2019 Annual Report of Accomplishments and Results

South Carolina
Clemson University
South Carolina State University

I. Report Overview

The NIFA reviewer will refer to the executive summary submitted in your Plan of Work. Use this space to provide updates to your state or institutions as needed.

1. Executive Summary (Optional)

Clemson University Cooperative Extension Service

Sustainable Animal Production Systems – Planned Program #1: In FY 2018-2019, Clemson Extension agents that are focused on livestock and forages assisted small producers with establishing load-lots of beef calves for sale at markets. This technique groups various beef calves together of similar size, weight and health history to establish a load-lot. These load-lots are then sold at market and bring a higher value. For small producers last year, the load-lots yielded a $250 per head increase for 4,000 beef calves, increasing total revenue by $1,000,000.

Sustainable Agriculture Production for [non-food] Horticulture Crops – Planned Program #2: The School Gardening for Educators program is designed to address both low academic performance and childhood obesity in youth in K-12 schools. The program assists K-12 educators to establish school gardens and use it as a teaching mechanism for various disciplines, such as STEM, as well as serve as a source for providing fresh produce to school children. The program is currently in 32 or 46 counties in South Carolina.

Natural Resource Management – Planned Program #3: The Healthy Pond Series is designed to increase stormwater management and maintenance and to decrease stormwater runoff. The Healthy Pond Series is now a model for two other growing locations in South Carolina.

Food Safety – Planned Program #4: The Center for Disease Control (CDC) estimates 1 out 6 people in American get sick from food-borne illnesses each year. In SC, there are more than 19,000 retail food establishments that require safe food handling training. Clemson Extension Food Safety Extension personnel deliver the ServSafe program. Based on CDC estimates and the number of retail food establishments completing ServSafe training in FY 2018-2019, Clemson Extension helped food establishments potentially save over $340,000 by preventing food-borne illnesses.

Agribusiness and Community Development – Planned Program #5: Providing locally sourced food is important as society becomes more aware of where their food comes from. Clemson Extension agribusiness agents helped to establish a network for farmers to provide their local produce to restaurants and other wholesale outlets. Clemson Extension agents also helped to educate the farmers on the best marketing tools, pricing

and other market factors prior to entering the network. This business model helps farmers increase profits, helps local restaurants meet a growing demand for locally sourced food, and provides a financial incentive to both.

4-H Youth Development and Families – Planned Program #6: In South Carolina, only 11% of females are ready for college STEM, with even lower statistics for underrepresented females. The Clemson Extension South Carolina 4-H Engineering Challenge is offered every spring to provide a safe learn environment to try, fail, gain life skills, increase interest, confidence, and knowledge in sciences and to encourage future STEM-related careers.

Nutrition and Childhood Obesity – Planned Program #7: The burden of diabetes impacts minority and low-resource populations disproportionately. In response to this, an Extension-clinical partnership was established to reach community members who may not have access or may not choose to access diabetes self-management education. Preliminary results mid-way through the 5-year project show that program clients reported significant indications of program success.

Sustainable Energy – Planned Program #9: The Woodland Management program is designed to assist first-time forest landowners to learn basic forest management principles. The Woodland Management Program, held in Edgefield County, had participants that either owned or managed over 9,400 acres across the county.

Global Food Security and Hunger – Planned Program #10: Clemson Extension agents work tirelessly in advising crop farmers on ways to increase production and efficiency, decrease costs, and remain financially solvent. The agents assisted farmers with scouting for crop pests and diseases, crop production, harvesting decisions, natural disaster relief, soil tests, pesticide applications and more.

Clemson University Experiment Station

Sustainable Animal Production Systems – Planned Program #1: The Experiment Station continues to work on forage-fed beef and dairy initiatives at the Research and Education Centers at Blackville and on the main campus farms and laboratories. Research activities are conducted on all Research and Education Centers as well as in the majority of counties in South Carolina and multiple locations throughout the southeastern U.S. Continued areas of emphasis include factors influencing marbling deposition in cattle, mechanisms that cause and management strategies that alleviate tall fescue toxicosis in ruminants, and factors that impact reproductive success and growth in beef cattle.

Sustainable Agriculture Production for (non-food) Horticulture Crops – Planned Program #2: Research programs at the Experiment Station are currently ongoing on turf and ornamental crops, both of which are valuable economic components of the state's agricultural sector. Joint activities take place at the Research and Education Centers at Blackville, Florence, and Charleston and on the main campus farms and laboratories. Programs underway in non-food horticultural crops are predominantly focused on plant disease management, weed management and insect pests.

Natural Resources Management – Planned Program #3: The Experiment Station works to transfer knowledge which leads to the development of best management practices impacting water quality and quantity in South Carolina. There are special integrated efforts on South Carolina's coast where salt water intrusion and intensive commercial and residential development put pressure on the state's water quality. Integrated work with the university's Intelligent River remote sensing technology is also in progress.

Food Safety – Planned Program #4: Research conducted by the Experiment Station seeks to improve the safety of the food in South Carolina through the rapid detection of toxic food agents and the development of strategies to reduce their presence in food, to include new packaging technologies. The Experiment Station continues to seek to reduce food-borne illness, promote healthy food choices, develop skills in the procurement of food for good health, and demonstrate skills in healthy food preparation. Research activities take place on the main campus with outreach components conducted throughout South Carolina.

Agribusiness and Community Development – Planned Program # 5: Experiment Station Researchers are currently involved in a multi-state USDA AFRI proposal to develop a Local Foods Vitality Index that involves primary data collection from both producers and consumers; allowing for more informed local decision making regarding food systems investments. Researchers are assessing the viability of a food hub or similar produce aggregation project in the Midlands of South Carolina. Like many others, the Experiment Station is becoming increasingly focused on local and regional food systems development as a marketing strategy for small-scale producers.

Global Food Security and Hunger – Planned Program #10: Research educational programs are being implemented to improve agricultural production, improve global capacity to meet the growing food demand, and foster innovation in fighting hunger by addressing food security. Research programs are underway in vegetables which is a valuable economic component of the state's agricultural sector. Joint activities take place at the Research and Education Centers at Blackville and Charleston and on the main campus farms and laboratories. The Experiment Station works closely in the development and transfer of technologies and ways to deal with pests and diseases, to include root rot and brown rot in commercial peach orchards with special emphasis on use of reduced risk fungicides. The Advanced Plant Technology program established at the Pee Dee Research and Education Center primarily focuses on technology and traditional plant breeding approaches to produce new varieties. The main goal of this program is translational, problem-solving science to advance crop agriculture in South Carolina. Members include over 20 world-class researchers, stationed throughout the state, who represent basic and applied sciences. Current crops of interest are corn, cotton, peaches, peanuts, sorghum, soybean, and wheat. In addition, crop pests, plant diseases, invasive weeds, and best-management practices for cultivation are studied. The Advanced Plant Technology Program is working to form a collaboration between scientists and Extension agents that will further assist and educate the constituents of South Carolina.

The Experiment Station is heavily involved in coordinated and integrated research, technology transfer and educational programs for growers. Integrated activities take place on the main campus, and at the university's Research and Education centers in Florence, Blackville and

Charleston. Major crops include cotton, soybeans, corn, wheat, and sorghum. In addition, work is underway in the area of nonfood crops which can be grown for energy production.

SC State University Extension

In August 2019, the administrative leadership at SC State Research and Extension changed. The new administrator approached the organization with a renewed vision, innovative ideas and enhancing the tri-part mission of research, teaching and outreach. The Executive Director unveiled a 100-day plan of operation. Teams were formed, planning sessions were held and the need to restructure and hire employees was instituted.
A SWOT (Strengths, Weakness, Opportunities, Threats) Analysis was conducted with staff and administration. The SWOT Analysis is a strategic tool to help an organization identify and evaluate the Strengths, Weaknesses, Opportunities, and Threats of a project, product, plan or business decision. It was an "All Hands-on Meeting." Every employee in the organization was asked to participate in the work session. A new organizational chart was distributed. Employees were fitted within the new structure. The new structure incorporated regions instead of the old cluster areas. The SC State Program will now serve 25 counties, which make-up six regions. The regions are as follows: Piedmont, Low Country, Pee Dee, Midlands, Santee-Wateree and Coastal Regions.
During FY 2018-2019, SC State Extension served a grant total of 8,158 individuals in public service activities. A total of 4,873 participants completed educational workshops. Approximately 1,326 different public service activities and programs were offered across the state. By utilizing the Integrated Crop Management (ICM) practices, 839 acres of farmland were improved. A total of 1,577 families and caregivers received information of adopting healthy life-style habits. There were 48 partnerships established with after-school programs, faith-based organizations, school districts and other agencies.
Sustainable Animal Production Systems – Planned Program #1: Small scale livestock producers were interested in improving their farm operations management. To help gain knowledge to increase acreage and forage use workshops were held. Three producers received Natural Resource Conservation Service (NRCS) funds; 1 producer's animals increased from 30 to 40, which was a 33% increase.
Sustainable Agriculture Production for (non-food) Horticulture Crops – Planned Program #2: Access to fresh vegetables is a problem for many communities in the Midlands Region, as many do not have local grocery stores. Micro-irrigation provides a necessary tool for farmers to produce a reliable supply of vegetables and ensures the success of other high value crops, such as industrial hemp. Farmers who installed micro-irrigation increased transplant survival by at least 80%, increasing fall greens profits by $1,662.00 and saving an estimated $78,000 worth of industrial hemp.

Natural Resources Management – Planned Program #3: Minority land loss is a serious issue in the Low Country of South Carolina. An outreach project was developed to address the decline of small/minority farms and landownership. Two hundred thirty-five participants gained knowledge and increased skills.

Food Safety – Planned Program #4: The Healthy Lifestyles Project in the Low Country helped 47% of the participants adopt handwashing and safe food handling practices.

Agribusiness and Community Development – Planned Program #5: The Citizenship Program builds on existing efforts of engaging individuals, civic, and community leaders to improve the economic, environmental, political, and social conditions of their community. The goal was to empower individuals, businesses and organizations to improve their community and give a voice to traditionally underrepresented and underserved community members. Eight hundred sixty-five youth participated in the program, with 305 completing their project series of lessons.

4-H Youth Development and Families – Planned Program #6: Strategies in Math and Reading using Technology (SMART) is a summer enrichment program designed to assist 3rd, 4th, and 5th grade students academically. SMART focuses on preparing youth for the upcoming school year in reading and math standards using technology. There was a 100% improvement in math and reading comprehension.

