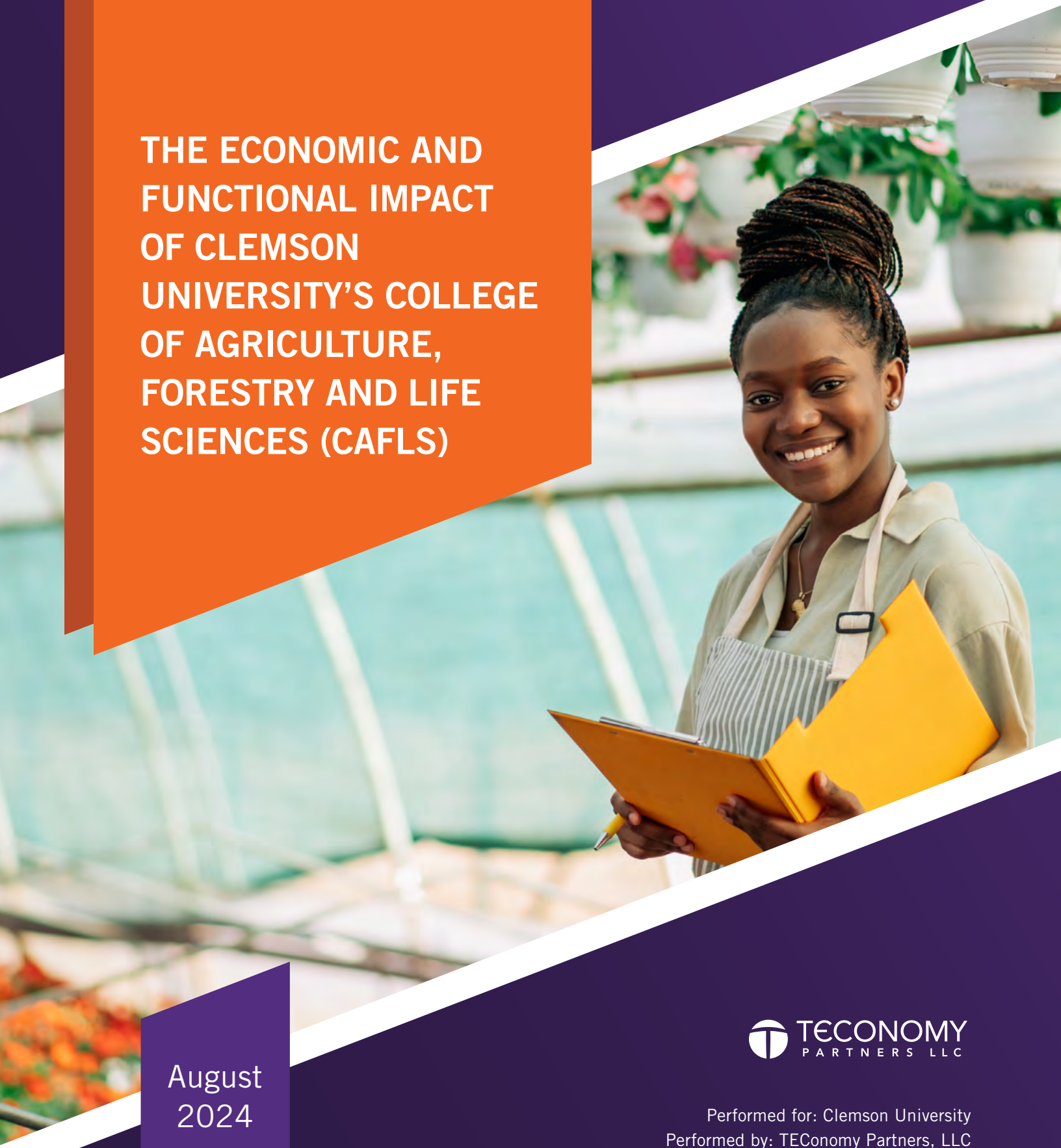
THE ECONOMIC AND FUNCTIONAL IMPACT OF CLEMSON UNIVERSITY'S COLLEGE OF AGRICULTURE, FORESTRY AND LIFE SCIENCES (CAFLS)



August 2024

TECONOMY PARTNERS LLC

Performed for: Clemson University
Performed by: TEConomy Partners, LLC

TEConomy Partners, LLC is a global leader in research, analysis, and strategy for innovation-driven economic development. Today, we're helping nations, states, regions, universities, and industries blueprint their future and translate knowledge into prosperity.

TABLE OF CONTENTS

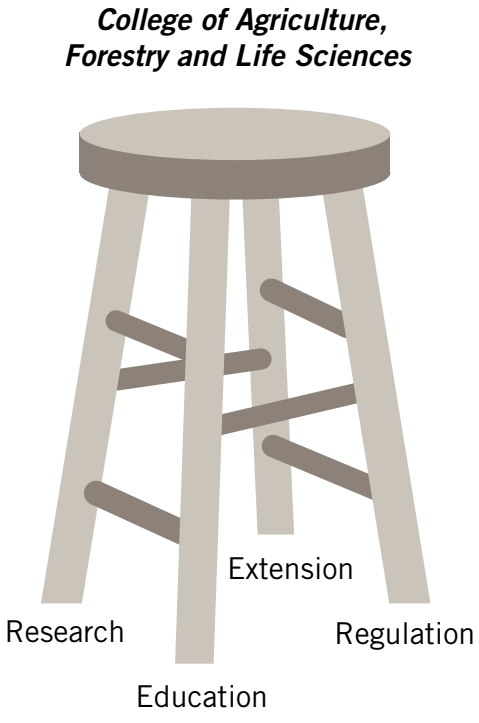
EXECUTIVE SUMMARY

The Mission of Clemson University's College of Agriculture, Forestry and Life Sciences (CAFLS)

Clemson University's College of Agriculture, Forestry and Life Sciences (CAFLS) has a unique quaternary-part (or four-part) mission. Much like a "four-legged stool," CAFLS four components—education, research, extension, and regulation—embodies founder Thomas Green Clemson's vision of a "high seminary of learning" focused on improving the lives of South Carolinians through education, discovery, and outreach in the agricultural and life sciences (Figure ES-1).

CAFLS Research and Agricultural Experiment Station System comprises CAFLS faculty, research scientists, and staff undertaking basic through applied research on the Clemson campus and at six Research and Education Centers (RECs). The RECs are strategically located throughout South Carolina according to the state's unique soil types and climates. They form a network of high-tech labs and collaborative teams comprising scientists and students tackling challenges in precision agriculture, plant genetics, natural resources management, sustainability, soil health, agribusiness management, livestock production, and more.

Figure ES-1: CAFLS's Quaternary-Part Mission



CAFLS Cooperative Extension is organized to carry forward the know-how, knowledge, and research findings of CAFLS to benefit all South Carolinians. With a presence in all 46 counties, Cooperative Extension is a large-scale organization with major initiatives and programs spanning the food and agriculture value chain, natural resources, environmental stewardship, health and family wellbeing, and youth education and development.

CAFLS protects and regulates agribusiness through:

- Clemson **Livestock Poultry Health (LPH)** that works to protect animal health through the control of endemic, foreign, and emerging diseases in livestock and poultry. It also protects the health of South Carolinians by providing a comprehensive inspection service to ensure that meat and poultry products are

safe, wholesome, and accurately labeled. In fulfilling its role, LPH serves as South Carolina's animal health authority, state meat and poultry inspection department, and state veterinary diagnostic center.

- Clemson **Regulatory Services** that protects the state from exotic and invasive species, ensures that pesticides are used safely, regulates the structural pest control industry, verifies that fertilizer and lime meet standards and labeled guarantees, conducts programs for seed and organic certification, provides diagnoses of plant pests, and ensures readiness to respond to a catastrophic event impacting the state's agriculture.

Education (including baccalaureate, master's, and doctoral degrees) is delivered through academic departments under CAFLS. The College contains five academic departments offering twelve undergraduate majors and eleven graduate programs. The departments are the academic home to the College's faculty, with most faculty having teaching, research, and/or extension components to their appointments.

