FY 2020 Annual Report of Accomplishments and Results

South Carolina
Clemson University
SC State University

I. Report Overview

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

1. Executive Summary (Optional)

The COVID-19 crisis that started in March 2020 impacted the ability of both Clemson University and SC State University to continue to deliver Extension programming through traditional methods. Many of the Extension programs from both institutions had to be changed from traditional delivery methods (i.e. on-farm visits, in-person workshops, etc.) to online delivery, when possible. The COVID-19 crisis caused a delay of delivery or complete abandonment of some Extension programs. Furthermore, COVID-19 also impacted many research projects and delayed data collection, laboratory sampling, and face-to-face visits, causing delays in project initiation or project completion. While both institutions were still able to deliver their mission, the COVID-19 crisis altered our delivery and results.

Clemson University

An analysis of data from Clemson Cooperative Extension Service showed that there was a significant decline in the number of direct contacts for March 2020 – June 2020 as compared to the same time frame in 2019. However, it also showed that Clemson Extension was on track to exceed the number of direct contacts in the reporting year prior to the COVID-19 crisis. For Clemson Cooperative Extension, March – October is typically the busiest times of years for programmatic activities and work. Many programs, while converted to online delivery, may have not been able to reach intended audiences due to a variety of barriers, such as lack of infrastructure.

SC State

The restructuring changes mentioned in the 2019 POW Report continued to be implemented for the administration to carry out the desires of moving the organization forward and striving for excellence. A revised organizational chart was incorporated. The chart outlined the first three levels of the chain of command. Employees continue to be hired to fill vacant positions to meet the obligations of the new focus. Plans for some facilities will be closed and/or moved to new locations. As the restructuring process continues, staff will be trained and cross-trained on the new procedures and job responsibilities. Upon completion, it is anticipated the organization will operate at a higher level of effectiveness and efficiency, regardless of where the personnel are stationed or the unit they are assigned. Staff members will be able to fill-in for absent co-workers and continue to represent the organization in a professional manner to complete the assigned work. In an imperfect world, the organization is striving for excellence.

During FY 2019-2020, South Carolina (SC) State focused on the tri-part mission of research, teaching and extension/outreach. The SC State programs focused on critical issues dealing with agrisystems productivity and profitability; agribusiness and community development; environmental and natural resources conservation; food safety, security, and nutrition and youth and family development.

The programmatic thrust looked at the needs identified by stakeholders as the emerging issues impacting their communities. Agents and researchers explored and administered self-sustaining and economically enriching programs and activities to the citizens of South Carolina. The agents/researchers engaged in workshops, hands-on demonstrations, field experiences, laboratory experiments, case studies and data collection.

However, in 2020, the COVID-19 virus caused a pandemic, and the way business was being conducted came to a halt or temporarily slowed down. Agents and researchers had to make quick adjustments to program delivery and research methods. Agents learned to teach classes on-line and reconfigure programming of activities to administer to stakeholders. Researchers also had to make some adjustments.

A total of 26 research projects were funded for the reporting period. Five research projects ended during the reporting period of October 1, 2019 – September 30, 2020. Four research project administrators requested and received extensions because of mitigating circumstances they were unable to meet their original completion date. Four final bulletins were written and submitted for publication. However, five new projects came aboard.

II. Merit and Scientific Peer Review Processes

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

Process	Updates ONLY
1. The Merit Review Process	**Clemson University Experiment Station Merit Peer Review Process** 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, which is the Associate Dean for Research and Graduate Studies, the Department Chair of the principal investigator, 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 proposals submitted for new projects in addition with (2) external reviewers' comments 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. 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 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.
2. The Scientific Peer Review Process	In 2019, Clemson Extension launched Land-Grant Press by Clemson Extension. This is a peer-reviewed outlet for Clemson Extension publications aimed at professionals and private citizens. Each article submitted is assigned 2 internal reviewers and 1 external reviewer for accuracy and readability of the article. Reviewers are considered experts in their field and they have the option to accept the article as written, accept it with revisions, or reject the article. Once the article is deemed acceptable for publication, a final review is conducted by the Managing Editor and a Contributing Editor. This peer-review process ensures that all publications generated by Clemson Extension are up-to-date, factual, and accurate.

III. Stakeholder Input

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

Stakeholder Input Aspects	Updates ONLY
1. Actions taken to seek stakeholder input that encouraged their participation with a brief explanation	SC State: Communication with partners played a large part in connecting with stakeholders. Because of confidentiality laws, there had to be a means of communicating with stakeholders. The partners reached out to the stakeholders and exchanged the necessary information to complete the required work.
2. Methods to identify individuals and groups and brief explanation.	SC State: The way individuals and groups were identified, staff had to communicate through partners to get to the stakeholders. Packets were dropped off to partners for them to submit to the stakeholders. Staff had to develop an alternative service delivery method.
3. Methods for collecting stakeholder input and brief explanation.	SC State: Agents and researchers had to change their data collection methods to reach the stakeholders. Virtual lessons, live webinars and podcasts were developed. Stakeholders had to learn to use social media to communicate with staff. Telephone calls were made, conference calls (ZOOM, Teams, etc.) and emails were sent.
4. A Statement of how the input will be considered and brief explanation of what you learned from your stakeholders.	SC State: The input was considered as a means of trying to educate the staff. It was learned internet service was not readily available to many of the constituents, because they lived in regions where service was limited. Transportation was an issue to get to hot spots to connect to the internet. The staff will consider the input an attempt to provide internet service remotely through the mobile technology unit and other sources.

IV. Critical Issues Table of Contents

No.	Critical Issues in order of appearance in Table V. Activities and Accomplishments
1.	Agrisystems Productivity and Profitability
2.	Agribusiness and Community Development
3.	Environmental and Natural Resources Conservation
4.	Food Safety, Security, and Nutrition
5.	Family and Youth Development
6.	
7.	

