu/</p>	Global Food Security - Plant Production Systems and Health/#1
5.	Researchers Contribute to State Effort to Develop Markets for Purple Carrots	<p>There is an increasing market for natural dyes, and purple carrots are a promising potential source of these dyes. The North Carolina Biotechnology Center, a state funded nonprofit, along with NC State researchers have been exploring new uses for purple carrots, including as a source of pigments that would provide an alternative to synthetic dyes, such as the controversial Red Dye 40, as well as for a variety of food products.</p> <p>After an initial small trial in 2017 conducted in Belvidere (Tidewater region), three agriculture research stations in geographically diverse areas of the state were selected for more comprehensive carrot testing managed by NC State researchers during the 2019 growing season. They included Waynesville (mountains), Kinston and Clinton (central). In addition, N.C. A&T's College of Agriculture and Environmental Sciences also grew purple carrots on its Greensboro farm. Additional trials were conducted across the state in 2019, resulting in a preliminary process for harvesting, blanching, and pureeing to obtain the final product.</p>	Global Food Security - Plant Production Systems and Health/#1

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		<p>The North Carolina Food Innovation Lab, an NC State research lab and certified manufacturing facility opened in November in Kannapolis, manages quality testing for the project. The lab is specifically testing for anthocyanin, the purple dye, and its quality and quantity. The purple coloration from carrots is different from, say, beets or purple sweet potatoes, because each crop will produce various types and quantity of anthocyanin. The Food Innovation Lab evaluated the qualities of each colorant to determine which would be best suited for companies to use.</p> <p>Six companies have already expressed interest in using purple carrots for dye, food processing, and other uses. North Carolina farmers have the potential to lead the way in producing natural purple colorants for the world. Purple carrots could be the state’s next signature cash crop. The economic potential of the purple carrot market is not yet clearly defined. Recent reports on the global natural food colors industry estimates an annual growth rate of 7% over the next several years.</p> <p>Additional information: https://www.ncbiotech.org/news/never-seen-purple-carrot-well-you-soon-may-see-them-nc https://www.ncfoodinnovationlab.org/</p>	
6.	<p>Extension Helps Growers Manage Devastating Pest That Threatens \$350M Crop</p>	<p>The guava root-knot nematode (GRKN) is a microscopic worm found in the soil that can infect sweet potatoes and other crops, forming knots or galls on the roots and ruining entire crops. North Carolina is home to a \$350 million sweet potato industry and grows more than 60% of the country’s sweet potatoes. To defend this crop, NC State Extension specialists developed an aggressive infected-crop training and identification program.</p> <p>The GRKN Training Program is an interactive, on-site session with a focus on creating a GRKN prevention culture in packing plants and production operations. Workers learn to detect and respond to potential symptoms of infection in sweet potato. Educators from the Extension Farmworker Health and Safety Program also offer instruction in Spanish to support worker comprehension, and they involve the packing house owner, manager, or senior supervisor to ensure they discuss GRKN protocols specific to each operation with workers. The training is scheduled to be offered to sweet potato packing facilities in eastern and central N.C. in 2020.</p> <p>In 2019, GRKN updates and training were presented to over 440 participants at educational meetings, field days, crop protection schools, agricultural consultants conferences, and ag expos in North Carolina. In addition, Extension presentations and talks have increased stakeholder awareness of nematode issues not only in sweet potato but also in soybean, tobacco, and other crops. The results of laboratory-based experiments and field-based trials at NC State are expected to lead to a more robust knowledge of plant-parasitic nematodes and more informed management decisions.</p> <p>Additional information: http://go.ncsu.edu/GRKN https://intranet.ces.ncsu.edu/grkn-resources/</p>	<p>Global Food Security - Plant Production Systems and Health/#1</p>
7.	<p>Rental and Cashback Program Expands Farmers’</p>	<p>Plasticulture production has been proven to increase yield by doubling or tripling production and extending the growing season for small farmers. However, plasticulture equipment is expensive. Due to the high initial cost of purchasing plasticulture equipment, small farmers do not routinely take advantage of the benefits plasticulture</p>	<p>Global Food Security - Plant Production</p>

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	Use of Yield-Raising Plasticulture	<p>offers, such as earlier harvests, better weed control, enhanced watering efficiency, and better plant nutrition through targeted nutrients applied through drip irrigation lines. Adopting plasticulture production has the potential to increase yield and profit for North Carolina small farmers.</p> <p>To make plasticulture production more accessible, Cooperative Extension at N.C. A&T created the Plasticulture Rental/Cash Back Program. Equipment is strategically placed at county Extension centers across North Carolina. The rental net-cost to the farmer is \$25/day. Low cost rental has expanded the use of plasticulture production across North Carolina. To date, the equipment has been rented over 50 times by 42 individual North Carolina small farmers. In 2019, the equipment was rented 24 times in 14 counties. The total savings to farmers using this equipment was \$67,580.</p>	Systems and Health/#1
8.	Grafting Workshops Lead to Additional Income for Apple Producers	<p>Grafting has become almost a lost art with only older farming populations having knowledge of the technique. Extension has received many inquiries about grafting as well as reports that some old heirloom apple varieties would be lost without improved education in grafting. Due to increased interest in heirloom apple varieties and grafting techniques, Extension staff in Yancey County, N.C. have offered a series of apple grafting workshops over the last 10 years. These workshops have been so popular and well received that Extension staff have been asked to conduct grafting workshops in surrounding counties as well. The purpose of these workshops is two-fold: to educate and train participants in the art of grafting and preservation of the many different heirloom apple varieties in the area.</p> <p>Nearly 450 growers have participated in, and nine of the local producers have begun grafting over 5,300 apple trees combined to sell for added income. With an average success rate of 85%, an additional 4,500 trees have been made available for sale with a conservative estimate of \$67,500 in additional income for producers.</p>	Global Food Security - Plant Production Systems and Health/#1
9.	Bringing Community Members Together to Grow Healthy Foods	<p>Community gardening is a way to bring community members together to grow healthy foods, learn about plants and horticulture, improve their diets, and provide healthy seasonal food options, especially in food deserts. Community gardens bring beauty to communities that have often been neglected and help limited-resource individuals and families stretch their food dollars. In 2019, the Community Gardening program through Cooperative Extension at N.C. A&T assisted 18 community gardens in 14 North Carolina counties, offering advice, consultation, and educational resources. Eight of those gardens were new gardens. The program conducted six training sessions at locations across the state that impacted 38 community members and seven at-risk youth. An additional three community garden trainings were conducted on the N.C. A&T campus and 23 people attended. Another 30 community gardeners attended a Community Garden Leadership training. The mobile app SOW, A Planters Companion had over 1,000 downloads from the Apple App Store and Google Play.</p> <p>In addition, the community garden team continued to develop a model community garden at the N.C. A&T State University Farm. The garden was developed to demonstrate best practices in garden design and growing techniques. For example, the garden illustrates how native plantings can be used to attract beneficial insects and</p>	Global Food Security - Plant Production Systems and Health/#1

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		pollinators while building soil, garden design, and layout methods. The garden is open to individuals and community organizations in Greensboro. Garden plots are available on a first come, first served basis.	
10.	Group Mineral Purchasing Program Vital to Beef Producers	<p>NC State animal scientists and Extension agents have worked for over 25 years with beef cattle farmers in an organized mineral supplementation program to provide the right mix of vitamins and minerals vital to cattle herd health. Scientists conduct mineral research to develop mineral mix recommendations, work with farmers to have suppliers improve formulas, and recommend working together to group-purchase the minerals. In Surry County, NC for example, N.C. State developed a county-specific mineral mix and worked with local producers and suppliers to produce the mix and sell it on a competitive bid basis.</p> <p>Since the inception of the group mineral purchasing program, beef producers in Surry County have reduced their mineral purchasing costs by \$381,000 collectively. In addition, the supplements have increased saleable weight by approximately 50 pounds per head annually, resulting in \$253,750 in increased farm income. Producers also use minerals to reduce the incidence of pinkeye during the summer months, resulting in an additional estimated \$446,250 in savings for producers. These higher local farm profits have a multiplier effect that yields communitywide economic benefits.</p>	Global Food Security - Animals and Their Systems, Production and Health / #2
11.	Regional Beef Conferences: Increasing Profitability through Education	<p>North Carolina is home to nearly 780,000 cattle, based on the 2017 Census of Agriculture. The profitability of these herds depends on grower knowledge and expertise in planning, management, health, and marketing. Providing education to help producers remain profitable is a paramount concern. In 2019, NC Cooperative Extension, in collaboration with the N.C. Cattlemen’s Association, local agricultural businesses, and veterinarians hosted several regional beef conferences to educate cattlemen on a variety of topics including nutritional needs, pasture management tools, breeding soundness exams, breeding stock selection, and cattle handling.</p> <p>At one event attended by 99 producers, 90% of participants increased their knowledge of low-stress cattle handling and 91% increased knowledge on fescue pasture renovation. All participants said the conference was of economic benefit to their operation. Participants reported an estimated economic impact of \$43,110 would be made or saved as a result of conference attendance. In a follow-up survey, 81% implemented rotational grazing strategies and 57% are now preventing their animals from overgrazing. One producer stated, “While you may not be able to implement something immediately from each topic, I think a seed gets planted to make you think of making changes. This can also add as reinforcement that the methods a producer uses are the correct methods.” At another regional event attended by 27 area producers who collectively owned 950 head of beef cattle, 40 bulls, 1437 acres of perennial pasture, 1000 acres annual pasture, 835 acres of hay fields, with an average of 12 years cattle experience per producer, all participants reported an increase in knowledge and skill from information learned during the conference. Participants estimated the information gained at the conference will have an impact of \$42,000-\$105,000 on their operations. A third event attended by 76 cattle farmers reported that 98% learned new ideas and 94% indicated the intention to use the knowledge to make changes on their farm. A 12-month follow up survey from the 2018 conference indicated that 78% made changes on their farms. From improvements of these practices, these 76 producers increased their profit by over \$20,000 per operation.</p>	Global Food Security - Animals and Their Systems, Production and Health / #2

