

2017 South Carolina State University and Clemson University Combined Research and Extension Annual Report of Accomplishments and Results

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I. Report Overview

1. Executive Summary

Since the inception and implementation of the Plan of Work (POW) Accomplishments and Results, Clemson and SC State have prepared a joint report. The POW reflects activities performed by both universities in Research and Extension. The NIFA primary target areas for South Carolina programming are Sustainable Animal Production Systems, Sustainable Agriculture Production for (non-food) Horticultural Crops, Natural Resource 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.

The working relationship between Research and Extension is based on the discovery and delivery of new knowledge through science-based relevant research leading to discoveries specific to South Carolina's needs that are delivered through Extension programs in the NIFA Planned Program Areas. The major focus areas include advancing the competitiveness of the agriculture and forestry industry, enhancing the economic potential of rural communities, safeguarding the food supply, preserving natural resources and preparing young people to become productive citizens. There is continued emphasis on evaluating all Research and Extension activities and providing quality performance information to stakeholders.

This, also, begins the second year of the Clemson Experiment Station's use of cluster or umbrella projects. As these clustered efforts continue to develop and reach their potential, the quality and quantity of outputs and outcomes is expected to continue to improve with each reporting period. Summaries for all programs are listed below.

Sustainable Animal Production

Clemson Extension and SC State Extension partnered to conduct animal production programs covering topics such as herbicides and Insecticides for use on Bermuda and fescue pastures, record-keeping, and sprayer calibration.

Clemson's Sire Seminar was developed to prepare producers for the bull-buying season. The course covered selection and evaluation, economics, artificial insemination, reproduction, nutrition and health. This course was a collaboration of Clemson Extension, Livestock and Poultry Health, Clemson Animal and Veterinary Faculty, and the beef industry. All participants agreed they would apply practices learned, which should translate to an improved beef product from South Carolina. Agents saw a significant increase in soil sampling, weed ID, waste management planning, and improved planning for pastures and forage as a result of the Equine Forage Management Workshops.

Grass Masters, a program developed by the Clemson Extension Livestock and Forages Team, was conducted for local producers to learn more advanced forage management techniques. Grass Masters provided producers with information on forages varieties and production expectation which allowed producers to develop a forage system to provide forage year-around. The introduction of grazing management through the Grass Masters program provides advanced concepts to extend the grazing season and get optimum forage utilization. These techniques assist in reducing the amount of stored or purchased feeds and ultimately increases production profitability. Grass Masters program participants report that they plan to use the information to start a cow herd, improve management of grazing, improve weed control, plan plantings, and improve pastures.

South Carolina Regulation R.61-43 provides requirements for confined animal facilities and the

utilization of animal manure from those facilities. Under this regulation, managers of confined animal facilities must obtain a manure management certification through Clemson University and maintain that certification. Twenty-two Confined Animal Manure Manager (Camm) recertification trainings were conducted and covered topics such as Water Quality Issues, Animal Manure Production, Manure Utilization, Odor Control, Vector Control, Biosecurity, Manure Nutrient Content, and a number of other topics.

A fact sheet on a soil sampling device design was developed and placed on the Clemson Livestock and Forages publications page. An easy-to-read graphical table to help producers use the correct times to apply a herbicide for best control was made available. It allows the grower to plan their weed control strategy in advance if a known weed pressure is present.

The Clemson Extension Specialist provided a service to producers that want their milk systems checked to make sure that they are functioning properly. Pulsators and vacuums are checked and milk lines and inflations are evaluated. Issues with any of these can cause an increase in somatic cell count and damage to the cows teats and udders. Thirteen milk system checks on seven farms have been performed in the past 12 months. Over 500 milking units affecting over 7,000 cows have been evaluated. As a result, producers are able to reduce the chance of losing their quality premiums due to faulty equipment which on some farms can amount to the loss of more than \$50,000. A paper was presented by a Clemson specialist at an international meeting and will be published on Solids and Plant Nutrient Content, and Settling Characteristics of Milking Center Wastewater on a Grazing Dairy, Chemical Engineering Transactions, Vol 58.

Clemson County Area Response Team meetings were conducted to plan for sheltering and protecting pets during disaster. A training was conducted for State Emergency Response Team (SERT) members that work at the State Emergency Operations Center (SEOC) during disasters. At least five counties collaborated to detect, recognize, diagnose, prevent, respond and recover from disasters during the year. Specialists made presentations at the National Alliance of State and Animal Agricultural Emergency Programs.

Clemson specialists developed and presented a one hour webinar titled Energy Conservation Opportunities: Poultry Ventilation Case Studies. The recorded webinar is available at www.conservationwebinars.net/webinars/understandingandimplementingenergyaudits. A Clemson specialist gave a presentation and served as a panel member at the 2016 Southeast Energy Efficiency Alliance and Association of Energy Services Professionals Southeast Conference held at the Georgia Institute of Technology Global Learning Center. The specialist also gave an educational presentation on Opportunities and Challenges Related to Improving Energy Efficiency for Broiler Facilities.

Sustainable Agriculture Production for (non-food) Horticultural Crops
Research at SC State under this planned program focuses on preventing the effects of noise induced hearing loss and high blood pressure among South Carolina farmers and agricultural workers. More than 30 million Americans (all ages) are exposed to hazardous sound (noise) levels on a regular basis, without the use of hearing protection devices (HPD). The project seeks to determine the percentage of farmers and agricultural workers in rural SC who are directly affected by this phenomenon and those who take proactive measures to protect their hearing from noise exposure. Data will be collected to measure the farmers and agriculture workers' noise exposure levels to compare with OSHA noise standards. Blood pressure will be observed and surveys distributed to assess the use of hearing protection devices. The results will be disseminated among the target audience through education (hearing conservation program).

Clemson research was initiated to test the physiological effects of using various dyes and pigments on creeping bentgrass and hybrid bermudagrass. Claims are being made that these products improve stress tolerance of turfgrasses. After intense investigations, many of the claims by manufacturers have not been supported by research.

Clemson researchers are working to find solutions for some of the most recalcitrant pathology problems in golf course bermudagrass greens. These problems include diseases such as spring dead spot, Rhizoctonia leaf and sheath spot or blight, and nematode infestations.

Clemson research is looking to develop a cost-effective, efficient, and environmentally sustainable water treatment system for the green industry. This model system will facilitate implementation of effective

treatment technologies beyond those chemically-based systems currently in use.

Clemson research projects are investigating diseases of ornamental plants and trees caused by *Phytophthora* spp. The goal is to improve methods for detecting propagules of these pathogens in plants, soil, and water, and to develop and evaluate effective disease management strategies.

Clemson Extension partnered with the College of Agriculture Forestry and Life Sciences students to form an on-campus Extension Service office run by students to help familiarize them with the Extension program and serve the campus and surrounding community. A Clemson Extension Farm & Home Day was sponsored by the on-campus office and organized by the Student Extension Office.

The first episode of Clemson Extension Live aired in April on Facebook Live, offering viewers an opportunity to ask questions that ranged from home gardening to birding. The weekly, hour-long program runs each Wednesday on Clemson Cooperative Extension's Facebook page and features Clemson University experts in horticulture, entomology, wildlife and more. Shows are archived at:

https://www.facebook.com/pg/ClemsonExt/videos/?ref=page_internal

A specialist presented Teaching Critical Thinking to Experiential Learners at the Annual Clemson CT2 Faculty Institute, Osher Lifelong Learning Institute (OLLI), for 25 new Clemson faculty from diverse disciplines. Participants learned teaching techniques used in the Sustainable Landscape Garden Design, Installation, and Maintenance Class.

Natural Resource Management

SC State research has two projects that operate within this planned program. One study looks at natural and microbial attenuation of Uranium (U) contaminated groundwater, soils and sediments. The research will examine how effectively two strains of bacteria will reduce the level of U from contaminated soil taken from the Mixed Waste Management Facility (MWMF) at Savannah River Site (SRS) (Aiken, SC). In the MWMF, U concentrations in sediments/soils are as high as 3000 mg/kg total U, with the U being in the hexavalent U (VI) oxidation state. Soil from the MWMF will serve as a source of non-radioactive U and be suitable for research testing. U removal in the presence and absence of the novel bacteria will be measured using inductive couple plasma mass spectrometry (ICP-MS).

In addition, research will focus on applying instrumental neutron activation analysis (INAA) to the study of toxic trace elements in cotton seeds. Cotton is an important cash crop in the Palmetto State. The seeds are about 15% of the value of the crop and used widely in making oil and feeding animals. Throughout the growing season, cotton assimilates numerous trace elements from the soil, including the toxic ones. Some of the trace elements are accumulated or enriched in cotton seeds. The research will study the cotton seeds and corresponding local soil with a radioanalytical method-- Instrumental Neutron Activation Analysis (INAA). The project will concentrate on the Midlands and Low Country of SC, particularly in Aiken, Charleston and Lexington counties. The immediate outcome of the project is a detailed survey map of toxic element levels in cotton seeds and local soil in SC, which will give the public a better understanding of the environmental impact of human activities on traditional cash crops and food industry.

A land use/land cover change analysis for the Savannah River Basin was designed and executed by Clemson scientists. Clemson is also investigating chestnut reestablishment in orchard and forest settings with special consideration of the current and historical knowledge of the species and its interaction with other pests and pathogens. Work continued towards identifying sources of resistance in hybrid chestnut families to *Phytophthora cinnamomi*.

Clemson research addresses the effects of severity and frequency of prescribed burns on the production and exports of pollutants and nutrients in forested watersheds. Clemson researchers are quantifying the growth differences and differential disturbance responses between loblolly and longleaf pine.

Clemson Extension Natural Resource Management agents are separated into three focus areas, Water Quality, Forest Management and Wildlife. Clemson Water Quality Agents focused primarily on the reduction of stormwater runoff, which is listed by the Environmental Protection Agency (EPA), as the number one threat to water quality across the United States. Workshops and trainings were conducted for citizens ranging from grade school children to professionals conducting inspections on retention ponds.

This effort is coordinated among Water Resources Extension Agents through a program called "Carolina Clear." The website contains information about ways to reduce stormwater runoff, past activities, and publications (<http://www.clemson.edu/extension/carolinaclear/index.html>). Clemson Extension partnered with the South Carolina ACE Basin National Estuarine Research Reserve Coastal Training Program to develop the Healthy Pond Series, which is a forum for pond owners to learn about stormwater pond management solutions.

Clemson Forestry Extension Agents conducted numerous workshops, met with landowners for individual consultations and fielded various emails and phone calls related to forestland management. A statewide program titled "Woodland Management" was continued that covered information on forestland ownership from basic forest biology and ecology to prescribed fire.

An economic analysis report evaluating forest resources status and forestry practices in South Carolina was developed and is freely available to landowners and forestry professionals in the state. The report assessed the size of the forestry economy and its impact in South Carolina, as well as, served as a resource guide for the future sustainable forestry and economic workshops/trainings that will be offered through Clemson Extension in the next fiscal year. Specialists, also, designed and conducted a study to assess the educational needs of forest landowners in South Carolina. The data is currently under analysis to design a statewide Forestry Master Volunteer Landowner Program that will be offered by Clemson Cooperative Extension.

Food Safety

Two research projects at SC State are under the Food Safety area. Research is being conducted on ozone treatment as an alternative for conventional fumigation to manage stored product insects. Stored product insects cause millions of dollars of loss annually to stored durable commodities such as grain, grain-based products, legumes, dried fruits, nuts and spices. 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. Ozone is a toxic gas, can kill insects effectively, but degrades rapidly to molecular oxygen in atmospheric conditions. The researcher proposes to evaluate the susceptibility of various life stages of the selected species to various doses and exposure time of ozone to effectively establish a dose-time-mortality relationship and to compare the model to strains of adult beetles collected from various states in the US. The research will provide cutting-edge training to SC State students and staff, as well as, educate farmers, industry representatives and pest control operators in the stored product industry.

Secondly, research focuses on the US-EU transatlantic trade and investment partnership (TTIP) and the potential impact on food safety and SC agricultural production, exports and trade. The project is in its final year. A bulletin will be published, at its completion, with the findings from the research. The study analyzes and evaluates potential state agricultural trade expansion attributable to TTIP, quantifies the effect of alternative levels of food safety regulatory stringency on farm exports and derives optimal standards to maximize export revenues with reduced risks to human health, uses SC Representative Farm Models to estimate and evaluate TTIP's impact on local farmers under alternative farm size category and region; creates a computerized bank of research data and determines the prevalence of aflatoxins and tests how ozone gas affects its levels.

Clemson research is addressing the food safety implications related to organic vs. conventional systems for egg laying, on-farm composting, natural antimicrobials, antimicrobial packaging and modified atmosphere packaging.

The Food Safety Modernization Act (FSMA) is a series of federal regulations that has completely redesigned the U.S. food inspection system. FSMA has seven key provisions that include the following: 1) The Produce Safety Final Rule; 2) Preventive Controls for Human Food Final Rule; 3) Preventive Controls for Animal Food Final Rule; 4) Foreign Supplier Verification Program Final Rule; 5) Sanitary Transportation of Human and Animal Foods Final Rule; 6) Mitigation Strategies to Protect Food Against Intentional Adulteration Final Rule; and 7) Accredited Third-Party Certification Final Rule. In SC, there are approximately 30,000 farmers and food processors that will be affected by one or more of the new FSMA rules. The Food Safety and Nutrition (FSN) Extension Program Team at Clemson University offers FSMA trainings statewide. FSMA workshops must be led by a certified lead trainer to be recognized as sufficient

by FDA. During FY 2016-2017, FSN Agents, Extension Associates and Specialists offered two Preventive Controls for Human Food Workshops, one Preventive Controls for Animal Food Workshop, one Foreign Supplier Verification Program Workshop and one Produce Safety Rule Workshop. These workshops certified approximately 90 individuals statewide and laid the foundation for building a more comprehensive FSMA program at Clemson University. Demand for FSMA training is increasing as the SC food industry becomes more aware of the federally-implemented deadlines. The FDA has provided extensions on some of the FSMA deadlines and that has impacted the training demands. During the FY 2017-2018, Clemson's FSN team will have regularly scheduled trainings and will add any additional workshops that are needed to meet the needs of our constituents.

Agribusiness and Community Development

SC State has six research projects actively working under the Planned Program. Five of the six research projects will end in the 2018-2019 reporting period. The remaining project began this reporting cycle. One research project addresses the dynamic linkages among capital investment, export, agribusiness, education, business climate, quality of life variables and economic development of SC. It identifies the quality of life and business climate variables that influence economic developments. It investigates the dynamic causal linkages among the determinates of economic development and the impact of macroeconomic factors on gross state product (GSP). A survey was conducted in the Tri-County Area (Orangeburg, Calhoun and Bamberg) to assess the needs of agribusiness and non-agribusinesses. Using the findings, the researchers will recommend economic and rural development strategies which are expected to improve businesses, increase per capita income, reduce poverty and improve standards of living for South Carolinians.

Furthermore, SC State research focusing on a Data Envelopment Analysis (DEA)-based integrated logistics network system design to improve supply chain efficiency in SC is being investigated. The primary objective of the traditional logistic network or supply chain design problem is to determine the most cost-effective location of facilities, assignment of lower-level facilities to higher-level facilities and distribution of products/items throughout the network structure. After identifying performance measures of the logistics network, a multi-objective optimization model will be built through goal programming (GP).

Another study examines if the US export credit programs enhance exporting opportunities and increase income for small agribusinesses and small farmers in SC. It addresses the problem of how jobs can be created to stimulate economic development and growth by establishing international markets and using the US export credit programs (ECPs) to mitigate non-payment risks associated with international markets. It is hypothesized that there is a beneficial linkage between increase export sale and job creation as long as one accepts the important differences of non-payment risks between domestic markets and international markets. The research findings will contribute to the body of knowledge of international finance and risk management.

In addition, research will look at accelerating the usage of digital communication technologies by small agribusiness firms in SC. SC agribusinesses are lagging behind other states in their adoption of technological tools for business communication. Today's consumers are doing online searches, reading reviews and making purchase decisions. Lack of a digital presence contributes to a loss of business reputation and sales. The study seeks to increase the digital footprint of small agribusiness firms in the state by understanding the challenges undermining their digital efforts and softening the barriers through the provision of tangible resources in the form of training programs, assistance with content creation and dissemination through various digital platforms.

Moreover, SC State research is being conducted on the reduction of transient instability related power blackouts to lessen the crops and livestock losses by US farms and the spoilage of refrigerated agricultural products. Many farms may not have any alternate (backup) source of electric power in case of power blackouts. When a transient instability related power blackout occurs, the crops and livestock are subjected to serious risks due to the unavailability of different farming processes. The result is significant losses in crops and livestock by US farms. Very simplified models are used as local control strategies due to the lack of availability of a suitable dynamic model for the external system and a transient stability method that can be implemented locally for the control of transient stability in practical power systems. The researcher plans to introduce a new transient stability method that is based on a completely

new concept of localized transient stability of power systems.

The new SC State research under the Agribusiness and Community Development priority goal focuses on improving agritourism marketing in SC. The project examines the 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. The research will identify current and potential small farm agritourism practitioners and the marketing challenges they face in developing and communicating agritourism experiences and resources. A set of "best practices" in agritourism marketing will be identified.

Clemson's patent pending anti-fouling deterrent technologies, in which the organism's own endocrine molecules when covalently bound to a polymeric coating act to deter settlement has the potential to be scaled up as a commercial product.

Clemson Extension led the development of the Ag and Art Tour. The self-guided tour consisted of family and commercial farms in nine counties, with local artists in action at each location. Potters, weavers, woodworkers, and quilters demonstrated their talents and skills. The tour allowed visitors to get an up close and personal view of 50+ area farms, while enjoying the work of local artists. The blend of agriculture and art created a unique experience and attracted over 7,000 farm visits. The tour also created an opportunity for an increase in purchases of locally grown food through new producer-consumer relationships. The tour included farms that have not historically implemented agritourism strategies in their business plan. Utilizing this businesses opportunity will help to reduce some of the financial risks associated with ag-based businesses. The 2016 tour, the largest tree farm tour in the nation, has been recognized by regional and statewide organizations for its uniqueness and economic development potential.