V. Activities and Accomplishments

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

No.	Project or Program Title	Outcome/Impact Statement	Critical Issue Name or No.
1.	**Forage Production Webinars** *Clemson Extension*	***Situation:*** This spring has brought unusual circumstances for extension agents and producers as we maintain proper safety measures due to COVID-19. With hay season not stopping, a committee of livestock agents developed a series of forage production meetings via zoom. These meetings cover topics for warm-season forage production and weed management. This series will continue into the fall with plans to cover cool-season forages. ***Response:*** Two workshops in the series have been offered with around 30 producers participating in each webinar. ***Results:*** According to post-program surveys, producers found the topics timely and useful. A majority indicated they have started or plan to start implementing management practices learned in their operations. Over 1,000 acres of forage production was represented from participants gaining new or improved	**Agrisystems Productivity and Profitability** (Critical Issue #1)

		knowledge on warm-season forage production. Producers that responded to the survey indicate that these webinars have a significantly positive impact on their operation. On average the economic impact these webinars have, according to producers, ranged from $500-$3,000 for forage operations.	
2.	**Water Management and Quality for Ornamental Crop Production and Health** *Clemson Experiment Station*	***Situation:*** Floating wetlands are a relatively new technology used to remove nutrients from stormwater, but the capacity of floating wetlands to remove nutrients from nursery and greenhouse production runoff is not well documented. Plant production in greenhouse and nurseries typically generates irrigation return flow that contains nutrients above ecosystem-safe levels. Since 2015, researchers at Clemson University have tracked and assessed the growth and nutrient removal potential of over 10 species of plants in floating wetlands under variable nutrient levels, exposure times, and pH and alkalinity levels representative of the industry. ***Response:*** It was determined that modeling nutrient removal from water based on plant species used to establish floating wetland is possible and is additive, so if we can characterize plant nutrient uptake individually, we can predict how effectively mixed-species plantings in floating wetlands will remove nutrients from water. This information is critical for design and sizing of floating wetland installations to meet water quality goals. We also finished collating 3.5 years of flow rate and water quality (sediment, nutrients, and plant diseases) data from a Piedmont nursery. An extensive dataset related to water application volume and irrigation return flow volumes is now available. ***Results:*** The results were analyzed and both pre- and post-treatment technology installation data will be used in the future to characterize the impact of floating treatment wetlands on sediment, nutrient, and plant disease movement in the nurseries water infrastructure. We are confident in the quality of recycled water available for irrigation and are redesigning the irrigation infrastructure to enable use of recycled water for irrigation of outdoor container crops. In addition, experiments were concluded determining if phosphorus-saturated iron-oxide residuals from mine drainage could be used both (1) in filters to remove phosphorus from irrigation return flow and then (2) the P-saturated iron-oxide of the filter reused as a P fertilizer source in container production. Differences in crop appearance were evident among the 5 test species. Analytical results related to leachate, plant P uptake, and P remaining in the substrate are ongoing. Researchers further analyzed and published results from experiments with	**Agrisystems Productivity and Profitability** (Critical Issue #1)

		floating treatment wetlands determining the impact of plant species (single species vs. multi-species) on nutrient remediation. Uptake of nutrients from water by plants was additive in nature, as one could calculate removal rates of single plants and add them together to predict system nutrient uptake from water; while nutrient uptake within plant tissues was species dependent. Researchers have worked with collaborators at the University of Florida and developed an effective outreach platform that synthesizes information from researchers across the USA and collates it into useable information that growers can access on demand.	
3.	**Producers Focus on Better Integrated Management Practices** *SC State University Extension*	***Situation:*** Small scale commercial vegetable producers, farmers, gardeners, and livestock producers are facing increasingly higher production costs with their enterprises. They are seeking ways to keep their businesses afloat. Many of the small-scale producers have seen their profit margin decline. Unless they can get a handle on production costs, they could very well fail with their individual operations. ***Response:*** From the Low Country Extension region, participating small producers and gardeners received training in sustainable agriculture practices to include Integrated Pesticide Management of vegetable crops and livestock. The training activities were conducted in production meetings, training sessions, workshops, field demonstrations and farm tours. The primary focus was to limit off-farm input and maximize the on the farm output. It was evident that sustainable agriculture practices helped to reduce production costs and improve product marketability. ***Results:*** As a result of the training activities, ninety-two (92%) participants gained knowledge of sustainable agriculture practices, sixty-two (62%) adopted the practices and fifty (50%) of producers reported increased income.	**Agrisystems Productivity and Profitability** (Critical Issue #1)
4.	**Hearing Loss and the Health of Farmers and Agricultural Workers** *SC State University Research*	***Situation:*** Without safe food to consume and healthy farmers, sustainability of life in this country would be difficult. Therefore, people such as healthcare professionals, the public, farmers, agricultural workers, farm equipment manufacturers, and others should care about healthy farmers. Historically, noise exposure has been considered an occupational hazard to hearing health of farmers and other agricultural workers, and it has been recently implied that it contributes to ischemic heart disease and high blood pressure (Lusk, Hagerty, Gillespie, & Ziembaet, 2004; McCullagh, Lusk, & Ronis, 2002). Hypertension (high blood pressure) has been a major risk factor for African Americans and a precursor for transient ischemic attacks (TIA; mini-stroke) and cerebral vascular	**Agrisystems Productivity and Profitability** (Critical Issue #1)