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12.	Research Leads to Longer Lives, and More Offspring, for Sows	<p>The length of time that sows remain in production is directly related to their lifetime productivity. The annual replacement rate for sows in the United States is around 60%. This creates a situation in which most sow farms must replace their sows before they have recovered the cost of producing them and before they reach their most productive parities.</p> <p>Researchers in NC State’s Department of Animal Science have worked with the North Carolina Pork Council and the National Pork Board to develop management strategies for improving sow longevity and the creation of a proactive physiological test for sow longevity. Sow retention rates have doubled in the past four years on farms that have adopted these neonatal management strategies for replacement gilts. This has reduced the annual culling rate for sows from about 60% to 30%. This translates into each sow producing about 25 more pigs over her lifetime. Economically, based on current market prices, this translates into an increase of about \$5,000 in gross income generated per sow.</p>	Global Food Security - Animals and Their Systems, Production and Health / #2
13.	Small Ruminant Education and Outreach	<p>Small ruminant production and management education is provided for county Extension agents and producers across the state. A major emphasis has been on training county agents and producers in anthelmintic stewardship, parasite control methods, breeding and selection, and nutrition management through field days, workshops, and hands-on training. The impact of this statewide programming has been significant. Until fall of 2018, small ruminant programming at the university level had been nonexistent for several years, leaving county agents and producers without access to research-based information to make key management decisions and herd improvements.</p> <p>The need for such programming was determined through needs assessments disseminated to county agents. Workshops, curricula, and agent-specific trainings were developed and prioritized. Although N.C. A&T has small ruminants available, the herd and flocks have been largely unmanaged for some time. The flocks and herd were not in a state to be a model for demonstration, education, and outreach. After several months, owners implemented numerous herd improvements, such as acquiring a new breeding buck, reducing the herd to a manageable size, and culling underperforming animals.</p> <p>Through herd improvements and training programs, the university goat herd managed by Cooperative Extension has facilitated successful training and educational outreach to both county agents and producers.</p>	Global Food Security - Animals and Their Systems, Production and Health / #2
14.	Small-Scale Poultry Growers Gain Access to Mobile Processing Unit	<p>There are no small-scale poultry processing facilities operating in North Carolina for the backyard poultry grower. In response, NC Cooperative Extension led a comprehensive seminar with hands-on processing instruction at a farm which houses a mobile processing unit owned by a group of women farmers. This group allowed Extension to use their equipment to teach regional producers about the rules and regulations for poultry processing. This initiative was supported by the NC Choices Program at NC State, N.C. A&T State University and the N.C. Department of Agriculture and Consumer Services.</p> <p>Participants’ written evaluations rated the training as excellent and much needed. The participants now know where they can lease a complete processing mobile unit for poultry and turkeys, and they know who to contact</p>	Global Food Security - Animals and Their Systems, Production and Health / #2

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		<p>with questions about their operations. They can now direct market their birds to local communities, netting each a projected income increase of \$10,000.</p> <p>Additional information: https://cefs.ncsu.edu/food-system-initiatives/nc-choices/</p>	
15.	<p>Poultry Companies in North Carolina and Beyond Benefit from Feed Milling Research</p>	<p>Feed manufacturing efficiency, feed formulation, and nutrient utilization of poultry have a significant effect on the economic and environmental sustainability of poultry production in North Carolina and around the world. In collaboration with colleagues and industry collaborators, several studies were conducted to determine the optimum dietary inclusion of coarse ground corn in pelleted feed for broiler chickens and turkeys. In these studies, feed manufacturing efficiency was determined, as well as the resulting effects on growth performance and nutrient utilization of broilers. Improvements in nutrient digestibility and reduced nutrient emissions by the inclusion of coarse corn in pelleted feed, especially when supplemental enzymes were included in the feed formula was also observed.</p> <p>Over the past 5 years, most of the integrated poultry production companies in North Carolina and abroad have implemented the concepts NC State has developed for feed milling and feed formulation, and they have realized significant benefits in poultry production, including reduced feed manufacturing cost, a 3% improvement in feed conversion, significant improvements in nutrient utilization, and reduced liter moisture and ammonia emissions. Most remarkably, this technology improved the enteric health of broilers, which is especially important when raising broilers without antibiotics.</p> <p>Additional information: https://feedmilling.ces.ncsu.edu/</p>	<p>Global Food Security - Animals and Their Systems, Production and Health / #2</p>
16.	<p>Researchers Examine Potential Antibiotic Alternative for Poultry Industry</p>	<p>The early development of the intestines of post-hatch chicks is vital for the absorption of essential nutrients, subsequent growth, and protection against colonization by pathogenic bacteria. Until recently, most chicks were treated with antibiotics. However, this practice is becoming less common, and the commercial poultry industry, broiler chicken producers, animal scientists, and food scientists within and outside the U.S. need to adopt alternative approaches to promote both the health and growth of broiler chickens.</p> <p>N.C. A&T researchers are exploring the use of spray-dried plasma (SDP) as a potential alternative to antibiotics because it contains various functional proteins—such as albumin, immunoglobulins, growth factors, and biologically active peptides—that can stimulate the immune system. Several studies have been conducted to determine the effects of SDP on chicks’ immunocompetence, followed by the effects on early intestinal development and chick growth, and lastly to determine how SDP performs on broiler chicks challenged with <i>Salmonella enteritidis</i>.</p> <p>In all cases, SDP supplemented broiler chicks were found to have higher immunocompetence levels than chicks treated with a commercially used antibiotic (Bacitracin methylene disalicylate), produce comparable intestinal growth and development, and experience reduced colonization of <i>Salmonella enteritidis</i> and improved growth performance. These results were obtained in field conditions without controlling for contamination in the chicks’ living environment.</p>	<p>Global Food Security - Animals and Their Systems, Production and Health / #2</p>

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17.	Extension Helps Growers Manage Around 4 Million Tons of Manure and Litter Waste	<p>North Carolina leads the nation in poultry and egg production and ranks among the top three states for the production of pork and turkeys. As a result, the state’s farmers must manage around four million tons of manure and litter waste annually. This waste contains nitrogen, potassium, phosphorus, and other nutrients that make it valuable as fertilizer, but it also contains antibiotics, heavy metals, and other hazardous substances, so farmers must take careful steps to avoid excess nutrient runoff and other negative environmental impacts.</p> <p>NC State Extension provides poultry and hog producers with education to gain and maintain waste management certifications. Extension agents help these producers remain up to date on evolving guidelines and regulations, and they work with farmers to assess their soil fertility needs to optimize the application of animal waste-based fertilizers. These efforts not only reduce environmental impacts but also improve animal health and the profitability of poultry and livestock operations, which generate about two-thirds of the state’s annual agricultural income. Through Extension programming efforts, 2,405 individuals working in animal production increased their knowledge of animal waste management practices, and 4,326 animal waste management credits were earned. On-farm changes included 962 animal producers implementing Extension-recommended best management practices for animal waste management and the development or updating of 339 waste utilization/waste management plans, 12 producers had waste management plans for sludge application developed with over 7 million gallons of sludge used as fertilizer across 230 acres of land, 21 farms received assistance in performing sludge surveys on 27 lagoons and 220 on-site sludge surveys or equipment calibrations were conducted by Extension agents.</p> <p>Additional information: https://animalwaste.ces.ncsu.edu/</p>	Global Food Security - Animals and Their Systems, Production and Health / #2
18.	Training and Workshops to Preserve the State’s Clean Waters	<p>As one of the nation’s fastest-growing states, North Carolina is facing increasing pressure on water resources. NC State provides a number of programs to preserve the quality of the state’s water resources</p> <p>Increasing stormwater flows are causing stream impairment, sedimentation, and property loss that affects growers, landowners, and local government. In 2019, nine streambank repair workshops were held statewide, reaching over 215 participants, and hundreds more accessed online educational videos produced by Extension and local government partners. During the workshops themselves, 1,100 linear feet of streambanks were repaired, with surveys indicating an additional 3,500 feet repaired. These efforts will reduce soil loss by 290 tons per year, and the value of nutrients removed from the water is estimated at \$2,486,371. NC State developed a stormwater certification program in 2006 to help inspectors and contractors learn to maintain stormwater infrastructure. At least six certification and four three-year update classes are conducted across North Carolina each year. During 2019, 3,724 people were certified in stormwater inspection and maintenance.</p> <p>Due to changing legislation, increased public awareness, and an increasingly sophisticated population of environmental professionals, there is also a growing need for training programs on wastewater management, nutrient management, and watershed protection. In 2019, 3,842 participants received technical training for license renewal or professional development at one or more of the short courses and conferences offered by NC State Extension specialists. Overall, Extension agents and specialists across the state delivered training in storm water systems, septic system maintenance, erosion control, rain gardens, and forestry to over 17,400 participants,</p>	Climate Change / #3