Nutrition and Childhood Obesity – Planned Program #7: The Expanded Food and Nutrition Education Program (EFNEP) continues to educate the public. As more and more people learn the benefits of eating more fruits and vegetables, they in turn become healthier. Of the 398 program participants, 80% of them stated they gained knowledge about eating healthy foods.

Global Food Security and Hunger – Planned Program #10: EFNEP agents worked tirelessly with parents and youth to encourage them to eat healthy and understand food insecurity. Two hundred fifty-four participants were involved in a taste testing exercise, after the EFNEP sessions. As a result of the sessions, 99% of the youth gained knowledge and were able to choose healthier foods, while 97% of adults improved their diet quality.

SC State University Research

The SC State researchers conducted extensive work during the reporting period on various research projects. The projects included Sustainable Agriculture Production for (non-food) horticulture crops, Natural Resources Management, Food Safety, Agribusiness and Community Development, 4-H Youth Development and Families, Nutrition and Childhood Obesity, Sustainable Energy, and Global Food Security and Hunger. Several of the research projects also had an outreach component included in the research.

Sustainable Agriculture Production for (non-food) Horticulture Crops – Planned Program #2: Noise exposure is considered an occupational hazard to the hearing health of farmers and farm workers (Lusk, Hagerty, Gillespie and Ziembaet, 2004; McCullagh, Lusk and Ronis, 2002).

According to the National Institute of Deafness and other communication disorder (NIDCD), more than 30 million Americans (all ages) are exposed to hazardous sound (noise) levels on a regular basis, without using hearing protection devices (HPD). The research on assessment of hearing loss and high plod pressure changes the attitude and behavior of farmers regarding the active use of hearing protection devices.

Natural Resources Management – Planned Program #3: The contamination of soils and groundwater by Uranium (U) is a global problem of great concerns. The human health hazards presented by exposure to Uranium are great significance (with kidney and bone being high-risk targets). The research aims to remove and/or stabilize non-radioactive U (and heavy metals) utilizing a unique combination of specific microbial activities from novel bacteria isolated from U-contaminated soils and sediments**.**

Food Safety – Planned Program #4: The major goal of ozone treatment as an alternative for conventional fumigation to manage stored product insects project was to evaluate ozone (O3) as an alternative control option for the management of stored product insect pests, which are known to cause millions of dollars of loss to stored products such as grain-based products, and dried fruit and nuts.

Agribusiness and Community Development – Planned Program # 5: An examination of marketing capabilities of small farmers who engage in agritourism activities as a supplemental or primary means of earnings and seeks to provide research-based measures to improve the marketing viability of such farms was demanded. Research will identify current and potential small farm agritourism practitioners and the marketing challenge they face in developing and communicating agritourism experiences and resources.

4-H Youth Development and Families – Planned Program #6: Based on the South Carolina test results of the 2015 – 2016 academic year, most test takers (grades 3 – 8) did not meet state established reading expectations in Orangeburg County Schools, according to the SC State Department of Education. The influences of music instruction on reading and music achievement in grades PreK-5 aims to test the influences of two discrete courses (Music Instruction on Reading and Music Appreciation) linked by agriculture literacy outcomes involving food, health, and lifestyle.

Nutrition and Childhood Obesity – Planned Program #7: Obesity is a serious medical condition that affects large populations in the United States and is evident in South Carolina. In South Carolina, and specifically Orangeburg County, obesity rates are quite high. In 2013 South Carolina children age 2-17 were classified as overweight (14.9%) and obese (16.7%), according to South Carolina Department of Health and Environmental Control (DHEC). There were various issues related to obesity, and one of them was *obesity prevention*, which is the focus of the research. An achievement motivation boosting procedure for the cortex was designed, which took advantage of the possibility of a subject to use brain signals to control movement of a physical devices. The method is known in science as brain-computer interface. It is a non-invasive method and is often considered as a computer+robot game of interest for children.

Sustainable Energy – Planned Program #9: Research is underway to reuse port-consumed plastics for solvent extraction of resins and other reprocessing. The project centers on saving energy by recovering resin and reutilizing post-consumed plastics (PCPs) and waste plastics. It has been estimated that the availability of PCPs increases yearly by over 2%, and it is slightly higher than the rate of resins production.

Global Food Security and Hunger – Planned Program #10: National, there are more than 42 million households dealing with food insecurity and 13 million are children. There have been many programs developed and strategies aimed at reducing food insecurity. SC State proposed a school-based program to address food insecurity of public-school students that reside in rural areas (Orangeburg and Calhoun counties). Researchers will examine the relationship of school-based programs and their effect on nutrition and behavior, as well as, developing initiatives that will enhance participation in food programs an access to food to address food insecurity.

II. Merit and Scientific Peer Review Processes

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

Process	Updates
1. The Merit Review Process	No updates or changes from Clemson University or SC State University
2. The Scientific Peer Review Process	No updates or changes from Clemson University or SC State University

III. Stakeholder Input

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

Stakeholder Input Aspects	Updates
1. Actions taken to seek stakeholder input that encouraged their participation with a brief explanation	No updates or changes from Clemson University or SC State University
2. Methods to identify individuals and groups and brief explanation.	No updates or changes from Clemson University or SC State University
3. Methods for collecting stakeholder input and brief explanation.	No updates or changes from Clemson University or SC State University
4. A Statement of how the input will be considered and brief explanation of what you learned from your stakeholders.	No updates or changes from Clemson University or SC State University

IV. Planned Program Table of Contents

V. Planned Program Activities and Accomplishments

Please provide information for activities that represent the best work of your institution(s). See Section V of the Guidance for information on what to include in the qualitative outcomes or impact statements. Add additional rows to convey additional accomplishments. You may expand each row as needed.

No.	Title or Activity Description	Outcome/Impact Statement	Planned Program Name/No.
1.	**Beef-cattle load lots** *Clemson Extension*	***Situation:*** The average beef cattle operation in South Carolina maintains a herd size of approximately 30 beef cows. With smaller herd sizes, South Carolina producers can often be limited to local marketing options. Cattle coming from the southeast are going to be transported (more than likely west/north) in large truck/trailers in what is referred to as load lots (50,000 pounds) of cattle. While local marketing options are sufficient, lack of calf history and co-mingled groups lead to decreased assessed value. Larger operations have increased marketing options by grouping calves in load-lots, and marketing like cattle with similar health history to buyers. ***Response:*** Clemson Extension works with local producers to group calves of similar weight, health history, and genetic background for load-lots. Livestock agents across South Carolina work with producers within each region to facilitate the improved marketing of these cattle. The impact of this program is truly a work of multiple years of education and outreach on behalf of Clemson Extension by each local agent and specialist. The increased value is representative of the basic management practices taught and demonstrated through multiple workshops, farm visits, and phone calls. Workshops and seminars include, Market Volatility workshops (3), Master Beef Producer (2), and local presentations (on avg. 10/agent), all to address management to increase profit. ***Results:*** The team has facilitated improved marketing of over 4,000 head of beef calves in the past 6 months. The average increased revenue was $250/head or $1,000,000 total. Increasing farm revenue leads to a decrease in anxiety, improved mental health, less mood disorders, and increased family stability. Increasing farm revenue also has a trickle-down effect in the community, with increased wages for farm workers, increased spending in the community, and increased financial stability.	Sustainable Animal Production System (Planned Program #1)
2.	**Management systems to improve the economic and environmental sustainability of dairy enterprises (multistate)** *Clemson Experiment Station*	***Situation:*** Clemson researchers studied pre and post weaning strategies and milk replacer regimes to improve rumen adaptation during the transition period. ***Response:*** Three in-vitro projects examining the effects of using high concentrations of fat in precision fed system for heifers were also completed as were three projects to improve nutrient utilization efficiency and animal health. In-vitro and in-vivo projects were also undertaken continuing our work of evaluating rumen modifiers and ameliorating milk fat depression through dietary manipulations. Two in-vivo projects were conducted to	Sustainable Animal Production System (Planned Program #1)

		determine if a treatment process applied to protein capsules containing fish oil slowed protein disintegration time in rumen buffer and prevented biohydrogenation of internal omega fatty acids in lactating dairy cows. A third project used continuous culture fermentation to determine the effects of caffeine on rumen fermentation, digestibility coefficients and microbial flow. ***Results:*** Gradual weaning seems not to affect successful growth and development when calves are fed moderate amounts of milk replacer. However, when high amounts of milk replacer are provided, it is necessary to wean gradually to allow enhanced rumen development, microbial establishment and increase feed efficiency. Rumen protection technology shows initial promise and further evaluation using in-vivo approaches is ongoing. Increasing levels of fat under precision feeding system showed a potential to reduce DMI yet maintain optimal rumen fermentation conditions and nutrient utilization. These findings have the potential to impact dairy weaning strategies throughout the region and improve dairy heifer development.	
3.	**Livestock Producers Increase Acreage and Forage Use** *SC State Extension*	***Situation:*** Livestock producers would like to increase the carrying capacity/stocking rate of their acreage and increase forage utilization. Raising more animals on the same amount of acreage will provide more animals to market, which will increase income. The available grazing acreage will also be better utilized with less wasted forage. ***Response***: A management intensive grazing (MIG) workshop and tour was held in March 2019 in McCormick, South Carolina. Participants were able to view a MIG system utilizing electric fencing components, discuss forage options, and hear from NRCS representatives concerning cost funds to implement a grazing system on their farms. Twenty-six (26) individuals attended the workshop and tour. ***Results:*** Three producers received NRCS funds to assist in implementing their grazing system, and one producer reported increasing his number of animals from 30 to 40 on the same amount of acreage which was an increase of 33%.	Sustainable Animal Production System (Planned Program #1)
4.	**School Gardening for South Carolina Educators Program** *Clemson Extension*	***Situation:*** South Carolina public schools consistently rank low in academic performance. Statewide, 39% of elementary, 40% of middle, and 30% of high school students are classified as overweight or obese. School garden-based learning is a low-cost and high-impact initiative that addresses both poor academic performance and childhood obesity. A major barrier to educators who wish to engage students in garden-based learning is a lack of horticulture skills to successfully grow a school garden. In addition, educators are often unclear about what types of equipment and materials are necessary to grow a school garden and may use grant funds to make costly purchases that do not result in long term success. Purchasing and acquiring materials also takes time and can be slowed by school purchasing policies. A comprehensive garden-based STEM curriculum aligned to South Carolina teaching standards is required to fully integrate garden-based learning into the classroom.	Sustainable Agriculture Production for (non-food) Horticulture Crops (Planned Program #2)