4-H Youth Development and Families

Under 4-H Youth Development and Families regarding research, SC State has three projects. South Carolina is one of the lowest ranked states for graduating black males. It has been reported that black males score the lowest on standardized tests, especially in mathematics. Therefore, research is addressing the issue of increasing African-American males' exposure to mathematical related careers, to provide exposure, awareness and importance of mathematics to African-American males. The project plans to increase mathematics proficiency and develop a support system through tutoring and mentoring of sixth to eighth grade black males. Students will participate in ACT/SAT mathematics workshops, a summer math enrichment program, experience campus life by living on SC State University's campus, be involved in focus groups and take pre and post test dealing with math and complete surveys/questionnaires.

More SC State research will concentrate on financially literate entrepreneurship for rural youth and families as a pilot study in two SC lowcountry high schools. Some youth have little access to comprehensive financial literacy training to support successful entrepreneurship. The pilot study is implemented to improve rural youth and families' economic and employment situations by providing quality education in entrepreneurship and financial literacy. The research will address building an infrastructure for ongoing community development; growing learning opportunities for youth and adults in rural communities; encouraging community investment in rural-based entrepreneurs; reducing challenges faced by youth entrepreneurs and sharing the methodologies. One hundred fifty program participants will be encouraged to explore their entrepreneurial potential by tracking each cohort's progression.

A third research project deals with assessing the degree of developmentally appropriate assessment, curriculum and best strategies utilized by community-based child care center-based programs. When reviewing child care programs in South Carolina, only a few can be thought of as providing quality early care and development based on national accreditation best practice or regulatory compliance. The study explores the quality of assessment, curriculum and interaction between early childhood educators and children in Orangeburg, Calhoun, Bamberg, Barnwell and Allendale early childhood programs and record the structural characteristics of the early childhood programs. Data has been collected from 10 center-based early childhood private/non-profit programs. Expected results are that rural based early childhood programs utilize less high quality assessment curricular practices that more urban-based centers and both

rural and more urban centers practice a very similar type of developmentally appropriate teaching approach. The research is in its final year and a bulletin of the findings will be published.

Clemson Extension Agents and volunteers conducted over 3,543 4-H programs that reached over 78,648 youth and family members with programs on agriculture, science and technology, natural resources, food safety and nutrition, and leadership skills. More than 200 4-H members attended 4-H Legislative Appreciation Day at the South Carolina State Capitol to share the impact that 4-H has had on their lives. Four youth represented SC at the 2017 National 4-H Conference in Washington, DC where they engaged in developing and presenting ideas about important issues that affect the entire country. 4H youth were engaged in personal development experiences to increase their knowledge, resources and skills to present a youth voice about specific issues to a partnering federal agency affecting youth and communities nationwide. The expected results is that youth will mobilize to create positive change in their communities in a meaningful and genuine way.

Youth participated in the SC Jr. Beef Round Up. 4H Agents provided 4H Embryology Curriculum and brooder equipment for students at schools that were used in classrooms as science school enrichment. 4-H Community Gardening efforts alone have impacted more than 2400 youth and families through active participation and community outreach. Youth learned about their communities and were contributing members in them. Youth led and participated in citizenship and service projects. Youth used math skills, critical thinking, and creativity, which are valuable life skills.

Sophomore and junior students attended the 4-H Pinckney Leadership Conference. South Carolina 4-H created the Conference last year to honor the late Clementa Pinckney, the pastor and state senator who was among nine churchgoers killed in June 2015 during a Bible study group meeting at Emmanuel AME Church in Charleston. Pinckney was a strong advocate for 4-H, the youth development arm of Clemson University Cooperative Extension. He is one of the organization's most notable South Carolina alumni. He had received the 4-H Distinguished Alumni Medallion from the National 4-H Council.

The Science and Engineering EXPO was hosted at Clemson University and 2nd grade students participated in a variety of hands-on, science and engineering activities. The South Carolina 4-H Engineering Challenge, 4-H Robotics Cam, 4-H Homeschool Club Drone Discovery, and Home School Science Camp were conducted. 4-Hers worked with the app-controlled robotic spheres known as Spheros. Nutrition and Childhood Obesity

SC State research has five projects under the priority goal of Nutrition and Childhood Obesity. Two of the projects ended during the 2016-2017 reporting period. One will end in FY 2017-2018, while two other studies are new for the report cycle. The research on the reduction of cancer risks caused by obesity and metabolic syndrome will focus on the inhibition of Insulin-like Growth Factor 1 (IGF-1) receptor signaling. The factor that links diabetes, obesity and metabolic syndrome with cancer is believed to be hyperinsulinemia. The research seeks to test the concurrent targeting of multi components of the signaling pathway initiated by IGF-1, order to inhibit cell proliferation and restore apoptosis to test the feasibility of the strategy to inhibit cancer cell growth. The data/results will be peer reviewed and published for the general public and research community.

Another research project that ended during the report cycle dealt with reclaiming a healthy heritage. The study addresses the obesity epidemic impacting young children. It is theoried that prevention and/or management of the problem could be done utilizing an intergenerational approach to make children aware of the value of knowing how to produce and prepare locally grown foods. Preschoolers were given a food habit questionnaire. Food histories were completed and a medical screening was given to understand the eating habits, food intake of the children and how they fared on the pre and post project weight as a result of being in the study. The project's intent was to decrease the incidence of childhood obesity, increase intergenerational activities for young children and increase young children's ability to prepare simple, economically healthy foods.

Additionally, an investigation on food derived AGEs (Advanced Glycation End-products) in relation to obesity and breast cancer was conducted. The researcher is examining the extent of carbohydrate and fat derived AGEs, measuring amounts of carboxymethyllysine (CML) and carboxyethyllysine (CEL) from obese (BMI.30) and breast cancer - noncancerous tissue samples from similar age groups and known BMI values. The results will help to better understand the significance mechanism of AGEs formation and

progression of obesity and breast cancer and the relationship between the two diseases.

A new research project underway is achievement motivation for child obesity prevention. Obese children usually do not have motivation to apply needed diet and exercise to avoid obesity. A need for developing and boosting achievement motivation goes beyond obesity prevention. A procedure that boosts achievement motivation in the cortex (conscious part of the brain) will be used, which activates the reward circuits in the hypothalamus, which in turn can influence appetite control. An achievement motivation boosting procedure for the cortex, which takes advantage of the possibility of a subject to use brain signals to control the movement of a physical device has been designed. The method is known in science as brain-computer interface. It is a non-invasive method and often considered as a computer+robot game of interest for children.

Another new project deals with analyzing the role of high pro-inflammatory diets and childhood obesity in the risk of adult carcinogenesis in South Carolinian children. Children from households that do not have access to healthy, nutritious foods are significantly more likely to be obese earlier in life than other children. Obesity in children can lead to numerous health complications. The study will enroll SC children from varying degrees of rurality to determine if obesity and/or high-fat pro-inflammatory diets contribute to increased levels of pro-inflammatory markers, raising the possibility that long-term chronic inflammation may contribute to increasing the risk of adult cancers.

Clemson's Health Extension is an educational partnership with health care providers (initial partners MUSC, JF Sullivan Center, and Greenville Health System) throughout the state using the Extension model to deliver health promotion and education. Many rural areas are being targeted as some are losing health care facilities and becoming health care deserts. Health Agents met with local health care workers to conduct mini needs assessment for Clemson Mobile Clinic. These agents also worked with patients from all demographics at the Sullivan Center through the Best Chance Network, which provides free mammograms and pap smears to women who qualify through certain income criteria. These women are provided education on self-breast exams and other ways to stay healthy. Women over the age of 40 received blood work, nutrition coaching, and exercises to keep themselves heart healthy. Health Agents taught First Line Therapy Modules on important minerals present in the diet. Qualifying participants (women over 40) received a produce box to improve diet. Agents also assisted patients on diabetes management at the Walhalla Free Clinic.

Eating Smart Being Active is being marketed to the Latino community using Extension educators who are indigenous to the population. The educators are identified as Latino, Spanish-speaking, and are perceived as trusted service providers. This allows the educator to connect participants to relevant nutrition resources. There are three nutrition educators that serve Cherokee, Spartanburg, Greenwood and Greenville.

Youth participated in 4-H Food & Nutrition contests held at regional fairs. The Senior 4-H Healthy Lifestyles Cooking Team participated in the national competition at the Great American Seafood Cook-off in New Orleans where they learned how to cook seafood and research South Carolina grown commodities. Agents reached youth and adults during in school and after school programs, healthy lifestyles day camps, summer camps, summer feeding programs, community centers, senior action centers, lunch and learn, Head Start, churches, soup kitchens, housing authority apartments, and libraries. In addition, agents used various media, including social media outlets to publicize nutrition information. Agents implemented a program for SOS Health Care Fit for Life program. The program prepares youth with autism and other disabilities with the skills they need to enter the workforce on a small scale.

Sustainable Energy

SC State Research is underway in reusing post-consumed plastics (PCPs) for solvent extraction of resins and other reprocessing. The new, first year, research project will extract the resins from post-consumed plastic products; use the post consumed plastics to produce other useful construction materials and depolymerize post-consumed plastics to low molar mass material useful as fuel. Recovering resins from PCPs for reuse is very energy efficient, environmentally friendly and economically advantageous compared to making new resins from petrochemicals. As the research continues, papers will be developed, presentations made and articles submitted for publication.

Clemson Extension agents and specialists have developed educational programming through

traditional workshops and a video series published on eXtension.

Global Food Security and Hunger

SC State Research has two research projects in the Planned Program area. One deals with the investigation of alternative sources of vegetable oil from non-edible plant seeds for biodiesel production. The other research study examines a Social Worker's role in improving food insecurity to promote healthy student development through school-based services. The project investigating alternative sources of vegetable oil is looking for a vegetable oil source that is non-food or non-staple based with a relatively high oil yield, easy to grow and with a short maturation period. Oils have been extracted from plant seeds and the densities and yields determined for each. Suitable plant seed candidates have been identified. Sample biodiesel was experimentally produced from the oils of some of the selected seeds.

The research on a Social Worker's role in improving food insecurity is providing strategies and resources to enhance food insecurity of school aged children. The project is focusing on a charter school in Orangeburg County (Felton Laboratory Charter School), one high school (Calhoun County High School) and two K-8 schools (Sandy Run K-8 and Saint Matthews K-8), both are located in Calhoun County. The study will identify students and families experiencing food insecurity, assess their needs and link them with services. In addition, the project will improve nutrition of students and families through school-based programs and nutrition education. Research indicates there is a direct link to the lack of food as it relates to behavior, academics and attendance in school. Many students are experiencing food insecurity in the targeted counties. For some students, breakfast and lunch are the only meals they receive during the school day. The project is attempting to close the gap and help seek ways in which schools can continue to sustain a food pantry, in order to serve students in need.

At Clemson, work is underway to measure the effects of systemic insecticides on the survival of adult and larval honey bees and track translocation of the insecticides throughout the plant tissues over time to evaluate residue levels. Researchers are working to find sustainable solutions for the control and management of two major hive pests by looking at hygienic behavior and the genes that may underlie that behavior and breeding bees with resistance characteristics.

Second-year fall- and summer-planted cover crop plots of rye + clover and millet + sunn hemp, respectively, were established by Clemson scientists. Fall-planted cover crop residue in tilled plots produced approximately 20% less biomass than in no-till plots that were terminated immediately before vegetable transplanting in April. Tilled cover crop residue contained more N at termination compared with residue in no-till plots. Squash in tilled plots significantly out-yielded no-till plots. Squash leaf tissue showed that no-till and tilled plants were below the recommended N. Tomato leaf tissue N was 15% higher in no-till compared to tilled treatments. Minimal weeding was required in no-till plots.

Results from research in 2017 in a test field with different soil types showed that the Clemson designed algorithm recommended 54, 47, and 31 lbs of N per acre in low, medium and high EC (electrical conductivity) zones, respectively, compared to grower's conventional uniform rate N application method (90 lbs./acre). On average, the Clemson algorithm applied 48% less N without affecting cotton yields. Similar results were obtained with other field trials in South Carolina, reducing N usage by 45 to 100 lbs./acre in cotton, compared to growers' application rates, with no negative effects on crop yields. This resulted in \$27 to \$60 savings/acre in fertilizer costs. The Clemson corn side-dress N algorithm reduced rates of fertilizer by 21% and 34% in two different soil types, compared to the normal grower practice (200 lbs. N/acre) with no reduction in corn yields.

In 2017, hardware and software components were developed and initial field tests were conducted, utilizing a wireless sensing network, to automate a subsurface drip irrigation system. This was used to irrigate a cotton field based on real time soil moisture data from sensors installed in the field.

A study was initiated in 2015 to investigate the influence of plant architecture, specifically the number of leaves and branches, on the foraging behavior of the predatory beetle, *Cryptolaemus montrouzieiri*. When offered varying densities of the invasive citrus mealybug, *Planococcus citri*, on chili pepper plants, *Cryptolaemus montrouzieiri* had greater attack rates on plants with fewer branches and leaves, suggesting that the predator was more efficient in searching for prey on plants of lower structural complexity. Results of this research helped growers in adjusting the number of predators to release in crops of varying

structural complexity.

An online thrips infestation predictor for cotton (TIP) has been developed by Clemson and North Carolina State University researchers for the use of cotton growers in managing thrip populations in their fields.

The soybean planting season and growing region can be extended using the new Agustina soybean which possesses the long juvenile (LJ) trait which gives it the ability to produce high yields even when days get shorter and daylight hours are fewer. The LJ trait also allows the Agustina soybean to be grown in regions not suited for most existing soybean cultivars.

Clemson is developing and refining strategies for managing insect pests of soybean, particularly invasive species that will include the bean plataspid (also known as the "kudzu bug"), *Megacopta cribraria*, and potentially the brown marmorated stink bug, *Halyomorpha halys*.

Clemson researchers are evaluating the influence of rootstocks on temperate-zone fruit tree characteristics. Trees are grown under varying environments using sustainable management systems, to develop improved rootstocks for temperate-zone fruit trees using genomics.

Clemson Extension Agronomic, Horticulture and Agribusiness Agents and Specialists worked with the local lending community and the SC Department of Agriculture to provide person-to-person assistance to those affected by the historic flooding of October 2015 and by Hurricane Matthew (fall of 2016) by assessing damage, filling out forms, and estimating crop losses using production and pricing. The total disbursed to SC farmers who experienced at least a 40% loss on affected crops was \$35,512,560. Total applications were approved for 1,253 farmers with an average payment of \$28,399. Clemson Extension conducted 21 training sessions in 20 days and provided assistance with the application process reaching at least 80% of the applicants.

Clemson University and SC State Extension collaborated with limited resource farmers to bring innovation and new agricultural practices to help limited resource farmers save time and money. During these workshops farmers learned how to properly calibrate their fertilizer and herbicide spreaders. Later more advanced workshops taught them how to properly irrigate, scout for diseases, and target specific markets. After the first year of collaboration, the agents saw an increase in farmer profits, which reflected the fact that most farmers implemented new methods that they had learned.

The Small Farm Projects, facilitated by SC State University and Clemson University resulted in thousands of dollars in savings due to improved fertility and pest management with some reporting a 50% increase in sales volume and a 25% increase in profit margin again. Clemson Extension and SC State Extension agents partnered on farm visits to identify pests and cabbage fertility problems. Specialists and agents produced reports to help warn against and manage fruit and vegetable disease. Due to improved knowledge of tree management, pest management, and fertility management, growers have saved or gained in better quality and yields.

Official Variety Trials of all major agronomic crops were conducted in multiple locations across the state. The information generated from these trials is then used by growers to select the varieties that perform best in their region of the state. Agents scouted thousands of acres of corn for Southern Rust, soybeans for Soybean Rust, cotton for square retention, and peanuts for disease issues. Early detection is critical to insure the crop health and grower profit. Agents also scouted strawberry fields for spidermite, and squash for bug pests. Collard fields were scouted for bacterial leaf blight. Peach scale and other fruit insect damage assessments were conducted.

Clemson agents evaluated wheat fields for damage from winter freeze. Farmers saved between \$45,000 to \$137,000 as a result of agent and specialists recommendations. Agents also partnered with a local foundation to provide free health screening to the local farmers.

As a result of agents traveling to Haiti to meet with the President Jovenel Moise, and other high ranking officials, lines of communication have been opened between Clemson and officials in Haiti. Discussions are underway on ways to involve Clemson Extension with Haitian agricultural agents.

The Clemson Agricultural Service Laboratory provides a variety of analytical agricultural testing for farmers and gardeners across the state so they know how to best fertilize their soil for optimal fertility. The Laboratory is a member and certified as a participant of the Agriculture Laboratory Proficiency Program for Soil, Plant, and Water Analysis Laboratories which provides quarterly exchanges of plant, soil, and water

samples. In the year 2016, the Ag Service Lab analyzed 54,296 samples, including 1408 plant tissue, 1003 feed and forage, 870 animal waste, 837 irrigation water, and 85 compost samples.

The economic impact of selected Clemson Extension Food Crop Horticulture Programs for 2016 - 2017 was estimated at \$1,795,000. Extension commercial vegetable production was \$750,000, commercial fruit production was \$950,000, and the Clemson Small Farm Projects was \$45,000. The impact on Pecan Production was reported to be approximately \$50,000. Extension horticulture programs focused on Organic Vegetable Production, Strawberry Production, Collard Pest and Diseases, and farm visits to scout for disease such as powdery mildew on zucchini and squash crops. After using Extension information, disease suppression was observed on fields.

Clemson Extension agents partnered with the South Carolina New and Beginning Farmer Program to offer the "New Growers Toolbox" training to discuss equipment and resources that are needed to start a farm. Eighteen new and beginning farmers from various parts of the state attended. All of the farmers gained knowledge and indicated that the training provided a knowledge and networking base to jump start their business.

Pesticide certification programs teach appropriate and safe use of pesticides. Topics such as turf management, weed and disease identification, fire ant management, and pesticide safety were presented to private and commercial applicators. A total of 129 license holders attended these training opportunities, each receiving at least two continuing credit hours for each of the trainings. A total of 14 CEU's were awarded. Credits were approved by DPR for a total of 14 re-certification credits.