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		<p>increasing their knowledge of best management practices contributing to cleaner and safer water throughout North Carolina.</p> <p>Additional information: https://cals.ncsu.edu/crop-and-soil-sciences/extension/training-programs/workshops/ https://www.bae.ncsu.edu/workshops-conferences/#srp</p>	
19.	Extension Grows Precision Farming Technology Testing and Education Programs	<p>Precise agricultural data offers producers the opportunity to make informed decisions about future crop management, and the range of digital agriculture products and services used to collect this data has increased dramatically over the last five years. However, producers need guidance to put this data into action. Extension agents are well positioned to provide this guidance; they have no vested commercial interest in selling specific inputs or technology products, and they have local relationships with producers.</p> <p>NC State hosted the two-day Data Science for Extension Agricultural Agents event in 2019, which was attended by 15 agents and about 25 others, including invited university and industry thought leaders. Best practices in conducting on-farm investigations and using free, open-source data analysis tools were introduced. Videos of speaker presentations and hands-on exercises using real data were used to develop training modules for Extension agents.</p> <p>Unmanned aerial vehicle (UAV) licensing opportunities have also been made available to Extension agents, and an in-depth training session was organized at the Cherry Research Station in Goldsboro to teach Extension agents and research station staff about best practices for leveraging modern technology to improve planter performance.</p> <p>Since the completion of this training, projects in four counties are investigating the use of UAV imagery to assess forage crop quantity and quality and the use of digital agricultural approaches to quantify yield variability in cotton variety trials. The video content is also slated for use in a new sixth-grade STEM curriculum. An NC State researcher has also recently launched the Advanced Ag podcast to spread information about precision agriculture.</p> <p>Additional information: https://www.rdoequipment.com/rdo-news/agriculture-technology-podcast-precision-ag-in-the-cotton-industry https://online.bae.ncsu.edu/2018/06/jason-ward-using-precision-agriculture/</p>	Climate Change / #3
20.	Gardeners Learn Economical, Environmentally Friendly Practices	<p>Improper fertilization and other poor gardening practices degrade water quality in streams and lakes and have many other negative environmental impacts, including damage to sensitive pollinator populations and the spread of invasive exotic plants. Extension in Vance County has implemented a comprehensive outreach effort to educate gardeners about economical gardening and landscape management practices that safeguard the environment.</p> <p>In 2019, these efforts included a Master Gardener Volunteers demonstration at a farmers' market viewed by thousands of visitors, a spring gardening symposium, and a quarterly newsletter. These initiatives complement mass media efforts by Extension staff, including news articles and a weekly radio program.</p> <p>These outreach efforts allowed Extension to engage with approximately 700 in-person contacts and approximately 100,000 indirect contacts through email, internet, social media, and mass media. Over 90% of the program</p>	Climate Change / #3

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		<p>participants indicated that they gained valuable knowledge, and 75% indicated an intention to implement best practices.</p>	
21.	<p>Model Shows Users How to Make On-Farm Sustainable Energy Projects More Profitable</p>	<p>Farmers need new, sustainable energy sources to enhance the long-term economic and environmental sustainability of their farms. However, they cannot always afford to finance sustainable energy projects, and these projects are not always profitable for a single farm.</p> <p>With support from the University of Wisconsin-Madison and Dane County, Wisconsin, NC State researchers have developed a model that could boost investment in farm-based sustainable energy projects by allowing investors to more accurately predict whether a project will be profitable.</p> <p>This model improves on earlier efforts by using advanced computational techniques to address uncertainty. By running repeated simulations that account for variations in key sources of uncertainty across diverse site locations, capacities, and service areas, maximal profit generation plans can be developed.</p> <p>The model also tells users how to maximize the economic return on anaerobic digestion systems for converting animal waste into energy, offering insight on where such systems should be located, what their capacities should be, and how large a geographic area they should serve. It's now available to encourage investment in environmentally sustainable farm operations, and researchers are enhancing its format for improved use and distribution.</p>	<p>Sustainable Energy and Biotechnology / #4</p>
22.	<p>Scientists Lay Groundwork for Viable Energy Crops for North Carolina</p>	<p>As the demand for alternative energy increases, the development of renewable bioenergy crops becomes increasingly important. Global research builds a strong case that energy grasses will become key bioenergy crops. At NC State, researchers are working to fulfill that promise through a wide range of research.</p> <p>Energy grasses include high biomass-producing perennial grasses such as sugarcanes, miscanthus, and giant reed. Energy canes are especially promising potential biofuel crops given their broad adaptability, high water and nitrogen use efficiency, high yield, and perennial, non-invasive nature. NC State researchers are exploring the physiology, production, selection, genetics, reproductive biology, and improvement of bioenergy crops. They've identified superior germplasm, developed more efficient production techniques, and improved understanding of the genetic, physiological, and biochemical mechanisms that regulate resistance to environmental stress, disease, and insects.</p> <p>A multidisciplinary team of researchers and business partners is furthering these efforts. The team's focus is miscanthus, a bamboo-like plant that's currently produced in North Carolina for poultry bedding but could be used to produce biofuels and other bioproducts. The high-yielding perennial crop is easy to grow and maintain and typically doesn't require pesticides or fertilizers. Researchers are taking a broad view, examining the productivity, environmental sustainability, and economic viability of the crop across different regions of the state and other areas in the Southeastern United States.</p>	<p>Sustainable Energy and Biotechnology / #4</p>

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23.	Scientists Patent Biotech Advances for Improving Biofuel Production	<p>Dwindling petroleum reserves and the significant environmental impacts of exhaust gases from petroleum diesel have resulted in an increased demand for renewably and environmentally friendly biofuels. Although biofuels burn clean, biofuels derived from unimproved oil crops cannot realistically compete with fossil fuels due to production costs and the limited availability of cultivable land for fuel crops.</p> <p>NC State researchers are exploring three areas of biotechnology that show promise for improving biofuel production. Synthetic biology approaches are being investigated to improve oilseed crop productivity, microorganisms are being used to produce energy sources that can be converted into transportation fuels, and microorganisms found in the guts of household wood-eating insects are being examined for their potential to convert biomass into biofuels and other high-value chemicals.</p> <p>Researchers are modifying the oilseed producing plant <i>Camelina sativa</i>. Algal strains have been improved to stimulate increased algal oil production, and microbial genes have been identified and characterized to potentially improve oil production in microalgae. A patent has been filed describing the genetic modification of the marine microalgae <i>Dunaliella salina</i>. In addition, microorganisms have been isolated from the guts of wood-eating insects, and an invention disclosure has been submitted describing the technology that NC State researchers have developed to isolate them.</p>	Sustainable Energy and Biotechnology / #4
24.	Researchers Pave Way for a New Market for a Biodiesel Byproduct	<p>Biodiesel fuels, which power most trucks, buses, and tractors in the United States, produce lower levels of air pollutants than petroleum-based diesel fuels. Over the past two decades, increased demand for biodiesel has led to a large surplus of the byproduct glycerol. At NC State University, researchers are working to improve prospects for sustainable biodiesel production by finding ways to use more of the high-energy substance in livestock feed.</p> <p>Glycerol is recognized as a safe feed ingredient, but the amount that can be added to the diet of ruminant animals such as cows is limited. That's because glycerol is rapidly fermented in the rumen, and that can negatively affect the microbial fermentation and limit animal performance.</p> <p>An NC State animal scientist, along with a visiting scholar from Egypt's National Research Center, identified a process to encapsulate glycerol using alginate and alginate-chitosan, two naturally occurring non-toxic polymers. Research found that encapsulating the glycerol minimized its release in the rumen and maximized bioavailability in the small intestine. Because the polymers resisted microbial attack, the negative effect of glycerol on microbial fermentation was minimal.</p> <p>The research shows that polymer encapsulation can improve gut use of glycerol, a high-energy substance, and benefit the biodiesel industry by including it in greater amounts as an affordable ingredient in livestock feed.</p> <p>Additional information: https://doi.org/10.5713/ajas.18.0110</p>	Sustainable Energy and Biotechnology / #4
25.	N.C. A&T Research Boosts Biochar's Promise for the	<p>Government agencies and industry are seeking technically and economically feasible strategies to mitigate climate change by removing CO₂ from the carbon cycle. This project is developing a model for a sustainable system to treat</p>	Sustainable Energy and Biotechnology / #4

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	<p>Environment and the Economy</p>	<p>waste biomass, recover energy, mitigate CO₂ emissions, and produce biochar-based functional materials for various novel applications.</p> <p>Target audience include government agencies, environmental agencies or any organizations interested in remediation of soil and water contaminated with heavy metals, small farmers interested in growing miscanthus grass on their marginal lands to improve farm revenue, and agricultural, biofuel and chemical Industry interested in the bio-energy production, energy storage, catalysis, environmental protection and other biochar-based materials production for industrial purposes.</p> <p>Biochar was produced from biomass sources including miscanthus, wood bark, swine manure. The structure of these biochar samples including their surface area and pore structure were analyzed. The application of these biochars in terms of their energy storage, radiation absorption, carbon dioxide absorption and catalyst were studied. In addition, the economic, energy, and environmental sustainability of the integration of green biomass as a non-fossil fuel energy source were evaluated.</p> <p>Findings indicate that biomass-derived biochar could be used as a raw material for the production of low-cost high-performance materials for production of supercapacitors. The biochar-based materials performed at comparable levels to industry standards at blocking ionizing radiation. The pressed polymer biochar seemed to perform most efficiently with every type of radiation given its density and thickness. Also, there exists a significant potential to make inexpensive biochar based advanced carbonaceous materials commercially.</p>	
<p>26.</p>	<p>EFNEP Helps Low Income Youth Prepare Nutritious, Safe Foods</p>	<p>Youth enrolled in the Expanded Food and Nutrition Education Program (EFNEP) have fun while they learn about MyPlate and the five food groups, good food safety practices, and physical activity. Through hands-on active learning, students learn new skills, new foods to try, and new ways to get fit.</p> <p>With so many fast-food restaurants popping up in one North Carolina county, cooking seems to a dying art and many youth don't know the proper way to prepare food at home safely. In response, 4-H partnered with the NC State EFNEP program to teach youth vital cooking skills, such as knife cutting skills, grilling safety skills, baking homemade bread, and preparing a quick, easy omelet. The youth were so excited that they took these skills home. Weeks after the class, several parents reported their children wanting to be involved in meal preparation in the kitchen. Some parents posted pictures on their social media of their children cooking meals or dishes at home. Youth were grilling homemade burgers, making homemade oven fries, and cooking omelets for themselves and their parents. Now that the youth are preparing recipes at home, they are improving their eating habits by reducing the high fat fast foods in their diets.</p> <p>Through EFNEP's 6-week Teen Cuisine program in a North Carolina County, youth learned about proper knife-cutting skills and safety, kitchen safety rules, MyPlate, and the importance of hand washing. The youth were particularly interested in the Teen Cuisine lesson regarding breakfast. A boy in the program shared that he ate frozen breakfast sandwiches for breakfast, which are high in sodium. For this lesson, the EFNEP educator demonstrated how to make a cheesy-egg burrito with milk, eggs, salt, pepper, cheddar cheese, and whole-wheat tortilla and the students made their own cheesy-egg burritos. The following week, the boy shared that he had</p>	<p>Childhood Obesity / #5</p>