		Response: Clemson Extension responded by developing the pilot program, "School Gardening for SC Educators" with initial funding from The College of Charleston and Boeing South Carolina. The extension-based program combines horticulture training, ongoing technical support and equipment for schools to start and sustain successful school gardens. The interdisciplinary team developed innovative approaches to overcome common school gardening obstacles such as poor soil, seasonality, and food safety concerns specific to the school gardening community. Educators engage in a 5-week online professional development course. Teams of three school faculty members are encouraged to participate together to build sustainability into the program. Licensed South Carolina teachers receive 20 renewal credits approved by the South Carolina Department of Education upon completion. Each participant receives program materials including The Garden STEM Science Technology Engineering & Math Curriculum for Your Garden Classroom, a comprehensive curriculum for K-8 students aligned to South Carolina educational standards. Additionally, the regionally specific technical guide, Seasonal Planting Guide and Calendar for School Gardens: Upstate Region or Lowcountry Region is provided. The guide instructs school gardeners when to plant transplants and seeds in a series of four raised beds. It also indicates when to harvest a wide array of common vegetables. The calendar begins as the school year opens and ends in late spring when sweet potatoes are planted and allowed to grow over the summer so that students can harvest them upon their return in the fall. Following completion of the online course, educators must attend a one-day hands-on workshop where they are introduced to statewide resources including 4-H Youth Development, SC Farm to School, and SC Farm Bureau Ag in the Classroom. Additionally, technical skills are emphasized, with educators engaging in hands-on activities such as irrigation system setup, worm composting and seed starting. Lessons from The Garden STEM curriculum are modeled for educators so they can confidently take them back to the classroom and engage students in the garden. During the pilot phase, a turn-key school garden kit was conceived to reduce the amount of grant funds spent on unnecessary equipment and materials. The kit includes tool free, dovetail joint, untreated cedar raised beds; a simple irrigation set up; bagged soil and compost; tools, mulch and seeds. All of the items are delivered to the school garden team thus alleviating the need for teachers to source materials. The turn key kits were so well received the program continues to offer this technical support. An important factor that influences school garden success is planting seasonally appropriate transplants and seeds. To assist school gardens in South Carolina, 4-H youth development agents, horticulture extension agents and Master Gardener volunteers have committed to delivering transplants to schools in their counties four times per year as outlined in the Seasonal Planting Guide and Calendar for School Gardens: Upstate Region or Lowcountry Region. ***Results:*** Since 2012, over 1,200 educators, parents and volunteers have received training in five key modules including site analysis, raised bed gardening, vegetable gardening,	

		food safety practices, and community resources. A 2017 survey conducted by Taylor et al. found that 73% of educators report using their school garden to teach during the school day; 70% of instruction is science-based and 51% of educators use the garden for up to 2 hours per week. During the 2018-19 school year, 35,700 youth participated in 4-H youth development plant science programs connected to the statewide school gardening initiative. In 2018, a full-time School and Community Gardening Extension Agent position was created to continue extension research and development in this area. More than 140 school gardens remain active since the initial pilot phase. In school year 2017-18, eighty-nine schools opted into the transplant delivery program which was carried over from the pilot phase. Partnerships with the SC School Nutrition Association, SC Department of Education Farm to School and the Medical University of South Carolina have resulted in more than 40 additional grant funded school gardens and approximately 100 more educators trained in school year 2018-19. School gardens resulting from this program are now in 32 of South Carolina's 46 counties. School-based gardening is a low cost and high-impact initiative that addresses two key issues South Carolina faces: high rates of obesity and poor academic performance. While most gardens fail within the first year, approximately 80% of the school gardens who participated in this program are still growing 3-5 years after initial setup. There is a growing body of evidence to suggest that school gardens lead to improved academic performance for students. In addition to the many educational opportunities that gardening offers, it is also a lifelong pursuit that provides many mental and physical health benefits. The goal of this extension led initiative is to continue to lead the way for garden-based learning in South Carolina, fulfilling our mission of improving the lives of all our citizens.	
5.	**Knowledge-based management of economically important weeds of SC** *Clemson Experiment Station*	***Situation:*** Invasive plant species are key drivers of global environmental changes leading to the disruption of ecosystems. Many invasive species engage in novel niche construction through plant-soil feedbacks facilitated by the input of secondary compounds, which help their further spread and survival. These compounds can persist in soil even after the removal of the invasive species thus creating a legacy effect that inhibits the return of native flora and fauna or inhibit growth of economically important crops. ***Response:*** Clemson researchers have developed active intervention strategies that can reverse niche construction and improve restoration of invaded ecosystems or establishment of crops. Altering management practices that can reverse soil carbon and nutrient cycling in invaded ecosystems can facilitate the rapid restoration of the invaded sites. This was tested by adding soil carbon amendments such as activated carbon and biochar to alter the microbial functional activity and nutrient cycling for restoration of invaded habitats. We tested this hypothesis in an old-field habitat that has been invaded by Japanese knotweed (*Polygonum cuspidatum*) for >20 years.	Sustainable Agriculture Production for (non-food) Horticulture Crops (Planned Program #2)

		Results: Plots with activated carbon and biochar had 80% more biomass of native prairie species than the control plots. The nitrate content of carbon amended plots was 5 times higher than the non-amended control plots indicating an increased nitrogen mineralization in carbon amended plots potentially due to the sorption of phenolic compounds by activated carbon and biochar that makes them unavailable. This was further supported by the increased phenol oxidase activity which might have been less inhibited by tannins and led to increased organic matter decomposition. Fungal biomass decreased in the carbon amended plots potentially leading to faster nutrient cycling. This research indicates the potential for carbon amendments to reverse niche construction and legacy effects of polyphenol-rich invasive species and indicate that biochar could be a more economically feasible alternative to activated carbon in restoring invaded ecosystems. Understanding the mechanism through which invasive species engage in niche construction is vital in formulating suitable knowledge-based restoration practices for invaded ecosystems and can be exploited to manage polyphenol-rich invasive species.	
6.	**Installation of Micro-Irrigation** *SC State Extension*	***Situation:*** High value crops, especially those that are grown from transplants, have a window of time that they need to grow their root system. It was during this time many of the small farmers were losing a high percentage of crops if they had some degree of survival, they often lost production and quality during high moisture demand periods of the crop. ***Response:*** The SC State Midlands region Small Farm Program hosted a series of information meetings where participants were given an opportunity to learn about cost share programs offered by the local Natural Resource Conservation Service, and other USDA agencies that could help interested producers address irrigation improvements. A few farmers were able to apply and obtain cost share for micro-irrigation systems. They then had issues finding vendors to install the systems. The Extension agent addressed this issue by providing the guidance needed for the farmers to install the systems themselves. ***Results:*** This is the reportable, quantifiable difference or potential difference a program makes in the life of a participant. It shows a sustainable societal, environmental, and/or economic change. Farmers who have installed micro-irrigation have increased transplant survival by at least 80 percent, increasing fall greens profits by $1,662.00, and savings an estimated $78,000.00 worth of Industrial Hemp. The Industrial hemp farmers who the extension agent assisted to install micro-irrigation systems during the 2019 growing season have reported that they would not have had a crop to harvest had it not been for the extension agent's efforts.	Sustainable Agriculture Production for (non-food) Horticulture Crops (Planned Program #2)
7.	**Assessment of Hearing Loss and High Blood Pressure Among Farmers and Agricultural Workers**	***Situation:*** Historically, noise exposure has been considered an occupational hazard to the hearing health of farmers and farm workers (Lusk, Hagerty, Gillespie, & Ziembaet, 2004; McCullagh, Lusk, & Ronis, 2002). Prolonged exposure to noise can result in Noise Induced Hearing Loss (NIHL). According to the National Institute of Deafness and other Communication Disorders (NIDCD, 2010), more than 30 million Americans, of all ages, are	Sustainable Agriculture Production for (non-food) Horticulture Crops (Planned Program #2)

	SC State Research	exposed to hazardous sound (noise) levels on a regular basis. Research pertaining to the contribution of noise exposure in farmers is limited; however, there are numerous hearing conservation programs among manufacturing workers. The United States Department of Labor the Occupational Safety and Health Administration (OSHA) set the legal limits on noise exposure in the workplace based on a time weighted average over an 8-hour day (2018). NIHL may cause temporary damage, permanent damage or acoustic trauma (Depczynski, J, Challinor, K. & Fragar, L., 2011). The literature has also indicated that exposure to chronic or acute noise is associated with the prevalence of hypertension (Munzel et al, 2018). The ultimate goal of the research is to educate farmers and agriculture workers (minority and majority populations) in South Carolina of the implications that excessive noise levels over a period of time may potentially cause and complications related to ischemic heart disease and high blood pressure. The societal benefit in rural South Carolina includes potentially lowering the incidence of noise induced hearing loss thereby improving the quality of life of countless farmers and agricultural workers. ***Response:*** This study was designed to be conducted in two phases. Phase I: The mobile van was designed and built. Participants were recruited through university faculty, community engagement, conducted presentations, professional newsletters, local newspaper, and SC State's Research and Extension. Initial surveys were designed and administered about the use of hearing protection devices. The hearing conservation program was designed. Phase II: Hearing levels were assessed using a clinical audiometer. Additionally, the noise levels of farming equipment were measured using a sound level meter along with the farmer's blood pressure before as well as after using farm equipment. Hearing health and blood pressure educational support materials were distributed to S.C. farmers and agricultural workers to change their practices and attitudes. ***Results:*** One hundred percent of participants were surveyed and responded as follow: When 100% were surveyed and asked whether they used hearing protective devices while operating farming machinery 56% of the farmers responded "No" to wearing any type of hearing protective devices at all while operating their farm equipment. Of that 100%, only 44% responded "Yes" to usage of hearing protective devices, but the devices were not worn on a consistent basis. When the same participants were asked whether they would consider using protective devices if they were given to them 78% of the participants responded "Yes" they would wear hearing protective devices and 22% of the participants responded "No" when surveyed. When the participants were asked if they ever received any prior training or education about noise exposure in an occupational setting, only 33% of the participants responded "Yes" to receiving some type of education or train while 67% responded "No" to receiving any prior training on noise exposure in an	