Increasing prices and growing demand are making plasticulture unreachable for some small scale squash producers. Farmers struggle to make a yield because of weed and disease problems, which forces farmers to buy plastic at expensive prices resulting in lower profits. In order to decrease cost inputs, Extension Agents, local producers and experienced squash producers developed a spray schedule to reduce weed and disease incidence. After the planning stage was completed, several trials were conducted. Best method recommendations were made for each producer.

Total Actual Amount of professional FTEs/SYs for this State

Year: 2017	Extension		Research	
	1862	1890	1862	1890
Plan	135.0	41.0	82.0	13.0
Actual	148.0	38.0	53.1	11.0

II. Merit Review Process

1. The Merit Review Process that was Employed for this year

- Internal University Panel
- External Non-University Panel
- Expert Peer Review
- Other (Research Results Reviewed by selected growers and commodity groups and associations)

2. Brief Explanation

The Research and Program Development Committee of the South Carolina State Extension Advancement Council reviews and comments on new programs initiated by Clemson University and South Carolina State University. The Council meets three to four times a year. The seven-member Research and Program Development Committee is one of the Council's three committees that review the list of programs

and descriptions annually. The committee serves as the external non-university panel for program review. The committee members have participated in Extension programs, are knowledgeable of South Carolina's social and economic demographics, and are sensitive to the needs of underserved and underrepresented populations. The total Council, which is composed of Extension volunteers, producers, forestry consultants, a community center program coordinator, public school educators and business owners (bank, funeral home, insurance, lawn care), has the opportunity to give input about programs.

There are internal university review panels at both Clemson and South Carolina State. They are reviewed by State Extension Program Team Leaders and by administration, at each institution. Both panels review projects and programs at their institutions based on organizational capacity, relevance and impact. The internal university panels are asked to review annually South Carolina's Plan of Work. The Research and Program Development Committee is kept abreast of national program areas and the realignments of research and extension activities at both institutions. The program review activities of the committee complements the scientific peer review process established at both institutions.

An internal review panel meets to review all research outputs and outcomes with faculty members in preparing to initiate new research projects. The review panel consists of the Experiment Station Director, the Associate Dean for Research and Graduate Studies, the Department Chair of the PI, a member of media services, and other subject matter experts as needed. The panel is appointed by the Experiment Station Director in consultation with other administration, faculty and staff. The panel reviews all pre-proposals submitted for new projects to ascertain the merit of the project and to assure that it fits the overall goals and objectives of the Experiment Station and the College. The panel also reviews the full proposals along with external reviewers' comments and the final proposal before submission to NIFA in Washington, D.C. This panel also reviews the outcomes and outputs from each project when annual and final reports are submitted. A project termination meeting is held at the conclusion of the project to discuss the project and determine the next steps for a new project. In addition, all research projects go through a review process as outlined under Hatch or Evans-Allen regulations. This serves as the Expert Peer Review process, as each project is sent for external review, comments and suggestions, which are examined and incorporated into the new project, as appropriate.

III. Stakeholder Input

1. Actions taken to seek stakeholder input that encouraged their participation

- Use of media to announce public meetings and listening sessions
- Targeted invitation to traditional stakeholder groups
- Targeted invitation to non-traditional stakeholder groups
- Targeted invitation to traditional stakeholder individuals
- Targeted invitation to non-traditional stakeholder individuals
- Targeted invitation to selected individuals from general public
- Survey of traditional stakeholder groups
- Survey of traditional stakeholder individuals
- Survey specifically with non-traditional groups

Brief explanation.

Clemson and South Carolina State Universities have a long history and tradition of seeking stakeholder input into the Plan of Work process. The process of seeking stakeholder input includes identifying stakeholders that should have input in the POW process and determining the process used in seeking stakeholder input. Through correspondence and meetings follow up is made and feedback is reported. Groups understand that their input is valued and will be followed up. Invitations are usually mailed to groups that participate in our programs. Traditional and social media are used to invite the general public. Input is shared with research faculty to assist in

determining research priorities.

2(A). A brief statement of the process that was used by the recipient institution to identify individuals and groups stakeholders and to collect input from them

1. Method to identify individuals and groups

- Use Advisory Committees
- Use Internal Focus Groups
- Use External Focus Groups
- Open Listening Sessions
- Needs Assessments
- Use Surveys

Brief explanation.

Extension partners with agencies and organizations that serve non-traditional audiences, which include low-income, non-Anglo, etc. Individuals who are involved in the Research and Extension Programs and/or receive services as well as persons who may have an interest or concern are identified and contacted. Stakeholders are identified and invited to attend meetings. Stakeholders included those internal to the Cooperative Extension System--administrators, extension agents, agent professional associations, specialists, faculty, department chairs, associate deans and faculty, as well as, those external to the system. External stakeholders are Extension advisory board members, commodity group representatives, community leaders, human service providers, business/industry representatives and collaborators (Farm Bureau, Chamber of Commerce, Farm Service Agencies, etc). Representatives from all audience groups are invited to county and local advisory meetings to collect input.

2(B). A brief statement of the process that was used by the recipient institution to identify individuals and groups who are stakeholders and to collect input from them

1. Methods for collecting Stakeholder Input

- Meeting with traditional Stakeholder groups
- Survey of traditional Stakeholder groups
- Meeting with traditional Stakeholder individuals
- Survey of traditional Stakeholder individuals
- Meeting with the general public (open meeting advertised to all)
- Meeting specifically with non-traditional groups
- Survey specifically with non-traditional groups
- Meeting specifically with non-traditional individuals
- Meeting with invited selected individuals from the general public

Brief explanation.

The most recent process used in collecting stakeholder input included regional meetings that were held with representatives from all counties in the state to identify issues and set priorities for agricultural research and Extension. In addition, an electronic Customer Satisfaction Survey was administered to collect data from citizens who have received services sponsored by the Extension Service. The goal was to help county staff and administrators find ways to improve program quality, information delivery, and to assist in the accountability process. Commodity groups, the SC Farm

Bureau, the Department of Natural Resources and the State Department of Agriculture as well as individual growers and producers are in on-going dialogues to identify issues and make decisions on the use of available research resources. In addition, evaluations of at least one statewide program, per Extension program area, were conducted using Qualtrics (web based survey tool) to determine program impact.

3. A statement of how the input will be considered

- In the Budget Process
- To Identify Emerging Issues
- Redirect Extension Programs
- Redirect Research Programs
- In the Staff Hiring Process
- In the Action Plans
- To Set Priorities

Brief explanation.

County data are compiled from stakeholder meetings and the information is used to make recommendations and adjustments in Extension program design and implementation as well as research initiatives. The Customer Satisfaction Survey report and Qualtrics impact report was shared with Extension administrators, State Extension Advancement Council members and the Extension system.

Brief Explanation of what you learned from your Stakeholders

In general, respondents felt Extension was a valuable service and a great use of public funds.

IV. Expenditure Summary

1. Total Actual Formula dollars Allocated (prepopulated from C-REEMS)			
Extension		Research	
Smith-Lever 3b & 3c	1890 Extension	Hatch	Evans-Allen
{No Data Entered}	{No Data Entered}	{No Data Entered}	{No Data Entered}

2. Totaled Actual dollars from Planned Programs Inputs				
	Extension		Research	
	Smith-Lever 3b & 3c	1890 Extension	Hatch	Evans-Allen
Actual Formula	5535420	1870988	4604017	2284797
Actual Matching	5535420	1870988	6317756	2284797
Actual All Other	0	0	11653934	0
Total Actual Expended	11070840	3741976	22575707	4569594

3. Amount of Above Actual Formula Dollars Expended which comes from Carryover funds from previous				
Carryover	4537330	0	4377578	0

V. Planned Program Table of Content

S. No.	PROGRAM NAME
1	Sustainable Animal Production Systems
2	Sustainable Agriculture Production for (non-food) Horticultural Crops
3	Natural Resource Management
4	Food Safety
5	Agribusiness and Community Development
6	4-H Youth Development and Families
7	Nutrition and Childhood Obesity
8	Climate Change
9	Sustainable Energy
10	Global Food Security and Hunger

V(A). Planned Program (Summary)

Program # 1

1. Name of the Planned Program

Sustainable Animal Production Systems

Reporting on this Program

V(B). Program Knowledge Area(s)

1. Program Knowledge Areas and Percentage

KA Code	Knowledge Area	%1862 Extension	%1890 Extension	%1862 Research	%1890 Research
301	Reproductive Performance of Animals	10%	20%	37%	0%
302	Nutrient Utilization in Animals	15%	20%	0%	0%
303	Genetic Improvement of Animals	15%	15%	0%	0%
307	Animal Management Systems	15%	20%	13%	0%
308	Improved Animal Products (Before Harvest)	15%	15%	23%	0%
311	Animal Diseases	15%	0%	9%	0%
315	Animal Welfare/Well-Being and Protection	10%	10%	18%	0%
723	Hazards to Human Health and Safety	5%	0%	0%	0%
Total		100%	100%	100%	0%

V(C). Planned Program (Inputs)

1. Actual amount of FTE/SYs expended this Program

Year: 2017	Extension		Research	
	1862	1890	1862	1890
Plan	11.0	8.0	6.5	1.0
Actual Paid	12.0	7.2	2.3	0.0
Actual Volunteer	0.0	0.0	0.0	0.0

2. Actual dollars expended in this Program (includes Carryover Funds from previous years)

Extension		Research	
Smith-Lever 3b & 3c	1890 Extension	Hatch	Evans-Allen
546344	339636	463430	0
1862 Matching	1890 Matching	1862 Matching	1890 Matching
546344	339636	426322	0
1862 All Other	1890 All Other	1862 All Other	1890 All Other
0	0	1455760	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

Clemson and South Carolina State Extension partnered to conduct programs on Herbicides & Insecticides for use on Bermuda & fescue pastures, record keeping, sprayer calibration basic swine care and health. Other Clemson Extension activities focused on marketing, reproduction, basic management, meat quality, forages, and herd health. Programs included artificial insemination breeding, Bermudagrass stockpiling and winter feeding workshops, Grass Masters, managing cattle during drought, sire seminar, small ruminant management, southern forages seminar, clover production field day, grazing management, goat management, equine management, fire ant control in pastures, hay workshop, livestock liability law, reproductive herd health and biosecurity, Master Cattlemen's Association, Beekeepers Association meetings, the Edisto Forage Bull test, and Beef Quality Assurance recertification training. In addition, program topics included mass care issues and resources for emergency pet sheltering, and service dogs and emotional support animals in SC. Extension programs reached county emergency managers, regional DHEC partners, regional DSS partners, regional Red Cross locations and the Lt. Governor Council on Aging. One county conducted a drill to prepare local individuals in the event of a radiological disaster or event. Livestock agents gave presentations for 4-H Livestock, Horse Club, and Beekeeping programs.

Clemson Researchers are working to identify the prevalence of microorganisms, which play a significant role in calf illness and production loss in beef and dairy operations.

2. Brief description of the target audience

Producers, limited-resource farmers and agency personnel, etc.

3. How was eXtension used?

eXtension was not used in this program

V(E). Planned Program (Outputs)

1. Standard output measures

2017	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	19367	48872	1051	123

2. Number of Patent Applications Submitted (Standard Research Output)
Patent Applications Submitted

Year: 2017
 Actual: 1

Patents listed
 Method of Fine Needle Biopsy As a Diagnostic Tool

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2017	Extension	Research	Total
Actual	1	7	8

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Disclosures

Year	Actual
2017	0

Output #2

Output Measure

- Licenses

Year	Actual
2017	0

Output #3

Output Measure

- Number of people completing educational workshops.

Year	Actual
2017	8881

Output #4

Output Measure

- Number of educational workshops conducted.

Year	Actual
2017	388

Output #5

Output Measure

- Grant Awards

Year	Actual
2017	0

Output #6

Output Measure

- Active Grants

Year	Actual
2017	0

Output #7

Output Measure

- Grant Applications

Year	Actual
2017	0

Output #8

Output Measure

- Grant Expenditures

Year	Actual
2017	0

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O. No.	OUTCOME NAME
1	Number of people reporting increased knowledge and indicating adoption of animal production practices.
2	Number increased percentage of forage fed beef production in the State and Region
3	Increased income due to producers and growers improved production efficiency of confined animal systems.

Outcome #1

1. Outcome Measures

Number of people reporting increased knowledge and indicating adoption of animal production practices.

2. Associated Institution Types

- 1890 Extension

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	1009

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

SC State Extension Animal Production Systems is designed to assist small herd producers (15 - 20 heads of cattle) in improving the quality of their herds, cow/calf production efficiency and reduce the cost of production while increasing their price received premium. By increasing the knowledge of producers, they will be more willing to effectively practice the procedures learned from workshops and trainings.

What has been done

The producers were trained in forage management, bull quality selection and soil nutrient management. They were grouped under a cooperative system to enhance their input purchasing power and share better quality bulls to improve their herd quality.

Results

Some Cooperative members began to receive premium price for their calves due to grouping their animals of uniform size. Twenty-eight small farm livestock producers participated in the educational training series. Six classes were held over a three month period. At the end of the training, all 28 producers received a certificate of completion.

4. Associated Knowledge Areas

KA Code	Knowledge Area
301	Reproductive Performance of Animals
302	Nutrient Utilization in Animals
303	Genetic Improvement of Animals
307	Animal Management Systems
308	Improved Animal Products (Before Harvest)

Outcome #2

1. Outcome Measures

Number increased percentage of forage fed beef production in the State and Region

Not Reporting on this Outcome Measure

Outcome #3

1. Outcome Measures

Increased income due to producers and growers improved production efficiency of confined animal systems.

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Condition Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	6000

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

The Sustainable Animal Production Systems program aims to improve the production efficiency, environmental sensitivity, and profitability of animal production systems and reduce the environmental impact of animal waste in South Carolina. One way that cattle producers can maximize profit potential is to market feeder calves in semi-truck load lots. Smaller producers lack the cattle number needed to fill a semi-truck.

What has been done

Clemson Extension worked with area cattlemen to coordinate an annual feeder calf sale. The year 2017 was the 40th year that area cattle producers worked together with Clemson Extension to market semi-truck loads of feeder calves. The sale marketed 19 loads or 1,280 head. The largest farm sold 250 head, while the smallest farm sold eight head.

Results

Marketing feeder calves in truck load lots of uniform size commands about \$75 more per calf than traditional cattle auction markets. This difference was a gain to participants in the 2017 sale an average of approximately \$6,000 additional income per farm. Participating farms varied in size.

4. Associated Knowledge Areas

KA Code	Knowledge Area
307	Animal Management Systems

V(H). Planned Program (External Factors)

External factors which affected outcomes

- Economy
- Appropriations changes
- Public Policy changes
- Government Regulations
- Competing Public priorities
- Competing Programmatic Challenges
- Populations changes (immigration, new cultural groupings, etc.)

Brief Explanation

V(I). Planned Program (Evaluation Studies)

Evaluation Results

Clemson's work on the integration of alfalfa into forage grasses highlighted national applications for the forage fed beef sector.

Twenty-eight livestock producers that attended 1890 Extension programs gained knowledge by completing the educational training and received a certificate of completion.

Ninety-four percent of the participants completing Clemson Extension programs indicated that they gained knowledge as a result of their participation. Four hundred sixty-three growers attended the CAMM recertification trainings held from May through December 31, 2017. All participants indicated knowledge gained in the CAMM recertification programs. All received two hours of recertification credit.

Key Items of Evaluation

Forage fed beef

Optimum housing for maximum production in laying operations

Value of direct exposure to the sun for short periods in the health of fryers

V(A). Planned Program (Summary)

Program # 2

1. Name of the Planned Program

Sustainable Agriculture Production for (non-food) Horticultural Crops

Reporting on this Program

V(B). Program Knowledge Area(s)

1. Program Knowledge Areas and Percentage

KA Code	Knowledge Area	%1862 Extension	%1890 Extension	%1862 Research	%1890 Research
111	Conservation and Efficient Use of Water	10%	0%	10%	0%
204	Plant Product Quality and Utility (Preharvest)	0%	0%	10%	0%
205	Plant Management Systems	20%	0%	25%	0%
211	Insects, Mites, and Other Arthropods Affecting Plants	20%	0%	35%	0%
212	Pathogens and Nematodes Affecting Plants	20%	0%	0%	0%
215	Biological Control of Pests Affecting Plants	5%	0%	0%	0%
216	Integrated Pest Management Systems	20%	0%	20%	50%
601	Economics of Agricultural Production and Farm Management	5%	0%	0%	50%
	Total	100%	0%	100%	100%

V(C). Planned Program (Inputs)

1. Actual amount of FTE/SYs expended this Program

Year: 2017	Extension		Research	
	1862	1890	1862	1890
Plan	15.0	0.0	8.0	0.0
Actual Paid	16.0	0.0	5.8	1.0
Actual Volunteer	0.0	0.0	0.0	0.0

2. Actual dollars expended in this Program (includes Carryover Funds from previous years)

Extension		Research	
Smith-Lever 3b & 3c	1890 Extension	Hatch	Evans-Allen
702787	0	789503	144027
1862 Matching	1890 Matching	1862 Matching	1890 Matching
702787	0	665511	144027
1862 All Other	1890 All Other	1862 All Other	1890 All Other
0	0	2489153	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

Clemson Extension agents and specialists taught weed management, basic lawn care workshops, pest and plant management for commercial and private pesticide license holders, nursery equipment calibration, pesticide safety, fire ant biology and management, turfgrass management, sustainable landscape design, fire ant management, Master Gardener Training, historic landscapes and gardens, and protecting local waterways and estuaries. Agents hosted a turf school, conducted onsite plant and turfgrass diagnostics, and implemented a Turf Field Day. Agents and specialists spoke at the National Turfgrass Entomologists Workshop and Spring SC Sports Turf Managers Association Meeting. Agents hosted the Making It Grow live television show to address consumer horticulture questions. The Home and Garden Information Center (HGIC) experts provided gardening information to 9,291 individuals by telephone or in person. In addition, the HGIC website recorded 3,541,177 hits last year. HGIC updated 112 fact sheets and created 15 new fact sheets. Fact sheets related to plant species and environmental problems were translated into Spanish.

Research at Clemson has provided support data for the registration of five new products for turfgrass managers to use. This includes two nematicides which the industry hasn't had in over 20 years and are considered lower risk environmentally products compared to traditional ones.