		accidents (CVA; stroke). According to the South Carolina Department of Health Environmental Control (2013), South Carolina had the sixth highest stroke death rate in the nation in 2010 and is among a group of Southeastern states with high stroke death rates that is referred to as the "Stroke Belt". Because of the overwhelming statistics, it is imperative that we as healthcare professionals be the change agent in health literacy in every facet of life. ***Response:*** In Phase I of the project, the investigator was able to design the mobile hearing van with a sound treated booth and waiting area; develop a hearing conservation program to educate farmers on the importance of wearing hearing protection during continuous exposure to loud noises; develop a survey that assesses farmers' usage of hearing protection devices and exposure to loud noise; recruit participation from the Farmer Associations and Young Farmers of Orangeburg & Clarendon (expansion into Richland, Charleston, Bamberg, and Berkeley) counties. In Phase II of the project, the investigator obtained on-site hearing, noise levels, blood pressure measurements, and collected pre- and post-data. In addition, farmers were provided hearing protection devices (earmuffs and plugs), along with education materials and techniques for usage of hearing protection devices. ***Results:*** The project provided outreach to farmers and the agricultural communities of limited resources such health literacy in rural South Carolina. Because the leading cause of death in South Carolina was heart disease and African Americans face a higher risk of developing ischemic heart disease and suffer from stroke deaths more often than Caucasians, the project is attempting to educate and introduce healthy practices to improve farmers' level and quality of living while helping them achieve their goals through wise resource management.	
5.	**COVID-19 Market Development for SC farmers** *Clemson Extension*	***Situation:*** The impact of the COVID-19 pandemic has been felt in all areas of South Carolina's agricultural community. As restaurants and school cafeterias closed due to COVID-19 restrictions, some South Carolina farms saw the majority of their business disappear almost overnight. One area farm saw their sales drop 80% as their once regular wholesale accounts shut down. Some South Carolina farmers had to quickly change the way they have traditionally sold and marketed their products in order to sustain their farm businesses. ***Response:*** The Clemson Extension Agribusiness Team has been helping create an environment for SC farmers that will shield them from sudden market fluctuations by providing technical assistance and market development support.	**Agribusiness and Community Development** (Critical Issue #2)

		Results: One such initiative was working with the Catawba Farm and Food Coalition to facilitate the development of new market infrastructure and platforms, such as The Catawba Fresh Market, an online farmers market serving farmers in 5 counties. Since the Catawba Fresh Market platform allows customers to purchase local products virtually and then pick them up safely from pre-determined sites, sales have increased over 250% since the start of the COVID-19 restrictions. This growth in farmer revenue has helped to offset losses in other traditional markets while providing consumers with a safe outlet to buy local, fresh products.	
6.	**A Framework for Secondary Schools Agriscience Education Programs that Emphasizes the STEM Content in Agriculture** *Clemson Experiment Station*	***Situation:*** The focus of this research is to revitalize an interest in agriculture as a career path and ensure secondary school students have the prerequisite competencies to succeed in college and careers. Compounding the issue of recruiting and preparing qualified graduates to enter careers in agriculture sciences is the demand for workers with scientific expertise by numerous career areas. ***Response:*** The demand for traditional STEM workers continue to grow. The increasing demand for STEM talent allows for and encourages the disbursement of students and workers with STEM competencies across various career paths. However, these career paths cannot necessarily be predicted, so it is paramount for STEM-related programs to be on the cutting edge in terms of skills and abilities needed to perform at some level of occupation and education. ***Results:*** We have created awareness and interest in the middle and high school levels for careers in agricultural sciences. We are also preparing students for success in college, leading to a sustainable supply of well-educated agricultural scientists. Although it is important for agricultural educators to be able to discuss the application of principles from all aspects of STEM, the science and math concepts in the context of agricultural education have garnered the most attention in the literature base because of their direct application to agriculture. During this reporting period, we conducted a pilot test and the data is currently pending analysis. We also solicited feedback from stakeholders, reached out to agriculture teachers, university, faculty, and principals to gather feedback as we work toward reaching our goals. Their responses are currently being reviewed and planning is ongoing to move this forward for the next reporting period.	**Agribusiness and Community Development** (Critical Issue #2)

7.	**Citizenship: Hope for Young Men of Hope Youth (YMOH)** *SC State University Extension*	***Situation:*** It is essential for youth to understand the role of citizens in a democratic society and build skills that fosters basic life skills and character development. A recent study conducted by the Department of Applied Social Services from the University of Toledo and Hong Kong reveals positive youth development activities will increase youth's overall well-being, reduce behavior problems, and positively impact life satisfaction. The US Department of Education research states youth growing up in high-risk conditions are 50% more likely to be successful adults if they are engaged in cognitive and social skill development. Youth are projected to experience productive adulthood when they participate in experiences that provide opportunities for youth to develop competencies, values, and social skills. The goal of the Citizenship Project is to engage participants in projects and activities that promote social balance and focus on positive character traits and help to develop basic life skills. The YMOH is a male youth development initiative that focuses on encouraging participants to cultivate attitudes, attendance, academic achievement, and career paths. ***Response:*** The Low Country Region conducted projects and activities focused on character education and career preparation with 8 youth groups. Five hundred thirty-nine (539) youth were served in a combination of 33 presentations and workshops. The Extension service conducts Character Education and Career Preparation workshops and assists the group with scheduling motivational speakers and field trips. ***Results:*** As a result of the project activities, 55% of the participants reported knowledge gained. Fifty-nine percent (59%) of the participants developed better communication skills. Through participation in workshops and field trips, a high school participant was afforded the opportunity to gain employment upon graduating from high school. The participant credits his guidance in the program as the reason for identifying his career path and pursuing his goals. The participant was hired with the local school district as an auto-mechanic assistant.	**Agribusiness and Community Development** (Critical Issue #2)
8.	**Design of Resilient and Efficient Supply Chain Logistics Network (SCLN) System** *SC State University Research*	***Situation:*** Due to today's globalized, more complex supply chain systems and highly uncertain business environment, supply chains have become susceptible to disruptions. Thus, managing supply chain disruptions has received increasing attention following many costly and highly publicized disruptions. From a supply chain perspective, disruptions can result in serious economic and financial consequences and can lead to severe consequences. Since not all disruptions could be prevented or managed, companies are striving for more secure, resilient, and less vulnerable supply chains. With predictions that various types of	**Agribusiness and Community Development** (Critical Issue #2)