		occupational setting. When the participants surveyed were asked if education was supplied to them free of charge through the SC State Program about noise hazards in their work environment and the protection of their hearing health; would they be willing to participate in the training/education and 89% of them responded "Yes" while only 11% of the participants responded "No." The complete research study results are being published in a research bulletin.	
8.	**Healthy Pond Series** *Clemson Extension*	***Situation:*** Stormwater ponds are the most frequently used engineering practice to help manage flooding and pollution in South Carolina, with more than 9,000 stormwater ponds in the eight coastal counties of the state alone. ***Response:*** Clemson Extension has offered a variety of outreach tools to help meet the needs of stormwater pond owners in South Carolina that have included workshops, guidebooks, billboard, television, conferences, and more. Clemson Extension partnered with the SC Department of Natural Resources to launch the Healthy Pond Series in the Charleston, SC area. The Healthy Pond Series was developed as a networking opportunity to connect stormwater pond owners with others in their community to discuss best practices in pond maintenance and lessons learned. Each segment in the series, which is offered quarterly, includes a lecture portion on a maintenance topic and interactive hands-on discussion time for owners to share ideas. Target audience includes stormwater pond owners and property management professionals from across the Charleston, SC region. ***Results:*** During the 2018-2019 fiscal year, the Healthy Pond Series held three series covering shoreline plantings for stormwater ponds, aeration, and wildlife management. A total of 61 people attended the programs, 15 of those people were repeat participants and attended multiple dates in the series during the year. The shoreline planting program included the installation of a 200 square foot shoreline buffer at the Coastal Research and Education Center, in Charleston, SC, that showcases erosion control methods for pond banks. Evaluation summaries from the three programs showed that 100% of participants said their knowledge of pond management increased as a result of their participation, and 97% of participants said that they were planning to apply knowledge learned to their pond management or job. Healthy Pond Series has continued to be offered since its inception and is now serving as a model for delivery in other areas of South Carolina in Beaufort and Myrtle Beach.	Natural Resource Management (Planned Program #3)
9.	**Impacts of Hurricane Storm Surge or Prescribed Fire on Forest Dynamics** *Clemson Experiment Station*	**Situation:** Clemson researchers at the Waccamaw Research and Education Center have utilized long-term forest structure datasets from damage following Hurricane Hugo in 1994. This dataset was strengthened with more recent storm surge damage from Hurricane Matthew to elucidate mechanisms of forest mortality from storm surge. **Response:** Additional intensive sampling of soil salinity and measures of tree health using biometric survey and UAV imagery will further strengthen the dataset	Natural Resource Management (Planned Program #3)

		allowing improved understanding of forest dynamics following increased salinity from sea level rise or storm surge. **Results:** Clemson researchers have observed that frequent prescribed fires in southeastern forests can help prevent wildfires like those that have impacted much of Northern California as well as improve overall forest health and productivity. Researchers are studying the role of fire in the Appalachian Mountains and is part of a team bringing prescribed burning back to the region. Pre-, post-, and day-of-burn fuels data were collected on 7 burns (3 in the growing season, 4 in the dormant season) on US Forest Service lands (Andrew Pickens Ranger District, Sumter National Forest (SC) and Chattooga River Ranger District, Chattahoochee National Forest (GA)). Analyses have revealed that growing season burns are significantly hotter (approximately 70 degrees Celsius hotter) on average than dormant season burns, and they consume more fuels -- despite fuel moisture and relative humidity being similar between treatments. As a byproduct of this, growing season burns have a longer residence time, which results in a much longer pulse of heat into the soil and into vegetation. Dormant season burns did not impact the duff layer, while growing season burns, in some cases burned up to a 1 cm of duff. Growing season burns were also more variable in their behavior. All of our growing season burns displayed a wide range of severity and intensity (from extremely hot microsites that consumed nearly all available fuel, to sites that burned only minimally). Preliminary assessments suggest that growing season burns were more effective at eliminating undesirable shrubs, and there has also been a substantial increase in oak regeneration in burned units (regardless of season). Considering the linkages between fire behavior and vegetation, we anticipate that growing season burns will be more effective at creating the "mosaic" effect that many scientists and managers desire.	
10.	**Retention of Small/Minority Farmers and Landownership** *SC State Extension*	***Situation:*** According to Census Data for FY2010, there has been a serious decline in number of minority farms in the SC Low Country. This decline in minority agriculture production and land ownership could be attributed to a number of factors, but partially due to lack of knowledge of available resources, economics, and poor farm management skills. A decline in minority landownership due to land loss issues continue to grow. Much land is tied up in heirs' property, a major problem of many minority farmers. The small scale/minority farm producers and landowners need to be involved in agriculture programs, learning updated production and farm management practices and landowners risk and responsibilities. Anything less contributes to continued small farm decline and minority land loss ***Response:*** The SC State Extension Program developed an outreach project, "Retention of Small/Minority Farms and Landownership," to address the decline of Small Farms and Landownership of Minorities. Collaborative partnerships were initiated with USDA	Natural Resource Management (Planned Program #3)

		agencies and groups, 3 Small Farm Cooperatives, 2 established farms, Center for Heirs Property Preservation, SC Forestry Commission, and County Courthouse Personnel responsible for land issues. USDA agencies assisted with a Farmers and Landowners resource meeting updating the group on available resources in USDA offices. A region wide conference was held on "Landownership and Responsibility." Three follow-up meetings were held on Alternative Agriculture Enterprises, Land Use Options, and Heirs Property Resolutions respectfully. Two farm tours were conducted to show case Sustainable Agriculture Practices. A final meeting focused on Natural Resources and the Environment, Soil Conservation Practices, Small Scale Forestry, and Wildlife and Pond Management. ***Results:*** Two hundred thirty-five (235) farmers and landowners attended and participated in project activities. New and beginner farmers were particularly guided through activities focused on landownership and responsibilities, County Clerk of Court, Probate Judge, Land Surveyor, and USDA – Farm Service Agency leading the way. Forestry agencies followed up with forestry related activities, assisting with field visits, available applications, and demonstrations. Extension agents and USDA – Natural Resources Conservation agents assisted with "Land Use Options" and "Sustainable Agriculture Practices." Attorneys from "The Center for Heirs Property Preservation" conducted presentations on Heirs Property Resolution and assisted clientele with preparation of wills. Two small farmers assisted the project by providing field demonstrations on their farms with updated equipment and facilities. Small Farm Cooperative members assisted in field demonstrations. Two hundred thirty-five (235) participants gained knowledge/increased skills in the area of agriculture production practices and landownership, Natural Resources and Environment, Land Use Options and Small Farm Management to limit off farm input, increase on farm output and increase income.	
11.	**Contamination of Soils and Groundwater by Uranium** *SC State Research*	***Situation:*** The contamination of soils and groundwater by uranium (U) is a global problem of great concern. The human health hazards presented by U are of great significance (with kidney and bone being targets). Studies have also shown that crops can uptake and store U when grown in U contaminated soil, or when the plants are grown hydroponically in water containing U. A number of microorganisms have been identified which are capable of performing U bioremediation. Many of the bacteria produce substance called bio surfactants which increase the bioavailability of U, a necessary step in U remediation. From a hydrocarbon contaminated region in Poland, specific natural soils bacteria which can be involved in U bioremediation, *Pseudomonas pituda* Biotype B SRS and *Alcaligenes piechaudii* SRS, have been identified and partially characterized. The goal of the project is the characterization of natural microbial produced biosurfactants, with respect to their chemical properties and interactions for metal and radionuclide remediation. Under aerobic and anaerobic conditions, the researcher is determining functional diversity of subsurface groundwater microbiota under the influence of uranium (U) contamination,	Natural Resources Management (Planned Program #3)

		identifying the associations and interactions between environmental variables and U (VI) reducing microorganisms using microcosm and enzyme studies, and determining the impact of bio surfactants on U bioavailability through enzymatic studies. The natural biosurfactants could be potentially applied in conjunction with current technologies for natural attenuation of U. ***Response:*** SC State researchers created transconjugant mutants of *A. piechaudii*, a microorganism capable of reducing U levels in soil/groundwater. The transconjugants were screened using the MBAS assay to identify genes involved in biosurfactant production/activity in the bacterium. Increased the number of underrepresented minorities conducting research in the area of environmental molecular biology by allowing SC State students to perform independent studies. The students participated in and presented their research at several conferences and won at least one prestigious award. A protein that may be involved in biosurfactant production/activity and degradation of other environmental contaminants was identified. A collaboration between SC State and the Savannah River National Laboratory (Aiken, SC) was created. ***Results:*** The microorganism *Alcaligenes piechaudii* has been demonstrated to create biosurfactants and reduce U levels. A random transpositional mutagenesis was performed to identify specific genes in A. *piechaudii* involved in biosurfactant production, which allow the bacteria to utilize U. The conjugal plasmid pUTminiTn5-Tc was used as the source for the Tn5 transposon. Four different methods of performing transpositional mutagenesis were tested to determine which process would produce the most transconjugants: electroporation, chemical treatment, dot conjugation and line streak conjugation. The results showed that line streat conjugation was the most efficient method of transpositional mutagenesis of A. piechauddi, as it produced approximately 1,800 transconjugants. The researcher then established a mechanism by which to screen the A. *piechauddii* transconjugants. An atomized paraffin oil overspray to detect biosurfactants was employed. Biosurfactant production is indicated by the production of a halo around the bacterial colony. The assay failed to identify biosurfactants in *A. piechaudii*, as well as other strains currently being studied, ie. P. pituda and R. pickettii, was only successful in detecting biosurfactants in the positive control P. syringae. A methylene blue active substance (MBAS) assay to detect biosurfactants was employed. The production of biosurgactants in the assay was indicated by the blue coloring of the bacteria and/or a blue halo around the well in which the bacteria was placed. The MBAS assay successfully detected biosurfactants produced by A. piechaudii and P, piruda will be employed to screen all transconjugants. The project has led also to the identification of a protein that may be involved in biosurfactant production. While conduction the studies and establishing the parameters for the MBAS assay, a previously studied strain, Sphingomonas BPH, to the assay was subjected. Sphingomonas BPH was demonstrated to be capable of producing biosurfactants, but two pheanthrene utilization mutants of the	