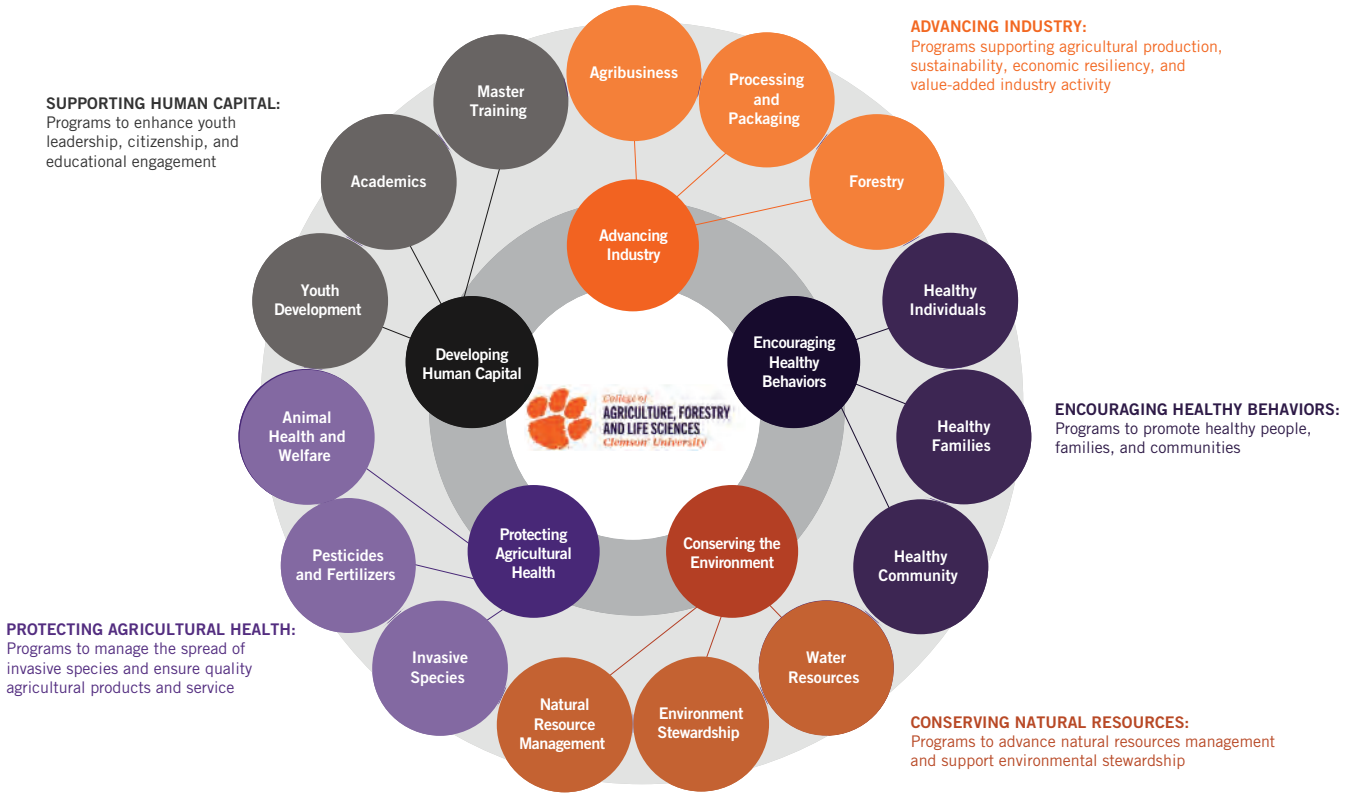
Through the activities of these mutually dependent components, CAFLS has helped to build, sustain, and grow South Carolina's agriculture, forestry, and related industries as well as empower people and communities to solve problems and improve their lives. Yet, as much as CAFLS has helped drive South Carolina's economic growth and prosperity in the past, it is likely to be even more critical in the state's increasingly technology- and innovation-driven economy. As knowledge, intellectual capacity, and innovation become the foremost drivers of modern economies, the importance of academic R&D centers, advanced higher education institutions, and knowledge and practice diffusion organizations as engines for economic growth becomes very clear. Innovation, the transfer of knowledge, and the enhancement of productivity (activities at the core of CAFLS's mission) are keys to the long-term sustainability of South Carolina's economy.

Recognizing a need to communicate the value, modern relevance, importance, and impact of CAFLS, Clemson University engaged TEConomy Partners, LLC (TEConomy) to conduct an independent study on economic and functional impacts across CAFLS's key mission areas. At its heart, CAFLS constitutes a pragmatic, action-oriented organization dedicated to generating positive impacts in South Carolina through the application of science, technology, regulation, training, and knowledge diffusion. These impacts are the subject of this report.

The Functional Impacts of CAFLS

CAFLS is a diverse organization with a broad mission of serving South Carolina's complex and multi-variant needs. Its work can be understood as taking place in five key areas of impact, which are highlighted in Figure ES-2. The activities conducted by CAFLS, and the results obtained through them, are termed "functional impacts."

Figure ES-2: Key Areas of Impact Addressed through CAFLS Programming and Activities



Source: TEConomy Partners, LLC.

These impacts are categorized as "forward-linkage impacts" or "functional impacts," which are related to institutional mission and function rather than being related to institutional spending. These are the impacts that Congress envisioned as benefits to be provided through the formation of land-grant universities. They constitute a broad and multifaceted array of positive economic and social impacts for South Carolina. Through the activities and functions of CAFLS, South Carolina benefits in terms of the following:

- **Enhanced Human Capital**—Produced through the formal academic education of students, the creation and deployment of positive youth development programming, and the development of lifelong learning opportunities.
- **Employment and Personal Income**—Generated in agriculture, forestry, and related industries via CAFLS's impacts on business development, profitability, and economic growth.
- **Economic Diversification**—Achieved through the application of CAFLS's new R&D discoveries, innovations, and practice recommendations.

- **Economic Output and Economic Growth**—Sustained through innovations, practice recommendations, and scientific and extension activities in support of multiple sectors of the South Carolina economy.
- **Local and State Government Revenue**—Generated through the enhanced economic activity supported in the state by CAFLS research, extension, and education.
- **Environmental Protection and Environmental Sustainability**—Supported through CAFLS research, education, extension, and regulation services to promote conservation, enhanced stewardship, and management of South Carolina's natural resources.
- **Enhanced State and Community Sustainability**—Supported by CAFLS's work in maintaining business profitability, developing diversified economic sectors, producing new and enhanced products, and managing South Carolina's natural and community resources.
- **Improved Quality of Life**—Supported on multiple fronts by CAFLS work in community development, economic development, human capital development, and programs targeting sustainability and environmental conservation and protection.
- **Health and Wellness**—Sustained through CAFLS activities in a broad range of functional areas, such as health and nutrition education and training and food safety.
- **Reduced Social Costs**—Supported by CAFLS's work in the prevention or reduction of adverse impacts requiring environmental remediation, elimination of self-destructive behavior, development of alternative paths for at-risk populations, etc.
- **Public Service and Volunteerism**—Promoted through CAFLS's work with youth development, continuing education and training, and leadership development activities.

The programmatic efforts of CAFLS fulfill important public needs that would not be fulfilled, or would be inadequately fulfilled, if left completely to market forces. The fulfillment of these public needs is provided through the forward-linkage functions of its operations. The forward-linkage impacts of CAFLS can be classified into five macro themes:

- **Advancing the agriculture, agribusiness, forestry, and forest product industries of South Carolina.**
- **Encouraging healthy behaviors of individuals, families, and communities.**
- **Conserving the environment by advancing natural resources management and supporting environmental stewardship.**
- **Protecting the health of the agricultural environment.**
- **Developing human capacity through youth development, formal academic education, and lifelong learning opportunities.**

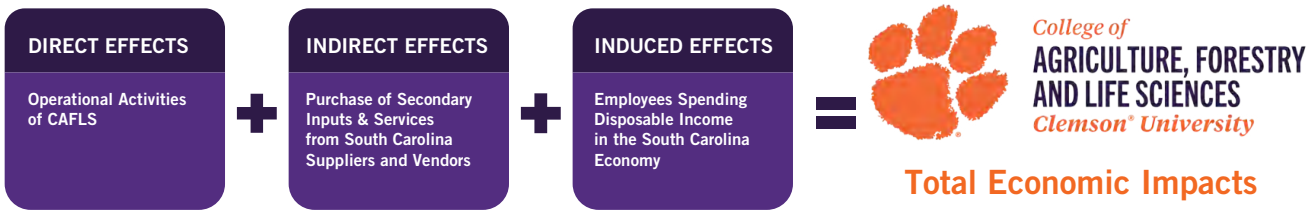
Each of these primary areas of activity contains multiple programs and initiatives that build and sustain South Carolina's economic and social well-being. Programs are delivered across all 46 South Carolina counties. CAFLS makes them available to South Carolinians young and old, in rural and urban environments, at home and in the workplace.

The Expenditure-Based Economic Impacts of CAFLS

In addition to the mission-based functional impacts of CAFLS, there are additional economic impacts generated via the College's operational expenditures. Although CAFLS does not exist to simply generate economic stimulus through its expenditures, given its total operating expenditures of $157 million and direct employment of 2,024 employees who work across all 46 counties in South Carolina, the stimulus effect is not insignificant.

To measure the impact of CAFLS's expenditures, TEConomy used input-output (I-O) analysis. The analysis calculates the direct, indirect, and induced impacts, as shown in Figure ES-3.

Figure ES-3: Components of Expenditure-Based (Backward-Linkage) Economic Impacts



Source: TEConomy Partners, LLC.

The results of the I-O analysis of CAFLS's operational expenditures are shown in Table ES 1. The analysis finds that the expenditures generated a total output impact of $278 million in the South Carolina economy and supported 2,756 jobs with labor income totaling $128 million. Because CAFLS is found across all 46 counties, these impacts are distributed across the entire State of South Carolina.

Table ES-1: CAFLS All Units Combined Total FY 2023 Expenditure Impacts ($ in Millions)