SC State research continues to examine the effects of preventing noise induced hearing loss and high blood pressure among South Carolina farmers and agricultural workers. The major goal of the project is to recruit and educate farmers and agricultural workers in rural South Carolina of the implications of being exposed to excessive noise levels over a period of time could potentially bring about complications of ischemic heart disease and high blood pressure. Farmers have been contacted to complete surveys to determine their exposure to noise during daily tasks and informed consent forms have been obtained. Information was disseminated about the adverse effects of noise-induced hearing loss on farmers' lives. Educational materials have been developed. Five paper presentations were developed for professional conferences and workshops. A mobile speech pathology unit has been purchased and outfitted for data collection with farmers.

2. Brief description of the target audience

The audience included producers, small farmers and Extension personnel, horticulture professionals, residents in counties with Master Gardener programs, Master Gardeners, and consumers.

3. How was eXtension used?

eXtension was not used in this program

V(E). Planned Program (Outputs)

1. Standard output measures

2017	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	18115	5502430	0	0

2. Number of Patent Applications Submitted (Standard Research Output)

Patent Applications Submitted

Year: 2017
 Actual: 0

Patents listed

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2017	Extension	Research	Total
Actual	0	3	0

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Disclosures

Year	Actual
2017	0

Output #2

Output Measure

- Licenses

Year	Actual
-------------	---------------

2017 0

Output #3

Output Measure

- Number of people completing horticultural educational workshops

Year	Actual
2017	10336

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O. No.	OUTCOME NAME
1	Number of participants gaining knowledge and applying skills learned in environmental horticulture education.

Outcome #1

1. Outcome Measures

Number of participants gaining knowledge and applying skills learned in environmental horticulture education.

2. Associated Institution Types

- 1862 Extension
- 1890 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	9380

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

The Sustainable Agriculture Production for non-food horticultural crops program at Clemson University seeks to inform horticulture professionals and consumers on environmentally sound horticultural practices that will improve communities.

What has been done

Agents and specialists conducted over 1300 programs. Agents developed and presented a 4-hour Advanced Master Gardener Training titled, Guide to Solving Lawn Problems. Participants received information on diagnosing turfgrass problems, weeds of the south, a jump drive loaded with weed guides, pest management guides, wildlife fact sheets, and more. Other Master Gardener training topics have included yard varmints, fire ant management, soils, plant nutrition and physiology, botany, entomology, plant pathology, woody plants, herbaceous plants, turf, irrigation, sustainable landscape design, historic landscapes and gardens, local waterways and estuaries.

Results

Master Gardener volunteers participated in Ask-A-Master Gardener events during exhibits and farmers' markets and served as panel guests answering horticulture questions on the award-winning Making It Grow television show. Master Gardeners contributed 44,841 hours of volunteer service through programs, oral presentations, newsletters, radio programs, and TV appearances. This represents over 23 hours of service contributed by each volunteer and a value of \$979,776 in program support.

4. Associated Knowledge Areas

KA Code	Knowledge Area
205	Plant Management Systems

211	Insects, Mites, and Other Arthropods Affecting Plants
216	Integrated Pest Management Systems

V(H). Planned Program (External Factors)

External factors which affected outcomes

- Economy
- Government Regulations
- Competing Public priorities
- Competing Programmatic Challenges
- Populations changes (immigration, new cultural groupings, etc.)

Brief Explanation

The SC State researcher has been unable to utilize the mobile technology hearing unit on the farms due to the lack of receipt of State vehicle tags and registration.

V(I). Planned Program (Evaluation Studies)

Evaluation Results

A total of 91% of the participants in the Sustainable Agriculture Production for non-food Horticultural Crops programs indicated that they gained knowledge as a result of their participation.

Key Items of Evaluation

Importance of turf grass research in the South Eastern United States

V(A). Planned Program (Summary)

Program # 3

1. Name of the Planned Program

Natural Resource Management

Reporting on this Program

V(B). Program Knowledge Area(s)

1. Program Knowledge Areas and Percentage

KA Code	Knowledge Area	%1862 Extension	%1890 Extension	%1862 Research	%1890 Research
111	Conservation and Efficient Use of Water	10%	0%	17%	25%
112	Watershed Protection and Management	30%	0%	0%	10%
122	Management and Control of Forest and Range Fires	3%	0%	33%	0%
123	Management and Sustainability of Forest Resources	35%	0%	32%	10%
124	Urban Forestry	1%	0%	0%	0%
131	Alternative Uses of Land	0%	0%	0%	10%
133	Pollution Prevention and Mitigation	10%	0%	13%	15%
135	Aquatic and Terrestrial Wildlife	1%	0%	5%	0%
136	Conservation of Biological Diversity	10%	0%	0%	0%
201	Plant Genome, Genetics, and Genetic Mechanisms	0%	0%	0%	30%
	Total	100%	0%	100%	100%

V(C). Planned Program (Inputs)

1. Actual amount of FTE/SYs expended this Program

Year: 2017	Extension		Research	
	1862	1890	1862	1890
Plan	18.0	0.0	17.0	1.0
Actual Paid	17.0	0.0	8.4	2.0
Actual Volunteer	10.0	0.0	0.0	0.0

2. Actual dollars expended in this Program (includes Carryover Funds from previous years)

Extension		Research	
Smith-Lever 3b & 3c	1890 Extension	Hatch	Evans-Allen
687668	0	285560	284992
1862 Matching	1890 Matching	1862 Matching	1890 Matching
687668	0	2141445	284992
1862 All Other	1890 All Other	1862 All Other	1890 All Other
0	0	693655	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

Clemson researchers assessed the resilience of wetlands to sea level rise along a transitional gradient from tidal freshwater forested wetland to marsh by measuring processes controlling wetland elevation. It was found that these wetlands were resilient, although some marginally to sea-level rise. Fundamental differences we detected in how resilience is maintained across wetland community types, which have important implications for management activities that aim to restore or conserve resilient systems.

SC State has two Natural Resource Management research projects in their embryonic stages. One study looks at natural and microbial attenuation of Uranium (U) contaminated groundwater, soils and sediments. As of the reporting period, viable cultures of *P. pituda* and *A. piechaudii* were procured from the Savannah River National Laboratory (SRNL), subcultured and stored. Plasmids were recently received and are now ready to be used in conjugation experiments to yield biosurfactant deficient mutants. The second project focuses on applying instrumental neutron activation analysis (INAA) to the study of toxic trace elements in cotton seeds. Cotton seeds and whole cotton plant samples have been collected in Orangeburg County. Neutron irradiation of samples was conducted at North Carolina State University (NCSU). The PN and medium-lived isotope spectra were collected at NCSU. All the spectra of short-lived isotopes and medium-lived isotopes were measured.

Clemson University Extension Agents and specialists conducted trainings for Certified Stormwater Plan Reviewer (CSPR), Certified Erosion Prevention & Sediment Control Inspector Program (CEPSCI), Master Pond Manager, QDMA Deer Steward I, Master Naturalist, and Woodland Management Series that are now annual events and trainings. Agents worked with clients to develop forestry and wildlife habitat improvement plans. Agents and specialists conducted Coyote Control workshops, Wildlife Management Workshop, forage and fish pond assessments, a stormwater pond conference, forest landowner association meetings, and worked with individual families. Agents and specialists were involved in the delivery of the TOP logger certification program, conducted an assessment for forest health and thinning, developed an online program of the Forest Roads, Wood Supplier Systems and Logging Cost Analysis, and conducted a forest ethics webinar. Agents gave presentations during forest landowner association meetings. A Trees for Energy Conservation video series was developed. Agents taught the Invertebrate biodiversity class for the Wildlife Action Pioneer Camp and the Entomology class for Wild 4H camp.

2. Brief description of the target audience

The target audience includes farm and forest landowners, Extension agents, and administrators, natural resource professionals, land management agency personnel and user groups, civil engineers, homeowners, land developers, homeowner associations (HOA), professional pond managers nature-based tourism operators/industry, South Carolina citizens, tourists, children in school, after-school, summer and 4-H programs, agents and volunteers, urban, suburban and rural residents, farmers, ranchers, poultry and swine producers, foresters, urban agents, agency personnel, urban planners and land owners/managers, municipal officials, and local community groups statewide, managers, government officials and recreation and tourism operators.

3. How was eXtension used?

An Extension Agent hosted Carolina Yards Online Guide to Environmentally Friendly Landscaping on eXtension. This five week online class provided information and techniques to create and maintain a more environmentally friendly landscape. Weekly modules guided participants through the 12 Carolina Yards principles and the interactive discussion forums provided opportunity to share helpful tips and advice with others enrolled in the class.

V(E). Planned Program (Outputs)

1. Standard output measures

2017	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	22472	2743919	2061	0

2. Number of Patent Applications Submitted (Standard Research Output)

Patent Applications Submitted

Year: 2017
 Actual: 1

Patents listed

Chemical Control of Terminal Buds in Cucurbit Rootstock Seedlings used for Grafting

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2017	Extension	Research	Total
Actual	0	66	66

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Disclosures

Year	Actual
2017	0

Output #2

Output Measure

- Licenses

Year	Actual
2017	0

Output #3

Output Measure

- Number of people completing educational workshops.

Year	Actual
2017	18975

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O. No.	OUTCOME NAME
1	Number of people gaining knowledge and using practices to improve water quality and quantity.
2	Number of people applying wildlife habitat improvement practices.
3	Number of acres affected by sustainable forestry practices.

Outcome #1

1. Outcome Measures

Number of people gaining knowledge and using practices to improve water quality and quantity.

2. Associated Institution Types

- 1862 Extension
- 1890 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	16045

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Water is essential to all life, flora and fauna. The Environmental Protection Agency has identified storm-water runoff as the number one threat to water quality in the surface waters of the United States. As the world continues to increase in population, and thus, continues to develop and create more impervious surfaces, management of storm-water runoff becomes imperative. In addition to storm-water runoff, other non-point source pollution is also contribution to degraded water quality. There are also economic costs of degraded water quality through water filtration and treatments systems to the local governments. In an attempt to control storm-water runoff retention ponds are created that are designed to slow the water and decrease pollutants beings carried to freshwater sources downstream. While detention ponds can perform as designed, without proper maintenance they can become another source of pollution.

What has been done

Extension Agents delivered traditional programs, conducted television campaigns, created and distributed print media and utilized online resources in an attempt to educate and entice behavioral changes amongst the citizens of South Carolina. Various techniques appropriate for the target audience were provided either hands-on instruction or information on how to control storm-water runoff and other non-point source pollutants. Techniques for land developers, civil engineers and HOAs included the use of bio-retention ponds and designs for low impact development. For homeowners, construction of downspout planter boxes, rain barrels and rain gardens were demonstrated and their use espoused at private homes. For natural resource professionals and engineers, the use of shoreline buffers to minimize erosion was presented and hands-on workshops utilized to promote this water quality technique.

Results

As a result of improving water quality efforts by Clemson University Extension Agents, demonstration bio-retention ponds and shoreline erosion techniques were demonstrated throughout South Carolina, but particularly in the Lowcountry which is experiencing high population increases. In eight coastal counties alone there are almost 22,000 ponds (according to 2013 counts). The outreach efforts of the Agents combined with ad campaigns and printed, readily available information on management had the potential to impact tens of thousands of retention ponds covering thousands of acres throughout the state of South Carolina. Through the course of this work, Clemson University Extension Agents collaborated and partnered with other state agencies and local governments as well as non-governmental entities in an attempt to increase impacts and effectiveness of programs and materials. Some of the results of the efforts were documented through evaluations conducted at the end of programs to gauge the effectiveness and potential for behavioral change as a result. Most workshop participants indicated that they gained new knowledge related to water quality and improved water quality techniques (> 94%).

4. Associated Knowledge Areas

KA Code	Knowledge Area
111	Conservation and Efficient Use of Water
112	Watershed Protection and Management
133	Pollution Prevention and Mitigation
136	Conservation of Biological Diversity

Outcome #2

1. Outcome Measures

Number of people applying wildlife habitat improvement practices.

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	346

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

All wildlife has value, intrinsic or extrinsic, and as such, wildlife conservation is important in the light of increasing populations and land fragmentation. Some wildlife species can be assigned an economic value, such as white-tailed deer or turkey, but other species such as neo-tropical migratory birds and herpetofauna, only have intrinsic values. All wildlife has a function in the ecosystem and provides some ecosystem service that is of benefit to humans. One example includes the benefits of native pollinators, such as bees and butterflies, to the agriculture industry.

What has been done

In order to increase the awareness and benefits of native pollinators, demonstration sites were installed at a state park and at the Clemson University Sandhill Research and Education Center. These sites demonstrated the use of native wild flowers and grasses that are beneficial to attracting and supporting native pollinator populations. In conjunction, two workshops were also held in order to solidify the concepts and practices installed in the public areas. Other demonstration areas to increase the awareness and importance of songbirds were also implemented. Trails were installed that demonstrated the importance of habitat features such as snags and woody debris to landowners.

Results

Through the use of demonstration plots and trails, landowners have the potential to increase wildlife habitat, not just for native pollinators and songbirds, but for other wildlife as well, particularly those that have adapted to urban environments. Given the new landowner knowledge, landscape plans in and around private homes can actively consider and incorporate wildlife friendly plants and habitat features.

4. Associated Knowledge Areas

KA Code	Knowledge Area
111	Conservation and Efficient Use of Water
135	Aquatic and Terrestrial Wildlife
136	Conservation of Biological Diversity

Outcome #3

1. Outcome Measures

Number of acres affected by sustainable forestry practices.

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	1210552

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Forests provide economic, ecological and social benefits. Managing for healthy forests is important in order to increase fiber production, reduce the risk of wildfire, decrease risk of pest infestations and improve wildlife habitat. However, there are impediments to forest management given various social factors. First, one of the primary tools for forest management is the use of prescribed fire. While prescribed fire has numerous ecological, environmental benefits, and economic benefits, the biggest barrier to the use of it is smoke management. Smoke created by prescribed fire creates a liability for a landowner, especially if used near busy roads, large urban centers and other heavily populated areas. As such, many landowners tend to shy away from prescribed fire, thus leading to unhealthy forests. A second external factor is the transfer of property to heirs throughout the country. This turnover in land ownership creates a gap in knowledge for proper management, and again, can lead to unhealthy forests.

What has been done

In response to the barriers for healthy forests, Clemson University Extension Agents led efforts to close the knowledge gap to forest management and to educate landowners on proper prescribed fire management. Traditional workshops across the state were conducted to educate landowners and other natural resource professionals about the use of prescribed fire. Topics discussed included South Carolina laws, how to write a burn plan, prescribed fire certification, wildland urban interfaces, weather conditions, smoke management and insurance policies and safety. A youth education program discussing good fire from bad fire was also presented to 5th graders across the state. To assist new landowners on best forest management practices, a program was developed titled, Woodland Management Program. This program is a series of workshops and rotates around the state delivering content. The content for the 2017 program included invasive species management, insect and diseases and habitat management practices that included backpack sprayer calibration. In addition, there has been increased efforts to reach out to new landowners through county landowner associations.

Results

As a result of the efforts by the Agents, an increased number of landowners are considering using prescribed fire as part of a forest management plan. The prescribed fire program has potentially impacted 438,430 acres of forested land. The 5th grade students throughout the state, through pre- and post-tests indicated that they learned prescribed fire is beneficial and it is ok to use it when appropriate. This is in direct contrast to the pre-test which showed a bias against all fire, controlled or otherwise. This increase in knowledge among youth can have a synergistic effect to educate parents and siblings when a situation, such as the use of prescribed fire to control a wildfire, is presented. The Woodland Management Program has impacted new and existing landowners throughout the state through the 5-week series on forest management. This new knowledge acquired by participants has the potential to see gains for improved forest health, fiber production, and wildlife habitat over the next 20 years. The increased efforts to target new landowners to join county landowner associations has seen positive results. With participation now between 30-40 members for one single county representing over 10,000 acres, and another county reporting over 19,500 acres, better forest management practices will likely be implemented with long-term benefits.

4. Associated Knowledge Areas

KA Code	Knowledge Area
112	Watershed Protection and Management
122	Management and Control of Forest and Range Fires
123	Management and Sustainability of Forest Resources
124	Urban Forestry
136	Conservation of Biological Diversity

V(H). Planned Program (External Factors)

External factors which affected outcomes

- Economy
- Competing Public priorities

Brief Explanation

V(I). Planned Program (Evaluation Studies)

Evaluation Results

The SC State research projects are in their embryonic stages, therefore evaluation results have not materialized.

A total of 1,249 programs were conducted reaching 18,975 people and potentially impacting over 1.2 million acres of forested land. Volunteers such as Master Naturalists contributed over 19,359 hours, which represented \$422,994 of program support (\$21.85/hr.). The total acres affected by Master Naturalist volunteers was over 1,000,000. Therefore, a combined 2.2 million acres has the potential of being impacted statewide.

Key Items of Evaluation

V(A). Planned Program (Summary)

Program # 4

1. Name of the Planned Program

Food Safety

Reporting on this Program

V(B). Program Knowledge Area(s)

1. Program Knowledge Areas and Percentage

KA Code	Knowledge Area	%1862 Extension	%1890 Extension	%1862 Research	%1890 Research
502	New and Improved Food Products	10%	0%	20%	0%
503	Quality Maintenance in Storing and Marketing Food Products	10%	20%	17%	5%
703	Nutrition Education and Behavior	15%	30%	0%	35%
712	Protect Food from Contamination by Pathogenic Microorganisms, Parasites, and Naturally Occurring Toxins	30%	20%	33%	20%
723	Hazards to Human Health and Safety	35%	10%	30%	20%
724	Healthy Lifestyle	0%	20%	0%	20%
Total		100%	100%	100%	100%

V(C). Planned Program (Inputs)

1. Actual amount of FTE/SYs expended this Program

Year: 2017	Extension		Research	
	1862	1890	1862	1890
Plan	5.0	3.5	3.5	2.0
Actual Paid	5.0	5.5	2.8	2.0
Actual Volunteer	0.0	0.0	0.0	0.0

2. Actual dollars expended in this Program (includes Carryover Funds from previous years)

Extension		Research	
Smith-Lever 3b & 3c	1890 Extension	Hatch	Evans-Allen
239222	255469	171289	329566
1862 Matching	1890 Matching	1862 Matching	1890 Matching
239222	255469	116570	329566
1862 All Other	1890 All Other	1862 All Other	1890 All Other
0	0	502858	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

The major goal of the SC State research dealing with ozone treatment as an alternative for conventional fumigation to manage stored products in insects was to evaluate ozone as an alternative control option. Ozone is an oxidizing agent that degrades rapidly into oxygen, thereby making it a safe potential alternative. Research focused on the effects of ozone on three stored product insect pests; the merchant grain beetle - MGB (*Oryzaephilus mercator*), cigarette beetle - CB (*Lasioderma serricorne*) and rice weevil - RW (*Sitophilus oryzae*). Insects were exposed to different ozone concentrations in a custom-built bench-top model of ozone generating equipment for different durations. All insect stages: eggs, larvae, pupae and adults of all insects were tested. Prior to the experiments, the MGB was reared on rolled oats, while the CB was reared on a 95% whole wheat flour and 5% yeast diet mix. The RW was reared on whole wheat. Data is recorded in Microsoft Excel spreadsheet files for statistical analyses.