		strain, #1778 and #1882, exhibited a diminished ability to produce biosurfactants. Nucleotide sequencing revealed that in #1778, a lasso peptide gene had been disrupted. Lasso peptides have been shown to have a variety of functions, but none involve environment contaminant reduction or biosurfactant production/activity. Several operon-grouped genes are typically required to produce a lasso peptide (genes A-D). In Sphingomonas BPH, a lasso operon has been identified which consists of genes A-C. Gene A encodes the peptide, gene B is a protease that cleaves the precursor peptide, and gene C is a cyclase that gives the lasso peptide a lariat like conformation. Adjacent to the operon, and has been observed in other microorganisms, are two divergently transcribed genes: isopeptidase (geneE and a TonB receptor). The research also exposed underrepresented minorities to research in the area of environmental molecular biology. The training received by students at SC State allowed them to conduct research independently and participate in several scientific conferences. Two SC State students presented posters of their research at the 2019 Association for Research Directors Biennial Symposium in Jacksonville, Florida. One student was awarded 1st Place for a poster presentation. Participation in such conferences raises awareness of the issue U contamination.	
12.	**Foodborne Illness Prevention** *Clemson Extension*	***Situation:*** A foodborne illness is a disease that is transmitted to people through food. The disease often originates from food that has been contaminated by a pathogen such as Salmonella, Escherichia coli, or Norovirus. A foodborne illness outbreak occurs when there has been a confirmed diagnosis of a foodborne illness by a laboratory and regulatory authority involving two or more people whom have consumed the same food and present with the same symptoms. The consequences of having a foodborne illness include lost work/school, medical costs, long term disability and death. The Centers for Disease Control and Prevention (CDC) reports that approximately one in six Americans get sick from a foodborne illness each year. The most recent CDC report from 2017 stated that there were 841 foodborne illness outbreaks across the United States, including Washington, D.C. and Puerto Rico. These foodborne illnesses resulted in 14,481 illnesses, 827 hospitalizations, and 20 deaths. Furthermore, of these nationwide outbreaks, 489 (64%) of the outbreaks (5,533 illnesses) were linked to foods prepared in retail food establishments. The CDC further reports that in 2017, there were 31 reported foodborne illness outbreaks in South Carolina originating from a retail food establishment or private home. These outbreaks resulted in 1,270 reported illnesses, 181 hospitalizations, and 2 deaths of South Carolina residents. ***Response:*** In South Carolina there are more than 19,000 retail food establishments permitted by the SC Department of Health and Environmental Control (SC DHEC). Clemson Extension Food Systems and Safety agents provide the ServSafe® Manager certification course and exam throughout the state of South Carolina on a monthly basis to ensure that retail food establishments meet the SC DHEC requirements of having a	Food Safety (Planned Program #4)

		certified food protection manager on staff, and to help reduce the number of foodborne illness outbreaks in the state. ***Results:*** Last year 33 classes were held with a total of 241 registered participants, and 75% of the participants passed the certification exam. Over 150 South Carolina retail food establishments were represented, and it was estimated that these establishments serve roughly 4,930 patrons daily. The National Restaurant Association estimates that a foodborne illness outbreak costs an establishment approximately $75,000. The economic impact of the trainings held by Clemson Extension agents could be estimated at $11,250,000 by preventing foodborne illness outbreaks at these establishments.	
13.	**Animal monitoring and assay development to improve food safety** *Clemson Experiment Station*	**Situation:** Clemson researchers continue to research food safety issues for the good of the general public. **Response:** One study is isolating bacteria from a range of chicken cecal samples. These isolates will be tested for resistance to a wide range of antibiotics. **Results:** Salmonella typhimurium was the most common serotype isolated. There was a substantial increase in the number of Salmonella isolates from a total of 32 new samples received in this reporting year and 100% of salmonella isolates were MDR. In addition, none of the received isolates were susceptible to all of the antibiotics tested. Additional assays are under development at Clemson University for measuring nutrients and secondary metabolites in food and feed. These assays will be utilized to study the metabolism of these compounds in animal models for determination of impacts on animal production and health.	Food Safety (Planned Program #4)
14.	**Healthy Lifestyles Through Food Safety** *SC State Extension*	***Situation:*** The US Department of Health and Human Services (DHHS) report indicates that less than 50% of Americans are active for at least 60 minutes daily. DHHS reports, also indicate that South Carolina is 10% below the national average of active Americans, below the national average in healthy food consumption, and above the national obesity rate average for youth and adults. Additionally, International Food Information Council research states 80% of Americans report they receive conflicting information on maintaining a healthy lifestyle and have trouble identifying a reliable source for information and strategies to healthy lifestyle issues. The goal of the Low Country Region was to introduce effective strategies that made healthier food consumption, increase water intake, and increase daily physical activities more feasible. Sixty percent (60%) of US citizens polled could not identify food and/or nutrients that would help them achieve their health issues and goals. ***Response:*** The Low Country Region Healthy Lifestyles Project developed 6 projects across 4 counties that focused on healthy eating habits, water intake, basic food handling, and increasing and sustaining daily physical activities. Three hundred eighty-six participants (386) were reached. The participants took advantage of 52 workshops. ***Results:*** One hundred ninety (190) participants increased an adequate amount of daily physical activities and sustained them at the completion of the project. In addition, 181	Food Safety (Planned Program #4)

		participants indicated their knowledge gained. Forty-seven percent of the participants adopted hand washing and safe food handling practices.	
15.	**Ozone Treatment Alternative to Manage Stored Product Insects** *SC State Research*	***Situation:*** Stored product insects cause millions of dollars of losses annually to stored durable commodities such as grain, grain-based products, legumes, dried fruits and nuts and spices. The cigarette beetle, *Lasioderma serricorne*, the merchant grain beetle *Oryzaephilus mercator* and the rice weevil *Sitophilus oryzae* are serious stored product insects, cosmopolitan in distribution and common pests found in South Carolina and the southeastern United States. Methyl bromide, a space fumigant widely used to control the insects since 1930s, has been completely phased out in the US due to its adverse environmental effects. Phosphine fumigation is a long-established effective method to control stored-product insects, but its continuous and indiscriminate use has resulted in the evolution of resistant populations and control failures. Therefore, alternative fumigants, especially those environmentally benign are warranted. Ozone application is currently attracting the attention of scientists, because of its inherent advantages in controlling insects and molds associated with grain. Ozone is a toxic gas, can kill insects effectively, meantime degrades rapidly to molecular oxygen in atmospheric conditions. Therefore, ozone can be safely and effectively used in food processing industries to manage insect infestations. The major goal of the project was to evaluate ozone (O3) as an alternative control option for the management of stored product insect pests. ***Response:*** The effect of ozone on two external grain feeders: the merchant grain beetle, MGB, and the cigarette beetle, CB, and one internal feeder, the rice weevil, RW, was studied during the project period. Insects were exposed to different ozone concentrations in a custom-built bench-top model of ozone generating equipment for different exposure times. All insect stages: eggs, larvae, pupae, and adults of all insects were tested. For the rice weevil, larval and pupal stages, referred to as immature stages, were exposed to ozone while they were still within wheat kernels. Prior to the experiments, the merchant grain beetle (MGB) was reared on rolled oats, while the cigarette beetle (CB) was reared on a 95% whole wheat flour and 5% yeast diet mix. New colonies were established by transferring newly emerged adults to rearing jars with diet specific for each species. The adults were removed after 48 hours and the rearing jars incubated until the larval, pupal or adult stage of the insect was reached and used for the experiments. To obtain eggs, newly emerged adults of each species were allowed to lay eggs on a thin layer of white flour for up to 48 hours. The research focused on determining the susceptibility of the various life stages of the insect species of economic importance, to ozone at different concentrations and exposure times, in order to establish concentration-time mortality relationships. ***Results:*** The study indicated ozone may be required in high concentrations and insects may have to be exposed to the gas for a significant amount of time for the gas to cause	Food Safety (Planned Program #4)

		significant mortality rate in the insects. Overall, the highest concentration of ozone tested for MGB and CB, 400 ppm, could not result in 100% kill of all stages tested in 1 hour. Higher ozone concentrations and/or exposure durations will be required when insects are provided with food and for ozone to be significantly toxic at deeper depths within grain mass. Research showed that ozone treatment has potential for the control of MGB, CB, and rice weevil (RW). Future studies may show that higher concentrations of ozone, extended exposure times, or a combination of both can increase the effectiveness of ozone against stored-product pests. The use of ozone to control the insects seems a promising alternative to conventional control methods. The full report of the research findings will be published in a research bulletin.	
16.	**Catawba Fresh Market** *Clemson Extension*	***Situation:*** Marketing to wholesale customers such as chefs and food buyers can be time consuming and tricky for farmers that are new to this marketing channel. Buyer connections can be tedious to make, pricing can be difficult to gauge, and delivery can make the deal cost ineffective. ***Response:*** Clemson Extension has provided assistance to area farmers interested in selling their products into wholesale channels through the creation and development of the Catawba Fresh Market Wholesale Program coordinated through the Catawba Farm and Food Coalition. ***Results:*** This program links local farmers with over 40 chefs in the Charlotte market and throughout the state through participation in the South Carolina Food Hub Network. Clemson Extension provided support covering facility development through the creation of the Chester Regional Agribusiness Center, logistics and delivery planning, operational support, and volunteer recruitment and management. A larger portion of local plates in area restaurants and institutions now have local food through this innovative program. Farmers are seeing an increase in sales allowing them the ability to scale up their operations to meet new demand. Having the support services of the Catawba Fresh Market helps to keep the farmer on the farm, managing their operations and growing their business.	Agribusiness and Community Development (Planned Program #5)
17.	**Determining factors that improve viability of local food hubs and regional food systems** *Clemson Experiment Station*	***Situation:*** Experiment Station Researchers are currently involved in a multi-state USDA AFRI proposal to develop a Local Foods Vitality Index that involves primary data collection from both producers and consumers; allowing for more informed local decision making regarding food systems investments. ***Response:*** Researchers are assessing the viability of a food hub or similar produce aggregation project in the Midlands of South Carolina. Like many others, the Clemson Experiment Station is becoming increasingly focused on local and regional food systems development as a marketing strategy for small-scale producers.	Agribusiness and Community Development (Planned Program #5)