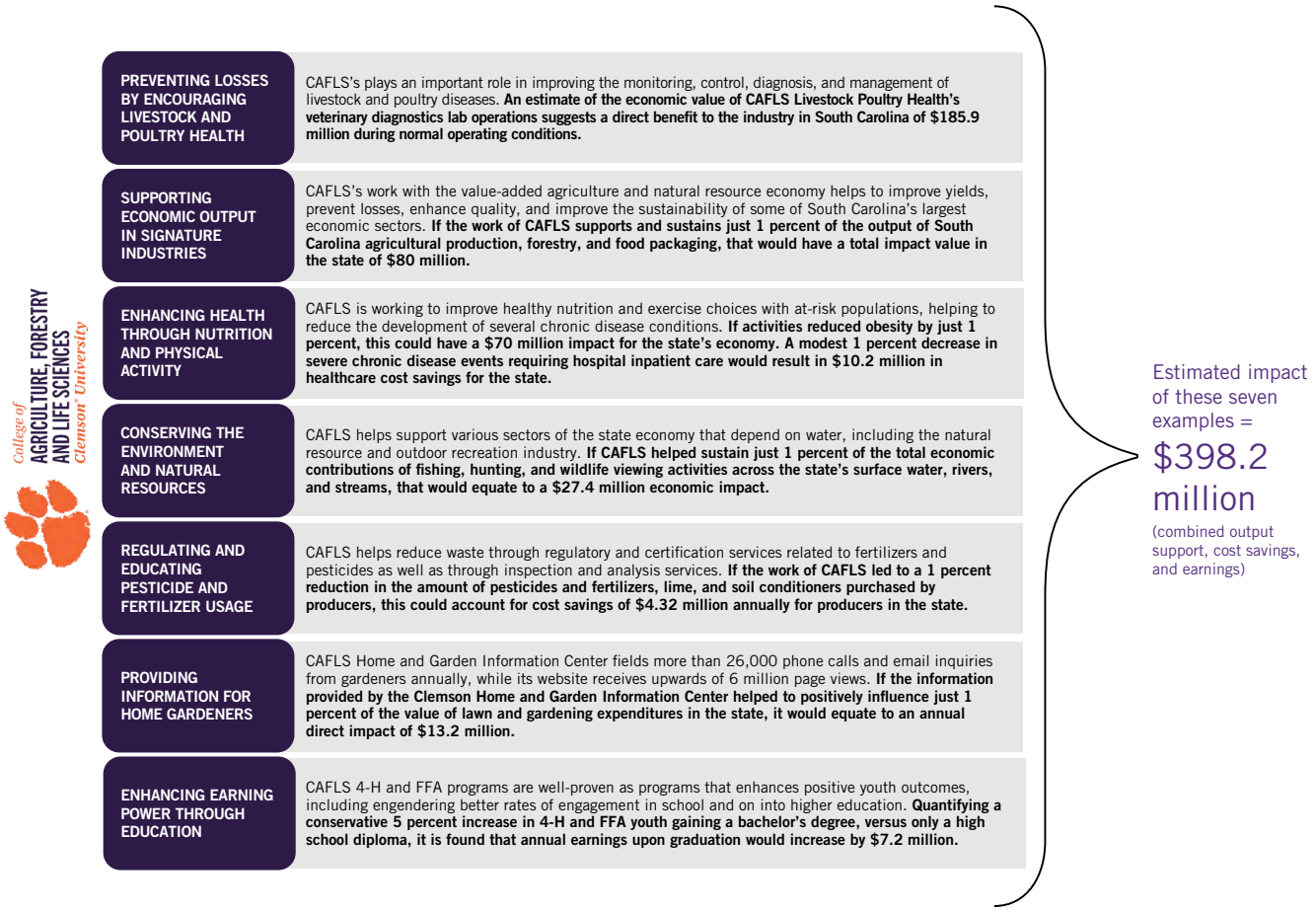
Impact Type	Employment	Labor Income	Value Added	Output	County/ Local Tax Revenue	State Tax Revenue	Federal Tax Revenue
Direct Effect	2,024.0	$93.63	$93.63	$155.80	$0.07	$1.45	$18.47
Indirect Effect	399.1	$20.16	$30.44	$67.85	$0.95	$1.28	$4.28
Induced Effect	333.0	$14.09	$31.54	$54.16	$1.84	$2.11	$3.47
Total Impacts	2,756.1	$127.89	$155.62	$277.80	$2.86	$4.84	$26.22
Multiplier	***1.36***	***1.37***	***1.66***	***1.78***			

Source: TEConomy analysis, South Carolina IMPLAN MRIO Model

Conclusion

Together, CAFLS's functional and expenditure-based impacts are making a difference in the everyday lives of South Carolinians in every county across the state. Figure ES-4 highlights just a few of the case studies and estimations that illustrate the functional impacts across thematic areas.

Figure ES-4: Examples of CAFLS's Functional Impacts



Source: TEConomy Partners, LLC.

CAFLS provides significant positive impacts in return for the funding it receives. For an annual total investment of $157.3 million (all sources of funding in fiscal year 2023), CAFLS's programs are generating wide-ranging returns. The total output impacts of the operation's expenditures ($278 million), when combined with the agricultural output, cost savings, and increased income generated from just the seven programs illustrated in Figure ES-4 ($398.2 million), totals $676.2 million (including both expenditure impacts and functional impacts) in an average year. This amount is four times higher than the annual investment in the system.

Into the future, CAFLS's unique quaternary-part mission of education, research, extension, and regulation will remain exceptionally relevant to securing a successful, healthy, and productive South Carolina.

INTRODUCTION

Knowledge—The Driver of Economic and Societal Progress

In today's modern economy, complexity is the defining characteristic of the world in which people now live. Complex global supply chains, wide-ranging social and business networks, rapidly expanding data resources, web-enabled real-time information access, the ongoing march of technological advancement, and a wide variety of additional factors contribute to a seemingly overwhelming, complex economic and societal environment.

As a result, deciphering the ever-growing deluge of information to possess value-added knowledge has become even more important for economic growth and development than possessing physical resources. Less than 50 years ago, traditional comparative advantage factors included natural resources, low-cost labor, and capital. Today, comparative advantage is no longer measured by tangible assets but rather in ease of access and timely control of knowledge-intensive, value-added capabilities to produce leading-edge, next-generation discoveries, breakthroughs, and systems.

Today we live in what has been termed the "knowledge economy." As the Organization for Economic Co-operation and Development (OECD) notes:

> *The OECD economies are increasingly based on knowledge and information. Knowledge is now recognized as the driver of productivity and economic growth, leading to a new focus on the role of information, technology and learning in economic performance. The term "knowledge-based economy" stems from this fuller recognition of the place of knowledge and technology in modern OECD economies.*[1]

At a time when knowledge is ever more critical to advanced economies, sources of information are rapidly expanding—but this is not always a positive development. Today, there are more than 1 billion websites on the Internet, expanding at a pace exceeding three new websites per second. Google is used to perform over 8.5 billion searches each day, or over 99,000 searches per second. Negotiating this complex modern reality requires not only information but, more importantly, the knowledge and skills that allow people to access, process, and make sense of the information they receive and discern what to trust and what to discard. As a result, having access to trusted, validated sources of reliable information and know-how is extraordinarily important and valuable.

Information, and the knowledge required to turn information into meaningful intelligence for action, are at the forefront of driving the knowledge economy and economic and societal progress in general. As such, knowledge also underpins individual prospects for success in navigating and thriving in modern society and the world of

1 OECD. (1996.) The Knowledge-Based Economy. Organization for Economic Co-operation and Development. OECD Publication OCDE/GD (96)102.

work. Because of the higher-order knowledge that is increasingly required for success in the global economy (and the competitive advantages that accrue to innovation), the capacity, capabilities, and sustainability of research universities have risen to the highest level of strategic importance for individual nations, states, and regions.

The Mission of Land-Grant Universities—To Deploy Knowledge

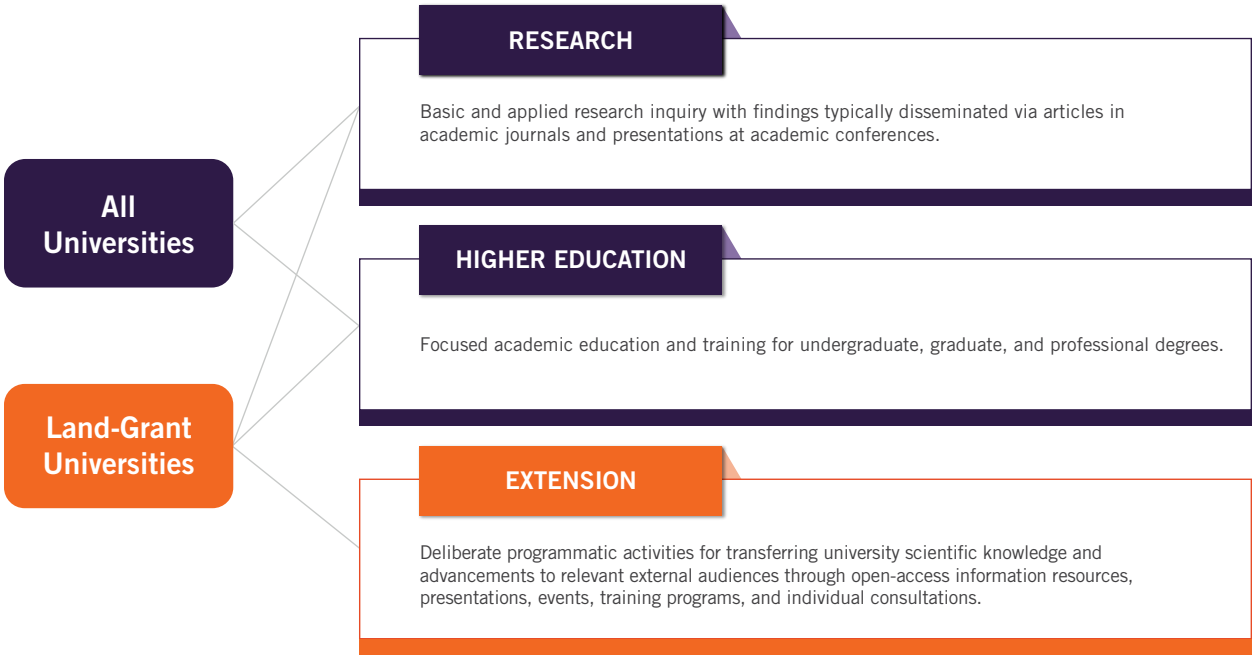
Although numerous economically advanced countries invest in higher education and research, the United States is unique in terms of the investments made in higher education capacity through the creation of land-grant universities. The Morrill Act of 1862 granted public lands to states, which they used to fund the establishment of colleges for teaching agriculture and mechanical arts. The resulting land-grant colleges provided a path for ordinary citizens to gain the higher education needed to advance their work, their communities, and the economy. Research became embedded in the land-grants through the passage of the Hatch Act in 1887, supporting research and innovation activity. This legislation funded the state Agricultural Experiment Stations system, which was predominantly set up under the land-grant colleges. It provided resources for both general and location-specific research aimed at improving agricultural productivity and the economic value chain dependent on it.

In 1914, the success of the land-grant colleges was further enhanced through legislation forming Cooperative Extension. The Cooperative Extension system was formed to help ensure that the expertise and research findings of the land-grant colleges and their experiment station systems were translated into action on the farm and in communities. Extension is paired with the word "cooperative" because it operates as a collaboration between the federal government, state governments, and county governments in supporting knowledge transfer.