SC State research is being conducted on the United States and European Union (US-EU) transatlantic trade and investment partnership (TTIP) focusing on its potential impacts on food safety and South Carolina agricultural production, exports and trade. The project has completed the design of the SC representative farm models. A preliminary analysis of NASS (National Agricultural Statistical Services) data on SC farms was conducted. The analysis included farms from 1992 through 2012. Surveys have been collected from 190 farmers assessing their knowledge of aflatoxins. Of the 190 farmers surveyed, 58% reported they never heard of aflatoxins, 26% indicated they somewhat knew about it, while only 16% definitely knew about aflatoxins. The results indicate a need to educate more farmers on information about aflatoxins. Testing for aflatoxin associated with peanuts and corn of SC farmers has been conducted. The results showed that peanut samples 4p and 6p exhibited aflatoxin levels greater than 25 ppb as recommended by the USDA. Similarly, corn samples 2C, 11C and 14C displayed levels greater than 25 ppb, thereby posing a health threat.

SC State Extension provided educational workshops and hands-on demonstrations of best handling food practices. The agents emphasized the hand washing techniques and proper personal hygiene when dealing with food. Participants were able to gain knowledge and skills for safe handling of food. Food safety and nutrition information was disseminated to the participants.

Clemson research will be conducted to develop a rapid, sensitive, specific, and cost-effective bioassay for detection of viable *Mycobacterium avium* subspecies paratuberculosis (Map) in milk and fecal samples.

Safe handling of food was taught by Clemson Extension agents to handlers in the food service industry and the general public. Commercial food processors were targeted in an effort to improve commercial food processing efficiencies and effectiveness to develop new markets and improve commercial handling, processing, preservation and packaging to provide safe and high quality foods. Agents and specialists covered topics such as common food-borne pathogens, additives, preservatives and basic kitchen safety

techniques. Participants increased knowledge and skills in safe handling of food. Managers and supervisors were certified to train food handlers in safe food handling techniques. Food handlers practiced safe food handling techniques. Specialists assisted in the development of new food businesses.

2. Brief description of the target audience

The target audience includes community leaders, agencies, policy makers, general public, limited resource families, food service managers, supervisors, food handlers, producers, commercial food handlers, processing and packaging industry, entrepreneurs seeking to start food businesses or improve existing food business, media and other marketing contacts, and publication outlets - doctors' offices and grocers.

3. How was eXtension used?

eXtension was not used in this program

V(E). Planned Program (Outputs)

1. Standard output measures

2017	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	1468	1034944	375	34

2. Number of Patent Applications Submitted (Standard Research Output)

Patent Applications Submitted

Year: 2017
 Actual: 0

Patents listed

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2017	Extension	Research	Total
Actual	0	4	4

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Licenses

Year	Actual
2017	0

Output #2

Output Measure

- Disclosures

Year	Actual
2017	0

Output #3

Output Measure

- Number of people completing educational workshops.

Year	Actual
2017	1790

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O. No.	OUTCOME NAME
1	Number of participants reporting increased knowledge in safe food handling and applying practices learned.
2	Number of managers/supervisors/food handlers completing educational program and receiving a course certificate
3	Number of new or improved food products entering the market as a result of adopting recommended practices
4	Number of people reached through media outlets that utilize Extension food safety resources.

Outcome #1

1. Outcome Measures

Number of participants reporting increased knowledge in safe food handling and applying practices learned.

2. Associated Institution Types

- 1862 Extension
- 1890 Extension
- 1890 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	1267

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

The Food Safety program promotes healthy lifestyles and improves the quality and safety of food for the citizens of South Carolina.

What has been done

Agents and specialists conducted 190 programs in the area of food safety and food preservation education, which included topics such as the Food Safety Modernization Act, the Food Entrepreneur, and Food Preservation. Agents also developed, produced, and edited a video titled "The Holidays, Hand Washing and Hygiene." The Better Process Control School was offered to certify food manufacturers who are using thermal processing to render their products safe for sale. Certification is required for sales in South Carolina. In addition, agents taught classes food preservation using canning, freezing, jam and jelly-making methods

Results

Videos are a useful medium for educating younger audiences on safe food handling practices. Agents, also, used radio, TV, YouTube, local newspapers, and journals to educate consumers on food safety. Topics covered included the proper use of food thermometers, food safety for summertime activities, and requirements to sell food in South Carolina. Agents also posted a series of 13 posts to Facebook during Food Safety Education Month.

4. Associated Knowledge Areas

KA Code	Knowledge Area
503	Quality Maintenance in Storing and Marketing Food Products

703	Nutrition Education and Behavior
712	Protect Food from Contamination by Pathogenic Microorganisms, Parasites, and Naturally Occurring Toxins
723	Hazards to Human Health and Safety
724	Healthy Lifestyle

Outcome #2

1. Outcome Measures

Number of managers/supervisors/food handlers completing educational program and receiving a course certificate

2. Associated Institution Types

- 1862 Extension
- 1890 Extension
- 1890 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	260

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

The Centers for Disease Control estimates that one in six individuals will become sick from the consumption of contaminated food each year. About 3,000 individuals each year die from foodborne illness in the U.S. A foodborne illness outbreak can be costly resulting in negative media exposure, potential lawsuits, legal fees and insurance premiums. In addition, a restaurant's sales, reputation and staff morale can all decrease.

What has been done

In an effort to reduce food-borne illness, agents conducted ServSafe® food safety training for managers, supervisors, and other food handlers. A total of 260 (73%) food-service employees earned a course completion certificate, representing 181 food establishments. The National Restaurant Association estimates that, on average, a food-borne illness outbreak costs an establishment about \$75,000.

Results

The approximate economic value of the trainings has been conservatively estimated to be \$13,575,000 by preventing foodborne illness outbreaks.

4. Associated Knowledge Areas

KA Code	Knowledge Area
503	Quality Maintenance in Storing and Marketing Food Products
703	Nutrition Education and Behavior
712	Protect Food from Contamination by Pathogenic Microorganisms, Parasites, and Naturally Occurring Toxins
723	Hazards to Human Health and Safety
724	Healthy Lifestyle

Outcome #3

1. Outcome Measures

Number of new or improved food products entering the market as a result of adopting recommended practices

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	257

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Food entrepreneurs need knowledge on safety and wholesomeness of their products before they may sell them to the public. Their product must be in compliance with all local, state, and federal regulations. Moreover, food industry personnel who manufacture, process, package or distribute food are required by the FDA and SC Department of Agriculture to be certified in either HACCP (Juice, Seafood, Poultry or Meat) or HARPC (all other human food not covered by HACCP and apart of the Food Safety Modernization Act).

What has been done

Food2Market is a Clemson University Cooperative Extension Service program that assists food entrepreneurs in meeting the state and federal regulations and safety requirements necessary to produce and sell foods. Food2Market personnel worked with the South Carolina Department of Agriculture, South Carolina Department of Health and Environmental Control and Clemson's Livestock Poultry Health Department to deliver regulatory information and requirements for foods produced and sold in state.

Results

A survey was conducted of entrepreneurs who have made contact since the program began. Of those surveyed, 30% had products tested through the program, 53% of the respondents had products currently on the market for sale, 42% remain in the development stage, with the intention to begin selling soon and 5% had decided that they no longer wished to produce their product(s) for sale. Approximately 65% of respondents stated that they would prefer on-line training and about 45% of respondents are interested in attending workshops. As a result of the Food2Market Program, a total of 257 product tests including pH, water activity, NFPs, and gluten were conducted. There were gross sales of \$23,085. A total of 409 entrepreneur contacts were made via phone and email and approximately 120 Process Control Letters mailed. Fourteen persons became HACCP certified. The team is currently developing an online food safety workshop and plans to have this available within the next year.

4. Associated Knowledge Areas

KA Code	Knowledge Area
502	New and Improved Food Products
503	Quality Maintenance in Storing and Marketing Food Products
712	Protect Food from Contamination by Pathogenic Microorganisms, Parasites, and Naturally Occurring Toxins

Outcome #4

1. Outcome Measures

Number of people reached through media outlets that utilize Extension food safety resources.

Not Reporting on this Outcome Measure

V(H). Planned Program (External Factors)

External factors which affected outcomes

- Economy
- Appropriations changes
- Public Policy changes
- Government Regulations
- Populations changes (immigration, new cultural groupings, etc.)

Brief Explanation

V(I). Planned Program (Evaluation Studies)

Evaluation Results

At SC State preliminary results indicated that wheat in 30 cm high, 10 cm diameter PVC pipes exposed to ozone may have lower germination rates depending on the exposure duration and the depth within the PVC pipe. Further studies will be carried out to validate the observation. The estimated lethal concentration values indicated that higher ozone concentrations were required when insects were exposed to ozone with food compared to

when the insects were treated without food. When food was provided, adults were the most tolerant and when food was not provided, eggs were the most tolerant. Larvae were the least tolerant regardless of the presence or absence of food. Longer exposure times are required to kill insects when they were treated with food. Food may be absorbing some of the ozone and, as a result, need to be saturated before the gas is available to have an effect on the insects.

A brochure was developed to give farmers an overview on the importance of being aware of the deleterious effects of aflatoxins on corn and peanuts. A questionnaire was developed by SC State researchers to ascertain the knowledge base of farmers regarding aflatoxins. A new protocol was developed testing the effects of ozone on peanuts. The protocol sought to explore the efficacy of using ozone as a deterrent for aflatoxin contamination on peanut and corn crops.

A survey was conducted of entrepreneurs who have made contact since the Clemson Food2Market program began. Of those surveyed, 30% had products tested through the program, 53% of the respondents had products currently on the market for sale, 42% remain in the development stage, with the intention to begin selling soon. Approximately 65% of respondents stated that they would prefer on-line training and about 45% of respondents are interested in attending workshops.

Key Items of Evaluation

V(A). Planned Program (Summary)

Program # 5

1. Name of the Planned Program

Agribusiness and Community Development

Reporting on this Program

V(B). Program Knowledge Area(s)

1. Program Knowledge Areas and Percentage

KA Code	Knowledge Area	%1862 Extension	%1890 Extension	%1862 Research	%1890 Research
601	Economics of Agricultural Production and Farm Management	10%	10%	0%	10%
602	Business Management, Finance, and Taxation	25%	10%	0%	5%
603	Market Economics	10%	10%	0%	10%
608	Community Resource Planning and Development	40%	10%	0%	15%
609	Economic Theory and Methods	0%	10%	55%	0%
610	Domestic Policy Analysis	10%	10%	0%	10%
801	Individual and Family Resource Management	0%	5%	0%	10%
802	Human Development and Family Well-Being	0%	5%	45%	15%
803	Sociological and Technological Change Affecting Individuals, Families, and Communities	0%	5%	0%	15%
806	Youth Development	0%	5%	0%	0%
903	Communication, Education, and Information Delivery	5%	20%	0%	10%
	Total	100%	100%	100%	100%

V(C). Planned Program (Inputs)

1. Actual amount of FTE/SYs expended this Program

Year: 2017	Extension		Research	
	1862	1890	1862	1890
Plan	10.0	7.0	7.0	5.0
Actual Paid	13.0	6.0	2.1	3.0
Actual Volunteer	0.0	0.0	0.0	0.0

2. Actual dollars expended in this Program (includes Carryover Funds from previous years)

Extension		Research	
Smith-Lever 3b & 3c	1890 Extension	Hatch	Evans-Allen
619379	363285	264442	573271
1862 Matching	1890 Matching	1862 Matching	1890 Matching
619379	363285	60640	573271
1862 All Other	1890 All Other	1862 All Other	1890 All Other
0	0	159285	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

Research papers were published in peer reviewed journals; professional presentations were made; surveys/questionnaires were developed and data collected. SC State has six research projects within the planned program. The research investigates dynamic linkages among capital investment, export, agribusiness, education, business climate, quality of life variables and economic development; data envelopment analysis (DEA) based integrated logistics network system designed to improve supply chain efficiency; exploring can US export credit programs enhance exporting opportunities and increase income for small agribusinesses and small farmers; accelerating the usage of digital communication technologies by small agribusiness firms; reduction of transient related power blackouts to lessen the crops and livestock losses by US farms; the spoilage of refrigerated agricultural products and improving agritourism marketing in South Carolina.

SC State research developed an innovative framework for designing an integrated logistics network, as it is an important strategic decision that significantly affects the overall performance of supply chain management activities. The procedure used generates inputs and outputs directly from the multi-objective mathematical model, so DEA would be more realistically applied to identify the efficient schemes. Case studies were used to illustrate the actual data in SC to demonstrate the applicability of the innovative approach. Another study focused on the beneficial linkage of export promotion of the US. It was reported from a designed questionnaire that the average farm income for a SC small farmer in 2016 was \$17,483 per annum. Three case studies were developed.

Investigation continues on accelerating the usage of digital communication technologies. Data was gathered from 174 small businesses that provided valuable insight into digital self-proficiency levels of agribusiness operatives in SC, their attitudes towards the benefits of digital visibility and the impact of having a website on business performance. An AgBusiness Digital Media Lab was established and assisted 7 businesses in creating and implementing a digital marketing strategy through logo design, content creation, website development and website optimization. Training modules related to digital marketing, social media, E-commerce and website optimization were developed.

In studying the reduction of transient instability related power blackouts to lessen crops, the researcher implemented a new transient stability method. The new method allowed for real-time localized control of transient stability, in order to reduce power blackouts. Transient inability is known to be a major cause of power blackouts that can have devastating effects in terms of significant losses of crops and livestock by US farms and substantial spoilage of refrigerated agricultural products.

A newly implemented research project for this reporting period is improving agritourism marketing in South Carolina. The research activities will lead to the identification of current and potential small farm agritourism practitioners and the marketing challenges they face in developing and communicating agritourism experiences and resources. A set of best practices in agritourism marketing will be identified.

Clemson Extension agents conducted the SC New & Beginning Farmer Program, the Feeding

Innovation program and Steps to Becoming a Successful Entrepreneur Workshop. Agents interviewed growers for development of the Peach Production Budget for the SCPC grant initiative, updated the Tobacco Enterprise Budget, taught financial management at the South Eastern Ag Lenders School, and helped farmers with financial record keeping systems. Agents coordinated the Ag and Art Tour to increase in purchases of locally grown food through new producer-consumer relationships and developed a Creative Inquiry Course to study avenues to increase economic opportunity for a small town. Agents continued assistance to existing farmers markets and with the establishment of new markets.

A new NIMSS system was developed by Clemson Researchers on a modern web framework and secured using industry standard techniques. Additional features and functions were developed at the request of the NIMSS management team and these features have been integrated into the application and are live for all appropriate users.

All projects are now indexed into search engine that allows for a much faster and more accurate search result from the system. This allows users to find projects that they are interested in much faster and will provide more accurate results

2. Brief description of the target audience

The target audience includes students, child care providers, limited-resource persons, community leaders, board/council members, nonprofit organization boards and groups, adults, youth, business and workforce preparation agencies and disadvantaged citizens and communities, state, federal, and local agency personnel, association members, citizens faced with public issues, and citizens engaged in economic and tourism development.

3. How was eXtension used?

eXtension was not used in this program

V(E). Planned Program (Outputs)

1. Standard output measures

2017	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	5366	78655	0	0

2. Number of Patent Applications Submitted (Standard Research Output)

Patent Applications Submitted

Year: 2017

Actual: 1

Patents listed

Signal Transduction Biology Based Antifouling Coating

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2017	Extension	Research	Total
Actual	0	10	10

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Number of publications and business plans.
Not reporting on this Output for this Annual Report

Output #2

Output Measure

- Total number of people completing educational workshops.

Year	Actual
2017	3663

Output #3

Output Measure

- Number of business owners increased knowledge.
Not reporting on this Output for this Annual Report

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O. No.	OUTCOME NAME
1	Total number of people reporting increased knowledge in community improvement and development as a result of participation in CLED activities.
2	Number of participants engaged in agribusiness and community promotion projects

Outcome #1

1. Outcome Measures

Total number of people reporting increased knowledge in community improvement and development as a result of participation in CLED activities.

Not Reporting on this Outcome Measure

Outcome #2

1. Outcome Measures

Number of participants engaged in agribusiness and community promotion projects

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	3663

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Clemson Extension recognized a need to create new and expand strategic relationships with municipalities and towns for rural development and workforce development.

What has been done

Agents implemented the Steps to Becoming a Successful Entrepreneur Workshop which was structured to use entrepreneurs for lectures and mentoring for undergraduate students. A partnership was formed with the Piedmont Technical College to promote the program. More than 500 people have attended the programs. In addition, the Freshwater Coast Center for Rural Development was created to promote professional/business relationship among students and businesses, to foment collaboration among local colleges in the area of entrepreneurship, and to build a network of advocates and financial supporters among entrepreneurs (of all kinds) to sustain the growth of the regions.

Results

Several feasibility studies were created to support local community members to assess the market potential for their enterprises. Two new farmers markets were created in the Freshwater

Coast region - the McCormick Farmers Market and the Calhoun Falls Farmers Market. Visibility for Clemson Extension has been increased in the Freshwater Coast region and can be measured by community involvement in terms of number of organizations participating and collaborating with the Freshwater Coast Center for Rural Development. Nearly 10 new businesses were created in the region due to this effort.