18.	**Developing Community Leaders One Community at a Time** *SC State Extension*	***Situation:*** The US Department of Education states youth growing up in high-risk conditions are 50% more likely to be successful adults if they are engaged in cognitive and social skill development. Amongst the top instrumental factors identified are social & academic competence and positive character development. These factors are also stated to foster a strong sense of citizenship. The SC State Citizenship Project has a goal to engage youth in experiences that provide opportunities for them to develop competencies, values, and social skills that are proven to produce successful adults. Communities are best served when the citizens plant positive contributions within. Youth develop career aspirations when their adolescent years include experiences that foster connections between social competence and life skills. ***Response:*** The SC State Citizenship Program implemented a Citizenship Development Project, which implemented 5 projects that focused on career preparation, basic life skills, and positive character traits. As a result of the 5 projects, 865 youth were served in a combination of 39 workshops, demonstrations, and field trips. ***Results:*** As a result of the project activities, 218 of the participants have established career achievement plans. Three hundred and five (305) participants completed their project series of lessons.	Agribusiness and Community Development (Planned Program #5)
19.	**Improving Agritourism Marketing in South Carolina** *SC State Research*	***Situation:*** Small farmers in South Carolina and across the nation are increasingly seeking ways to diversify their income streams as domestic and international competition makes the farming industry more competitive. One of the opportunities for creating or supplementing income for small farmers is participation in agritourism enterprises. Agritourism in the US is a growing industry that offers opportunities for farmers to capitalize on their knowledge and resources while also maintaining their primary agricultural activities, if desired. However, in order to fully capitalize on the opportunities, agritourism practitioners must develop marketing strategies that can produce and capitalize on demand for the agritourism experiences they can provide. ***Response:*** The research results formed the identification of "best practices" in agritourism marketing in the State and the region. The best practices were shared with agritourism businesses, in order to assist them in refining their marketing strategies. The development of effective marketing strategies should lead to increased financial performance among practitioners. The results will be shared via online resources, the state Department of Agriculture, and SC State Research and Extension. In order to understand the current state of agritourism marketing in South Carolina, the researcher has engaged in multi-method research inquiries that included participant observation, depth interviews, content analysis of agritourism websites and the creation of a survey for practitioners and tourists. ***Results:*** To date, the researcher has visited more than 20 agritourism farms in the State of South Carolina and conducted informal interviews with agritourism practitioners and tourists. A database of over 1000 agritourism businesses in South Carolina, North	Agribusiness and Community Development (Planned Program #5)

		Carolina, and Georgia were created, in order to conduct a comparative analysis of the marketing efforts of agritourism businesses in the three states. The database has been used to develop a content-analysis methodology to examine website development and related marketing efforts. To date, the website of 371 businesses across the three-state region have been analyzed on 74 variables that are part of the content analysis design. Statistical analysis is on-going but has revealed some significant differences in the use and effectiveness of websites among the sampled businesses.	
20.	**Building Confidence in STEM through the SC 4-H Engineering Challenge** *Clemson Extension*	***Situation:*** There are four anchor points of scientific literacy including science content, reasoning skills, interest and attitudes, and contribution through applied participation (Smith et al., 2015). Engineering challenges allow youth to compete in various STEM disciplines to improve scientific literacy with a special focus on science attitudes, particularly confidence in STEM skills. The majority of youth in the U.S. lack foundational skills and knowledge of science, technology, engineering, and mathematics (STEM), with low-income and minority youth at a further disadvantage (ACT, 2016). In South Carolina, only 11% of females are ready for college STEM and the statistics are worse for African American, American Indian, Pacific Islander, and Hispanic youth at 2, 4, 3, and 8%, respectively. There has also been a recent drop in STEM interest among ACT-tested high school graduates in our state (National Center for Education Statistics, 2011). Science programs in 4-H provide youth the opportunity to learn about STEM through fun, hands-on activities and projects. Inquiry-based education, such as 4-H, has been linked to benefits within science education, such as increased STEM interest and achievement (Kanter and Konstantopoulos, 2010; Wolf and Fraser, 2008). In addition, participation in out-of-school time programs has been linked with increases in science subject-matter knowledge (Miller et al., 2011). ***Response:*** South Carolina 4-H Engineering Challenge is offered in the spring annually to youth, ages 9-18, across the state. The goals are to provide a safe learning environment where youth can try, fail, and try again, gain valuable life skills, increase interest, confidence, and knowledge in science, and encourage futures in STEM-related careers. Currently, the challenges offered include bridge-building, coding, Lego robotics, mystery, photography, and rocketry. Some challenges require club or classroom work prior to the competition event; other challenges require youth to create their designs onsite. In addition to challenges, the South Carolina 4-H Engineering Challenge hosts a STEM Fair to further excite youth about opportunities in science-related careers and education. ***Results:*** Since it began in 2013, the competition has reached more than 1,300 youth and grown to approximately 250 participants annually. Youth that participated in the survey (n = 611) reported their participation in the competition increased confidence and knowledge in science skills and motivation for a science career. In addition, participants stated that preparing for the SC 4-H Engineering Challenge increased their science interest, confidence, and knowledge. Most participants indicated that they were "happy"	4-H Youth Development and Families (Planned Program #6)

		participating in the competition, working with their team, and working with their team leader (adult mentor). Therefore, the Engineering Challenge addressed at least three of the four anchor points of scientific literacy in South Carolina's youth.	
21.	**SMART Academy Helps Youth Achieve More** *SC State Extension*	**Situation:** Parents solicit academic camps that students can learn, especially standards needed for the upcoming school year. Teachers care because students participating in the program are more likely to comprehend the lessons being taught during the school year. A research study done by Cooper, Charlton, et al. (2000) found summer programs led to more favorable outcomes on mathematics assessments than on reading assessments. SMART Academy has a reading component, but focuses mainly on Math and English Language Arts (ELA). To help participants improve their Math and English Comprehension, participants were introduced to Math and Reading skills before being taught in the next grade level. One study from Brookings.edu using data from over half a million students in grades 2-9 from a southern state (from 2008-2012) found students, on average, lost between 25 – 30 percent of their school-year learning over the summer; additionally, black and Latino students tended to gain less over the school year and lose more over the summer compared to white students. Fifth grade Math and ELA builds upon all other standards taught throughout elementary school and lays the foundation for middle school. ***Response:*** South Carolina standards were taught daily by a South Carolina Certified Teacher and reinforced through quizzes and tests. Students took a pre-test before the program began and a post-test at the conclusion of the program. Nineteen (19) students participated in the 2019 5th Grade SMART Academy (7 African American females; 12 African American males). ***Results:*** Fifth Grade – 100% improvement in Math and 100% improvement in ELA. Seventeen (17) out of 19 students scored an 80 or above on the ELA post-test. Fifteen (15) out of 19 students scored an 80 or above on the Math post-test.	4-H Youth Development and Families (Planned Program #6)
22.	**Influences of Music Instruction on Reading and Music Achievement in Grades PreK-5** *SC State Research*	***Situation:*** Based on the South Carolina test results of the 2015-2016 academic year, most test takers (grades 3-8) did not meet state established, reading expectations in Orangeburg County Schools. Less than half of the students, who were tested in each public Orangeburg County school district, met or exceeded established, reading required scores. Furthermore, neither one of the school districts' reading results came close to the number of students who met or exceeded state requirements for reading. Moreover, the SC State Department of Education reported that beginning in the 2017-2018 school year, third graders who do not meet the established reading requirements would be retained. The overarching facts present a need that requires effective, intervention methods that might be started at the early childhood and elementary grade levels. The purpose of the exploratory, pilot one-group experimental study, was to examine the effects of two, intact courses, music and reading, on the reading achievement and music achievement of students at the early childhood, lower, and upper elementary grade levels.	4-H Youth Development and Families (Planned Program #6)

		Response: With purposes of achieving students' overall reading and music skills, this proposed project aims to test the influence of two discrete courses linked by agricultural literacy outcomes involving food, health, and lifestyle. Using PK, 1st, 2nd, 3rd, 4th, and 5th grade subjects, the investigator will test the effects of reading instruction and music instruction on those subjects' reading achievement and music achievement. Per grade level, Pre-K-5, two intact classes will serve as a convenient sample. Subjects of all intact classes will complete developmentally appropriate tests of reading and music at the onset of the one-group, pretest/posttest experiment design. After a 12-week instructional period, subjects' pretest and posttest scores will be compared to determine if significant changes occurred regarding subjects' reading skills and music skills. The investigator will also examine the effects of grade, gender, socio-economic levels, and race among subjects. Positive, significant findings may be used to suggest a method for the improvement of reading skills and music skills. Potentially, significant findings could impact Orangeburg County public school districts, Orangeburg County, and SC. It is a known fact that students who learn to read at a high proficiency level, read to learn. Additionally, such students are more prone to become independent thinking, successful citizens who make positive contributions to communities in which they live. Many times, such contributions are directly related to the economy of the communities in which the citizens live. ***Results:*** For Pre-K subjects, distribution of scores were approximately normal. Significant differences ($p < .00$) emerged between subjects' pre-test and post-test scores for reading. However, Pre-K subjects performed better on the test for age 4 (pretest) than they did on the test for age 5 (posttest). Significant gains emerged in favor of Pre-K subjects' posttest mean scores for rhythm ($p <. 00$) and melody ($p < .00$). Pre-K subjects' reading mean scores for females from pretest to posttest were not significant. However, the reading posttest mean scores for males were significant ($p <. 01$) as the males performed better on the *Brigance* reading 4-year-old test (pretest) than the 5-year-olld *Brigance* reading test (posttest). For the *Audie* music test, Pre-K subjects' pretest to posttest rhythm mean scores for females were not significant. Posttest melody mean scores for females were significantly higher than the melody pretest means scores ($p = .04$). The males' posttest mean scores for rhythm were significantly higher than males' rhythm pretest means scores ($p = .01$). Similarly, males' posttest mean scores for melody were significantly higher ($p = .00$) than the pretest means scores for melody. For kindergarten, there was a significant difference found between males and females on *PMMA r*hythm post-test scores ($p=.007$). Mean score of females ($M=27.65$, $SD=4.527$) was higher than that of males ($M=22.28$, $SD= 6.257$) by about 5.37 points. Confidence interval for the difference between the means was 1.59 to 9.15, indicating that the female's score could be higher than male's score by as small as 1.6 points, but it could be as large as 9 points, indicating a large range of difference.	