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		<p>made the recipe with his mom at home during the weekend and she loved it. He also shared that he would try to make this recipe before school if he had time instead of heating up a frozen breakfast sandwich.</p> <p>Because many busy families don't get home until dinner time, it is important that everyone helps out with the cooking and cleaning. Many youth have very little interest in cooking and are unsure how to use many of the tools in the kitchen. EFNEP classes taught youth in one North Carolina county food safety and nutrition lessons on making nutritious snacks along with understanding food safety issues. They learned how to use kitchen equipment safely and how to help with meal preparation and cleanup. Parents commented that their children talked about what was learned and are beginning to use more of the tools in the kitchen and their comfort level has increased. One mom said that food safety is one of many things that her child reminds her family of such as do not leave cooked food out for more than two hours. The parents and the youth participants reported being very excited about what has been learned. The youth participants and families have benefitted from the EFNEP because the youth are now active member in the kitchen.</p> <p>In 2019, NC State's EFNEP program reached 2,676 families and 17,563 youth participated in 4-H EFNEP. Among EFNEP participants, 96% improved their dietary intake (including consumption of fruits and vegetables), 88% practiced better food resource management, and 89% improved food safety habits.</p> <p>Additional information: https://www.ncfamilieseatingbetter.org/EFNEP/participants-youth.php</p>	
27.	Extension Helps Adults and Children Increase Physical Activity	<p>Participation in physical activity is important to maintaining a healthy weight and reducing the risk of many chronic diseases, including heart disease, high blood pressure, and diabetes. According to CDC guidelines, adults should do at least 150 minutes a week of moderate-intensity aerobic physical activity, and adolescents should be physically active at least 60 minutes per day. In North Carolina, about 66% of adults are overweight or obese, and that contributes significantly to health-care costs.</p> <p>NC State Extension's Expanded Food and Nutrition Education Program (EFNEP) targets key behaviors, such as increasing physical activity, to reduce the risk of overweight and obesity and associated diseases. One participant, a working single mom of four, shared that she often felt too tired to exercise. However, as a result of EFNEP, she now finds herself parking further away when she runs errands to invite more movement into her daily routine and now feels more equipped with small, manageable steps she can take towards a healthier life. After the last class, the participant shared, "It seems silly to make a big deal out of parking further away, but I really think it's making a difference."</p> <p>In 2019, EFNEP reached 2,676 families and 17,563 4H EFNEP youth participants. Among EFNEP participants, 86% reported daily physical activity. In addition, 54% of adult participants and 45% of youth improved their physical-activity practices, such as doing strength-training exercises or making small changes to be more active.</p>	Childhood Obesity / #5
28.	Sugary Beverages Are Out and Water is in for	<p>In North Carolina 15 percent of 2- to 4-year-olds are obese, as well as 30.9 percent of 10- to 17-year-olds and 16.4 percent of high school kids. The state is ranked 7th nationally when it comes to the prevalence of obesity in teens. Additionally, the prevalence of food insecurity is higher than the national average, with one in five children living in</p>	Childhood Obesity / #5

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	<p>Children, Taking Part in Steps to Health</p>	<p>food-insecure households and three in 10 children relying on the federal Supplemental Nutrition Program (SNAP) to meet their food needs.</p> <p>NC State Extension’s SNAP-Ed program, Steps to Health, educates and inspires limited-resource North Carolinians to eat smart and move more through education programs to promote positive behavioral changes targeting elementary-aged children, adults, older adults, and families by focusing on dietary quality and nutrition, effective shopping and food resource management, food security and food access issues, and strategies for avoiding a sedentary lifestyle. Steps to Health, in partnership with Extension professionals and Steps to Health nutrition educators, reached 7,392 participants (6,572 children and 820 adults) and made 52,940 educational contacts within 59 counties across North Carolina through direct education programs.</p> <p>One behavior that Steps to Health promotes is replacing sugary beverages with water. In one county, youth enjoyed trying five different flavors of water: cucumber, orange, lemon, mint, and kiwi. During the taste test, one boy said that he didn't know he liked kiwi but that water was good. This experience allowed students to learn an alternative to sugary drinks, add a possible serving of fruit into their diet, and enjoy a flavor they hadn’t previously tried. After this activity, each student received a free water bottle. Every teacher bragged about the water bottles and how they had helped kids drink more water. In another county, students were challenged to drink more water each day. Several weeks later, the nutrition educator saw that each child still had their water bottle sitting on their desk and that they were so excited to say they had been drinking at least one bottle of water in the morning and one in the afternoon each day.</p> <p>As a result of Steps to Health efforts during 2019 across North Carolina, over 87% of participating pre-school children are more willing to try fruits and vegetables, 69% of participating elementary school children are eating more fruits, and 40% of participating children and youth are more active.</p> <p>Additional information: https://ncstepstohealth.ces.ncsu.edu/about-ncstepstohealth/</p>	
<p>29.</p>	<p>Limited-Resource Families Learn to Buy, Cook, Eat and Savor Healthy Food</p>	<p>Poor eating habits and physical inactivity are taking a toll across the country, particularly in North Carolina, where diet-related chronic diseases are prevalent, and 32% of adults are obese. The problem is amplified in households with annual incomes below \$15,000. The federally funded Supplemental Nutrition Assistance Program Education (SNAP-Ed) helps limited-resource individuals and families nationwide. Extension’s SNAP-Ed program, Steps to Health, is dedicated to inspiring healthier communities by shaping the environments where limited income people buy, cook, consume, and enjoy food. NC State Extension professionals work with communities to create policies, systems, and environments that make the healthy choice the easy choice in locations that serve low-income families and individuals. In 2019, Steps to Health introduced comprehensive toolkits designed to guide these efforts in a number of settings, including community sites, farmers markets, food banks and food pantries, schools, and food retail establishments.</p> <p>The majority of food pantry clients are not meeting the recommended dietary intake for fruits and vegetables, contributing to an increased risk for diet-related chronic disease. In Lee County, N.C., 13.8% of people are food insecure, many of whom receive food from food pantries. One local food pantry provides approximately 7,500–</p>	<p>Childhood Obesity / #5</p>

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		<p>10,000 boxes of food to community residents per year. NC Cooperative Extension in Lee County developed a comprehensive nutrition program for a local food pantry that includes monthly cooking demonstrations, the delivery of the Steps to Health's Take Control program, and a Borrowing Kitchen. The Borrowing Kitchen is a lending library of kitchen equipment that gives Take Control participants the opportunity to borrow tools so they can use the cooking skills learned in the program at home and are not limited by not owning a particular kitchen tool.</p> <p>Steps to Health worked with 218 sites to implement at least one Policy, Systems, or Environmental (PSE) change, with an estimated reach of 145,087 individuals. The Healthy Food Pantry Toolkit had 781 pageviews in 2019, and the Farm to Food Bank Resource Guide had 271 pageviews in 2019.</p> <p>Additional information: https://ncstepstohealth.ces.ncsu.edu/about-ncstepstohealth/ https://localfood.ces.ncsu.edu/local-food-community-development/healthy-food-pantry-toolkit/</p>	
30.	Providing Nutrition Education to Low Income Youth and Families	<p>In North Carolina, one in three children between ages 10 and 17 is either obese or overweight and the trend is so severe that childhood obesity could contribute to children today becoming the first generation to lead shorter, less healthy lives than their parents. Extension at N.C. A&T addressed this problem through a variety of workshops aimed at children and their parents in underserved food desert communities.</p> <p>N.C. A&T provides nutrition education for limited-resource families in North Carolina through several programs. The Try Healthy Program at Cooperative Extension at N.C. A&T partners with community organizations, churches, and schools to provide free nutrition education classes to SNAP-eligible and low-income families. Try Healthy promotes healthy eating habits, encourages more physical activity, and provides tips for preventing and managing nutrition-related chronic diseases. In 2019, 10,889 youth were reached. There was a 51% increase in knowledge about the benefits of physical activity and strategies for reducing inactivity. Additionally, 49% of the children in Try Healthy families demonstrated increased knowledge of healthy food choices and the benefits that result from improvements in their daily diets.</p> <p>Another program aimed at improving the health of low-income North Carolinians offered by N.C. A&T is LIFT, an evidence-based, eight-week healthy lifestyle intervention. The program helps adults learn and engage in a strength-training practice with others in their group. Aerobic activity is encouraged between sessions, and basic nutrition information is covered. LIFT is a practice- and research-adapted version of <i>Strong Women, Strong Bones; Activity for the Ages</i>; and <i>Stay Strong, Stay Healthy</i>. To date, 40 EFNEP and Try Healthy educators and FCS agents have been trained to present the program.</p> <p>N.C. A&T's EFNEP program targets low-income youth and low-income families with young children and is designed to assist participants in acquiring the knowledge, skills, attitudes, and changed behaviors necessary to achieve nutritionally sound diets. The program also contributes to the participants' personal development and provides education to improve the total family diet and nutritional well-being. Adults in EFNEP programs learn to select more nutritional foods, gain skills in food production, preparation, storage, safety, and sanitation and learn better methods to manage their food budgets and related resources such as Food Stamps. Youth in EFNEP programs learn</p>	Childhood Obesity / #5