4. Associated Knowledge Areas

KA Code	Knowledge Area
601	Economics of Agricultural Production and Farm Management
602	Business Management, Finance, and Taxation
603	Market Economics
608	Community Resource Planning and Development
802	Human Development and Family Well-Being
803	Sociological and Technological Change Affecting Individuals, Families, and Communities

V(H). Planned Program (External Factors)

External factors which affected outcomes

- Economy
- Public Policy changes
- Competing Public priorities
- Populations changes (immigration, new cultural groupings, etc.)

Brief Explanation

V(I). Planned Program (Evaluation Studies)

Evaluation Results

The survey conducted by SC State revealed that a total of 2.7% of the farmers said that they export their products. Of those who did not export, only 41.6% said they wanted to learn about the export market. A total of 78.9% were not familiar with the Commodity Credit Corporation (CCC) of USDA. Ninety-four percent did not know about GSM 102 (General Sales Management), which is provided by the CCC for US farmers and agribusiness getting cover against non-payment risks from their foreign buyers. A total of 65.8% were willing to participate in a workshop to learn more about the US export credit programs.

Of the 174 surveys, 73% of the businesses stated having a website benefited them in attracting new customers. Sixty-eight percent reported an increase in new inquiries, 52% reported an increase in brand trust and 45% reported an increase in sales. Overall, businesses without websites evaluated themselves as less proficient, while dealing with technology than the ones that implemented technology in their day to day business operations.

One research project set-up a mini power system research laboratory.

More than 500 agritourism businesses in the region have been identified and input into a project database.

Key Items of Evaluation

Clemson's patent pending anti-fouling deterrent technologies, in which the organism's own endocrine molecules when covalently bound to a polymeric coating act to deter settlement has the potential to be scaled up as a commercial product.

V(A). Planned Program (Summary)

Program # 6

1. Name of the Planned Program

4-H Youth Development and Families

Reporting on this Program

V(B). Program Knowledge Area(s)

1. Program Knowledge Areas and Percentage

KA Code	Knowledge Area	%1862 Extension	%1890 Extension	%1862 Research	%1890 Research
801	Individual and Family Resource Management	5%	10%	0%	20%
802	Human Development and Family Well-Being	15%	20%	0%	25%
803	Sociological and Technological Change Affecting Individuals, Families, and Communities	30%	20%	0%	25%
806	Youth Development	50%	50%	0%	30%
Total		100%	100%	0%	100%

V(C). Planned Program (Inputs)

1. Actual amount of FTE/SYs expended this Program

Year: 2017	Extension		Research	
	1862	1890	1862	1890
Plan	22.0	11.5	0.0	2.0
Actual Paid	29.0	9.5	0.0	1.0
Actual Volunteer	15.0	0.0	0.0	0.0

2. Actual dollars expended in this Program (includes Carryover Funds from previous years)

Extension		Research	
Smith-Lever 3b & 3c	1890 Extension	Hatch	Evans-Allen
895343	411376	0	266545
1862 Matching	1890 Matching	1862 Matching	1890 Matching
895343	411376	0	266545
1862 All Other	1890 All Other	1862 All Other	1890 All Other
0	0	0	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

Clemson Agents as well as SC State Agents and volunteers reached youth and family members through educational programs on agriculture, science and technology, natural resources, leadership, food safety, nutrition, and health. In STEM programs, youth used critical thinking and problem-solving skills. Youth in Clemson Extension 4-H programs are involved in hands on nature based programs such as Jr. Master Gardener, 4-H20, Dairy Heifer, Livestock, Barrow, Swine, Sheep, Beef, Poultry/Embryology, Gardening, Goat, Horse, Rabbit, Lamb, 4-H Pollinator Program and other plant and animal projects. Youth participated in hunting safety programs, natural resource clubs, 4H20 camps, shotgun clubs, 4-H archery clubs, wildlife camp, water ecology projects, Wildlife Food Plot Projects, 4-H Small Engine Repair and 4-H Woodworking with Nature programs. Agents reached youth and adults during in school and after school programs, day camps, summer camps, community centers, Head Start, churches, and libraries. Agents used various media, including social media outlets to publicize nutrition information. Agents produced educational modules with videos for School Gardening for SC educators online course and produced a Jr. Naturalist curriculum. Extension Agents gave presentations at the National Association of 4-H Agents Conference on South Carolina 4H Wildlife Food Plot Project and the 4H Robotics and Drone Projects at 4-H National Congress.

SC State had two on-going research projects and one project that ended under the planned program, during the reporting period. One project investigates African-American males' exposure to mathematics, another project assesses the degree of developmentally appropriate assessment, curriculum and best strategies utilized by community-based child care center-based programs, while the other project focuses on financially literate entrepreneurship for rural youth and families in two lowcountry high schools of SC.

The summer mathematics enrichment program was a success for the cohort of sixth through eighth grade black males. All the parents and participants enjoyed the program and suggested making it longer. An After-School program and Saturday Academy were established. The researcher developed a support system through tutoring and mentoring. Another researcher examined financially literate entrepreneurship for 50 rural youth and families as a pilot study in two SC lowcountry high schools. Created, disseminated and collected pre-test and post-test survey data. Data were being analyzed, at the time of the reporting period. The research, also, provided entrepreneurship and financial literacy training as well as organized and held the first showcase of students' projects. The third project assessing community based child care center-base programs came to completion. The goals and objectives were accomplished and a bulletin was prepared documenting the final results.

2. Brief description of the target audience

The 4-H program targeted youth between the ages of five and eight, youth between the ages of nine and nineteen, parents and other adults interested in the development of South Carolina youth, parents and young adults ages 30-44, mature volunteers ages 45-64, grandparents and senior volunteers ages 65+, adult learners (college students), and Teachers. In addition to the youth and parents, a SC State research project targeted child care centers.

3. How was eXtension used?

eXtension was not used in this program

V(E). Planned Program (Outputs)

1. Standard output measures

2017	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	3546	1101756	77682	87

2. Number of Patent Applications Submitted (Standard Research Output)

Patent Applications Submitted

Year: 2017

Actual: 0

Patents listed

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2017	Extension	Research	Total
Actual	0	2	2

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Number of people participating in educational workshops conducted

Year	Actual
2017	73460

Output #2

Output Measure

- Total number of adult volunteers (including non-Extension staff) trained in club, school enrichment, and special interest program delivery and management in all 4-H project areas.

2017 South Carolina State University and Clemson University Combined Research and Extension Annual Report of Accomplishments and Results

Year	Actual
2017	3546

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O. No.	OUTCOME NAME
1	Number of trained adult volunteers and staff, (including non-Extension staff) who teach subject matter and life skills to youth
2	Number of youth who gain knowledge in leadership and citizenship project areas
3	Number of youth participating in service learning projects for the community and to improve themselves, and help others.
4	Number of youth who gain knowledge and skills about plants, livestock and/or pets.
5	Number of youth who develop knowledge and skills in science, engineering, and technology (including electricity, computers, pontoon classroom, etc.).
6	Number of youth who gain knowledge in natural resources and shooting sports.
7	Number of youth who develop and improve communication skills through speaking and debating.
8	Number of youth increased knowledge in financial management.

Outcome #1

1. Outcome Measures

Number of trained adult volunteers and staff, (including non-Extension staff) who teach subject matter and life skills to youth

2. Associated Institution Types

- 1862 Extension
- 1890 Extension

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	3546

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

There is a need for an effective system to develop volunteer trainers in 4-H Youth Development.

What has been done

Clemson Extension trained over 3,546 adult volunteers, who then trained youth in leadership development; hunting safety; plant and animal projects; science, technology and engineering projects; day and overnight camping; and nutrition, health and fitness. Agents and volunteers used Facebook, web pages, Skype, exhibits, and traditional media to promote youth development programs. Volunteers also participated in the state Volunteer Leaders Symposium. They receive a monthly newsletter with helpful information from the state 4-H office.

Results

Volunteers were equipped for leadership roles and have made positive impacts and contributions in their communities and trained youth with new knowledge and skills. 4-H adults and teens contributed 21,294 hours of volunteer service, which represents a \$465,273 value of program support. Volunteers reported seeing significant improvement in the children's overall problem-solving skills as well as the children's willingness to work together as a team to solve problems and make decisions. In addition, there were reports that youth used creativity and displayed increased self- confidence and self-pride as they accomplished projects.

4. Associated Knowledge Areas

KA Code	Knowledge Area
806	Youth Development

Outcome #2

1. Outcome Measures

Number of youth who gain knowledge in leadership and citizenship project areas

2. Associated Institution Types

- 1862 Extension
- 1890 Extension

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	16781

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Youth have basic needs that include developing a sense that they are valuable contributing members of their family and community. 4-H helps them serve more effectively in their leadership roles at the club, county, regional, or state levels.

What has been done

Clemson 4-H youth participated in leadership training which included record keeping and portfolio development for financial management, ambassador training, 4-H State Congress, Teen Council Retreat, Senior Teen Weekend, Jr. Teen Weekend, local club and teen council officer training, Junior Leadership, Parliamentary Procedures Training, and the Southern Region Teen Leadership Conference. Youth participated in 4-H Ambassador training, which teaches them how to effectively represent 4-H to the public and are involved in writing and speaking to the media. Youth also completed a 4-H Babysitter Course. The weeklong 4-H Pinckney Leadership Conference brought 30 high school sophomores and juniors from across South Carolina to Clemson's campus to participate in numerous activities designed to promote teamwork, leadership and citizenship. Educational sessions at the conference focused on understanding various leadership styles and getting to know themselves better.

Results

Pinckney Leadership Conference attendees reported that they learned much about self-awareness, integrity, respect, teamwork and patience. Special recognition was presented for character and the most improved. Each participant left the conference with a vision board, a plan to have a positive impact on their community, which could include volunteering time, starting a 4-H club, running for student council or other leadership areas. Overall, all of the youth indicated that they learned about Communication, Who I Am, Leadership Skills, Speaking Out for Myself, Taking Risks, The Importance of Service to the Community, the Importance of Getting Involved in

Your Community and Social Media. Gains have been reported in knowledge of civic engagement, improvement in self-esteem, new skills demonstrated, and improved connections to the community.

4. Associated Knowledge Areas

KA Code	Knowledge Area
801	Individual and Family Resource Management
802	Human Development and Family Well-Being
803	Sociological and Technological Change Affecting Individuals, Families, and Communities
806	Youth Development

Outcome #3

1. Outcome Measures

Number of youth participating in service learning projects for the community and to improve themselves, and help others.

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	4967

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Findings from the 4-H Study of Positive Youth Development indicate that young people in 4-H are three times more likely to contribute to their communities than youth not participating in 4-H.

What has been done

Students planned and participated in service projects at local nonprofits including Help4Kids (a weekend food distribution program for needy students across the county), Habit for Humanity, where students worked to get their resell store in place, and Lighthouse Ministries, where students performed a number of different hands-on jobs, such as organizing food pantry and wrapping Christmas gifts. Students participated in Operation Gratitude writing letters to our active armed forces. Members of one 4-H Club were bell ringers for the Salvation Army at Wal-Mart during the Christmas season. Other club members worked on a mosaic stones and made ornaments for the nursing home residents. Youth prepared 313 HERO packs for Army National Guard youth with deployed South Carolina family members. 4-Hers decorated holiday boxes for

nursing home residents and made gift bags for law enforcement. The Valentines for Vets was an activity where 4Hers made valentines cards and flower pens for Veterans. For Project Operation Young Heroes, 4Hers wrote letters to military children to be placed in hero packs and delivered during Month of the Military Child. Clubs conducted a canned food drive for victims of Hurricane Matthew. Eight youth attended the National 4-H Congress and participated in National Congress service projects.

Results

Youth volunteers gave approximately 3198 service hours. The service hours that were contributed were valued at more than \$69,876 (hrs. x \$21.85/hr.). Studies show that youth develop in areas of civic engagement, respect, and social responsibility through participating in service-learning projects. Service learning can also have a positive effect on students' ability to relate to culturally diverse groups (Fox, 2010). These traits have been observed in youth participating in service projects. Youth learned about their communities and were contributing members in them.

4. Associated Knowledge Areas

KA Code	Knowledge Area
801	Individual and Family Resource Management
802	Human Development and Family Well-Being
806	Youth Development

Outcome #4

1. Outcome Measures

Number of youth who gain knowledge and skills about plants, livestock and/or pets.

2. Associated Institution Types

- 1862 Extension
- 1890 Extension

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	66476

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Research reveals that when children have hands-on experiences with nature, the results can lead to fewer incidents of anxiety and depression, improved self-esteem, enhanced brain

development, and a sense of connectedness to the community and the environment. They have opportunities for such development by participating in the 4-H Plants and Animals project.

What has been done

Youth were involved in animal projects such as, pullet, embryology, livestock, swine, horse, rabbit, lamb, and goat. Youth participated in the Horse Bowl, Hippology Competition, Junior Beef Round Up, State Barrow Project, Southern Regional 4H Horse Championships, SC National Livestock Judging Team Contest. 4-Hers learned environmental conservation through participation in activities such as establishing community gardens, the SC 4-H Small Garden Project, and Jr. Master Gardener Program. County 4-H units continued to partner with school districts to establish and maintain butterfly and vegetable gardens.

Results

The youth were able to experience gardening, from soil and seed and from the market to the table. 4-H Community Gardening efforts alone have impacted more than thousands of youth and families through active participation and community outreach. Youth learned about composting, rainwater harvesting, and watershed pollutants. By raising show animals and competing in livestock shows, the youth learned valuable animal husbandry lessons in nutrition, genetics, reproduction, animal health, and handling techniques. Youth also were able to increase their ability to select good livestock and learned the responsibility needed to raise and manage these animals. Showing livestock also helps build confidence in the youth and teaches them responsibility. One 4-Her was awarded 1st Place in his showmanship class and 1st Place over his showmanship division at the North American International Livestock Exposition (NAILE) for his skills in showing and raising meat goats.

4. Associated Knowledge Areas

KA Code	Knowledge Area
801	Individual and Family Resource Management
802	Human Development and Family Well-Being
806	Youth Development

Outcome #5

1. Outcome Measures

Number of youth who develop knowledge and skills in science, engineering, and technology (including electricity, computers, pontoon classroom, etc.).

2. Associated Institution Types

- 1862 Extension
- 1890 Extension

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	34718

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Science and technology skills are needed if youth are to keep up with the rapidly changing knowledge-based and knowledge-transfer society. Most careers that began in 2012 required some knowledge of geospatial technology and systems. The 4-H program in South Carolina offers youth the opportunity to develop knowledge and skills in science, engineering, and technology.

What has been done

In 4-H Clubs youth worked with Ozobots. Ozobots introduce kids to simple coding. The 4H Tech Wizards at the Naval Weapons Station started Junk Drawer Robotics, a hands on 4H STEM curriculum, which engages youth in engineering design through the use of common household items. The curriculum was developed to focus on scientific and engineering practices frame activities in the experiential learning cycle and promote small group collaborative learning. The group completed several introductory activities meant to teach them how to communicate like a scientist and how to use the Engineering Design Process. Groups used Ozobots to design and build flashlights, a bubble machine and a drawing robot.

Results

Over 17,213 youth participated in the 4-H STEM projects. 4-Hers constructed simple robots and began programming robots using classroom laptops. These projects improved their technology skills as well as taught them teamwork and communication skills as they work together in groups. Through the robotics program they demonstrated the use of math, deductive reasoning, critical thinking, problem solving, and creativity, which are valuable life skills. They increased their knowledge of engineering as they designed, built and improved their designs.

4. Associated Knowledge Areas

KA Code	Knowledge Area
802	Human Development and Family Well-Being
803	Sociological and Technological Change Affecting Individuals, Families, and Communities
806	Youth Development

Outcome #6

1. Outcome Measures

Number of youth who gain knowledge in natural resources and shooting sports.

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	2061

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Many youth either participate in hunting or have family members who hunt and, therefore, have access to guns. Some youth do not have any formal training in the safe use and handling of firearms. Although rare, accidents with firearms do occur, and often are the result of improper handling of firearms. Exposing youth to firearms and teaching both adults and youth the proper way to safely handle firearms can reduce the risk of accidents. In addition, this program promoted natural resource conservation.

What has been done

Youth participated in hunting safety programs, natural resource clubs, 4-H archery clubs, forestry, and 4H20 camps, and wildlife programs. Some 2,061 youth participated in natural resources and shooting sports program, including shotgun clubs. Youth studied components of wildlife habitat, water quality, and environmental stewardship.

Results

4-H established partnerships with high schools and colleges to deliver programming. Youth demonstrated wise decision-making skills and self-confidence. They demonstrated caring of their environment and established food plots to benefit small game and other wildlife species. They demonstrated proper shotgun handling.

4. Associated Knowledge Areas

KA Code	Knowledge Area
806	Youth Development

Outcome #7

1. Outcome Measures

Number of youth who develop and improve communication skills through speaking and debating.

2. Associated Institution Types

- 1862 Extension
- 1890 Extension

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	474

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Youth need opportunities to develop assets such as good communication skills, organizational abilities, reasoning skills, and self-confidence. They have opportunities for such development, through their participation in the 4-H Communication and Expressive Arts projects.

What has been done

Thirteen programs were conducted reaching 474 (ES-237) youth. Youth gave presentations and demonstrations during club and county level contests and gave speeches at community organizations promoting 4-H.

Results

Youth successfully prepared and gave presentations. They demonstrated good communication skills, organizational abilities, reasoning skills, and self-confidence. Youth researched various topics and presented information.

4. Associated Knowledge Areas

KA Code	Knowledge Area
802	Human Development and Family Well-Being
806	Youth Development

Outcome #8

1. Outcome Measures

Number of youth increased knowledge in financial management.

2. Associated Institution Types

- 1890 Extension

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	1939

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

A 2017 study by the Program for International Student Assessment (PISA) showed that one in five (22%) US students lack basic financial literacy skills. The study emphasized there were no improvements in overall financial literacy among US teens compared with a similar study in 2012, which revealed significant differences in performance based on economic status. Three percent of US students from lower-income schools were high performers, compared to 45% of students from higher-income schools. Among the low-performers, 38% of students were from low-income schools, compared to 16% from higher-income schools.