The land-grant college system tradition is a group of higher education institutions designed to improve education, expand the national knowledge base through research, and apply that knowledge by transferring it from the academic world to agricultural producers, industries, workers, community leaders, and individuals. Although initiated in 1862, the land-grant system is as relevant today as it has ever been—perhaps even more so, given today's "knowledge economy" and the extreme complexity of industries like modern agriculture that draw upon wide-ranging areas of scientific inquiry and technological innovations. From humble beginnings, the 1862 land-grant universities have grown to become some of the world's largest and most prestigious research universities with an embedded ethos of knowledge generation, translational research, and dissemination.[2]

2 Further federal legislation in 1890 and 1994 built upon the land-grant system to integrate historically Black colleges and universities and Native American colleges, respectively.

Figure 1: Land-Grant Universities and the Additional Mission of Extension



Source: TEConomy Partners, LLC.

Figure 1 provides a simple illustration of the three-component mission of the land-grant universities. The actual structure and operation of such an important system, however, is rather more complex. Funding from federal, state, and local (county) level government is engaged, together with funding from industry and other research funders (such as foundations) who seek to access the specialized expertise and infrastructure at the land-grant universities. Federal government funding comes in the form of mandated "capacity" funds provided under a congressionally-set formula to each state's land-grant institution(s), together with competitive grant funding. Funds feed into a system that is uniquely enabled, resourced, and structured to understand both leading-edge scientific questions and the pragmatic needs and characteristics of agricultural production environments, economic value systems, communities, and individuals. The Cooperative Extension component of the system assures that research findings and best-practice recommendations are translated into use by those best able to use the knowledge and apply it to improve the economy and society.

Clemson University's College of Agriculture, Forestry and Life Sciences

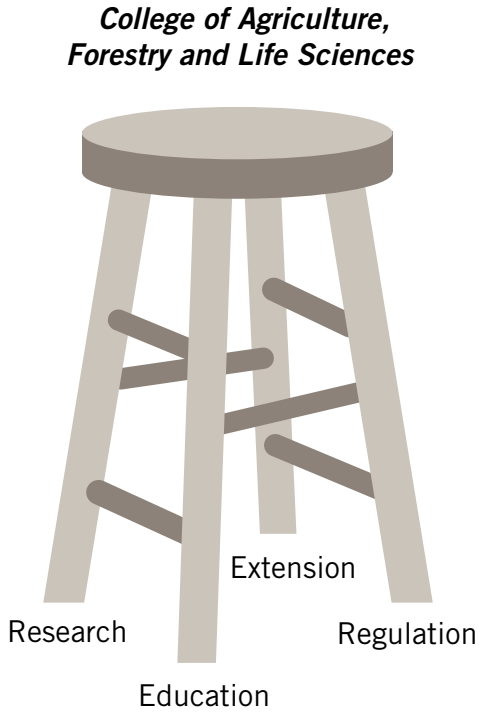
Clemson was founded in 1889 through a bequest from Thomas Green Clemson to create the Clemson Agricultural College. Thomas Green Clemson's will stated that the College was to provide outstanding academic opportunities, conduct research, and improve the prosperity of South Carolina. Opened in 1893, Clemson Agricultural College became the recipient of the Morrill Act and Hatch Act funds, federal funds provided for agricultural education and research purposes.

Clemson Agricultural College quickly understood the need to disseminate the knowledge developed on campus to farmers across South Carolina. As a result, it began developing Extension services in 1907 by deploying various demonstrations to instruct farmers on proper farming techniques. With the adoption of the federal Smith-Lever Act in 1914, Cooperative Extension received federal funds to support these efforts.

The tripartite mission of education, research, and extension is at the heart of all land-grant institution's focus. However, what sets Clemson apart from its fellow land-grant universities is the decision made in 1893 to have the Clemson Agricultural College be responsible for regulatory functions typically overseen within a state's agricultural department. As a result, even before a single class had been taught on campus, Clemson was working to meet the state's agricultural needs by creating fertilizer inspection services.[3] Today, Clemson works to safeguard the health and safety of livestock, poultry, and companion animals through the efforts of its Livestock Poultry Health Programs. At the same time, Regulatory Services ensures the safe, effective use of fertilizers and pesticides and the quality of seeds and plants grown in the state and conducts programs that prevent agroterrorism.

As a result, Clemson University's College of Agriculture, Forestry and Life Sciences (CAFLS) has a unique quaternary-part (or four-part) mission. Much like a "four-legged stool," CAFLS four components—education, research, extension, and regulation—embodies founder Thomas Green Clemson's vision of a "high seminary of learning" focused on improving the lives of South Carolinians through education, discovery, and outreach in the agricultural and life sciences (Figure 2).

Figure 2: CAFLS's Quaternary-Part Mission



Source: TEConomy Partners, LLC.

CAFLS **Research and Agricultural Experiment Station System** comprises CAFLS faculty, research scientists, and staff undertaking basic through applied research on the Clemson campus and at six Research and Education Centers (RECs). The RECs are strategically located throughout South Carolina according to the state's unique soil types and climates. They are an interconnected network of high-tech labs and collaborative scientists and students tackling challenges in precision agriculture,

3 http://www.nationalregister.sc.gov/MPS/MPS001.pdf

plant genetics, natural resources management, sustainability, soil health, agribusiness management, livestock production, and more.

CAFLS **Cooperative Extension** is organized to carry forward the know-how, knowledge, and research findings of CAFLS to benefit all South Carolinians. With a presence in all 46 counties, Cooperative Extension is a large-scale organization with major initiatives and programs spanning the food and agriculture value chain, natural resources, environmental stewardship, health and family wellbeing, and youth education and development.

CAFLS protects and regulates agribusiness through:

- Clemson **Livestock Poultry Health (LPH)** that works to protect animal health through the control of endemic, foreign, and emerging diseases in livestock and poultry. It protects the health of South Carolinians by providing a comprehensive inspection service to ensure that meat and poultry products are safe, wholesome, and accurately labeled. LPH serves as South Carolina's animal health authority, state meat and poultry inspection department, and the state's veterinary diagnostic center in fulfilling its role.

- Clemson **Regulatory Services** that protects the state from exotic and invasive species, ensures that pesticides are used safely, regulates the structural pest control industry, verifies that fertilizer and lime meet standards and labeled guarantees, conducts programs for seed and organic certification, provides a diagnosis of plant pests, and ensures readiness to respond to a catastrophic event impacting the state's agriculture.

Education (including baccalaureate, master's, and doctoral degrees) is delivered through academic departments under CAFLS. The College contains five academic departments offering twelve undergraduate majors and eleven graduate programs. The departments are the academic home to the college's faculty, with most faculty having teaching, research, and/or extension components for their appointments.

Over its 135-year history, Clemson has made substantial and diverse contributions to South Carolina's economy. Central to the founding mission, agricultural sciences have always formed a core of Clemson's education, research, extension, and regulatory activities. Clemson fulfills its mission through the programmatic activities of CAFLS, comprised of Clemson Experiment Station, Clemson Cooperative Extension, Livestock Poultry Health, and Regulatory Services. CAFLS has helped build, sustain, and improve South Carolina's agriculture, forestry, and related industries through the activities of these mutually dependent components. Yet, as much as CAFLS has helped drive South Carolina's economic growth and prosperity in the past, it is likely to be even more important in the state's increasingly technology- and innovation-driven economy. As knowledge, intellectual capacity, and innovation become the foremost drivers of modern economies, the importance of academic R&D centers, advanced higher education institutions, and knowledge and practice diffusion organizations as engines for economic growth becomes very clear. Innovation, knowledge transfer, and productivity enhancement (activities at the core of CAFLS's mission) are keys to the long-term sustainability of South Carolina's economy.

Today, CAFLS focuses on a wide array of critical issues affecting people's daily lives and the state's future. CAFLS's efforts empower people and communities to solve problems and improve their lives. Specifically, CAFLS works to improve the quality of life for all South Carolinians by helping to accomplish the following:

- Ensure a safe, secure, and abundant food supply.
- Improve agricultural and natural resource profitability and productivity.
- Protect animal and plant health.
- Increase effective decision-making regarding environmental stewardship.
- Promote sound human nutrition and health.
- Strengthen individuals and families.
- Foster the development of youth.
- Provide opportunities for career exploration and work readiness.
- Promote a strong local economy and workforce.
- Empower connected, engaged communities and leaders.

Through these activities, CAFLS personnel daily deploy fact-based knowledge to South Carolina's agricultural and natural resource producers, agribusinesses, community leaders, families, and youth.

Study Goals

Recognizing a need to communicate CAFLS's value, modern relevance, importance, and impact, Clemson University engaged TEConomy Partners, LLC (TEConomy) to conduct an independent study assessing the economic and functional impacts across CAFLS's key mission areas. TEConomy brings extensive experience in national program evaluations, including work for the USDA's National Institute of Food and Agriculture (NIFA) and multiple impact assessments for land-grant universities nationwide, making the consulting organization well-suited for this comprehensive assessment.

The study seeks to achieve several key goals. First, it seeks to measure the quantitative impact of CAFLS's operational expenditures on key economic metrics in South Carolina, including business volume, personal incomes, and employment. Second, it aims to provide an understanding of the broad range of functional economic, social, and community benefits resulting from CAFLS's activities across the state. Lastly, the study provides specific illustrations of the positive functional impacts generated by CAFLS's activities within South Carolina.

From an economic perspective, the impacts of CAFLS can be understood through two distinct pathways. The first is the "economic stimulus" or expenditure impacts, also known as "backward-linkage impacts." CAFLS's presence and operations generate significant economic stimulus through direct and indirect expenditures across South Carolina, covering all 46 counties where CAFLS has a physical presence. This stimulus includes the direct spending by CAFLS and its personnel, which contributes to the state's business volume, employment, and personal income. Notably, a significant portion of CAFLS's funding comes from external federal sources, which are then spent within South Carolina, amplifying the economic impact.