		disruptions are increasing, it is ever-more urgent that the firms identify, monitor, and plan for disruptive events. Supply chain resilience requires a backup supply, which needs backup facilities, backup capacities, and backup inventories. Backup supply requires various additional investment costs, inventory costs, and transportation costs besides the costs of primal facilities. Thus, the resilient SCLNs should also pursue supply chain efficiency. The supply chain efficiency can be obtained from the overall chain's performance rather than merely the performance of the individual supply chain members. Hence, an efficient supply chain system design has been a critical strategic decision. The project proposes an innovative approach and design procedure for obtaining the most efficient supply chain network schemes in terms of multiple objectives under the risk of facility disruption. ***Response:*** We have introduced the concept of an Emergency Backup Supply (EBS) System with the designated Secondary Supplying Facilities (SSFs) as well as the Primal Supplying Facilities (PSFs) for the Facility Location and Allocation (FLA) design problem under the risk of facility disruptions. The proposed productivity-driven FLA model with the EBS system could help decision-makers design and select efficient FLA schemes. Several papers were developed and submitted for publication. Hong, J. and K. Jeong, "Design of Facility Location-Allocation Network with an Emergency Backup Supply System," Preprint, 2020. *European Journal of Industrial Engineering*. Data envelopment analysis (DEA)-based ranking methods showed several shortcomings as the numbers of inputs and outputs for DMUs increase. To overcome such drawbacks, we have proposed an innovative two-step procedure of ranking DMUs more effectively and consistently. The following papers have been published or accepted for publication: Hong, J. and J. Mwakalonge, "Biofuel Logistics Network Scheme Design with Combined Data Envelopment Analysis Approach," *Energy*, 209, 118342 (October 2020). https://doi.org/10.1016/j.energy.2020.118342 Hong, J., "Application of Integrated Multiple Criteria Data Envelopment Analysis to Humanitarian Logistics Network Design," Preprint, 2020. *Journal of Systems Science and Systems Engineering*. Hong, J., "Applying Cross Efficiency Evaluation Methods for Multi-Objective Emergency Relief Supply Chain Network Model," Preprint, 2020. *International Journal of Industrial and Systems Engineering*.	

		We have applied a two-stage network DEA for designing the efficient biofuel supply chain logistics network configurations. This is the first attempt to use the concept of efficiency in designing biofuel facility location-routing network schemes. The following paper has been published: Hong, J., "Two-Stage Efficiency-Based Approach to Biofuel Supply Chain Logistics Network Design under the Risk of Disruptions," *International Journal of Industrial and Systems Engineering*, 36, no. 3 (October 2020): 339-360. https://doi.org/10.1504/IJISE.2020.110938 Besides, we have considered routing problems in addition to FLA problem and have applied various DEA methods to eliminate the traditional DEA methods' weaknesses: Hong, J. and K. Jeong, "Cross-Evaluation Based-Super Efficiency DEA Approach to Designing Disaster Recovery Center Location-Allocation-Routing Network Schemes," *Journal of Humanitarian Logistics and Supply Chain Management*, 10, no. 4 (2020): 485-508. doi 10.1108/JHLSCM-03-2020-0019. Hong, J. and J. Mwakalonge, "An Efficiency-Based Approach to Biofuel Facility Location-Routing Network Design," Preprint, 2020. *International Journal of Logistics Systems and Management*. ***Results:*** The project's most significant impact was the study sought to identify the option that would generate the most productive/efficient FLA with an Emergency Backup Supply (EBS) system under the risk of facility disruptions. The major difference between the research and the existing literature is that, under the EBS system in the study, a Primary Supplying Facility (PSF) can also serve as a Secondary Supplying Facility (SSF) for the demand points whose PSF cannot function due to the disruptions. In other words, each PSF is designated as an SSF for specific demand points. Most of the existing systems might result in increasing the number of facilities to maximize the second (backup) coverage, and a PSF can serve as an SSF on a needed basis, but none of the PSFs is designated. Also, not like existing literature, the study's model objective is to maximize productivity/ efficiency. The proposed EBS system would be more practical than the EBS systems in the existing literature from the strategic point of view since it is clearly defined when a PSF can serve as an SSF for specific demand points in case of disruptions. This innovative process would help practitioners and researchers generate FLA options to improve supply chain efficiency with the risk of disruptions. Most of the existing literature on the FLA problem with the second	

		(backup) coverage seeks the most economical option or maximal coverage option. The study aims to find the most productive/efficient FLA network scheme under the risk of facility disruptions. The productivity is defined as the ratio of the expected number of demands satisfied (ENDS) satisfied by the PSF or SSF to the TRC. The Multi-Objective Programming (MOP) model was formulated, considering the two-performance metrics simultaneously. Another substantial impact was the development of an innovative approach to evaluating decision-making units (DMUs) by integrating multiple criteria DEA methods with multi-objective programming models to evaluate DMUs more consistently than the traditional DEA. We have applied the approach for designing the biofuel supply chain network system and the humanitarian logistics network. The researcher was invited as a guest speaker for various international conferences on the Energy Engineering and Industrial Engineering Conferences. He has received accolades for his papers and was also nominated twice for the *Best Paper Award* at the national conferences in 2019. In addition, the two-stage network DEA method to analyze and design the biofuel supply chain network system was applied, which was the first attempt to use the concept of two-stage network efficiency in designing biofuel logistics network schemes.	
9.	**Women Owning Woodlands** *Clemson Extension*	***Situation:*** Sixty-three percent of South Carolina's almost 13 million acres of forestland are private, family forests, the majority of which have a man as the primary owner and decision maker. According to the U.S. Census Bureau, wives outlive their husbands 70 to 80% of the time, and therefore many women can be thrust into the role of decision-maker with little to no preparation when a husband passes away. There is a significant lack of programming targeting female landowners. ***Response:*** Based on models developed by the national Women Owning Woodlands (WOW) program, planning began in 2018 between Clemson Extension and the Forestry Association of SC to develop a WOW Network in SC. Initial funding was obtained through a Sustainable Forestry Initiative (SFI) Community Engagement Grant to host two pilot WOW workshops in SC in 2019 and 2020. ***Results:*** Surveys conducted prior to the workshops indicated that 25% of the participants felt they had no knowledge for managing their woodlands, 19% felt slightly knowledgeable, 54% felt moderately knowledgeable, and 2% felt very knowledgeable. No one indicated they felt significantly knowledgeable. An evaluation after the workshops indicated that participants gained knowledge on	**Environmental and Natural Resources Conservation** (Critical Issue #3)