What has been done

To improve the understanding of key personal finance concepts, lessons on budgeting and "paying yourself first", the difference between credit and debit, "wants vs. needs", charitable giving and other financial management topics were taught.

Results

As a result of the program, when reviewing the pre and post test scores, approximately 1721 of the program participants indicated knowledge gained (89%).

4. Associated Knowledge Areas

KA Code	Knowledge Area
801	Individual and Family Resource Management
802	Human Development and Family Well-Being
803	Sociological and Technological Change Affecting Individuals, Families, and Communities
806	Youth Development

V(H). Planned Program (External Factors)

External factors which affected outcomes

- Economy
- Appropriations changes
- Competing Public priorities
- Competing Programmatic Challenges
- Populations changes (immigration, new cultural groupings, etc.)

Brief Explanation

V(I). Planned Program (Evaluation Studies)

Evaluation Results

In regard to the African American male project, most of the participants showed improvement on their post-test. The average increase for the group was about 15 points.

Research dealing with financially literate entrepreneurship, administered pre-test and post-test surveys for data collection. Four workshops were conducted.

The project assessing community based child care center based programs came to an end. A final bulletin was developed providing the results of the research. Some of the findings, on a whole, were interpreted as child care teachers were unaware of the need to focus curriculum on democratic values; commitment to ethical behavior was anecdotally present amongst child care classrooms, if not systematically present; child care teachers at the centers did not consistently rely on using goals to guide their actions in a connected way; developmentally appropriate assessment may not be prevalent among rural-based child care centers; anecdotal records, audio video recordings and self-portraits were developmentally appropriate assessments used least of all by all child care center teachers in the study overall; deliberately forming positive relationships was not at the foundation of the participating teachers' daily teaching habits and the teachers in the study showed a lack of knowledge of a broad mastery of developmentally appropriate teaching approaches. The researcher suggested helping teachers change to more appropriate practices as some next steps were outlined in the bulletin.

Observation and pre-post tests were conducted. 4-H youth used math skills, critical thinking and creativity to address issues and solve problems which are valuable life skills. They contributed to their communities, learned how to work in teams, and demonstrated leadership. 4-H adults and teens contributed 21,294 hours of volunteer service, which represents a \$465,273 value of program support.

Of the 1939 participants utilizing the Money Smart Curriculum, 1721 indicated they increased their knowledge of financial management.

Key Items of Evaluation

V(A). Planned Program (Summary)

Program # 7

1. Name of the Planned Program

Nutrition and Childhood Obesity

Reporting on this Program

V(B). Program Knowledge Area(s)

1. Program Knowledge Areas and Percentage

KA Code	Knowledge Area	%1862 Extension	%1890 Extension	%1862 Research	%1890 Research
701	Nutrient Composition of Food	0%	10%	0%	10%
702	Requirements and Function of Nutrients and Other Food Components	0%	10%	0%	10%
703	Nutrition Education and Behavior	50%	30%	0%	40%
723	Hazards to Human Health and Safety	5%	30%	0%	10%
724	Healthy Lifestyle	45%	20%	0%	30%
Total		100%	100%	0%	100%

V(C). Planned Program (Inputs)

1. Actual amount of FTE/SYs expended this Program

Year: 2017	Extension		Research	
	1862	1890	1862	1890
Plan	21.0	5.0	0.0	3.0
Actual Paid	28.0	2.0	0.0	1.0
Actual Volunteer	10.0	0.0	0.0	0.0

2. Actual dollars expended in this Program (includes Carryover Funds from previous years)

Extension		Research	
Smith-Lever 3b & 3c	1890 Extension	Hatch	Evans-Allen
496117	161586	0	335303
1862 Matching	1890 Matching	1862 Matching	1890 Matching
496117	161586	0	335303
1862 All Other	1890 All Other	1862 All Other	1890 All Other
0	0	0	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

Clemson University Cooperative Extension and SC State Extension focused on nutrition and wellness programs for youth directed towards the prevention of childhood obesity, increasing physical activity and the development of food preparation skills that fit current nutritional needs and lifestyles. Agents organized health fairs and taught boot camps and workshops for school cafeteria supervisors and state staff from across South Carolina. Agents taught youth and adult audiences about basic nutrition, making healthy food choices, reading food labels, and the importance of eating a balanced breakfast through workshops such as Dietary Guidelines, Healthy Lifestyles, MyPlate, Eat Smart-Live Strong, Quest for Health, Cooking With A Chef, Kids in the Kitchen, Eating From the Garden, and Rethink Your Drink.

SC State Research had a total of five research projects under the planned program area. One researcher focused on using growth assays to establish that, in pancreatic and lung cancer cells, using a combination treatment of drugs, significantly inhibited cell growth. The IC 50 values showed a range of concentrations. Consequently, Western analysis experiments showed that apoptotic proteins were being expressed in 2 pancreatic cell lines and 1 lung cancer cell line. Several intermediates of the signaling pathway (PAKT, cleaved caspase PARP) have been verified. In order to provide further proof of apoptotic activity, ELISA assays were conducted successfully. Experiments using siRNA techniques are being developed.

In conducting research at SC State on investigating food derived AGEs in relation to obesity and breast cancer, a GC/MS analysis method useful for quantitation of the biomarkers CML and CEL from obese and normal breast tissue samples were achieved. Amounts of CML and CEL from cancerous and non-cancer tissue samples indicated implications of age and obesity in the development and propagation of ductal carcinoma cancer disease. The research was postponed due to a terrible car accident that involved the researcher, during the report period.

Furthermore, SC State research analyzed the role of high pro-inflammatory diets and childhood obesity. SC children from varying degrees of rurality (Chesterfield, Newberry and Richland counties) to determine if obesity and/or high-fat pro-inflammatory diets contribute to increased levels of pro-inflammatory markers and obesity related genes to include: Adiponectin, leptin, SAA1/2, Interleukin 1 and 6. Pro-inflammatory genes (SAA1, ADP, CRP and IL-1 β) were expressed at varying levels among participants with direct correlation to diet.

More research looked at achievement motivation for child obesity prevention. The research study aimed to find a relationship between child achievement motivation and child obesity prevention and use that knowledge in obesity prevention with the considered population. Being that the research was in its infancy, a web-based training course was completed.

To finalize the research on reclaiming a healthy heritage project, 40 preschool students were given a food habit questionnaire, food histories to complete and a medical screening, in order to understand the eating habits, food intake of the children and to realize how they have fared the pre and post project weight as a result of being in the study. Nutritional newsletters were developed and gardens were planted. Students assisted in the planting, picking and preparation of foods from the gardens. They, also, assisted in adding ingredients to nutritional recipes and tasting the vegetables during snack/lunch time.

2. Brief description of the target audience

The target audience includes agencies that serve all income levels, including limited resource families, youth and children as well as the general youth and adult audiences.

3. How was eXtension used?

V(E). Planned Program (Outputs)

1. Standard output measures

2017	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	35114	1057531	0	0

2. Number of Patent Applications Submitted (Standard Research Output)

Patent Applications Submitted

Year: 2017
 Actual: 0

Patents listed

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2017	Extension	Research	Total
Actual	0	0	0

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Number of children and youth reached in healthy eating programs.

Year	Actual
2017	17615

Output #2

Output Measure

- Number of youth completing educational workshops.

Year	Actual
2017	67155

Output #3

Output Measure

- Number of youth gained knowledge in nutrition and fitness.

Year	Actual
2017	17615

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O. No.	OUTCOME NAME
1	Number of people gaining knowledge as a result of participating in educational workshops.
2	Number of children and youth gaining knowledge in eating healthy foods.
3	Number participants reporting increase knowledge in safe food handling and nutrition.

Outcome #1

1. Outcome Measures

Number of people gaining knowledge as a result of participating in educational workshops.

2. Associated Institution Types

- 1862 Extension
- 1890 Extension
- 1890 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	27855

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

The prevalence of overweightness and obesity has become one of the most critical health issues in both South Carolina and the United States. Overweightness and obesity cut across all ages, economic levels, and racial and ethnic groups. In South Carolina, over sixty percent of all adults are now either overweight or obese. Children learn eating behaviors from adults and peers. In the US, nearly one out of three children and teens ages 2 to 19 is overweight or obese. The S.C. Obesity Burden Report found that 64 percent of middle school students and 76 percent of high school students did not attend physical education classes each week and less than 25 percent consumed the recommended daily servings for fruit and vegetables.

What has been done

Nutrition Agents taught or implemented some 3,512 programs including Youth Voice, Youth Choice children's nutrition lessons, cooking camps, 4H Healthy Lifestyles Programs and clubs, MyPlate, Eat Smart-Live Strong, Quest for Health, Cooking With A Chef, Kids in the Kitchen, cook-offs and contests, and other nutrition programs. Youth participated in 4H Food & Nutrition contests held during state and regional fairs. The Senior 4H Healthy Lifestyles Cooking Team participated in the national competition at the Great American Seafood Cook-off in New Orleans where they learned how to cook seafood and research South Carolina grown commodities. Culinary Boot Camp teaches food service workers how to create healthy and delicious school meals. Culinary Partners and Clemson University's Expanded Food and Nutrition Education Program (EFNEP) team offered eight boot camps and training for 288 school cafeteria, supervisors and state staff from across South Carolina. In addition, the Expanded Food and Nutrition Education Programs were conducted for 534 limited resource families, reaching 1,853 individuals, to improve nutrition practices, food safety, and food resource management practices such as planning meals, comparing prices, and using grocery lists.

Results

Ninety-eight percent of the participants in the Culinary Boot Camps reported that they increased their nutrition knowledge about fruits, vegetables, snacks and serving sizes. Food service workers identified at least one action to pursue in their districts. A total of 90% of the participants reported that they increased their nutrition knowledge about MyPlate, Dietary Guidelines and six basic nutrients.

4. Associated Knowledge Areas

KA Code	Knowledge Area
701	Nutrient Composition of Food
703	Nutrition Education and Behavior
723	Hazards to Human Health and Safety
724	Healthy Lifestyle

Outcome #2

1. Outcome Measures

Number of children and youth gaining knowledge in eating healthy foods.

Not Reporting on this Outcome Measure

Outcome #3

1. Outcome Measures

Number participants reporting increase knowledge in safe food handling and nutrition.

Not Reporting on this Outcome Measure

V(H). Planned Program (External Factors)

External factors which affected outcomes

- Economy
- Public Policy changes
- Competing Public priorities
- Populations changes (immigration, new cultural groupings, etc.)

Brief Explanation

An SC State researcher was in a terrible car accident and the research had to be postponed, during the report period.

V(I). Planned Program (Evaluation Studies)

Evaluation Results

In Expanded Food and Nutrition Education Programs, 98% of the participants improved in one or more nutrition practices. More than 81% improved in one or more food safety practices; 95% improved in one or more food resource management practices; 42% of participants increased the amount of physical activity; 98% of participants improved their diet; 53% increased fruit consumption; 54% increased vegetable consumption; and 55% increased consumption of calcium-rich foods. In evaluating the role of high pro-inflammatory diets and childhood obesity, SC State's preliminary results suggest increased expression of pro-inflammatory markers were directly correlated to diet irrespective of weight class (normal, overweight, obese). Survey analysis indicated that many of the participants ate a variety of foods, both healthy and processed foods. The results suggest that the intake of high-fat diets (pro-inflammatory/fast foods) present with increased expression of the pro-inflammatory markers seen irrespective of weight class (normal, overweight, obese). Despite recruitment efforts, participants were hesitant to enroll/participate in the study. Data analysis is ongoing.

SC State's research focusing on achievement motivation for child obesity prevention had chosen 15 participants for participation in the study. Three workshops were conducted to gain knowledge and use problem solving techniques.

To conclude the research on reclaiming a healthy heritage, two newsletters were provided to the stakeholders by SC State. Three vegetables were planted and harvested. The foods prepared and grown were tomatoes, collards and sweet potatoes. A summer nutritional camp was held. The study found that there was a decrease in physical activity among students and an increase in screen time (playing video/computer games, watching movies and television, etc.), which nutrition plays a key role in the prevalence of obesity. Two generations (preschoolers and elders) worked together to enhance the awareness of the benefit of growing and eating healthy foods. A bulletin is being edited for publication of findings.

Key Items of Evaluation

V(A). Planned Program (Summary)

Program # 8

1. Name of the Planned Program

Climate Change

Reporting on this Program

Reason for not reporting

Reason for not reporting

Research efforts in Climate Change were moved to the Natural Resources Program because there was complementary work underway there which will allow increased levels of collaboration and an expanded resource base. The move will also facilitate the Experiment Station's efforts to cluster related research at the project level.

V(B). Program Knowledge Area(s)

1. Program Knowledge Areas and Percentage

V(C). Planned Program (Inputs)

1. Actual amount of FTE/SYs expended this Program

Year: 2017	Extension		Research	
	1862	1890	1862	1890
Plan	0.0	0.0	5.0	0.0
Actual Paid	{NO DATA ENTERED}	{NO DATA ENTERED}	{NO DATA ENTERED}	{NO DATA ENTERED}
Actual Volunteer	{NO DATA ENTERED}	{NO DATA ENTERED}	{NO DATA ENTERED}	{NO DATA ENTERED}

2. Actual dollars expended in this Program (includes Carryover Funds from previous years)

Extension		Research	
Smith-Lever 3b & 3c	1890 Extension	Hatch	Evans-Allen
{NO DATA ENTERED}	{NO DATA ENTERED}	{NO DATA ENTERED}	{NO DATA ENTERED}
1862 Matching	1890 Matching	1862 Matching	1890 Matching
{NO DATA ENTERED}	{NO DATA ENTERED}	{NO DATA ENTERED}	{NO DATA ENTERED}
1862 All Other	1890 All Other	1862 All Other	1890 All Other
{NO DATA ENTERED}	{NO DATA ENTERED}	{NO DATA ENTERED}	{NO DATA ENTERED}

V(D). Planned Program (Activity)

1. Brief description of the Activity

The forest floor detritus layer is the major source of terrestrial nutrients to aquatic ecosystems, affecting many environmental processes in soil and water. New Clemson research addresses the effects of severity and frequency of prescribed burns on the production and exports of pollutants and nutrients in forested watersheds. The knowledge gained from combined laboratory and field studies will increase our understanding of fundamental physical and chemical processes controlling the formation and movement of pollutants and nutrients in forest ecosystems, and the roles of organic matter in pollutants transformation and transport in actively managed forests.

In southern USA, especially in the Gulf and Atlantic Coastal Plains, loblolly and longleaf pine are two major species under widespread management on both public and private lands. Managers are constantly making choices to favor one species over the other, and this decision will have a long-lasting impact on southern forests, especially considering ongoing climate change due to global warming. The new Clemson project is designed to quantify the growth differences and differential disturbance responses between loblolly and longleaf pine. Results from the project will help land managers to make better informed decision, which should result in a forest condition that is better adapted to, or better equipped to mitigate, future climate change.

2. Brief description of the target audience

The target audience will include regulatory agencies, resource managers, local county and municipal officials and public works staff.

3. How was eXtension used?

{No Data Entered}

V(E). Planned Program (Outputs)

1. Standard output measures

2017	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	0	0	0	0

2. Number of Patent Applications Submitted (Standard Research Output)

Patent Applications Submitted

Year: 2017

Actual: {No Data Entered}

Patents listed

{No Data Entered}

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2017	Extension	Research	Total
Actual	0	0	0

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Disclosures

Year	Actual
2017	0

Output #2

Output Measure

- Licenses

Year	Actual
2017	0

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O. No.	OUTCOME NAME
1	Provide knowledge to policy makers to assist in coping with the effects of climate change, particularly in the coastal region.

Outcome #1

1. Outcome Measures

Provide knowledge to policy makers to assist in coping with the effects of climate change, particularly in the coastal region.

2. Associated Institution Types

- 1862 Research

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	0

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

{No Data Entered}

What has been done

{No Data Entered}

Results

{No Data Entered}

4. Associated Knowledge Areas

KA Code	Knowledge Area
{No Data}	null

V(H). Planned Program (External Factors)

External factors which affected outcomes

- Natural Disasters (drought, weather extremes, etc.)
- Economy
- Public Policy changes
- Competing Public priorities
- Populations changes (immigration, new cultural groupings, etc.)

Brief Explanation

{No Data Entered}

V(I). Planned Program (Evaluation Studies)

Evaluation Results

{No Data Entered}

Key Items of Evaluation

{No Data Entered}

V(A). Planned Program (Summary)

Program # 9

1. Name of the Planned Program

Sustainable Energy

Reporting on this Program

V(B). Program Knowledge Area(s)

1. Program Knowledge Areas and Percentage

KA Code	Knowledge Area	%1862 Extension	%1890 Extension	%1862 Research	%1890 Research
123	Management and Sustainability of Forest Resources	100%	0%	30%	0%
402	Engineering Systems and Equipment	0%	0%	50%	0%
511	New and Improved Non-Food Products and Processes	0%	0%	20%	100%
	Total	100%	0%	100%	100%

V(C). Planned Program (Inputs)

1. Actual amount of FTE/SYs expended this Program

Year: 2017	Extension		Research	
	1862	1890	1862	1890
Plan	4.0	0.0	2.0	0.0
Actual Paid	1.0	0.0	0.6	1.0
Actual Volunteer	0.0	0.0	0.0	0.0

2. Actual dollars expended in this Program (includes Carryover Funds from previous years)

Extension		Research	
Smith-Lever 3b & 3c	1890 Extension	Hatch	Evans-Allen
32487	0	105791	145778
1862 Matching	1890 Matching	1862 Matching	1890 Matching
32487	0	49684	145778
1862 All Other	1890 All Other	1862 All Other	1890 All Other
0	0	154107	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

One new SC State research project dealing with reusing post-consumed plastics began this reporting period. The laboratories were cleaned and the instruments set to work for the project. The detector had to be repaired. Five types of the post consumed plastics were collected, washed and cut into small pieces, then air dried for further use.

The conversion of lignocellulosic biomass to soluble sugars remains the bottle neck for development of second generation biofuels. Clemson scientists are attempting to mimic natural degradation process by allowing the bacteria and fungi to work together to convert switchgrass to soluble sugars. A bacterial/fungal community has been developed and evaluated for the conversion of switchgrass.