The second, arguably significantly more important pathway, comprises functional or "forward-linkage impacts." These are the primary reasons for CAFLS's existence and are the result of its core programmatic missions aimed at helping South Carolina's economy, workforce, communities, families, and youth prosper. Through its extensive programmatic activities, CAFLS has a substantial track record of contributing to South Carolina's overall quality of life and positively impacting its economy. As knowledge becomes an increasingly important driver of modern economies, the significance of these functional impacts will continue to expand, further contributing to economic progress.

At its core, CAFLS is a pragmatic, action-oriented organization dedicated to generating positive impacts in South Carolina through the application of science, technology, regulation, training, and knowledge diffusion. The college's activities span education, research, extension, and regulatory services, all aimed at addressing critical challenges in agriculture, forestry, and the daily lives of South Carolinians.

The study aims to provide a well-rounded exposition of the multifaceted economic and functional impacts of CAFLS on South Carolina. By leveraging its extensive expertise and resources, CAFLS contributes substantially to the state's overall quality of life and economic development. The study highlights the importance of CAFLS's mission and the positive outcomes it generates for South Carolina's economy and communities, explaining its role as a crucial driver of progress and innovation in the state.

EXPENDITURE-BASED ECONOMIC IMPACTS OF CLEMSON CAFLS

Introduction to Expenditure Impacts

The true "impact" of Clemson University's College of Agriculture, Forestry, and Life Sciences (CAFLS) is derived from the individuals, students, farmers, families, firms, and communities that are engaged, educated, and supported by the various efforts of CAFLS's operations across all 46 counties and the State of South Carolina (the focus of the next chapter).

However, as part of the broader examination of the roles and impacts of CAFLS, TEConomy developed and performed an expenditure-based economic impact analysis of CAFLS's operations across the State. This economic impact analysis is explicitly focused on CAFLS's employment, operational, and capital expenditures across its five units:

- Clemson Research/Experiment Stations
- Clemson Cooperative Extension
- Livestock Poultry Health
- Regulatory Services, and
- Education and General.

From a traditional economic perspective, these CAFLS expenditures generate economic activity and impact through in-state purchases, other operational expenses, and, ultimately, the expenditures of its faculty, researchers, field agents, other staff, and service providers. In addition, many of these expenditures are then recirculated within the state economy as recipients of the first round of income re-spend a portion of this income with other businesses and individuals within the subject economy. This re-spending is termed the multiplier effect (incorporating both indirect and induced economic impacts).

This chapter describes the data and methods used to estimate these expenditure-based impacts (also known as backward-linkage effects), together with the analysis's results and findings. Appendix A provides the expenditure-based economic impact of CAFLS on each of the 46 counties.

Measuring Expenditure-Based Economic Impacts—Methodology

Overview of Economic Impact Analysis

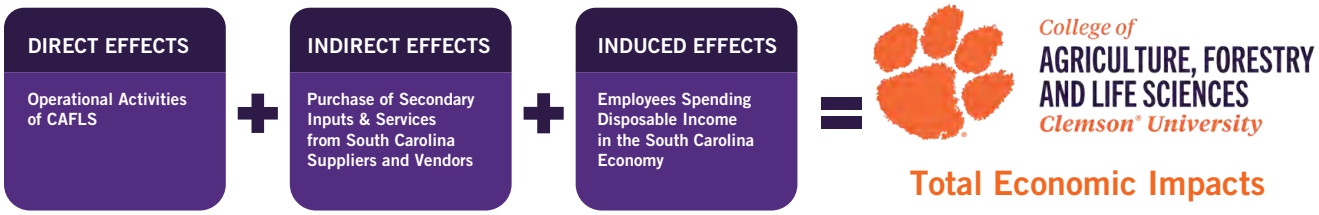
The standard analytical technique for quantifying expenditure impacts is input-output (I-O) analysis developed by Nobel Prize winner Wassily Leontief. I-O analysis uses a matrix representation of an economy that reflects the buy-sell interrelationships and flows of commodities among economic sectors and quantifies the impact of spending by one sector of the economy on all other sectors, consumers, and government for any given geography as specified. The data also show consumption activities by workers, owners of capital, and imports from outside the specified geography. The premise is that every dollar spent in the economy is re-spent on purchasing additional goods or services, generating additional economic activity and impact.

IMPLAN, a software and data application, allows for regional I-O modeling and impact assessment at varied geographic scales while incorporating additional detailed information when available. The IMPLAN models are the most widely used models in the nation and are based on federal datasets, including economic data from the U.S. Bureau of Economic Analysis (BEA), employment and wage data from the U.S. Bureau of Labor Statistics as well as other population and economic data from U.S. Bureau of the Census.[4]

TEConomy uses IMPLAN models to apply I-O analysis for economic impact estimation. It was performed using specific input-output models representing the State of South Carolina and each of the 46 counties.

These trade flows built into the model permit estimating the impacts of one sector on other sectors. These impacts consist of three types: ***direct effects*** (the specific impact of the institution and/or sector[s] in question), ***indirect effects*** (the impact on suppliers to the focus industry or institution), and ***induced effects*** (the additional economic impact of the spending of these suppliers and employees in the overall economy). These three effects combined are considered the ***total impacts*** (Figure 3).

Figure 3: Components of Expenditure-Based (Backward-Linkage) Economic Impacts



Source: TEConomy Partners, LLC.

4 This analysis uses the 2022 IMPLAN models (the most recent available).

The economic impact models and methodology allow TEConomy to calculate the expenditure impacts of CAFLS across multiple measures, including the following:

- **Output**, also known as business volume, is the total value of goods and services produced in an economy and represents the typical measure expressed as “economic impact” or “economic activity” in a standard economic impact study. For public/nonprofit organizations, including universities, “expenditures” are the most appropriate base measure of this economic activity.

- **Employment** includes both direct employment at CAFLS (including students and part-time employees) and jobs within the economy supported by CAFLS expenditures (indirect and induced employment).

- **Labor Income** is the total compensation received by labor in the economy because of the presence and operations of CAFLS via university payrolls and the compensation of other supported employment.

- **Value-Added** is the difference between a firm or industry's total output and the cost of its intermediate inputs, sometimes referred to as the "Contribution to GDP".[5]

- **Government Revenues** include estimates of revenues generated for county/local, state, and federal governments through the direct, indirect, and induced economic activity that is generated in the State of South Carolina. Taxes are adjusted to reflect reduced public-sector tax payments.

In other words, the economic impact analysis models the “ripple effect” that originates from the CAFLS-related expenditures in the regional economy, flows through suppliers and vendors as additional inputs are purchased, and through faculty, staff, and related supplier workers who spend their incomes in the South Carolina economy. The economic impact models estimate and treat purchases made outside of a specific geography as imports (or economic leakages) which are not captured in the total impacts. Similarly, sales to entities outside of the specific geography are also estimated and are considered exports that are not captured in the total impacts.

5 Given the public/nonprofit nature of Clemson University employment, the direct labor income will equal the direct value added for each of the five CAFLS units.

Specific Impact Modeling Developed for CAFLS

Given CAFLS's unique nature and broad geographic perspective, certain model parameters and characteristics were developed to specifically reflect and represent these activities.

First among these efforts included the development and use by TEConomy of an IMPLAN Multi-Regional Input-Output (MRIO) model to estimate the impacts of the five units within CAFLS across the 46 South Carolina counties. The specifics of this South Carolina MRIO model include:

- Each county is modeled—reflecting the direct impacts of the various CAFLS operations in the county.
- The state-level combined results are specified via the MRIO model to also account for cross-county purchases (e.g., CAFLS operations in Pickens County purchasing from Spartanburg County).
- These additional "interregional" impacts associated with each county are then captured in county-level results.

Second, each of the five CAFLS units is modeled as a single IMPLAN sector, or an aggregation of sectors developed by TEConomy, to better reflect and estimate the operations of a particular unit.

Finally, production functions (or purchasing profiles) for some sectors are modified to better reflect the operations of a particular CAFLS unit. For example, veterinary laboratories of all types are captured by NAICS codes and IMPLAN within the broad "veterinary services" sector, which also includes companion animal veterinary offices. For this effort, TEConomy reduced or eliminated some inputs not appropriate to the Livestock Poultry Health Unit's diagnostic role (e.g., purchase of dog/cat food).

Inputs to the CAFLS Economic Impact Models

Three data metrics drive the economic interactions within the models: ***employment*** (headcount basis); ***labor income*** (also called total compensation, including salaries, wages, and the full cost of benefits); and output, which is typically measured for public sector or nonprofit organizations such as CAFLS as ***total expenditures***, as they are a truer measure of total direct output than revenues.

Data were obtained from CAFLS regarding employment, operational expenditures, and detailed capital expenditures by Unit and County. Total CAFLS employment, as provided, reached 2,045.0 in FY 2023. Of these, 2,024.0 are located within one of South Carolina's 46 counties.[6] Table 1 profiles employees by five types (i.e., employment categories) for the five CAFLS units, with 39 percent considered to be "full-time" employees, with a similar percentage of students (undergraduate and graduate) working across the CAFLS units.

Table 1: CAFLS Employment by Employee Type and Unit, FY 2023

Employee Type	Research/ Exper- iment Stations	Coop- erative Extension	Livestock Poultry Health (LPH)	Regulatory Services	Education & General	Total
FTE Employees	212.5	329.9	62.3	69.6	114.9	789.1
Students	124.5	176.6	1.0	6.9	191.1	500.0
Grad	119.2	6.3	-	-	168.2	293.7
TEMP	118.5	80.5	5.6	0.6	79.5	284.7
TLP	70.0	45.6	1.6	14.3	45.9	177.4
Grand Total* (Headcount)	**644.7**	**638.9**	**70.5**	**91.4**	**599.6**	**2,045.0**

Source: Clemson University CAFLS FY 2023 Operational Data.
* These values include 21 CAFLS employees who do not work within the State of Carolina that were excluded from impact estimation.