		all topics presented, with some indicating that they had gained significant knowledge. A total of over 20,000 acres in South Carolina was represented at these workshop.	
10.	**Impacts of Coastal Freshwater Forested Wetland Ecosystems** *Clemson Experiment Station*	***Situation:*** Estuaries of the southeastern US and their surrounding wetlands are coastal transition zones where freshwater rivers meet tidal seawater. As sea levels rise, saltier water moves farther upstream into freshwater wetland areas causing forest mortality. Human changes to the surrounding landscape may amplify the effects of this tidal extension, impacting the resiliency and function of the upper estuarine wetlands. Conversion is related to both changing sea level and associated salt-water intrusion and to human influences (e.g., land use change, coastal development, construction of dams, river dredging, etc.). We also continued to manage the forests during this reporting period at Hobcaw Barony to measure carbon (C) and water budgets in a longleaf pine restoration area. ***Response:*** Because of the limited data on this process, this project took an integrated, large-scale approach to research and monitoring to expand our ability to model these processes and apply them to other coastal areas. We assessed the resilience of wetlands to sea level rise by measuring processes controlling wetland elevation. This research produced monitoring plots measuring productivity, water cycling, and climate sensitivity at high temporal resolution. ***Results:*** Clemson Researchers found that these wetlands were marginally resilient to sea-level rise. We identified fundamental differences in how resilience is maintained across wetland community types, which have important implications for management activities that aim to restore or conserve resilient systems. We also documented that these tidal wetlands store more C than many coastal wetland types documented throughout the world, including classically defined "blue carbon" wetlands, and they support high rates of annual C sequestration and lateral C export into aquatic environments that can influence critical near-shore and marine energy transformations. Results of this effort will provide critical data to guide future decisions regarding the fate of C, water quality, coastal resilience, wildlife and fisheries, and effective allocation of taxpayer dollars for ecosystem restoration. Clemson Researchers were also able to produce foundational knowledge and mechanistic understanding of forest functioning to aid the development of models that predict the response of forests to disturbances and environmental change. Datasets will quantify the impacts of management on forest productivity and functioning, which helps inform policy decisions that impact management. Measurements provided will help	**Environmental and Natural Resources Conservation** (Critical Issue #3)

		understand the effects of management on water yield from upland pine and how that influences downstream wetland forests. Wind data also informs wind stress modeling and helps to interpret load cell data.	
11.	**Land Management Practices to Increase Production** *SC State University Extension*	***Situation:*** At the request of stakeholders, SC State Extension Agents developed and implemented a "Small Scale Forestry Production and Forestry Alternative Enterprise Project" to address the needs of small, part time and limited resource landowners in the region. The project promoted land management practices to increase production of forest products, increase profits and small farm sustainability. ***Response:*** Conferences and workshops were conducted to provide risk management education training for the limited resource and minority landowners in the region. The workshops, conferences and training sessions focused on land ownership, management and responsibilities and addressed subject matters related to heir's property resolutions, estate planning, legal issues, taxes, and land use options. ***Results:*** Workshops and training sessions in land use options resulted in a 90% increase in awareness of serious issues (especially, minority land loss), while the adoption of recommended practices resulted in an increase of 50%. About 10% of the participants improved their forest land acres, 15% have considered recommended land use options to preserve land, 90% of the participants requested follow up programs and projects. Through the participation in the project, small landowners/forest landowners became more aware of the services that were available to them by agriculture agencies and organizations. In addition, the landowners increased their knowledge and use of current, research-based practices and techniques in forest production, enhanced their farm management skills, and cultivated viable and profitable enterprises by employing sustainable practices.	**Environmental and Natural Resources Conservation** (Critical Issue #3)
12.	**Reusing Post-Consumer Plastics for Solvent Extraction** *SC State University Research*	***Situation:*** Every segment of society uses commodities made of plastics, which after a single use they are discarded. The accumulation of post-consumer waste plastics is an epidemic sustained by every segment of society. A problem that once was considered to affect only the landfills, waterways, and oceans, is now spreading to air quality and food. The post-consumer plastic bags and bottles collected and stored in warehouses over time lose semi-volatile plasticizers, and break into small pieces producing microparticles. The plastic microparticles folate in water, air, and precipitate on surface of vegetables and fruits, which are consumed by every living system on earth including humans. The average lifetime	**Environmental and Natural Resources Conservation** (Critical Issue #3)