		No significant difference was found between scores for males and females in the second grade on the total score of the posttest reading achievement test (p=.223) as well as the PMMA Rhythm post- test score (p=.224). No significant difference was found between third-grade subjects' scores of the pre-test and post-test for any instructional area of the MAP reading test and for the ITML Rhythm test at .05 level. We further performed the t-tests on each gender separately to check if gender made any difference. For the PMMA Rhythm posttest at the third-grade level, Leven's test of equality of variances of two populations was not satisfied (p=.005), so equal variance was not assumed. Significant difference was found between mean scores of males and females (p=.026). Females (M=32.56, SD=2.26) scored higher than Males (M=29.18, SD= 6.25). The confidence interval for the differences indicates that the difference could be as small as .43, which is probably not practically important difference, but as large as 6.3. When mean scores of third grade males and females were compared separately, no significant difference was found between mean scores of the pre- and post-tests on any instructional area of MAP reading as well as on ITML Rhythm either for male or female students. Normality test was performed on MAP reading composite scores and the *Iowa Tests of Music Literacy* (ITML) Rhythm standard scores of pre- and posttests. Data on both tests were approximately normally distributed. To test if there were significant differences between the pre-test and post-test mean scores for reading achievement as well as music achievement taken by *fourth-grade* subjects, a t-test was performed on the scores of each instructional area. To test if there were significant differences between males and females in fourth grade on the post-test scores for reading achievement as well as music achievement, a t-test was performed on the post-test score of each instructional area. Leven's test of equality of variance between two populations of male and female was not significant for the scores of any instructional area. So, equal variance was assumed for the score variables. There was no significant difference found between males and females on the score of any instructional area of the MAP reading and ITML Rhythm post-test. Leven's test of equality of variance between two populations of male and female was not significant at .05 level for the scores of any instructional area except for the "Informational: Meaning and Context" area. There was a significant difference found between males and females on the scores of "Literary: Language, Crafts, Structure" instructional area of the reading post-test at .05 level. Mean scores of males (M=205.28, SD= 14.524) was higher than that of females (M= 192.22, SD=21.466) by 13.1 points. Confidence intervals for the difference between the means shows a large range of difference from 1.99 to 24.13, indicating that the difference between scores of males and females could be as small as 1.99, but it could be as large as 24 points.	

23.	**Health Extension for Diabetes** *Clemson Extension*	***Situation:*** The burden of diabetes impacts minority and low-resource populations disproportionately. ***Response:*** In response to this, an Extension-clinical partnership with PRISMA Health, funded by the Greenville Health Authority, was established to reach community members who may not have access or may not choose to access diabetes self-management education. The resulting community-based diabetes self-management and support program, Health Extension for Diabetes (HED), specifically aims to serve participants living in at-risk and distressed zip codes. Of those enrolled in the HED program in Greenville County, almost 40% live in an at-risk or distressed community, a designation that implies limited access to resources and adequate care. ***Results:*** Building on community trust, Extension has bridged a gap between at-risk and distressed communities and healthcare systems to provide community-based diabetes education and support while increasing awareness and access to appropriate clinical care. To date, 147 participants have graduated from the HED program. Preliminary results mid-way through the 5-year project show that program clients reported significant indications of program success. These include: 1) improvements in self-perceived overall health status (p=0.0015), 2) increased patient activation measures (PAM) scores (63.52 to 69.82, p=0.001), 3) increased diabetes-related knowledge scores (73.07 to 80.03, p=0.0062), 4) increased physical activity and improved exercise health behaviors (p=0.0062) and 5) increased self-confidence related to managing their diabetes (p=0.000) pre to post program involvement. Outcomes related to assistance with resource navigation show that approximately fifteen percent of program participants have received a clinical referral for services such as formal diabetes education by a certified diabetes educator and medical nutrition therapy by a registered dietitian. Through increased Extension-clinical collaboration, participants in at-risk and distressed communities have received community-based education that supports the ADA's Standards of Medical Care, increased access to clinical care in at-risk or distressed communities, and demonstrated improved health and health outcomes in Greenville County, SC. Because of strong preliminary results for this program, the American Diabetes Association has recognized the Clemson University Health Extension for Diabetes Program as an evidence-supported community program. The ADA now markets the CU-HED program and the model under which it was developed on the national ADA website.	Nutrition and Childhood Obesity (Planned Program #7)

24.	**Education Helps Childhood Obesity** *SC State Extension*	***Situation:*** South Carolina is becoming less active and more stagnant. Overall, the nation has vastly developed into one of the unhealthiest countries in the world. Kids Count Data indicates South Carolina has a 31.5% obesity rate. The state's obesity rate can be attributed to the number of physically inactive individuals who also have a diet that is high in fat and added sugars. The combination of the two leads to poor health for individuals. ***Response:*** The SC State Extension program provided its Expanded Food and Nutrition Education Program (EFNEP) to limited resource families in South Carolina through partnerships with schools, community centers, and various government agencies, which work directly with low income families using the Show Me Nutrition and Eat Smart Being Active Programs. The goal of the program was to provide wellness classes that focus on teaching participants the importance of eating healthy and being active. The eight-lesson series focused on teaching youth how and why they should eat fresh fruits and vegetables and inexpensive ways to be active as well as the benefits of being active through a combination of lectures and classroom activities. ***Results:*** Three hundred ninety-eight pre- and post-surveys were administered. From reviewing the entry and exit behavior checklist surveys, 80% of participants gained knowledge concerning eating healthy foods. Eighty-two percent (82%) of participants stated they were adopting recommended handwashing practices, while 59% stated they intended to adopt healthier eating patterns.	Nutrition and Childhood Obesity (Planned Program #7)
25.	**Achievement Motivation to Curb Childhood Obesity** *SC State Research*	***Situation:*** Obesity is a serious medical condition that affects large populations in the United States and is evident in South Carolina. In South Carolina and specifically Orangeburg County, obesity rates are quite high. Children are especially affected. In 2013, South Carolina children aged 2-17 were classified as overweight (14.9%) and obese (16.7%) (South Carolina DHEC, 2013). There were various issues related to obesity, and one of them was obesity prevention, which is the focus of the research. The prevention of obesity starts at an early age in childhood with various forms of education about healthy diets and physical exercise. The starting observation of the study is that most children who show tendencies toward being overweight already know they should change their diet and should exercise more. The problem is that although they know what to do, they are not doing it. Therefore, it is not so much about the lack of knowledge as it is about motivation to change behaviors in order to prevent obesity. The population under study will be middle school students, mostly African Americans. ***Response:*** The research hypothesis is that increasing achievement motivation will contribute to achieving obesity prevention. The main goal of the research study is to find a relationship between child achievement motivation and child obesity prevention and use the knowledge in obesity prevention. The research will show that children who participate in the study indeed benefit from it showing obesity prevention by losing or, at least, not gaining weight that would lead toward obesity. A physiological and medical	Nutrition and Childhood Obesity (Planned Program #7)

		science study of the hypothalamus and its role in both achievement motivation and obesity prevention was conducted. The research will help the Orangeburg community, especially children, in dealing with obesity reduction and avoidance. The approach to accomplish the investigation is to address achievement motivation through achieving EEG-based psychokinesis (also known as brain-robot interface). The methods to be used are 1) building achievement motivation through the brain-robot interface achievement task and 2) counseling for participants and their parents regarding behavior and attitudes in relation to health and nutrition. ***Results:*** Originally, 13 students were recruited from Felton Laboratory Charter School (Orangeburg, SC). Parents completed the Consent Forms and needed Questionnaires. However, two of the students had to leave the study before completing it. Ten new students were enrolled for the fall semester. For all students after enrollment, the Initial Measurements were provided: Anthropological measurements: weight, height, Body Mass Index (BMI), waist and hip circumference and blood pressure; Initial Electroencephalogram (EEG), recording the brain activities and Initial biofeedback measurements during relaxation and arousal. The Initial Measurements were taken as baseline data against which the researcher observes the progress of the training. After basic parameters were taken, students were instructed how to perform the achievement motivation training (controlling the movement of the robot arm using brain signals). The anthropological measurements and biofeedback training were provided regularly with the achievement motivation training. The participants came once per week for the activities when they were regularly at school. Six real training sessions were achieved.	
26.	*Clemson Extension*	Clemson Extension does participate in this Planned Program Area.	Climate Change (Planned Program #8)
27.	*Clemson Experiment Station*	Clemson Experiment Station is not reporting in this Planned Program Area for 2019.	Climate Change (Planned Program #8)
28.	*SC State Extension and Research*	SC State is not reporting in this Planned Program Area for 2019 in Research and Extension.	Climate Change (Planned Program #8)
29.	**Woodland Owners Workshop** *Clemson Extension*	***Situation:*** Often time people inherit forest property without knowledge of how to properly manage it. Other people may be purchasing land for the first time for reasons such as retirement or investment. Many first-time property owners want be good stewards of the land, regardless of varying land management goals and objectives. The Clemson Extension Service is one of the first places that people seek answers to questions related to various forest land management issues. ***Response:*** Clemson Extension hosted a live satellite feed program for beginning landowners that was broadcast by the Southern Regional Extension Forestry. This	Sustainable Energy (Planned Program #9)