As shown in Table 2, total CAFLS funding reached more than $157 million in FY 2023. The State of South Carolina (including Clemson University funds) accounted for more than $71 million in total funding or 45 percent of CAFLS's total funding. Federal funding (including NIFA capacity and competitive funding) accounted for more than $38 million in CAFLS's FY 2023 funding (24 percent). For the overall mission and operations of CAFLS, other funding sources are an important component of the overall annual budget, accounting for nearly $48 million or 30 percent in FY 2023.

6 The remaining 21.0 workers perform functions for CAFLS while located outside of South Carolina.

Table 2: CAFLS Expenditures by Category and Funding Source, FY 2023

Funding Source	Personnel*	Operating	Capital	Total Expenditures
State of South Carolina (Direct Funding)	$46,182,764	$20,301,969	$4,761,707	$71,246,440
Federal (e.g., USDA NIFA and others)	$21,267,320	$14,727,779	$2,109,718	$38,104,817
All Other Sources (e.g., tuition, philanthropic gifts, industry-sponsored research, generated revenue, etc.)	$27,248,872	$16,874,189	$3,788,846	$47,911,907
Total FY 2023 Clemson University CAFLS	$94,698,956	$51,903,937	$10,660,271	$157,263,164

Source: Clemson University CAFLS FY 2023 Operational Data.
* These values include wages, salaries, and benefits for 21 CAFLS employees who do not work within the State of Carolina and were excluded from impact estimation.

From an operational perspective, Table 3 details FY 2023 funding across the five CAFLS units again by personnel, operating, and capital expenditures. Personnel expenditures account for fully 60 percent (nearly $97 million) of CAFLS's total FY 2023 budget. The important research mission of CAFLS is underscored by the expenditures for the Research & Experiment Stations unit exceeding $63 million and accounting for 40 percent of FY 2023 expenditures. Cooperative Extension operations also constitute a significant share of CAFLS expenditures, accounting for 28 percent or more than $43 million in FY 2023. CAFLS's education mission is reflected in more than $29 million in FY 2023 expenditures (19 percent). Livestock Poultry Health and Regulatory Services, two units that are relatively unique to Clemson University and South Carolina, combine to account for $21 million or 13 percent of CAFLS FY 2023 expenditures.

Table 3: CAFLS Expenditures by Category and Unit, FY 2023

CAFLS Unit	Personnel*	Operating	Capital	Total Expenditures
Research & Experiment Stations	$31,071,555	$25,245,573	$7,365,379	$63,682,507
Cooperative Extension	$30,536,566	$11,961,617	$916,586	$43,414,769
Education and General (E&G)	$21,300,795	$6,466,180	$1,418,875	$29,185,849
Regulatory Services	$6,375,334	$5,705,157	$652,642	$12,733,133
Livestock Poultry Health (LPH)	$5,414,705	$2,525,411	$306,790	$8,246,906
Total FY 2023 Clemson University CAFLS	$94,698,956	$51,903,937	$10,660,271	$157,263,164

Source: Clemson University CAFLS FY 2023 Operational Data.
* These values include wages, salaries, and benefits for 21 CAFLS employees who do not work within the State of Carolina and were excluded from impact estimation.

FY 2023 Expenditure Impacts of CAFLS

The following subsections and tables capture the expenditure-based economic impacts of CAFLS across each of the five units.

CAFLS Research & Experiment Stations

The largest CAFLS unit, in terms of personnel and expenditures, Research & Experiment Stations' employment of 642.7 accounts for 31.8 percent of CAFLS total personnel. With the expenditures required to support this level of operation in FY 2023, the Research & Experiment Stations' unit generated and supported $120 million (43 percent) in statewide economic activity (total output impacts) leading to an output multiplier of 1.90—every $1 spent by the Research & Experiment Stations unit generates an additional $0.90 within the economy of the State of South Carolina (Table 4).

Table 4: CAFLS Research & Experiment Stations FY 2023 Expenditure Impacts ($ in Millions)

Impact Type	Employ-ment	Labor Income	Value Added	Output	County/ Local Tax Revenue	State Tax Revenue	Federal Tax Revenue
Direct Effect	642.7	$30.78	$30.78	$63.07	$0.02	$0.48	$6.12
Indirect Effect	222.6	$11.23	$16.44	$36.87	$0.47	$0.65	$2.40
Induced Effect	124.0	$5.21	$11.71	$20.13	$0.68	$0.79	$1.30
Total Impacts	989.3	$47.22	$58.93	$120.07	$1.18	$1.92	$9.82
Multiplier	***1.54***	***1.53***	***1.91***	***1.90***			

Source: TEConomy analysis, South Carolina IMPLAN MRIO Model

This overall level of economic activity supports an additional 346.6 jobs within the economy—for every individual CAFLS-funded job, an additional 0.54 jobs are generated within the state of South Carolina.

CAFLS Cooperative Extension

CAFLS Cooperative Extension, by its nature and function, includes employment in each of the 46 counties, ranging from two to four personnel in many counties to 10 or more employees in nine different counties. Cooperative Extension's 637.9 employees account for 31.5 percent of CAFLS personnel total (Table 5). With direct expenditures of $43 million, Cooperative Extension generated and supported more than $72 million in statewide total economic activity (26 percent of CAFLS statewide total output impacts)

Table 5: CAFLS Cooperative Extension FY 2023 Expenditure Impacts ($ in Millions)

Impact Type	Employ-ment	Labor Income	Value Added	Output	County/ Local Tax Revenue	State Tax Revenue	Federal Tax Revenue
Direct Effect	637.9	$30.18	$30.18	$43.06	$0.03	$0.49	$6.09
Indirect Effect	76.7	$3.82	$6.06	$13.61	$0.24	$0.31	$0.82
Induced Effect	96.8	$4.10	$9.16	$15.75	$0.54	$0.61	$1.02
Total Impacts	811.4	$38.10	$45.40	$72.41	$0.81	$1.40	$7.93
Multiplier	***1.27***	***1.26***	***1.50***	***1.68***			

Source: TEConomy analysis, South Carolina IMPLAN MRIO Model

CAFLS Livestock Poultry Health

CAFLS's state-supporting Livestock Poultry Health (LPH) unit is the smallest of the five units, with 70.5 personnel (3.5 percent of CAFLS total; across 18 counties) and direct expenditure of $8.25 million (Table 6). These direct expenditures generated and supported an additional $5.8 million in indirect and induced expenditures for a total economic (output) impact of $14 million. This level of economic activity accounts for 5.1 percent of CAFLS statewide impact.

Table 6: CAFLS Livestock Poultry Health FY 2023 Expenditure Impacts ($ in Millions)

Impact Type	Employ-ment	Labor Income	Value Added	Output	County/ Local Tax Revenue	State Tax Revenue	Federal Tax Revenue
Direct Effect	70.5	$5.41	$5.41	$8.25	$0.00	$0.08	$1.01
Indirect Effect	11.4	$0.74	$1.13	$2.23	$0.04	$0.05	$0.15
Induced Effect	21.1	$1.01	$2.07	$3.55	$0.12	$0.12	$0.23
Total Impacts	103.0	$7.17	$8.62	$14.03	$0.16	$0.25	$1.39
Multiplier	***1.46***	***1.32***	***1.59***	***1.70***			

Source: TEConomy analysis, South Carolina IMPLAN MRIO Model

CAFLS Regulatory Services

Regulatory Services, also a CAFLS state-supporting unit, consists of 91.4 personnel across 13 South Carolina counties and accounts for 4.5 percent of CAFLS total employment. Expenditures of $12.7 million generated and supported total output expenditures of more than $24.5 million in FY 2023. This level of total expenditure impact accounted for 8.8 percent of the CAFLS-supported statewide economic activity (Table 7).

Table 7: CAFLS Regulatory Services FY 2023 Expenditure Impacts ($ in Millions)

Impact Type	Employ-ment	Labor Income	Value Added	Output	County/ Local Tax Revenue	State Tax Revenue	Federal Tax Revenue
Direct Effect	91.4	$6.39	$6.39	$12.73	$0.01	$0.11	$1.31
Indirect Effect	43.4	$2.51	$3.48	$6.96	$0.09	$0.12	$0.50
Induced Effect	29.0	$1.30	$2.84	$4.83	$0.17	$0.19	$0.32
Total Impacts	163.7	$10.20	$12.71	$24.53	$0.26	$0.42	$2.13
Multiplier	***1.79***	***1.60***	***1.99***	***1.93***			

Source: TEConomy analysis, South Carolina IMPLAN MRIO Model

CAFLS Education & General

The CAFLS Education & General (E&G) workforce, while substantial at 581.5 personnel, consists of a large share of undergraduate and graduate students. This results in a lower direct total labor income for these employees due to a combination of less than full-time, lower wages, and limited benefits. At least in FY 2023, E&G also had a more limited spending profile compared to other CAFLS units. These factors cause the direct effects of E&G to generate a more limited set of indirect and induced impacts across the State. This is also reflected in the generally lower multipliers (Table 8).

Table 8: CAFLS Education & General (E&G) FY 2023 Expenditure Impacts ($ in Millions)

Impact Type	Employ-ment	Labor Income	Value Added	Output	County/ Local Tax Revenue	State Tax Revenue	Federal Tax Revenue
Direct Effect	581.5	$20.87	$20.87	$28.70	$0.01	$0.29	$3.94
Indirect Effect	45.0	$1.87	$3.33	$8.18	$0.11	$0.15	$0.41
Induced Effect	62.1	$2.47	$5.76	$9.90	$0.33	$0.40	$0.61
Total Impacts	688.7	$25.21	$29.96	$46.77	$0.45	$0.85	$4.96
Multiplier	***1.18***	***1.21***	***1.44***	***1.63***			

Source: TEConomy analysis, South Carolina IMPLAN MRIO Model

The results of the personnel structure within E&G accounts for 28.7 percent of the CAFLS workforce, while accounting for $46.7 million in total output impacts or only 16.8 percent of CAFLS statewide economic activity.