		of the plastics has been estimated to be over hundreds of years. The consumed microplastics either by birthing the contaminated air or digesting contaminated foods caused numerous health adversities with no effective cure or prevention. The problem affects everyone. However, it is even more severe in industrialized nations and it is even graver the effects for the minority and low-income communities around world. ***Response:*** Most of post-consumer plastic commodities are made of one of the listed six resins, (1) polyethyleneterephthalate (PET), (2) High-density polyethylene (HDPE), (3) polyvinylchloride (PVC), (4) low-density polyethylene (LDPE), (5) polypropylene (PP) and (6) polystyrene (PS). SC State researchers worked towards finding a solvent to dissolve various types of resins used to manufacture post-consumer goods. The dissolved resins were separated, purified, and characterized. Their properties were measured, they were close to the original resins; therefore, they were reused to fabricate new commodities. Students were trained in the process of achieving the key mission of the research, which was to enhance the workforce through education, research involvement, and initiative nurturing. The project involved over a dozen undergraduate students in the research. The students engaged in the meaningful scientific activities and habits of reducing post-consumer wastes and recycling through coordinated research activities. Recycling post-consumer plastics were and are promoted as students engaged in all aspects of the process including research to find an appropriated solvent for the plastics, characterization of the obtained resins and disseminations of the results. ***Results:*** Good results were obtained in three-fold actions: (1) extraction of resins from post-consumer plastics, (2) reuse the PC-plastics to fabricate new materials, and (3) depolymerize the PC-plastics to the original building block for making the resins or using as fuel. The results of the study showed the extracted resins almost are as good as the original resin. They could be reused to fabricate a new commodity. Also, some postconsumer plastics such as voluminous Styrofoam was used to make light weight cement blocks for construction. The mechanical properties of cement blocks with various portions of EPS were measured. At first glances, they are good for insulations. The industries build based of the achievements initiated with the project effectively reduced the amounts of plastic wastes and put them back in the cycle. By using the results of the project, new industries could build to reuse postconsumer plastics with outcomes of saving energy and a clean environment.	

		Through the efforts, it was found most of the used post-consumer plastics, PET, was extremely hard to dissolve in common organic solvents, except at high temperatures. Post-consumer PET (PC-PET) was soluble in tetrachroethane at a temperature over 100 °C. The dissolved PET was precipitated in methanol, and vacuum dried. The product, PET-R was characterized by thermogravimetric analysis (TGA) and differential scanning calorimetry (DSC). The thermal behavior of the PET-R was comparable to the original resin. Post-consumer High-density polyethylene (PC-HDPE) was cut to small sizes and converted to rods being useful for netting outdoor furniture, 3-D printing, and hot glue. The mechanical properties of rod with various diameter, including pick load was measured. The results showed a good strengthen of HDPE rods. Post-consumer polyvinylchloride (PC-PVC) was dissolved in tetrahydrofuran (THF) – dimthylformamide (DMF) and was precipitated in methanol to remove the fabrication impurities. The product was vacuum dried, and characterized by TGA, DSC, and size exclusion chromatography (SEC). An attempt to extract the plasticizers prior to processing is underway.	
13.	**WalkSC Program** *Clemson Extension*	***Situation:*** Exercise has been shown to help with both physical and mental well-being of individuals. However, with the COVID-19 pandemic, many citizens felt unmotivated to exercise or cut-off from their normal exercise routines. ***Response:*** The Clemson Extension Rural Health and Nutrition program team created the WalkSC virtual program to help motivate individuals and provide exercise goals that can be achieved during the pandemic. If participants completed the entire program, they would have walked the equivalent of the Palmetto Trail, which goes from the mountains to the coast (~500 miles). ***Results:*** The WalkSC program was a virtual 12-week program that challenged individuals to "walk across SC" based on personal step counts. A total of 374 participated in the program. A frequency-count and heat map of the data showed that most of the participants were located in "distressed" or "at-risk" zip codes, meaning the program reached the intended target audience. Furthermore, data showed overall improvements in health, healthy lifestyles, and exercise regimes. At present, a more in-depth data analysis is being conducted with plans to present the results of the program in a peer-reviewed academic journal article.	**Food Safety, Security, and Nutrition** (Critical Issue #4)
14.	**Food Safety from the Farm to the Fork** *Clemson Experiment Station*	***Situation:*** A disease outbreak in the animal livestock industry or from food animal products can have serious consequences to the rendering industry, food animal industry, food processing industries, and the consumer. It is imperative that the rendering industry have conclusive evidence on the	**Food Safety, Security, and Nutrition** (Critical Issue #4)

		effectiveness of rendering and post-process storage conditions to destroy and/or prevent the growth of animal disease pathogens. Additionally, it is imperative that non-vertebrate test methods are developed to screen if any isolated Salmonella have potential to be pathogenic. Maintaining food safety is an on-going commitment for food animal production. There are many aspects still unknown and food safety research to ensure foodborne outbreak prevention is timely and needed. ***Response:*** Protecting the public from foodborne illness is of paramount importance. Understanding the impacts of environmental factors on survival of pathogens and the mechanisms of bacterial transfer will help reduce negative consequences and promote food safety within food preparation settings. This research is needed since food safety is a continuing problem especially with the emphasis on minimally- processing of food and the desire and need for extended food shelf life. For this reporting period, we continued to conduct research on food safety for the general public interest. ***Results:*** During this period, we studied the sanitation of eating surfaces and transfer of bacteria during cleaning. Bacterial transfer is a concern when sharing food and drink, so to address this concern, this study examined the presence of microorganisms using the ATPase and the transfer of bacteria from one surface to others due to cleaning surfaces in sequence with the same cloth. Two experiments were performed to: 1) test random eating surfaces for the presence of microorganisms, and 2) transfer of bacteria from one surface to others by wiping 5 successive clean tile surfaces with the same cloth after the first surface had been inoculated with E. coli. In the first experiment, of the 165 randomly sampled eating surfaces, both 81% of the home eating surfaces and 81% of the public eating surfaces were categorized as unsanitary according to the ATPase testing. In the second experiment, a cloth rag (cotton gauze) was transferred from the first tile to the fifth tile by wiping each successive tile with a cloth initially clean before the first tile. This indicates that when wiping eating surfaces during cleaning with a cloth rag, other surfaces subsequently wiped will become contaminated. Thorough understanding of bacterial transfer from surfaces is at the heart of food safety and rapid detection methods for bacterial contamination are crucially needed in all aspects of food safety research and quality control.	