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		skills in nutrition, food preparation, and food safety as well as fitness, substance avoidance, and other health-related topics. The programs are delivered as a series of lessons taught by paraprofessionals and volunteers, many of whom are indigenous to the target population. In 2019 EFNEP educators served 50 adults and 1,500 family members resulting in 90% increasing diet quality practices, 69% increasing physical activity, 59% increasing food safety skills, and 72% increasing food resource management skills. Also, in 2019 N.C. A&T EFNEP educators served 800 youth resulting in 84% increasing diet quality practices 60% increasing physical activity, 44% increasing food safety skills, and 33% increasing food resource management skills.	
31.	Youth Get on the Speedway to Healthy	<p>Obesity in youth often carries into adulthood and contributes to the development of many chronic illnesses, such as heart disease and diabetes. The Speedway to Healthy project developed by Cooperative Extension at N.C. A&T, was created as a resource to fight childhood obesity and poor health among children in North Carolina. Speedway to Healthy is an interactive exhibit that provides experiential education to combat childhood obesity. The 1,200-square-foot walk-through teaching tool replicates parts of the human body.</p> <p>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 adverse effects in childhood and continue into adulthood. The concepts learned through this interactive exhibit support or reinforce common core standards used in N.C. public education. The activities conducted in the exhibit support the following standards associated with K–5th-grade requirements:</p> <ul style="list-style-type: none"> • Understanding wellness, disease prevention and recognition of symptoms. • Understanding the importance of consuming a variety of nutrient-dense foods and beverages. • Understanding body systems and organs, their functions, and their care. • Comparing unhealthy and healthy eating patterns, including eating in moderation. • Understanding the benefits of nutrition and fitness for disease prevention. • Explaining how nutrition and fitness affect cardiovascular health. • Inferring the benefits of limiting the consumption of foods and beverages high in fat and added sugar. <p>Speedway to Healthy continues to be one of Extension’s most popular programs. In 2019, 3,273 students from eight counties participated.</p>	Childhood Obesity / #5
32.	New Program Helps Participants Eat Better, Lose Weight, Increase Activity and Lower A1c	<p>Over one million North Carolinians, or 12.9% of the adult population, have diabetes. The medical costs associated with patients with diabetes are 2.3 times higher than those for patients without diabetes. In 2017, the state’s estimated direct medical expenses for diagnosed diabetes were \$7.7 billion, and another \$2.9 billion were spent on indirect costs from lost productivity due to diabetes.</p> <p>According to the CDC, participating in a lifestyle-change program with the goal of 5% to 7% percent weight loss and 150 minutes per week of physical activity can lower one’s risk for developing type 2 diabetes by up to 58%. In North Carolina, a team of professionals with expertise in nutrition, physical activity, and behavioral change</p>	Childhood Obesity / #5

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		<p>developed the Eat Smart, Move More, Prevent Diabetes curriculum. It uses evidence-based strategies approved by the CDC to address North Carolina’s need for accurate educational materials for diabetes prevention.</p> <p>In 2019, 48 Eat Smart, Move More, Prevent Diabetes online classes and four onsite classes were offered. Total enrollment was 719. The results for the yearlong program include:</p> <ul style="list-style-type: none"> - 80% of participants lost weight, and the percentage of those with healthy body-mass index scores improved from 2% to 4%. - Participants also improved their A1c levels, with the percentage of those with normal levels rising from 25% to 46%. Higher A1c levels increase a person’s risk of experiencing complications from diabetes. - 72% of participants increased their number of servings of fruits and vegetables consumed each day. - 72% of participants indicated they were active for at least 30 minutes on most days. - 50% of participants included at least two days of strength training in their physical activity routine. <p>Additional information: https://esmpreventdiabetes.com/</p>	
33.	Volunteers Glean 31,000 Pounds of Sweet Potatoes for Food Pantry and Food Bank Just in Time for Thanksgiving	<p>One in five kids are not able to get the food they need every day. This takes a toll on their health and development. Kids who eat breakfast miss less school, get better grades, and are more likely to graduate from high school. Missed meals create stress, physical and emotional pain, and the inability to thrive in the classroom. Hunger and poverty are primary contributors to the achievement gap, which develops well before kids are even in the third grade.</p> <p>Harnett County Cooperative Extension partnered with local sweet potato farmers, the Food Bank of Central and Eastern North Carolina, the Harnett County Food Pantry, 4-H Clubs, and many other organizations to glean sweet potatoes to support food banks in 34 counties. One hundred and forty volunteers of all ages helped glean sweet potatoes for six hours on two different days.</p> <p>Over the two days, 31,000 pounds of sweet potatoes were gleaned, a \$11,500 value, that were turned into 72,000 one cup servings to help combat hunger in Central and Eastern North Carolina. When receiving a truckload of sweet potatoes, the Director of the Harnett Food Pantry said, “I am so thankful to live in a community that comes together to make this event work on such short notice; 13,000 pounds of potatoes out of the dirt yesterday and on Thanksgiving tables today.”</p>	Childhood Obesity / #5
34.	Faith-Based Settings can be an Effective Link to Health Promotion Among Older African American Adults	<p>For older adults, regular physical activity and healthy dietary behavior is beneficial to health by preventing chronic disease and by helping maintain personal independence. Religious organizations may be uniquely positioned to address health-related problems and obesity by offering intervention or support. A research team from N.C. A&T State University conducted several workshops and focus groups with elderly African American adults over the age of 55 from a large church from a suburban community in Greensboro, North Carolina to identify the social determinants of health among older adults. They also investigated the potential of partnering with local churches to encourage their congregations to participate in activities relating to healthy living, physical activity, and healthy food consumption</p>	Childhood Obesity / #5

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		<p>Researchers observed changes in participants’ recognition in the importance of healthy food (e.g., gardening, shopping, preparing, eating), physical activities, relationship between spirituality and healthy eating. In addition, ministers/clergy also adjusted/adopted a more health-centered approach in their sermons and daily teachings.</p>	
35.	61 Years of Egg Strain Performance Testing	<p>The microbiological safety of shell eggs in alternative production systems is a concern due to the outbreaks of foodborne illness in humans attributed to eggs or egg products from range or backyard flocks. Understanding the impact of the production system on egg safety is necessary to reduce shell egg contamination risks.</p> <p>The North Carolina Layer Performance and Management Test Extension program has been on-going for 61 years in cooperation with the N.C. Department of Agriculture and Consumer Services and the Primary Breeders of Commercial Egg Strains. The purpose of the tests is to provide an unbiased evaluation of the overall performance of strains, to include the effects of various housing and husbandry practices on the performance of the genetic stocks entered into the test. This test is the only one of this type and size remaining in the world. Enhancements of the research capabilities including management related issues and environments, have increased the importance of this test to the industry. The annual reports are sent to all producers in North Carolina and to producers and industry representatives throughout the United States and 22 countries and are accessible on the Internet. The primary breeders, egg companies, and the EEC Animal Care Committee utilize the test to compare and evaluate their current commercial strains under the different environments imposed upon them.</p> <p>Additional Information: https://poultry.ces.ncsu.edu/layer-performance/</p>	Food Safety - Food Production Systems: Development, Processing and Quality / #6
36.	Program Keeps Food Protection Managers, Environmental Health Inspectors and Regulators Up to Date on Food Safety	<p>There are an estimated 48 million cases of foodborne illness in the United States every year. Many of these preventable illnesses are attributed to violations in handling in retail establishments. The North Carolina Food Code requires certification of a person-in-charge. The Safe Plates for Food Managers program is an Extension food protection manager training program with a behavior-change centered approach and opportunities for certification. In 2019, the program was updated to reflect the FDA Food Code 2017. In 2019, 13 new agents were trained in Safe Plates for Food Managers, bringing the total number of trained agents in North Carolina to 63. Over 75 classes were conducted with over 860 total certifications. In addition, the North Carolina Department of Public Instruction Career and Technical Education used Safe Plates for Food Managers in a public high school curriculum, reaching approximately 32,000 students.</p> <p>In North Carolina and many states across the U.S., retail food establishments continue to produce new and creative foods with specialized processes. According to the FDA Model Food Code, specialized processes require variances and HACCP Plans to manage food safety. However, most training programs available are for HACCP plans in manufacturing settings, which are very different from retail settings. The Safe Plates Retail HACCP Validation and Verification workshop was developed by NC State to help environmental health inspectors and regulators understand retail HACCP. In 2019, partnerships were made with other state environmental health and extension programs to meet their training needs in these areas. The course was offered to over 210 participants in seven states and the District of Columbia (Georgia, Hawaii, Nevada, New Hampshire, North Carolina, Rhode Island, and Washington). Instructors in Rhode Island conducted their first solo course, and connections were made with other</p>	Food Safety - Food Production Systems: Development, Processing and Quality / #6