CAFLS - All Units Combined

The five combined units of CAFLS account for more than 2,000 South Carolina workers and constitute personnel, operating, and capital expenditures of nearly $156 million within the state (Table 9). These operations generate and support 2,756 workers in the state (an employment multiplier of 1.36) and total output impacts of nearly $278 million. For every $1 of expenditures by CAFLS programs, an additional $0.78 is generated and supported within the economy of the state of South Carolina.

Table 9: CAFLS All Units Combined Total FY 2023 Expenditure Impacts ($ in Millions)

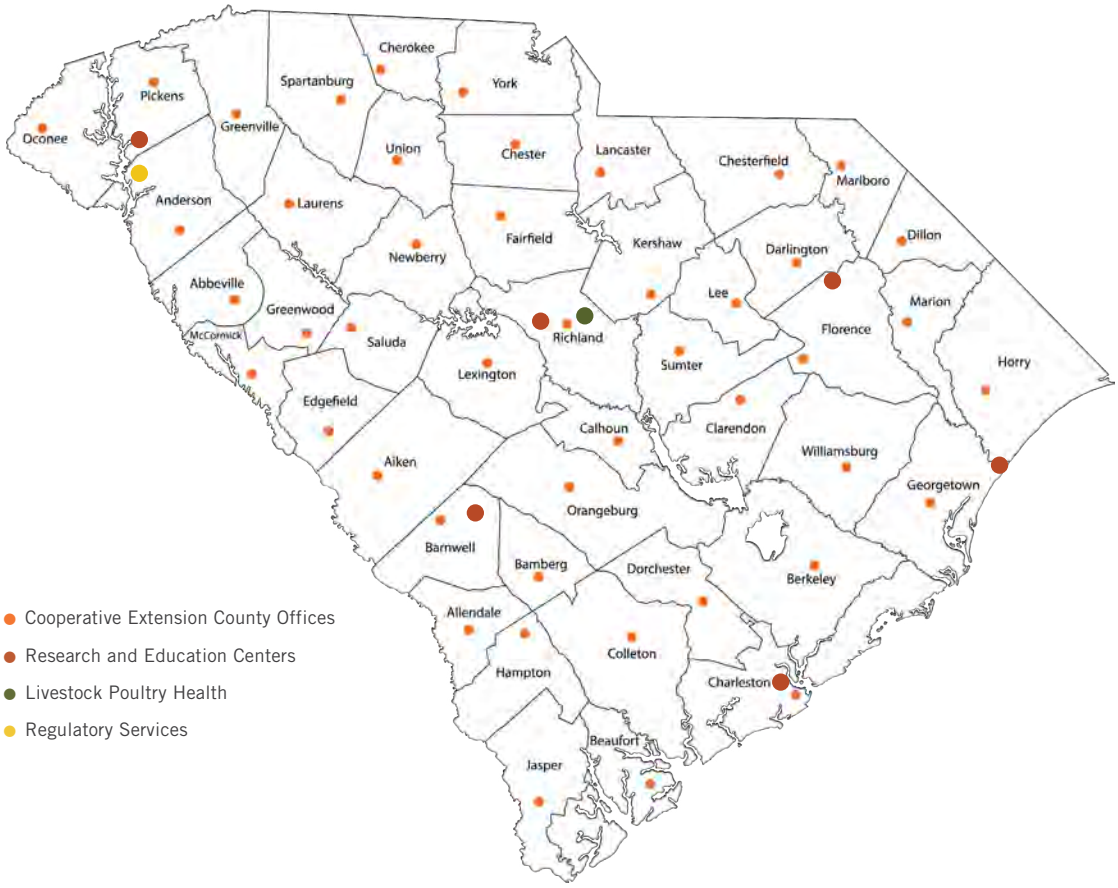
Impact Type	Employ-ment	Labor Income	Value Added	Output	County/ Local Tax Revenue	State Tax Revenue	Federal Tax Revenue
Direct Effect	2,024.0	$93.63	$93.63	$155.80	$0.07	$1.45	$18.47
Indirect Effect	399.1	$20.16	$30.44	$67.85	$0.95	$1.28	$4.28
Induced Effect	333.0	$14.09	$31.54	$54.16	$1.84	$2.11	$3.47
Total Impacts	2,756.1	$127.89	$155.62	$277.80	$2.86	$4.84	$26.22
Multiplier	***1.36***	***1.37***	***1.66***	***1.78***			

Source: TEConomy analysis, South Carolina IMPLAN MRIO Model

CAFLS Expenditure Impacts Across the State of South Carolina

As discussed, CAFLS has a statewide geographic footprint with personnel located throughout South Carolina. As illustrated in Figure 4, Cooperative Extension county centers, located in all 46 counties, house Extension personnel who: meet with agricultural producers and other key constituencies; respond to questions posed by the public; conduct proactive workshops and other educational events; and provide answers to commonly encountered problems through educational materials, web-based information, the telephone, and individual consultations. In addition, CAFLS manages six Research and Educations Centers (RECs) located throughout the state where personnel conduct research on eight research farms, four animal feeding facilities, 17 field laboratories, 18 greenhouses, and nine growth chambers that encompass nearly 10,000 acres of land. The CAFLS Livestock Poultry Health Unit is located in Richland County and Regulatory Services is located in Anderson County.

Figure 4: Map of CAFLS Operations



Source: Clemson University CAFLS

To summarize these county-based impacts, Table 10 provides the total number of CAFLS personnel in each county (direct employment) and total CAFLS expenditures in each county (direct output) and the levels of generated and supported total impacts (generated in the county and through interregional effects). Appendix A includes a summary profile for each South Carolina county.

Table 10: CAFLS County-Level FY 2023 Expenditure Impacts Summary ($ in Millions)

County	Employment		Output	
	Direct	Total	Direct	Total
Abbeville	5.0	6.3	$419,918	$635,129
Aiken	5.0	12.7	$349,174	$1,394,839
Allendale	3.0	3.5	$293,868	$381,738
Anderson	166.0	240.0	$15,644,265	$26,877,333
Bamberg	6.0	8.9	$523,142	$974,656
Barnwell	102.0	127.7	$8,510,114	$12,135,659
Beaufort	7.0	11.7	$735,916	$1,568,579
Berkeley	3.0	11.5	$284,940	$1,962,176
Calhoun	2.0	5.2	$145,609	$661,970
Charleston	88.0	154.3	$10,092,181	$22,831,506
Cherokee	3.0	3.6	$165,841	$286,797
Chester	5.0	5.4	$252,204	$333,824
Chesterfield	4.0	5.1	$367,459	$531,084
Clarendon	5.0	6.3	$364,222	$560,312
Colleton	5.0	7.0	$468,541	$783,173
Darlington	8.0	11.4	$607,568	$1,149,789
Dillon	3.0	3.7	$123,221	$236,938
Dorchester	6.0	11.4	$446,813	$1,338,054
Edgefield	3.0	3.5	$238,711	$320,044
Fairfield	3.0	3.4	$178,849	$255,559
Florence	96.0	132.6	$8,878,409	$15,163,455
Georgetown	70.0	93.0	$6,025,442	$9,664,968
Greenville	16.0	103.5	$1,665,320	$17,423,404
Horry	13.0	24.8	$1,204,341	$3,315,309
Jasper	4.0	4.5	$277,307	$363,523
Kershaw	6.0	8.5	$513,974	$912,186
Lancaster	5.0	9.1	$424,229	$1,207,120
Laurens	8.0	9.7	$448,540	$726,045
Lee	4.0	4.6	$385,668	$487,266

County	Employment		Output	
	Direct	Total	Direct	Total
Lexington	16.0	31.7	$1,622,879	$4,282,185
Marion	8.0	9.7	$460,635	$729,352
Marlboro	2.0	2.4	$149,442	$208,394
McCormick	4.0	4.4	$254,998	$313,986
Newberry	4.0	5.4	$428,793	$616,312
Oconee	28.0	49.5	$1,723,862	$5,614,536
Orangeburg	13.0	55.4	$8,007,853	$13,836,951
Pickens*	1,164.0	1,364.0	$69,029,793	$101,056,831
Richland	81.0	129.3	$10,199,205	$18,994,962
Saluda	6.0	6.7	$442,541	$556,701
Spartanburg	11.0	18.5	$816,052	$2,257,382
Sumter	8.0	10.8	$617,418	$1,046,163
Union	5.0	5.7	$389,493	$501,298
Williamsburg	6.0	8.0	$636,356	$908,653
York	6.0	11.4	$543,445	$1,581,664

***Note:** Pickens County is the primary location of Clemson's main campus including CAFLS's geographic base of operations.
Source: TEConomy analysis, South Carolina IMPLAN MRIO Model. County-level expenditures include those made for personnel, supplies & operations, and capital expenditures).

CAFLS Economic Activity Return on State Investment

As an education, research, and service component of Clemson University, CAFLS's role in the South Carolina economy is developmental and supportive (to be described within the Functional Impact chapter of this report). However, CAFLS operations are indeed an economic actor within the state economy as it employs a sizeable workforce, pays meaningful wages, and makes purchases from vendors and suppliers across the state.

As an economic actor the common examination of these operations through a Return on Investment (ROI) lens can provide some insight into the importance of these jobs, earnings, and purchase on the South Carolina economy.

In total, the State of South Carolina invested $71.2 million in CAFLS's FY 2023 operations, with activities occurring in every one of the state's 46 counties. These state funds, in turn, directly leverage and generate more than $86.0 million in federal capacity and competitive funding and funding from a wide variety of other sources. Basic ROI calculations show that **FY 2023 CAFLS expenditures, and the total output impacts they supported across the state, generated an economic activity (output) return of $3.90 for every $1 invested by the State of South Carolina.**

Summary

This economic impact analysis of CAFLS expenditure-based economic impacts develops and provides these key impact characteristics:

- Over the course of FY 2023, CAFLS employed 2,024 workers in the State of South Carolina—with employment and expenditures in every one of South Carolina's 46 counties.