15.	**Mobile Food Distributions Made a Difference** *SC State University Extension*	***Situation:*** Households that experience food insecurity lack access to enough food for an active, healthy life for all household members. Almost 700,000 people in South Carolina struggle with hunger and food insecurity, unexpected job loss or medical issues that can quickly become a financial burden. Thirty-point six percent (30.6%) of the population in Dillon County live below the poverty line, a number that is higher than the national average of 13.1%. The onset of COVID-19 created a "perfect storm" that has made the hunger and food insecurity greater than ever before. ***Response:*** The Pee Dee Region organized 2 mobile food distribution sites in Dillon County that focused on food insecure families/individuals to help meet their most basic human needs, while coping with COVID-19. ***Results:*** As a result of the two (2) mobile food distribution sites, along with twenty-nine (29) volunteers, three-hundred and sixty-two (362) families/individuals were able to receive fresh and nutritious food. The Mobile Food Distributions helped to bridge some of the food insecurity burdens for families/individuals in Dillon County. Three of the volunteers for the event stated, "Loved it! Great people for a great cause," "I feel this community greatly appreciated the event," "The success of the event was a direct result of good planning and excellent volunteer recruitment." Communities suffering from food insecurities are across the nation, making it a complex and more dangerous state of life. The Pee Dee Region Family Life Nutrition, Health and Food Safety Agent partnered with other organizations and made an impact on the communities served by the region.	**Food Safety, Security, and Nutrition** (Critical Issue #4)
16.	**Targeted and Un-Targeted Multi-Residue Pesticides Analysis in Food** *SC State University Research*	***Situation:*** Modern agriculture relies heavily on the use of pesticides in the US and around the world. In the US alone, more than 800 million to 1 billion pounds of pesticides are used each year. Besides the direct exposure of pesticides among agricultural related workers, for the public, pesticides exposure occurs mainly through long-term food/water consumption. According to USDA, some foods, such as strawberries or tomatoes, contain up to 20 – 40 pesticides, while most foods contained at least one or more pesticides. Pesticide toxicity is often only evaluated individually based on short-term animal studies, although it may require a long period of time to evaluate the toxicity of a pesticide (such as DDT). Synergistic effects of multiple pesticides are also far from being clear. It is therefore of critical importance to avoid pesticides as much as one can, especially for children and infants.	**Food Safety, Security and Nutrition** *(Critical Issue #4)*

		Response: The SC State project was created to investigate pesticide residues in foods, which are certain in vegetables and fruits. An analytical lab (with power, temperature control, fume hood, and other lab supplies and equipment etc.) was set up and an Agilent 6545 liquid chromatography quadruple time of flight mass spectrometer (LC Q-TOF MS) was purchased and installed in the lab. The LC Q-TOF MS is the dedicated instrument for the analysis of pesticide residues. The training on the operation and maintenance of the instrument was completed. Celery samples were purchased from the local grocery stores. Celery was divided into different groups according to different pretreatment methods such as cleaning with soda powder, salt, vinegar, hot water, vapor, etc. Each group of celery was size reduced and homogenized using liquid nitrogen freezer mill. The homogenized samples were measured, and solvent extraction was performed to extract pesticide residues out from the celery. The extracts were centrifuged to obtain the clear samples for LC-MS analysis. An undergraduate student research assistant was trained on basic lab skills, including lab safety, waste handling, data logging, quantitative calculations, solution making, sample preparation, etc. The student was also trained on the basic principles of liquid chromatography and mass spectrometry, literature searching and reading, and writing of literature reviews. Before analyzing extracted celery samples, the instrument was calibrated and tuned for quality assurance purposes. The extracted samples were injected onto the LC-MS instrument in triplicates, i.e., there were three replicates of extracted samples for each pretreatment method. The LC-MS data was processed and analyzed with the help of a pesticide database. Based on the database search results, manual inspections of LC-MS data were conducted to confirm the presence of certain pesticides in the original sample. The relative levels of pesticides identified using the above methods were compared according to the pretreatment methods used. ***Results:*** The results were analyzed and compiled to create a research poster for the presentation at the 68th American Society for Mass Spectrometry (ASMS) Annual Conference. The undergraduate student assistant and the principal investigator attended and presented the poster. Various samples of 8 dried and 18 fresh foods or parts (vegetables and fruits) were collected and pretreated to be analyzed for the levels of metals. The purpose of the analysis was to evaluate whether there was a difference in metal concentrations in foods of organic and non-organic sources. A technical report	

		and a poster were drafted as the result of the analysis of metals in foods of organic and non-organic sources.	
17.	**SC 4H@Home** *Clemson Extension*	***Situation:*** Due to state mandates imposed by governors in response to the COVID-19 crisis, schools were closed in March 2020, and thus, extracurricular activities for youth impacted. ***Response:*** In response to this situation, Clemson Extension 4-H Youth Development Agents created the SC 4H@Home program. This program created age appropriate lessons that were delivered daily (Monday-Friday) through the end of May 2020 (corresponding to the end of the school year) via email. These lessons continued to provide the hands-on learning opportunities that many youth would have experienced during regular, in-person 4-H programming activities. ***Results:*** A total of 53 lessons were developed and delivered to 2,497 registered participants. The participants were located not just in SC but represented 46 states, 1 US territory, and 8 countries. A survey at the conclusion of the program showed that the SC 4H@Home program appeared to be beneficial to youth during the school closure and contributed to youth education during the school closures. The favorite activities were STEM-focused activities and many parents appreciated the fact that youth could continue to learn STEM lessons in a hands-on fashion that was not tied to a computer. The program also had evidence of social and developmental benefits for youth by providing increased opportunities for parent-child interactions. Parent involvement in children's lives has been shown to improve brain development, and early childhood development. Furthermore, parents felt that the SC 4H@Home program helped their children continue to "feel connected to a larger audience" while quarantined at home. This may have contributed to improved mental well-being of children during quarantine. The results of this program evaluation have been submitted to the Journal of Extension for publication.	**Family and Youth Development** (Critical Issue #5)
18.	*Clemson Experiment Station*	Clemson Experiment Station does not participate in this Critical Issue	**Family and Youth Development** (Critical Issue #5)
19.	**Bridging the Digital Divide** *SC State University Extension*	***Situation:*** In 2018 under new standards proposed by the State Department of Education, all South Carolina public school students in kindergarten through eighth grade were required to learn computer science. According to the U.S.	**Youth and Family Development** (Critical Issue #5)