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		<p>states to bring the course to them in 2020. The state and local health department personnel that were trained in this program oversee regulatory programs that impact 42,000 food businesses across the United States. Evaluation results show that these regulators are more comfortable in the science of specialized processes, HACCP, and evaluation of culinary practices.</p> <p>Additional Information: https://foodsafety.ces.ncsu.edu/nc-safe-plates/</p>	
37.	Food Safety Info Center Posts Reach Hundreds of Thousands	<p>The Safe Plates Food Safety Information Center (FSIC) was launched in 2018 by the NC State Extension food safety team. Throughout 2019, the team steadily increased outreach on social media channels, Twitter, Facebook, and Instagram. Safe Plates FSIC is a practical approach to sharing science-based food safety information with all consumers. In 2019, 1,095 posts were developed, reaching 352,044 individuals. Highlights in 2019 include the development of a March Madness and food safety push to reach a larger audience, establishment of a conference giveaway to target FCS agents across the country, and dissemination of the annual holiday food safety campaign.</p> <p>During November and December of 2019, the Safe Plates Food Safety Information Center (FSIC) implemented a holiday food safety campaign on Twitter, Facebook, and Instagram. The coordinated campaign involved the development of 189 posts and 121 stories, as well as the number of posts 22 FCS agents shared with people in their counties. Topics covered included preparing holiday pies, a turkey talk series, making homemade food gifts, and eggnog safety. Overall, the holiday food safety campaign reached 84,360 individuals and gained 118 new followers.</p> <p>Additional Information: https://foodsafety.ces.ncsu.edu/nc-safe-plates/</p>	Food Safety - Food Production Systems: Development, Processing and Quality / #6
38.	Growers Gain Better Understanding of FSMA and Produce Safety Rule	<p>Federal food safety regulations require fresh produce growers to adhere to a protocol that reduces the possibility of food contamination by pathogens. The Food Safety Modernization Act (FSMA) includes routine farm inspections for farms covered by the produce rule and requires that a responsible member from each farm successfully complete Grower Produce Safety Alliance Training prior to inspections. With the FSMA Produce Safety Rule being relatively new, many smaller produce operations are unsure where their farms fit within the rule.</p> <p>To ensure that farms had the required training and information needed to comply with FSMA and third-party audits, County Cooperative Extension, along with area specialized agents, provided training to 143 individuals in FSMA and provided 1,801 individuals training in GAPs (good agricultural practices). Extension agents also distributed newsletters and factsheets, held general information sessions, and made individual farm visits. Growers received vital information pertaining to compliance with FSMA and the Produce Safety Rule and reported having a better understanding of their requirements under the law. Growers who received consultation specifically related to food safety from Extension indicated that they were ready for food safety audits and site inspections.</p> <p>Additional Information: https://ncfreshproducesafety.ces.ncsu.edu/</p>	Food Safety - Food Production Systems: Development, Processing and Quality / #6
39.	Program Aims to Strengthen Family and Community	<p>Even small decreases in the rate of substance abuse can have a dramatic impact on the societal costs of substance abuse disorders, reducing losses in productivity and the high costs of criminal justice and health care. Opioid addiction has reached epidemic proportions throughout the United States as healthcare professionals fight to</p>	Human and Community Development- Youth

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	<p>Efforts to Prevent Teen Substance Abuse</p>	<p>reduce access to and dependency on these drugs. Two years ago, 4-H youth specialists with NC State Extension responded by establishing a grassroots effort called the Empowering Youth and Families Program (EYFP).</p> <p>The program, which targets middle school youth and their families, began two years ago in nine North Carolina counties with a rural health and safety grant from the USDA’s National Institute of Food and Agriculture (NIFA). This grant was the first of its kind to be awarded to a 4-H group.</p> <p>EYFP is made up of two components: The Strengthening Families Program 10-14 and Powerful Communities. The Strengthening Families Program 10-14 is an evidence-based parent, youth, and family skills-building curriculum that discourages teen substance abuse and other behavior problems, strengthens parent and youth communication skills, increases academic success in youth, and seeks to stop violence and aggressive behavior at home and at school. Powerful Communities is a pilot program written by NC 4-H to equip participants with knowledge and understanding about the opioid crisis in the U.S. and locally. Powerful Communities empowers families to resist opioid abuse and to share what they have learned with their communities.</p> <p>The success of these programs led NIFA to extend funding for two more years and attracted additional funding from the Substance Abuse and Mental Health Services Administration (part of the U.S. Department of Health and Human Services). The true success of the program comes directly from the participating families; one family shared that this program was better for their family than professional family counseling. Another family expressed that this program was exactly what they needed when they needed it.</p> <p>Additional information: https://opioidpreventionnc.org/</p>	<p>Development and Families / #7</p>
<p>40.</p>	<p>Training Helps Youth Avoid Alcohol, Tobacco and Drugs</p>	<p>North Carolina rural youth are more likely to use marijuana, cocaine, heroin, methamphetamines, inhalants, and other opioid drugs than urban youth. Youth need continued support and education related to drug-use prevention, including a holistic view of health that reduces other factors, such as stress, which contributes to and exacerbate substance abuse among youth. NC 4-H currently includes healthy living with a focus on substance abuse prevention in statewide efforts.</p> <p>NC 4-H has provided 4-H Health Rocks! program trainings across North Carolina. This research-based program provides youth with skills for making good decisions in relation to alcohol, tobacco, and drugs. In 2019, Extension agents, adult volunteers, and youth-adult partnership teams provided over 10 hours of Health Rocks! training to 2,960 youth across North Carolina. In each county, the 4-H agent worked with volunteers and teen leaders to deliver programming to youth.</p> <p>The Health Rocks! evaluation survey found statistically significant differences on each of 13 items, including knowledge-based statements about smoking and other drug use; skills-based items about managing stress, dealing with peer pressure, and making positive decisions; and attitude-related items about future goals, self-esteem, and willingness to help peers stay away from alcohol and drugs.</p>	<p>Human and Community Development- Youth Development and Families / #7</p>

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<p>41.</p>	<p>Programs Involving Livestock Help Spark Kids' Interest in Agricultural Careers</p>	<p>Less than 1% of Americans are involved in food production. Similarly, the percentage of Americans that have grown up with any agricultural (farm) experience is dropping rapidly. Over 22,000 agricultural jobs annually remain unfilled due to a deficit of educated candidates. The livestock industries are a tremendous asset for North Carolina, but they are constantly feeling the pressures of a lack of applicants and negative public perceptions.</p> <p>NC 4-H youth programs provide a variety of avenues for youth to learn about careers in agriculture, including 4-H livestock projects, judging, skill-a-thons, quizbowls, and school enrichment programs. One highlight is NC State's Farm Animal Days event. This event is open for youth pre-school through second grade and allows them to learn about animal agriculture. With the help of the NC State Animal Science Department, Lake Wheeler Road Field Labs, and numerous collegiate clubs, NC State is able to offer a substantial learning event. In 2019, nearly 10,000 youth, parents, and teachers attended this three-day event.</p> <p>For older youth, the Livestock Science Camp program was developed to provide the opportunity to explore animal agriculture in a safe environment, regardless of background experience. The weeklong residential camp program brings together 36 youth with a dozen current NC State students for a full immersion experience. Campers have the opportunity to explore how producers work with animals to promote animal welfare, engage in animal management techniques, explore operations of various management styles, engage with industry leaders, and expand their horizons through career exploration. Approximately 50% of the diverse pool of campers report having no livestock experience prior to attending camp. After the week of camp, participants reflected on their experience with, comfort working with, and knowledge of five different livestock species, leadership, careers with animals, and quality assurance. In eight out of 10 categories, participants showed a 12–21% increase in knowledge of these topics. Improving youth awareness of accurate livestock production can expand well beyond the participant through their interactions with others.</p> <p>Additional information: https://youthlivestock.ces.ncsu.edu/</p>	<p>Human and Community Development- Youth Development and Families / #7</p>
<p>42.</p>	<p>High Schoolers Get Hands-on Horticulture Experience Through Campus Institute</p>	<p>According to USDA statistics, an average of 35,400 new U.S. graduates with expertise in food, agriculture, renewable natural resources, or the environment are expected to fill 61% of the expected 57,900 average annual openings. College graduates with training in these areas are critical to food security, sustainable energy, and environmental quality nationwide. 4-H is well positioned to support career pathways that will lead to enrollment in higher education programs to meet the growing challenges in global agriculture.</p> <p>NC State provides an opportunity for high school students to spend a week at the university climbing trees, grafting tomatoes, snacking on raspberries, discovering new genes, and so much more. The Horticultural Science Summer Institute is a residential, hands-on, pre-college program designed to engage youth in the many career opportunities within horticulture.</p> <p>Students dig into workshops led by faculty, staff, and students on topics ranging from breeding better vegetables, propagating ornamental shrubs, lengthening the life of cut flowers, learning sustainable production and design practices, and delving into practical tools that enhance our understanding of plant processes. Students visit unique and innovative North Carolina farms, markets, greenhouses, and gardens. Youth also explore college-making</p>	<p>Human and Community Development- Youth Development and Families / #7</p>