Clemson Extension conducted educational programs and demonstration projects to help the producer make informed decisions to improve profitability of energy crops. A Clemson specialist developed a series on Trees For Energy Conservation Tree Selection and Placement video series. The video discusses the importance of tree selection and placement in maximizing energy savings from trees.

2. Brief description of the target audience

All consumers in the state will benefit from research and education programs related to lower cost energy options.

3. How was eXtension used?

A Trees for Energy Conservation video series was developed and published to eXtension.

V(E). Planned Program (Outputs)

1. Standard output measures

2017	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	285	0	0	0

2. Number of Patent Applications Submitted (Standard Research Output)

Patent Applications Submitted

Year: 2017
 Actual: 0

Patents listed

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2017	Extension	Research	Total
Actual	0	2	2

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Disclosures

Year	Actual
2017	0

Output #2

Output Measure

- License agreements

Year	Actual
2017	0

Output #3

Output Measure

- Number of people completing educational workshops

Year	Actual
2017	26

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O. No.	OUTCOME NAME
1	Number of people reporting knowledge gained in sustainable energy and land management and diversification strategies.

Outcome #1

1. Outcome Measures

Number of people reporting knowledge gained in sustainable energy and land management and diversification strategies.

2. Associated Institution Types

- 1862 Extension
- 1890 Extension

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	26

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Biodiversity is the foundation of ecosystems to which human well being is linked. Decisions that humans make that influence biodiversity affect the well-being of themselves and others.

What has been done

A Trees for Energy Conservation video series was developed and published to eXtension. The video series is provided by the Southern Regional Forestry Extension Office and the USDA Forest Service National Urban and Community Forestry Advisory Council. An Extension specialist presented a paper on the demand for tough trees in tough sites while fostering biodiversity at the Southern Chapter 75th Annual Conference & Trade show, in partnership with the Utility Arborist Association.

Results

Biodiversity is relevant to managed systems such as wildlands, nature preserves, parks, plantations, farms, croplands, aquaculture sites, and rangelands. Given that cultivated systems alone now account for more than 24% of earth's terrestrial surface, it is critical that any decision concerning biodiversity address issues of maintenance, as humans have the capacity to affect environment in either good or bad ways. Those attending the conference indicated that they gained knowledge.

4. Associated Knowledge Areas

KA Code	Knowledge Area
123	Management and Sustainability of Forest Resources
402	Engineering Systems and Equipment

V(H). Planned Program (External Factors)

External factors which affected outcomes

- Economy
- Public Policy changes
- Competing Public priorities
- Populations changes (immigration, new cultural groupings, etc.)

Brief Explanation

V(I). Planned Program (Evaluation Studies)

Evaluation Results

One manuscript was accepted for publication, in addition to poster and oral presentations being made.

Key Items of Evaluation

V(A). Planned Program (Summary)

Program # 10

1. Name of the Planned Program

Global Food Security and Hunger

Reporting on this Program

V(B). Program Knowledge Area(s)

1. Program Knowledge Areas and Percentage

KA Code	Knowledge Area	%1862 Extension	%1890 Extension	%1862 Research	%1890 Research
203	Plant Biological Efficiency and Abiotic Stresses Affecting Plants	10%	10%	10%	10%
204	Plant Product Quality and Utility (Preharvest)	10%	25%	21%	15%
205	Plant Management Systems	15%	25%	24%	20%
211	Insects, Mites, and Other Arthropods Affecting Plants	0%	0%	7%	0%
212	Pathogens and Nematodes Affecting Plants	25%	0%	10%	0%
213	Weeds Affecting Plants	10%	0%	4%	10%
216	Integrated Pest Management Systems	20%	10%	8%	15%
601	Economics of Agricultural Production and Farm Management	5%	30%	16%	10%
701	Nutrient Composition of Food	5%	0%	0%	20%
	Total	100%	100%	100%	100%

V(C). Planned Program (Inputs)

1. Actual amount of FTE/SYs expended this Program

Year: 2017	Extension		Research	
	1862	1890	1862	1890
Plan	30.0	8.0	33.0	1.0
Actual Paid	27.0	7.8	20.5	1.0
Actual Volunteer	0.0	0.0	0.0	0.0

2. Actual dollars expended in this Program (includes Carryover Funds from previous years)

Extension		Research	
Smith-Lever 3b & 3c	1890 Extension	Hatch	Evans-Allen
1316073	339636	2524002	205315
1862 Matching	1890 Matching	1862 Matching	1890 Matching
1316073	339636	2857584	205315
1862 All Other	1890 All Other	1862 All Other	1890 All Other
0	0	6199116	0

V(D). Planned Program (Activity)

1. Brief description of the Activity

Clemson Extension agents taught row crop scouting, and scouted thousands of acres for pests and other problems. Extension horticultural programs included topics such as pesticide certification and re-certification, record-keeping and financial decision-making, New and Beginning Farmer Program, reduction of soil loss on newly established orchards, school gardening, strawberry production meetings, organic vegetable production workshop, soil health, peach update program, vegetable meeting, vegetable field day, sprayer calibration, high tunnel workshop, Food Safety Modernization Act Class. Official Variety Trials of all major agronomic crops were conducted in multiple locations across the state. Clemson Extension agronomic related educational programs were conducted during the year pertaining to farm safety, pasture hay irrigation and nutrient management planning, insect management, sprayer calibration, peanut maturity, and private and commercial pesticide application training. The pass rate for the private applicator exams was 88%. Topics that were covered during the programs included pesticide record keeping, personal protective equipment for safe pesticide application, calibration of liquid and dry pesticide application equipment, and pesticide use in field crops common to the area.

The SC State research dealing with alternative sources of vegetable oil from non-edible plant seeds identified seeds based on their ease of cultivation and short maturation periods. The seeds included peanut, soybean, pecan, black-eyed susan and bachelor button cornflower. Other seeds include wild sunflower, lavender, Shasta daisy, morning glory and purple coneflower. Oils were extracted from the seeds and the densities and yields were determined. The iodine numbers and oil viscosities were identified. Biodiesel samples were experimentally produced from some of the selected seed oils. The Social Worker's role in improving food insecurity to promote healthy student development research has received referral forms from the two school sites (Calhoun and Orangeburg Counties), approved by the IRB (Institutional Review Board), since the project's inception in mid-year of 2017. Backpacks were provided to students in Calhoun County on the second and fourth Fridays of each month. A community resource booklet was developed. A partnership was established with Downtown Orangeburg Revitalization Association (DORA) farmers for the students and their parents. Food pantry sites were developed. The SC State Social Work students volunteered a total of 323.3 hours during the report period. The researcher trained 286 individuals (teachers, staff and administrators) to work with the grant.

Organic production has long been limited by the lack of potency of organic fertilizers. A Clemson Researcher developed a method for using bacteria isolated from the stomachs of cattle to produce an organic fertilizer so rich with ammonium that it rivals traditional synthetic fertilizers. The key is in hyper-ammonia-producing, or HAP, bacteria. The patented methodology describes methods for producing ammonia and ammonium in accordance with strict organic farming certification standards, as well as the systems -- in this case, bioreactors -- needed to carry out those methods.

2. Brief description of the target audience

Research in this program has the potential to benefit growers, state, federal and international agencies dealing with food production and distribution and with end users in countries around the world. Also, students and families needing resources to address food insecurities are targeted.

The target audience includes producers, Limited-Resource farmers and Extension personnel, agency personnel, producers, master gardeners, and growers.

3. How was eXtension used?

eXtension was not used in this program

V(E). Planned Program (Outputs)

1. Standard output measures

2017	Direct Contacts Adults	Indirect Contacts Adults	Direct Contacts Youth	Indirect Contacts Youth
Actual	40066	2107630	182	124

2. Number of Patent Applications Submitted (Standard Research Output)

Patent Applications Submitted

Year: 2017
 Actual: 2

Patents listed

Electro-Mechanical Controller for Adjusting Pump Stroke on the Go. Soybean Cultivar "Augustina" Release

3. Publications (Standard General Output Measure)

Number of Peer Reviewed Publications

2017	Extension	Research	Total
Actual	0	31	31

V(F). State Defined Outputs

Output Target

Output #1

Output Measure

- Disclosures

Year	Actual
2017	8

Output #2

Output Measure

- Licenses

Year	Actual
2017	1

Output #3

Output Measure

- Number of people completing educational workshops

Year	Actual
2017	13028

Output #4

Output Measure

- New Variety Releases

Year	Actual
2017	3

Output #5

Output Measure

- Number of youth participating in 4-H food systems programs

Year	Actual
2017	2400

V(G). State Defined Outcomes

V. State Defined Outcomes Table of Content

O. No.	OUTCOME NAME
1	Number of people reporting increased knowledge in agronomic practices that are environmentally sensitive and economically efficient.
2	Number of youth gaining knowledge of food systems
3	Number of producers indicating adoption of recommended agronomic crop production practices
4	Number of Master Gardeners applying skills learned and reporting activities.

Outcome #1

1. Outcome Measures

Number of people reporting increased knowledge in agronomic practices that are environmentally sensitive and economically efficient.

2. Associated Institution Types

- 1862 Extension
- 1890 Extension

3a. Outcome Type:

Change in Knowledge Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	27

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

The Sustainable Horticultural Production Program sought to improve profitability, increase efficiency, and reduce negative environmental impacts of horticultural cropping systems in South Carolina.

What has been done

Clemson Extension and 1890 Extension collaborated with limited resource farmers to bring innovation and new agricultural practices to help limited resource farmers save time and money. During these workshops farmers learned how to properly calibrate their fertilizer and herbicide spreaders. More advanced workshops taught them how to properly irrigate scout for diseases, and what markets to target. In order to decrease cost inputs, Extension Agents, local producers and experienced squash producers developed a spray schedule to reduce weed and disease incidence. Several trials were completed and concluded the best method for each producer.

Results

After the first year of collaboration, the agents saw an increase in farmer profits, which reflected the fact that most farmers implemented new methods that they had learned.

4. Associated Knowledge Areas

KA Code	Knowledge Area
203	Plant Biological Efficiency and Abiotic Stresses Affecting Plants
204	Plant Product Quality and Utility (Preharvest)
205	Plant Management Systems
212	Pathogens and Nematodes Affecting Plants

213	Weeds Affecting Plants
216	Integrated Pest Management Systems
601	Economics of Agricultural Production and Farm Management
701	Nutrient Composition of Food

Outcome #2

1. Outcome Measures

Number of youth gaining knowledge of food systems

2. Associated Institution Types

- 1862 Extension
- 1890 Extension
- 1890 Research

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	2400

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

Good food practices learned early on in life can mean the difference between healthy and unhealthy lifestyles for the consumer. Youth need to understand what the food systems means to them and how it affects their health.

What has been done

Agents conducted a five week online course for SC educators to teach fundamentals of school gardening. The program was designed to teach educators the horticulture principles so they can be successful building and growing school gardens. The program was developed in partnership with the College of Charleston's Food Systems Change Initiative, a multiagency partnership that works to improve student learning and health outcomes with funding from Boeing South Carolina. Agents also gave presentations on school gardening for SC educators at the 2016 American Horticulture Society National Children and Youth Gardening Symposium. Thirty educators from 18 schools participated.

Results

Teachers reported that students at one school have not only learned about science but are improving social skills as a result of growing a garden. Elementary schools are using the garden as part of their science curriculum. In addition, Clemson Extension agents conducted Master Gardening classes which covered topics such as raised bed gardening, fruit culture, pollinators in

the garden. Master Gardeners, in turn, implemented demonstration garden sites and garden education programs. 4-H Community Gardening efforts alone have impacted some 2400 youth and families through active participation and community outreach.

4. Associated Knowledge Areas

KA Code	Knowledge Area
701	Nutrient Composition of Food

Outcome #3

1. Outcome Measures

Number of producers indicating adoption of recommended agronomic crop production practices

2. Associated Institution Types

- 1862 Extension

3a. Outcome Type:

Change in Action Outcome Measure

3b. Quantitative Outcome

Year	Actual
2017	7095

3c. Qualitative Outcome or Impact Statement

Issue (Who cares and Why)

The proper timing of peanut harvest is one of the most important aspects of peanut production. Improper timing of peanut harvest can cause farmers to lose yield and profits. During the 2017 season, determining a digging date was extremely important due to the extremes in weather that local producers had throughout the summer, which resulted in several different stages of peanut maturity in fields across the area. Currently, the best solution to properly time peanut digging is proper monitoring of crop maturity.

What has been done

Agents educated and assisted farmers by conducting peanut maturity clinics and farm visits. Peanut maturity clinics were held in Orangeburg and Dorchester Counties. Samples of peanuts from fields were checked using the pod blast method. At the clinics, the samples that were checked represented approximately 5,000 acres of peanuts. After the clinics farm visits were made over the months of September and October, during the two month period, September and October farm visits were made to 25 farms with approximately 10,000 acres of peanuts. After determining the maturity of a field, agents were able to recommend that the producer either start or delay digging the crop. To further educate farmers on peanut production, copies of the Peanut Newsletter was provided throughout the peanut growing season by email or direct mailing for those without email addresses. Fifty peanut producers received timely information on current

management options for peanuts in South Carolina through emails.

Results

With a conservative estimate, it is easy to assume that the assistance with determining maturity and digging date saved producers 250 pounds of peanuts per acre. With the contract price of peanuts being \$500 per ton for Virginia Type (\$0.25 per pound) and \$450 for Runner Type (\$0.225 per pound) in 2017, these savings equal \$62.5 or \$56.25 per acre of peanuts, respectively. In 2017 these savings could have been a lot more on the Virginia type acres that were checked, due to the extremely high levels of the foliar disease, Late Leaf spot (*Cercosporidium personatum*), which can lead to defoliation of the plants and loss of peg strength.

4. Associated Knowledge Areas

KA Code	Knowledge Area
203	Plant Biological Efficiency and Abiotic Stresses Affecting Plants
204	Plant Product Quality and Utility (Preharvest)
205	Plant Management Systems
211	Insects, Mites, and Other Arthropods Affecting Plants
212	Pathogens and Nematodes Affecting Plants
213	Weeds Affecting Plants
216	Integrated Pest Management Systems
601	Economics of Agricultural Production and Farm Management

Outcome #4

1. Outcome Measures

Number of Master Gardeners applying skills learned and reporting activities.

Not Reporting on this Outcome Measure

V(H). Planned Program (External Factors)

External factors which affected outcomes

- Economy
- Public Policy changes
- Government Regulations
- Competing Public priorities
- Competing Programmatic Challenges
- Populations changes (immigration, new cultural groupings, etc.)

Brief Explanation

Wheat fields suffered damage from winter freeze.

V(I). Planned Program (Evaluation Studies)

Evaluation Results

In improving food insecurities research, 74 referrals were made from the project sites. Calhoun County high school distributed 35 food backpacks to students. At Saint Matthews K-8 school, 131 backpacks were distributed. The SC State Principal Investigator developed a community resource booklet and distributed 50 booklets to each grant site for parents and teachers. A partnership was formed with Downtown Orangeburg Revitalization Association (DORA) farmers to participate in selling produce at the grant sites to all accessibility to the students and their families. Seven community and SC State University partners donated over 3,000 canned goods and other non-perishable food items to the school pantries for the grant sites. Two additional partners (Food Lion and Aldi) donated monetary grants or gift cards totaling \$1,025.00.

Newly adopted planting method of peaches on raised beds shared by Clemson agents has increased the severity of rainfall runoff and resulting exponential increase in soil loss associated with erosion. Typical practice of pre-bedding with a heavy forestry bedding plow prior to transplanting of trees meant that field operations to level and establish seedbed for planting row middle cover was delayed until late December into January. This reduced the ability of the small grain cover to establish itself well enough to control / minimize runoff. Prior demonstration work with cover crops had established a potential soil savings to USDA and landowner stakeholders, but timing based on available equipment was the hindrance to success. The County Extension Agent secured grant dollars to secure a more appropriate bedding plow that could be operated after the establishment of cover crops was secured, modified, and tested on orchards in 2017. Cover was established immediately after fumigation which added a minimum of 90 days of growth compared to standard method. Several seed mixtures are established per Soil Health Initiatives (USDA funded demo) and soil loss calculations are being compared with the assistance of USDA-NRCS for typical soil series. A field demo and grower discussion was held to show the benefits of early establishment and proper operation of the equipment.

Soil loss in row middles was reduced by as much as 72% according to calculations using the Universal Soil Loss Equation. Overall soil loss reduction is noted, while on steeper slopes, still above sustainable levels. While concerns still bare true for continued issues with non-engineered planting sites, those without benefit of terraces or grasses outlets for water runoff.

Key Items of Evaluation

Results from research in 2017 showed in a test field with different soil types that the Clemson designed algorithm recommended 54, 47, and 31 lbs of N per acre in low, medium and high EC (electrical conductivity) zones, respectively, compared to grower's conventional uniform rate N application method (90 lbs./acre). On average, the Clemson algorithm applied 48% less N without affecting cotton yields. Similar results were obtained with other field trials in South Carolina, reducing N usage by 45 to 100 lbs./acre in cotton, compared to growers' application rates, with no negative effects on crop yields. This resulted in \$27 to \$60 savings/acre in fertilizer costs. The Clemson corn side-dress N algorithm reduced rates of fertilizer by 21% and 34% in two different soil types, compared to the normal grower practice (200 lbs. N/acre) with no reduction in corn yields.

VI. National Outcomes and Indicators

1. NIFA Selected Outcomes and Indicators

Childhood Obesity (Outcome 1, Indicator 1.c)	
14396	Number of children and youth who reported eating more of healthy foods.
Climate Change (Outcome 1, Indicator 4)	
0	Number of new crop varieties, animal breeds, and genotypes with climate adaptive traits.
Global Food Security and Hunger (Outcome 1, Indicator 4.a)	
8463	Number of participants adopting best practices and technologies resulting in increased yield, reduced inputs, increased efficiency, increased economic return, and/or conservation of resources.
Global Food Security and Hunger (Outcome 2, Indicator 1)	
0	Number of new or improved innovations developed for food enterprises.
Food Safety (Outcome 1, Indicator 1)	
0	Number of viable technologies developed or modified for the detection and
Sustainable Energy (Outcome 3, Indicator 2)	
0	Number of farmers who adopted a dedicated bioenergy crop
Sustainable Energy (Outcome 3, Indicator 4)	
0	Tons of feedstocks delivered.