		Bureau of Labor Statistics, computer and information technology fields were expected to add nearly 500,000 new jobs between 2014 and 2024. A report by the National Center for Women and Information Technology projected 70 percent of new job openings in South Carolina could be filled by workers with computer degrees. Every child will not be a computer scientist, but knowledge and understanding of computer science helps ease the digital divide between students in poverty and their wealthier counterparts. Despite the growing demand for computer science graduates, schools rarely offered more than keyboarding classes on their roster of coursework. Quinn Burke, an education professor at the College of Charleston and a member of the Education Department's team, was charged with writing the standards. The lack of computer education coupled with the poverty and limited to lack of access to internet, the youth in the Pee Dee Region needed assistance and support in STEM education to enhance learning and excel in the area. ***Response**:* The Pee Dee Region partnered with two (2) local elementary/middle schools to host the 2019 National 4-H Youth Development's National Youth Science Day's (NYSD) "Game Changers" challenge, which taught young people coding skills through three engaging hands-on activities. The program accessed an opportunity for kids within the region to take an interest in STEM education and activities. ***Results:*** A total of seventy-five (75) K-7 grade Pee Dee Region youth participated. Wallace Elementary/Middle School (WEMS) After School Program in Marlboro County had fifty-six (56) 3rd-7th graders and Florence 1 Theodore Lester Elementary School's Extended Day Academy in Florence County had nineteen (19) K-6th graders participate. The youth learned about automation, optimal efficiency, and programming, through the Hack Your Harvest Challenge, and learned how to develop and invent playground games through concepts like pattern recognition and abstraction in the Program Your Playground Challenge. They also learned online activities that allowed them to create an animation advocating for a cause or issue they cared about using CS First and Scratch. Pre/Post-tests were administered to each participant. Forty-four percent (44%) of the thirty-six (36) participants who completed the entire program, reported knowledge gained.	
20.	**The Link of Reading and Music to Education Awareness** *SC State University Research*	***Situation:*** The SC State Department of Education reported in the 2017-2018 school year, third graders who do not meet the established reading requirements would be retained. The overarching facts present a need that requires effective,	**Youth and Family Development**

		intervention methods that might be started at the early childhood and elementary grade levels. With purposes of achieving students' overall reading and music skills, the research aims to test the influence of two discrete courses linked by agricultural literacy outcomes involving food, health, and lifestyle. Using PK, 1st, 2nd, 3rd, 4th, and 5th grade subjects, the investigator will test the effects of reading instruction and music instruction on the subjects' reading achievement and music achievement. Per grade level, Pre-K-5, two intact classes will serve as a convenient sample. Subjects of all intact classes will complete developmentally appropriate tests of reading and music at the onset of the one-group, pre-test and post-test experiment design. ***Response:*** For the research, food, health, and lifestyle served as a thematic component that linked music and reading. Other linking components included the threads of literacy, 21st century work skills, and executive functioning in the classroom space. Consequently, agricultural literacy and awareness were realized via books that were read-aloud. Opportunities were also provided such that elementary students worked with information they received via reading and writing activities. Likewise, subjects experienced the same content when they attended their general music class. A linked-curriculum framework was created that corresponded to the 'what.' A process of procedures was practiced that corresponded to the 'how,' and the range of grade levels, which is an indication of 'when.' Promising results represented scientific proof, although limited, of a teaching/learning method for improved reading achievement and music achievement. Two intact classes of students in grades PK -5 had many books read to them related to food, health, and lifestyle. The students had opportunities to develop reading projects and complete writing tasks. Resultantly, students communicated, collaborated, created, and thought critically, while working with their classroom teacher, English Language Arts (ELA) teacher and peers in the classroom. Additionally, students experienced music activities whereby they sang, moved, played instruments, and created melodic and rhythm tasks to accompany agriculture-theme texts developed in groups by way of using 21st century work skills in the music classroom space. An interdisciplinary team of a music education specialist, a reading specialist, and a writing specialist were embodied. Additionally, music education majors acquired experience teaching, collecting data, presenting, and creating grade-level, developmental melodies that	(Critical Issue #5)

		accompanied an agriculture-theme book. The team shared results at music conferences and education conferences nationally and internationally to include Texas, Austria, and Sweden. The Principal Investigator presented workshop proposals to pre-k directors and two elementary principals based on results acquired thus far and presented results at music and education conferences. Synergy learning, with a focus on agriculture, was explored by way of examining the influence of music instruction when music is linked with reading. ***Results:*** From the research, results suggested that music instruction, when linked with reading, can influence elementary students' reading achievement and music achievement. In that way, synergy learning is achieved. This type of learning is particularly useful for female and male students at the pre-k, kindergarten, 2nd-grade, and 4th-grade levels. Students of the study acquired literacy skills and music skills while, simultaneously, becoming agriculturally aware of varied foods, good health maintenance, and quality lifestyles. Other linking components such as the threads of literacy, the 21st century work skills, and students' executive functioning in the classroom were emphasized by the music specialist, the ELA teacher, and the classroom teacher by way of activities that engaged the whole person as interaction occurred.	

OPTIONAL **Youth Development Expenditures (dollars)**	
State and/or Institution:	FY 2020 Expenditures ($)
1862 Smith-Lever	$961,127.41
1890 Extension	$585,991.00