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		<p>decisions and leadership development, enjoy evening entertainment and team-building activities, and live in a campus residence hall with campus dining. The camp provides a close-knit forum for high school students across the state (and country) to gather together and broaden their interest and knowledge about horticulture. All high school students with a career or hobby interest within the field of agriculture and horticulture are encouraged to apply to the summer institute.</p> <p>The Horticultural Science Summer Institute is a part of a programmatic pathway for youth engaged in local Extension programs across the state. It provides a bridge to the College for undergraduate enrollment. Evaluation materials are being developed in partnership with Extension evaluation specialists and could be used for local 4-H horticulture programs. The data correlation shows that 15% of the students that participate in the institute enroll in an undergraduate degree program in the Department of Horticultural Science, and 17% enroll in another degree program within the College of Agriculture and Life Sciences. The student evaluation data shows a positive increase in attitudes around STEM and agricultural science and increased interest in careers and degree programs in agriculture.</p> <p>Additional information: https://growforit.ces.ncsu.edu/</p>	
43.	Grant Allows Nearly 200 Youth to Attend 4-H Camp for the First Time	<p>A goal of the 4-H camping program is to provide youth with the opportunity to thrive; providing experiences that increase the likelihood of enhanced wellbeing and optimal development. Unfortunately, history has shown that youth from vulnerable populations have not had the same opportunities to attend overnight camp as youth from other populations and there are few tools as powerful as the camp experience to help positively change the lives of young people.</p> <p>With the Capital and Access to Maximize Participation (CAMP) grant through the National 4-H Council, 187 first-time campers from vulnerable populations were given the opportunity to attend one of the three North Carolina 4-H camps. These campers were also provided with supplies and transportation as needed. The additional campers contributed to an increase of over 20% in summer camp enrollment from 2018 to 2019. This grant proved to be one of the most impactful projects for N.C. 4-H Camps and Centers in 2019.</p> <p>Key survey results indicated that 97% of campers said that camp is a place where adults care about them; at its core, the relationships between caring adults and young people are critical to youth realizing their full potential; or thriving. In addition, 81% of campers said they learned ways to help their community. Youth who build knowledge of their community experience a sense of connection to a larger community and develop an interest in giving back to others, a hallmark outcome of the 4-H program. 96% of campers said that camp is a place where they feel safe, a critical component of a quality youth development program. And finally, 86% of campers said that camp is a place where they feel like they belong. Establishing and maintaining connections with other people has been identified as a developmental outcome of thriving youth. There is no telling how many of these youth experienced Sparks and began to see the potential within themselves during their week at camp and now are on a path to thriving.</p> <p>Additional information: http://www.nc4hcamps.org/</p>	Human and Community Development- Youth Development and Families / #7

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		https://nc4h.ces.ncsu.edu/camps-centers/	
44.	PowerPay Program Helps Participants Manage their Debt	<p>According to the Federal Reserve, 46% of Americans with credit cards have outstanding credit card debt. Those with debt have more debt currently than they did a year ago. The program PowerPay Your Way to a Better Credit Score was designed to assist individuals with managing and reducing their overall debt by providing a debt management plan. The program uses PowerPay (www.PowerPay.org), an online debt reduction tool. PowerPay provides a plan for paying off debts sooner. This means individuals pay less interest overall. Participants are able to reduce their credit utilization ratio and debt-to-income ratio, thereby improving their credit scores. An improved credit score is a powerful device for successfully applying for major purchases, such as a home or car, or for requesting lower interest rates on current credit cards. With continued changes in the labor market, more families and individuals struggle to stretch their wages to meet the costs of necessities. Families and individuals turn to credit cards to help meet their needs, not just their wants.</p> <p>A total of 70 North Carolina family consumer sciences and 4-H agents completed PowerPay trainings and 50 attended a conference session held in 2019. Based on evaluations, the agents found the training to be useful for themselves and for their audiences (limited resource adults). The agents stated the training was most useful when using the debt reduction tool site and phone application. North Carolina agents provided financial management educational workshops that increased the financial capacity of North Carolina residents, making them better prepared to make financial decisions for their life circumstances. There were 2,886 contacts by agents.</p> <p>Participation in workshops and educational activities across the state resulted in 92% of participants gaining knowledge and skills in topics such as budgeting, goal setting, managing credit, and managing credit reports and scores. Outcomes of the educational workshops showed that 100% of participants were able to write SMART goals. An estimated 50% of participants learned to implement basic financial management strategies, such as developing a budget and managing and reducing credit card debt. North Carolinians increasingly understand the need and support strategies to teach financial management practices that can be easily implemented. To help meet this need, the North Carolina legislature, passed Bill 924, which requires all high school student to complete a course on personal finance as part of their graduation requirements.</p>	Human and Community Development- Youth Development and Families / #7
45.	STEM Program, Mentoring Organization Partner to Spark 4-Hers Interest in Ag Science Through Hydroponics	<p>No Soil, Just Water is designed around the N.C. Essential Standards to help participants understand basic science, such as biology and chemistry. The program promotes awareness of, and exposure to, the agricultural sciences, technology, engineering and math (STEM) fields and potential careers in those fields. The activities are intended to pique middle school students' curiosity and interest in AG-STEM subjects and careers. No Soil, Just Water is a fun, interactive program in which participants have an opportunity to grow plants using a hydroponic system. Hydroponic plant production is an emerging growing technique that has major positive implications for the future of farming and the environment. The target audience for this program is minority and underrepresented middle school youth ages 11 – 13.</p>	Human and Community Development- Youth Development and Families / #7

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		<p>The 4-H Ag-STEM program developed a partnership with the BEST Mentoring non-profit organization to assist with its hydroponics plant production and introduce 4-H'ers to Ag-STEM concepts, practices and careers using the No Soil, Just Water lessons. BEST Mentoring serves at-risk and/or adjudicated males with the intent to encourage and motivate them to explore life options through agriculture activities. Various activities are utilized to promote character development; teach financial literacy and money management; exercise life options; understand and promote healthy eating; practice presentation skills; and explore STEM, including agriculture-related career opportunities. Through hydroponic gardening knowledge and explorations, the groups' harvests from BEST Mentoring assist communities in the fight against hunger by supplying fresh fruits, vegetables, and cooking herbs to families residing in food deserts.</p> <p>In 2019, six adult mentors worked with 14 students who provided food assistance to 28 families. They produced, harvested, and delivered 284 one-pound bags of food to those families. In addition to serving needy families, BEST Mentoring provided 325 pounds of food to four church ministries that they then distributed to communities within the food desert areas.</p> <p>The youth participants were introduced to diversified plant production through this venture. They successfully grew and distributed nine varieties of lettuce, five types of leafy greens, and four different herbs.</p>	
46.	Giving a Voice to the Unheard	<p>Community Voices is an educational, community-based program aimed at developing the leadership base of communities. The program particularly targets those who often do not have a voice, who feel that their voices are unheard, or are unaware that they need a voice in community decision-making. Participants learned how the program can: (1) help residents identify, frame, and identify issues; (2) address real issues with interaction and collaboration with diverse community partners; (3) work effectively with a range of audiences within the community; and (4) develop decision-making skills which bring people together. The training covers a host of topics such as group leadership, group decision-making, conflict management, problem-solving, communication, managing change, and community and economic development. In 2019, the program worked mainly with adult audiences in multiple counties. Those counties included Halifax, Vance, Cumberland, Nash, and Edgecombe. Approximately 60 people were trained in the program.</p> <p>In Vance County, one participant stated that his interest in attending was to help him understand community needs and how to better connect in the community. He wanted to understand how to connect with residents in Henderson, to gather input, and to understand how to work together to get things done in the community. He completed the training, went on to run for a councilman position and was elected. He shared that his participation with Community Voices will help him to be a better councilman. Another Community Voices participant who completed the program in November 2019 successfully ran for the Whitaker Town Council. She already served as president of a local community organization and said that Community Voices made her want to learn about needs in the larger community and to develop strategies to empower residents to take action to solve their problems.</p>	Human and Community Development- Youth Development and Families / #7

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47.	Community Leaders, Extension agents Take Part in 'Coming Together for Racial Understanding' Event	<p>N.C. Cooperative Extension hosted an event for staff and community partners called Coming Together for Racial Understanding an initiative supported by the Extension Committee on Organization and Policy (ECOP). This training targeted Extension personnel interested in building their capacity to assist with difficult conversations around race. The program seeks to build a first-of-its-kind cohort of facilitators who are trained to help communities engage in civil dialogues around racial issues. Two two-day training opportunities were offered for interested participants; one was held in August in Johnston County and the second was held in November in Union County. Cooperative Extension at N.C. A&T co-sponsored the training workshops, thanks to funding from the W.K. Kellogg Foundation. Participants learned how these challenging conversations can be implemented within communities.</p> <p>At the two workshops, 43 Extension staff and six community-based leaders from 23 counties were trained. The immediate feedback from both workshops has been positive. Many of the participants realized that the dialogue process can be used to address other challenging topics (e.g., food equity, food access, education, poverty, immigration, etc.) that might arise in their day-to-day experiences. Respondents reported opportunities for using dialogue in racial understanding as a way to build social capital by bringing together different groups of people from the community to bridge cultural and intergenerational gaps.</p>	Human and Community Development- Youth Development and Families / #7
48.	Innovation Station: Bringing the STEM Lab to You	<p>Many schools and community organizations in rural and low-income communities lack access to technology and opportunities/resources to produce innovative ideas and products. Through making, tinkering, and engineering, youth learn 21st-century skills and the value of "design thinking." In 2018, Cooperative Extension at N.C. A&T launched Innovation Station, a 40-foot-long mobile learning experience. The vehicle holds up to 15 students and provides cutting-edge technology as well as exterior programming capabilities. Innovation Station is a mobile STEM lab and makerspace, equipped with 14 workstations, including one wheelchair accessible desk, 3D printers, a laser cutter, and other resources for youth to build skills in the engineering design process, design thinking, computer science, and digital literacy. The Innovation Station enhances and expands 4-H youth programs and enrichment efforts to reach underserved populations. It brings technology and campus resources to those communities that need it most. In 2019, the Innovation Station visited 29 counties in North Carolina and engaged 2,862 youth.</p>	Human and Community Development- Youth Development and Families / #7
49.	Research Contributes to Nutritionally Enhanced Food Products from Biofortified Crops	<p>Micronutrients and phytochemicals from fruits and vegetables show promise for preventing and treating many chronic and degenerative disease, but challenges remain when it comes to developing, producing and marketing food products that realize this potential. Through fundamental research, NC State scientists at the Plants for Human Health Institute have gained a deeper understanding about the interactions among micronutrients, phytochemicals and individual food components, shedding light on how processing and formulating foods affects the bioavailability and stability of these bioactive components. In collaboration with partners from Purdue University, the International Maize and Wheat Improvement Center, and institutions in Senegal, Kenya and Niger this team is working to reduce post-harvest agricultural loss, promote economic growth, improve nutrition and enhance food security in Africa. The project is helping food entrepreneurs translate the research into nutritionally enhanced products that leverage both biofortified crops and so-called food-to-food fortification strategies that</p>	Human Health, Nutrition and Well-Being / #8