		program was held for four nights at the Edgefield County Extension office. Participants were provided a 3-ring binder of all the presentations as reference. Topics included basic forest management concepts, agency services, forest products and other elementary information for new landowners. ***Results:*** All participants said they understood the information in a follow-up evaluation and these participants owned collectively 3,416 acres and managed 6,000 acres for a total impact of 9,416 acres in a single county.	
30.	**Improving conversion efficiency of cottonseed oil to bioenergy** *Clemson Experiment Station*	**Situation:** Researchers continue to develop and refine conversion of biomass to bioenergy and bioproducts. **Response:** An enzymatic catalyst was used to transform glandless and crude cottonseed oils into biodiesel this reporting year based on the modeling techniques from the previous reporting period. Various combinations of water, lipase and temperatures were tested and product composition was determined. **Results:** Conversion of cottonseed oil to fatty acid methyl esters averaged 98.5% with temperature having the only effects on conversion. Oil types had equal conversion rates, but stability of the oils was significantly different. The methods will be further refined in the coming year.	Sustainable Energy (Planned Program #9)
31.	*SC State Extension*	SC State is not reporting in this Planned Program Area for 2019 in Extension.	Sustainable Energy (Planned Program #9)
32.	**Reusing Post-Consumed Plastics (PCPs)** *SC State Research*	***Situation:*** Waste plastics recognized as a worldwide and particularly, a national epidemic. The accumulation of post-consumer waste plastics is an epidemic sustained by every segment of the society. A problem once considered to affect only the landfills, waterways and oceans, is now spreading to air quality and food. The post-consumer plastic bags and bottles collected and stored in warehouses over time lose semi-volatile plasticizers, and break into small pieces and microparticles. The plastic microparticles folate in water, air, precipitate on surface of vegetables and fruits, which are consumed by every living system in earth including humans. The average lifetime of the plastics has been estimated to be over hundreds of years. The consumed microplastics either by birthing the contaminated air or contaminated foods caused numerous health adversities with no effective cure or prevention. The problem affects everyone, however, it is even more severe in industrialized nations and it is even graver in minority-and low-income communities around the world. ***Response:*** SC State researchers have designed and launched a comprehensive program encompassing reusing, recycling and solvent extraction of the resins, the main building block of the post-consumer plastics. The results are vital to helping remove the postconsumer plastics from environment into the recycling and reusing system. The results will be a healthier, cleaner, and safer environment, plus saving energy. Strengthened the capabilities of SCSU to address the increasing problem of postconsumer	Sustainable Energy (Planned Program #9)

		plastics accumulation in open and deep landfills and warehouses. Established working collaborations between academics and students who are next generation of work force in the nation and SC State Research and Extension and engineering and sciences. Created a solution to solve the problem of postconsumer plastics by reusing and extraction of the resins. ***Results:*** Most of the post-consumer plastic commodities are made of six resins, polyethyleneterephthalate (PET,1), High-density polyethylene (HDPE,2), polyvinylchloride (PVC, 3), low-density polyethylene (LDPE, 4), polyethylene (PP,5) and polystyrene (PS,6). South Carolina State University researchers have worked towards finding a solvent to dissolve various types of post-consumer plastics and to reuse the post-consumer plastics to fabricate new commodities. The project has involved over a dozen undergraduate students in the research. Recycling post-consumer plastics were promoted as students engaged in finding a solvent for the plastics and a use for the post-consumer materials. Through the efforts of the most used post-consumer plastics PET is extremely hard to dissolve in common organic solvents, except at high temperatures. Post-consumer PET (PC-PET) was soluble in tetrachroethane at a temperature over 100 degrees ^{0}C. The dissolved PET was precipitated in methanol, and vacuum dried. The product, R-PET was characterized by thermogravimetric analysis (TGA) and differential scanning calorimetry (DSC). The thermal behavior of the R-PET was comparable to the original resin. Post-consumer High-density polyethylene (PC-HDPE) was cut, met and converted to rods being useful for netting out-door furniture, 3-D printing and hot glue. The mechanical properties of rod with various diameters, including pick load was measured. The load bearing capacity of the PC-HDPE also was measured. The results of reheating on the strengthen of HDPE was studied. Post-consumer polyvinylchloride (PC-PVC) was dissolved in tetrahydrofuran (THF) – dimthylformamide (DMF) and was precipitated in methanol to remove the fabrication impurities. The product as vacuum dried and characterized by TGA, DSC, and size exclusion chromatography (SEC). The researcher extracted the plasticizers prior to processing. Post-consumer low density polyethylene (PC-LDPE) was found soluble in toluene and xylene at temperatures above 80 ^{0}C. The dissolved PC-LDPE was precipitated in methanol to be purified from filler and plasticizers. An admixture of solvents capable to dissolve the polymer at a lower temperature was reviewed. Post-consumer polypropylene (PC-PP) was found soluble in toluene and xylene at reflux temperatures. The dissolved PC-PP was precipitated in methanol to be purified from filler and plasticizers. An admixture of solvents capable to dissolve the polymer at a lower temperature was tried. The research is on-going.	
33.	**Agronomic Crop Assistance** *Clemson Extension*	Clemson Extension agents spent a great deal of time in FY 2018-2019 making on-site visits to farmers to assist with problem identification and solution prescriptions. These activities included things such as scouting for pests and diseases, advising on peanut production, determining maturity in peanuts, various crop harvesting questions and	Global Food Security and Hunger (Planned Program #10)

		recommendations, organic farming preparation for certification, representing farmers at water use meetings, hurricane damage assessment, hemp production, soil tests, pesticide applications and pesticide trainings for various crops, conducted local growers meetings, and assisted with field trials.	
34.	**Improving soybean quality for future markets** *Clemson Experiment Station*	***Situation:*** In 2018, soybeans were the third highest value row crop in SC with $86 million in revenue. In 2018, 9.5 million bushels of soybeans were produced with a total value of $10.42/Bu, planted on 390,000 acres. This was the highest number of acres for any row crop. An increase of 5 Bu/A from the varieties produced, planted on only one quarter of the acres grown in 2018, could increase revenue by $5 million. ***Response:*** Clemson researchers are currently in the late stages of trialing three breeding lines, with high yield and high meal protein, that are on course for release. Data collected from 2019 has not been analyzed yet and will be reported in our next report. Additional testing is needed in 2020 before these lines will be considered for release. Also, in 2019, we proposed to use four different sources of soybean meal for a feeding study to determine the added value of high meal protein produced from soybean. We included two controls and the two iso-lines, that differ only in protein content. ***Results:*** All the samples have been processed and prepared for the feeding study. Soybean meal is the number one source of protein for animal feed stock, so this study should prove to be very valuable. The negative correlations of soybean seed protein with seed yield and seed oil are the biggest hurdle to the development of high-protein lines. The seed protein content of US soybean varieties has been declining over many decades due to the continuous selection for yield, without considering seed protein. In order for US soybeans to stay competitive on the world market, increasing the protein content of US soybean, without reducing yield, is vital.	Global Food Security and Hunger (Planned Program #10)
35.	**Youth and Adults Improve their Quality of Life** *SC State Extension*	***Situation:*** Orangeburg County, SC is one of the counties that ranked the lowest in health outcomes, according to the Robert J Woods Foundation. To help promote healthy lifestyles for families with school-age children, they needed to be made aware of information that can change or improve their lives. Eating healthy and participating in physical activities can increase the overall outlook in life and decrease health problems. To help youth and adult participants improve their quality of life by educating them on why it is important to eat a healthy balanced diet and be physically active. The adults learned more about stretching their food dollars and how to cook quick but healthy meals. With the information provided, families and youth will be empowered to make healthy food decisions, understand food insecurity and understand how to prevent diseases such as diabetes, high blood pressure, and obesity. ***Response:*** During the workshops, a pre-and post-test was administered. The pre-test allowed Agents to measure the participants' knowledge of health and nutrition. At the end of the sessions, a post-test was given to see if knowledge was gained. Adult participants were given information on how to create a grocery list from items left in the	Global Food Security and Hunger (Planned Program #10)

		kitchen prior to going shopping and creating a monthly grocery shopping budget. It would help them stretch their food dollars. The adults were encouraged to eat more fruits and vegetables to lower the risk of common diseases related to nutrition and being more active. The youth participants were encouraged to eat foods from all the five food groups, drink more water and less sugary drinks, and a discussion of where most of the foods come from was held. The goal is to give youth the knowledge to make better decisions when it relates to nutrition and health, in order for them to improve their quality of life and avoid falling ill from a poor diet. ***Results:*** During the EFNEP sessions, two hundred fifty-four participants were involved in tasting a different fruit or vegetable in season. After following up with the participants, they continued to try different fruits and veggies. This allowed the participants to increase their fruit and veggie intake. The post-test results showed ninety-nine percent of the youth participants improved their abilities to choose healthier foods and gained knowledge. Adult participants showed a ninety-seven percent improvement in their diet quality.	
36.	**School-Based Program to Address Food Insecurity** *SC State Research*	***Situation:*** Schools are very limited in addressing food insecurity and understanding the link between food insecurity, academic achievement, absenteeism, and behavior. Food insecurity can lead to many challenges for students. Research indicates that food insecurity can be linked to absenteeism, behavior and emotional problems, and developmental issues that can inhibit school success. In the state of South Carolina, food insecurity exits in every county. In South Carolina, 14.1% of families are living in households that are considered to be food insecure. Food insecurity is common in rural areas especially in Orangeburg and Calhoun counties. SC State research indicated that school-based programs such as community gardens and nutrition education services can help alleviate food insecurity found in school aged students. Establishing food pantries and school-based gardens can play an important role in promoting lifelong healthy eating habits among school-ages students. Schools have attempted to address the issue of food insecurity by providing informal programs and summer meal programs, but that has not been enough. Schools are limited with resources; therefore, hiring a school social worker is essential to the school environment. Using a school social worker to assist students and families can help close the gap of food insecurity to produce healthier and more productive students. ***Response:*** School social workers are the direct link between schools, homes, and communities. Social workers are aware of the challenges that students have with food insecurity and are a great resource to teachers, administrators, students, staff, and parents if hired within the school systems. Research indicated that providing direct services has proven to be successful and has the greatest impact on school-aged children. It is also the researcher's belief that with school based services a social worker was a	Global Food Security and Hunger (Planned Program #10)

		great asset to help meet the goals of the key focus area of the 1890 Research and Extension initiatives. ***Results:*** The school social worker and researchers have created "Pantry Pals" a school-based food pantry and bi-weekly backpack program for one Orangeburg County school and three Calhoun County schools. Pantry Pal participants were referred to the school social worker by their Guidance Counselors, Teachers, and/or parent. Pantry Pals has provided over 2,270 meals to students who are food insecure. Researcher and school advisory boards have established two community gardens at the project sites to provide access to fresh fruits and vegetables to "Pantry Pals" participants and the community. Students were able to host a "Farmers' Market" where the produce was sold and monies were invested back into their schools. During the summer, 25 students from "Pantry Pals" attend a weeklong culinary camp that provided them the opportunity to learn about kitchen safety procedures, healthy meal alternatives, and participated in community experimental learning activities. This culinary camp has been successful for the last two years of the project cycle. Created a resource directory to assist families to locate services and programs that fits their needs within their community. Established working partnerships between community stakeholders to sustain school-based food pantries. The school social worker and researchers have provided in service training related to nutrition, health, agriculture, and warning signs of food insecurity for students, teachers, staff, and guidance counselors at the targeted school sites. The in-service trainings provided information on the importance of school social workers understanding the challenges food insecure school-ages children face.	