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		<p>help consumers achieve meet the need for micronutrients (iron, zinc and vitamin A) to sustain and improve their health.</p> <p>In 2019, the lead scientist authored or contributed to more than 20 scientific papers and presentations highlighting research progress. Topics included the effects of phenolic-starch complexation of pasting properties and digestibility; the effects of steeping on provitamin A carotenoid stability and bioaccessibility from biofortified orange maize; and the collaborative assessment of consumer acceptance and willingness to pay for biofortified cereal products in Africa. Thanks to this and other work, new nutritionally enhanced products made from local and biofortified maize, millet and other crops are now becoming available through African entrepreneurs in local markets. Ongoing tests are taking place to see if such improved foods will meet consumers' preferences and demand.</p> <p>Additional information: https://plantsforhumanhealth.ncsu.edu/</p>	
50.	Study of Bacterial Cultures Count Boost State's Dairy Industry and Benefit Yogurt Consumers	<p>Yogurt in the U.S. is produced primarily from two species of bacterial cultures, <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, and these are imported from Europe. These imported strains have limited capacity for rapid growth and desirable production of acid and flavor compounds. Consequently, the availability of new, strains of <i>L. bulgaricus</i> would not only help to reduce dependence on imported sources but will also provide bacterial strains that include more desirable properties for American consumers. This research conducted by N.C. A&T State University will have the potential to positively impact the dairy industry of North Carolina through the introduction of new strains of <i>L. bulgaricus</i> 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> <p>A medium able to count and detect <i>L. bulgaricus</i> was developed and checked against a standard medium for comparable detection performance. Strains from different sources of <i>L. bulgaricus</i> were isolated using the new developed medium. In addition, the phenotypic profiling for the strains were done. The developed agar medium was able to detect and count <i>L. bulgaricus</i> in all tested samples and was superior to the standard agar medium. A total of 47 new strains were identified. Viability testing is underway.</p>	Human Health, Nutrition and Well-Being / #8
51.	Effects of an Enzymatic Allergen Reducing Process on Nutritional Quality, Sensory Attributes and Storage Stability of Peanuts	<p>Previous studies have shown that the enzymatic treatment by protease significantly reduces allergen content and allergenicity of peanuts. However, the influence of enzymatic process in flavor and nutritional value of the peanut needs to be explored. The target audience include peanut processor who are interested in producing value-added peanut products and consumers who are at risk of hypertension.</p> <p>The effects of using an enzymatic allergen reducing process on the compounds that contributing to nutrition and flavor of peanuts have been evaluated by researchers at N.C. A&T. The focus of this investigation was to examine the effects that enzyme treatments have on the nutritional constituents (sugar and vitamin E), the antioxidant activity of peanut protein extract and the oxidative stability of peanut kernels.</p>	Human Health, Nutrition and Well-Being / #8

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		Enzymatic treatment was found to not only to reduce the allergenicity of peanuts, but also produced antioxidant and antihypertensive peptides, which could enhance peanut storage stability and add additional health benefit to the peanuts. However, the enzyme treatment also impacted the flavor of roasted peanuts due to reduction of sugar that occurred as part of the treatment process.	
52.	NC State Scientist Pioneers Gene Editing Systems, Applying Them for Better Health, Poultry Production, Plant Breeding and More	<p>CRISPR-Cas has been hailed as one of the biggest science breakthroughs in recent decades, yielding solutions that affect medicine, biotechnology, agriculture and other spheres. An NC State University CRISPR pioneer and food scientist is at the forefront in using and improving the genome editing systems and their applications. His research has broad implications for fields ranging from antibacterial production and food fermentation to plant, livestock, and tree breeding and more. He and colleagues in his lab and across campus have made significant headway recently using genome editing and other advanced scientific tools:</p> <ul style="list-style-type: none"> • They conducted <i>in vivo</i> studies providing the first look into the molecular mechanisms of <i>Lactobacillus acidophilus</i>, a beneficial bacterium frequently found in fermented foods, yogurts, and supplements. They learned more about how the bacterium survives in the mammalian gut environment and exerts its health-promoting properties. The genomic “hotspots” they discovered could be key to engineering the species for oral delivery of biotherapeutics and vaccines. They are currently working on engineering this bacterium to develop a COVID-19 vaccine. • They found that the CRISPR-Cas system can be used to effectively target and eliminate <i>Clostridioides difficile</i>, or C. diff, the pathogen that causes colitis, a chronic, degenerative disease. In lab and mice studies, they found a way to kill the bacteria. But in mice, the levels occasionally grew back after a couple of days. Their next steps will be retooling their methods to keep the bacteria from coming back. A local start-up company, Locus Biosciences, is commercializing NC State-based intellectual property developed through this research. • They discovered four strains of <i>Lactobacillus</i> bacteria that could potentially be added to chicken feed as health-promoting probiotics. The finding opens new opportunities for enhancing animal growth, preventing disease, and reducing the costs farmers pay to protect animal welfare. • They gained a better understanding of bile salt hydrolase (BSH) proteins in several probiotic lactobacilli. BSH enzymes play an important role in shaping the gut microbiota and influencing digestion and fat use by the host, and deciphering the molecular mechanisms involved could shed light on how to better manage digestive diseases in humans, pets, and food animals. <p>Additional information: https://crispr.cals.ncsu.edu/</p>	Human Health, Nutrition and Well- Being / #8
53.	Healthier Foods, Less Waste and New Companies Emerge from NC State Technology	The demand for foods made with fewer and simpler ingredients is rising, and food allergies, some of which are life-threatening, pose an additional challenge for consumers in a world of complicated processed foods. Thanks to NC State University research and a partnership with a health-food ingredient technology company called SinnoVita, protein-packed fruit gummies are being produced using a technology that concentrates healthy proteins and fruit compounds and modifies proteins so they don’t trigger allergic reactions. The technology also allows a company Ripe Revival to make use of leftovers from farms and food processors. Sold throughout the United States, Ripe Revival’s gummies evolved from the research and technology developed at NC State’s Plants for Human Health	Human Health, Nutrition and Well- Being / #8

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		<p>Institute. The breakthroughs make it possible for food manufacturers to quickly extract non-essential nutrients called polyphenols from fruits and vegetables and then fuse them to a protein source. The result: a protein ingredient enriched with health-promoting compounds. An NC State food science graduate came up with the idea of using the technology to create gummies. She'd studied the ingredient technology and brought that knowledge with her when she joined SinnoVita's parent company, SinnovaTek, as a food technologist in 2018. SinnovaTek was founded in 2016 based on patented and licensed technologies developed by NC State's food science department. Scientists are now working on ways to use the NC State-patented ingredient technology, called Vitero, to create healthier protein bars and beverages as well as ingredients for the cosmetic industry. Meanwhile, SinnoVita is creating gummies with different flavors as it actively pursues new markets in Europe and Africa.</p> <p>NC State expects additional economic development impacts like these to spin out of the NC Food Innovation Lab (NCFIL), a food manufacturing pilot plant located at the N.C. Research Campus alongside the Plants for Human Health Institute. The lab opened in 2019 with the goal of speeding plant-based food research and development and supporting the growth of new food businesses like SinnoVita and Ripe Revival.</p> <p>Additional information: https://cals.ncsu.edu/news/coming-up-healthier-foods-with-less-food-loss/ https://www.riper revival.com/ https://plantsforhumanhealth.ncsu.edu/ https://www.ncfoodinnovationlab.org/</p>	
54.	<p>Researchers Discover Atypical Immune System Activity That Could Be Key to Delaying Symptoms and Improving Lives for Patients with Severe Neurological Disorder</p>	<p>Rett syndrome (RTT) is a severe neurological disorder that has profound impacts on patient quality of life, with deaths often occurring in patients' mid-40s. Though scientists understand RTT's genetic cause, they don't thoroughly understand RTT's pathogenic mechanisms. That has hampered the development of novel therapeutics for RTT and related autism spectrum disorders.</p> <p>At NC State, scientists are examining the pathogenic mechanisms behind some of RTT's clinical manifestations, such as oxidative stress and inflammation. This work not only sheds light on the development and progression of RTT symptoms, it also suggests potential therapeutic targets.</p> <p>NC State researchers have found an abnormal inflammatory response in serum and cells obtained from RTT patients. These findings reveal, for the first time, that atypical activity of some immune system components may be a key factor in the complex interplay between oxidative stress and inflammation in RTT. This understanding represents an important step toward finding ways to delay symptom progression and improving quality of life for RTT patients and their families.</p> <p>Additional information: https://plantsforhumanhealth.ncsu.edu/</p>	<p>Human Health, Nutrition and Well-Being / #8</p>