- The economic impact of CAFLS FY 2023 expenditures resulted in:
  - A total of 2,756 jobs supported across South Carolina, generating nearly $128 million in labor income (total compensation) to state residents.
  - The generation and support of nearly $278 million in total economic impact (total supported state output)
  - The total economic activity associated with CAFLS expenditures returned $2.9 million in county/local taxes and $4.8 million in state taxes.
  - Significant employment and output impacts across all five CAFLS units (Table 11).

Table 11: CAFLS Unit-Level FY 2023 Expenditure Impacts Summary ($ in Millions)

CAFLS Unit	Employment		Output ($M)	
	Direct	Total	Direct	Total
Research & Experiment Stations	642.7	989.3	$63.07	$120.07
Cooperative Extension	637.9	811.4	$43.06	$72.41
Education and General (E&G)	581.5	688.7	$28.70	$46.77
Regulatory Services	91.4	163.7	$12.73	$24.53
Livestock Poultry Health (LPH)	70.5	103.0	$8.25	$14.03
Total FY 2023 Clemson University CAFLS	2,024.0	2,756.1	$155.80	$277.80

Source: TEConomy analysis, South Carolina IMPLAN MRIO Model

It is important to note that the principal impacts of CAFLS are generated through the mission-oriented programs and activities that are delivered by faculty, staff, and field agents throughout South Carolina – these impacts are known as functional impacts or forward-linkage effects and have not been captured in these analyses. These functional impacts are described and discussed in the following chapters.

AN OVERVIEW OF THE FUNCTIONAL IMPACTS OF CLEMSON CAFLS

The previous chapter highlights the significant economic impacts in South Carolina via the operational and personnel expenditures of CAFLS. These expenditure impacts are certainly of significant statewide benefit to South Carolina as well as in the individual locations where CAFLS has operations across the state. However, as noted previously, CAFLS does not exist to generate expenditure impacts (that is a side benefit of its presence in South Carolina); rather, **it exists to generate wide-ranging, mission-specific impacts** that are termed ***functional impacts*** and are the true signature benefits generated.

Through its unique quaternary-part (or four-part) mission of education, research, extension, and regulation, CAFLS delivers through its Research and Agricultural Experiment Station System, Cooperative Extension Services, Livestock Poultry Health, Regulatory Services, and academic departments the following:

- An **innovation engine**, relaying needs and challenges from the field to university researchers and research teams; and testing new practices, technologies, and innovations to sustain and advance the economy, social progress, and individual capacity.

- A **transformational educator** working to provide continuous, credit and noncredit education to audiences statewide—education that improves recipients' personal and working lives. CAFLS is a teaching organization that works to significantly enhance human capital, generate well-prepared practitioners, and promote lifelong learning across the State of South Carolina.

- A **regional network** with a presence in every South Carolina county—linking communities, businesses, and the general population to the intensive research and development (R&D) and technical resources of the university and its partners.

- A **transdisciplinary entity** able to adopt holistic, integrated approaches to tackle complex problems in scientific, economic, technological, and social areas of importance to the citizens of the state.

- A **catalyst** for the improvement of natural resource management practices, enhancing the environment, and sustaining South Carolina's quality of place, thus ensuring the attractiveness of the state and its communities for human capital, new ventures, and industry retention and expansion.

- A **deliverer** of research, teaching, and extension efforts to bolster food safety, ensure a secure food supply, and protect and promote the health of the state's citizens.

- A **strengthener** of the quality of life of individuals and families, thereby contributing to community sustainability and vitality.

- A **provider** of 4-H Youth Development, FFA, and leadership services, helping to provide the next generation of workers, leaders, and responsible citizens.

CAFLS is a diverse organization with a broad mission of serving South Carolina's complex and multi-variant needs. Its work can be understood as taking place under five major thematic areas, which are highlighted in Figure 5. The activities conducted by CAFLS, and the results obtained through them, are termed "functional impacts."

Figure 5: Key Areas of Impact Addressed through CAFLS Programming and Activities

Source: TEConomy Partners, LLC.

These impacts are categorized as forward-linkage impacts or functional impacts, which are related to institutional mission and function rather than being related to institutional spending. These are the impacts that Congress envisioned as benefits to be provided through the formation of land-grant universities. As will be discussed in the narrative that follows, they constitute a broad and multifaceted array of positive economic and social impacts for South Carolina. Through the activities and functions of CAFLS, South Carolina benefits in terms of the following:

- **Enhanced Human Capital**—Produced through the formal academic education of students, the creation and deployment of positive youth development programming, and the development of lifelong learning opportunities.

- **Employment and Personal Income**—Generated in agriculture, forestry, and related industries via CAFLS's impacts on business development, profitability, and economic growth.

- **Economic Diversification**—Achieved through the application of CAFLS's new R&D discoveries, innovations, and practice recommendations.

- **Economic Output and Economic Growth**—Sustained through new innovations, practice recommendations, and scientific and extension activities in support of multiple sectors of the South Carolina economy.

- **Local and State Government Revenue**—Generated through the enhanced economic activity supported in the state by CAFLS research, extension, and education.

- **Environmental Protection and Environmental Sustainability**—Supported through CAFLS research, education, extension, and regulation services to promote conservation, enhanced stewardship, and management of South Carolina's natural resources.

- **Enhanced State and Community Sustainability**—Supported by CAFLS's work in maintaining business profitability, developing diversified economic sectors, producing new and enhanced products, and managing South Carolina's natural and community resources.

- **Improved Quality of Life**—Supported on multiple fronts by CAFLS work in community development, economic development, human capital development, and programs targeting sustainability and environmental conservation and protection.

- **Health and Wellness**—Sustained through CAFLS activities in a broad range of functional areas, such as health and nutrition education and training and food safety.

- **Reduced Social Costs**—Supported by CAFLS's work in the prevention of reduction in negative environmental impacts requiring remediation, self-destructive behavior, development of alternative paths for at-risk populations, etc.

- **Public Service and Volunteerism**—Promoted through CAFLS's work with youth development, continued education and training, and leadership development activities.

The programmatic efforts of CAFLS fulfill important public needs that would not be fulfilled, or would be inadequately fulfilled, if left completely to market forces. The fulfillment of these public needs is provided through the forward-linkage functions of its operations. The forward-linkage impacts of CAFLS can be classified into five macro themes:

- Advancing the agriculture, agribusiness, forestry, and forest product industries of South Carolina.
- Encouraging healthy behaviors of individuals, families, and communities.
- Conserving the environment by advancing natural resources management and supporting environmental stewardship.
- Protecting the health of the agricultural environment.
- Developing human capacity through youth development, formal academic education, and lifelong learning opportunities.

Each of these primary areas of activity contains multiple programs and initiatives that build and sustain South Carolina's economic and social well-being. Services and programs under these themes reach across all 46 South Carolina counties. They are made available by CAFLS to South Carolinians young and old, in rural and urban environments, and at home and in the workplace.

The principal functions and associated functional impacts of each of the five themes are illustrated in Figure 6 and discussed further in the narrative detail that follows. For each area of impact, TEConomy provides a description of the program area, outlines the tangible needs being addressed in South Carolina, and provides specific examples and case studies of CAFLS in action and the positive impacts being generated.

Figure 6: CAFLS Functional Impact Roadmap

Areas of Impact	Topical Domains	Focus Areas	South Carolina Functional Impacts	Returns to South Carolina
Advancing Industry	Agribusiness	Animals, Livestock, and Forage	Improved Yield and Productivity	Enhanced Agricultural and Forestry Sector Financial Stability and Profits
		Crop Production and Agronomic Crops	Economic Diversification	
	Processing and Packaging	Horticulture	Improved Competitiveness	Globally Competitive Economy
		Food Nutrition and Packaging	Growth in Value-Added Industries	
	Forestry	Experimental Forestry	Enhanced Employment and Personal Income	Economic Output and Employment Growth
		Wood Utilization and Design	New Business Development	
Encouraging Healthy Behaviors	Individuals	Chronic Disease Prevention/Management	Problem-Solving for Existing Industry	Increased Exports
		Food and Nutrition Education (EFNEP)	Rural and Urban Development	
	Families	Maternal Health	Improved Quality of Place	Enhanced Personal and Household Incomes
		Fiscal Empowerment	Quality of Life Across the Life Span	
	Communities	Community Beautification	Enhanced Lifestyle Management	Economic Diversification
		Food Safety and Security	Enhanced Individual Health	
Conserving the Environment	Water Quality	Water Resources	Improved Financial Management	Local/State Government Revenue
		Coastal Ecology	Environmental Sustainability	
	Climate-Smart Practices	Wildlife Conservation	Natural Resource Management	Rural, Small Town, and Urban Economic Opportunities
		Climate-Smart Agricultural Practices	Enhanced Quality of Life and Public Health	
	Natural Resource Mgmt.	Experimental Forests and Gardens	Environmental Sustainability	Human Capital Skills Development
		Environmental Conservation	Natural Resource Management	
Protecting Agricultural Health	Invasive Species	Agricultural Services and Lab Testing	Enhanced Quality of Life	Improved Quality of Life and Quality of Place
		Fertilizer Standardization	Enhanced Public Health	
	Pesticides and Fertilizers	Pesticide Regulation and Education	Safe and Secure Food Supply	Environment and Natural Resource Conservation and Sustainability
		Managing Exotic/Invasive Plants and Insects	Maintained Ecosystem Stability	
	Animal Health and Welfare	Disaster Management/Preparedness	Resilience to Natural Disasters	Resource Use Efficiency
		Seed, Turfgrass, and Organic Certification	Risk Management, Mitigation, and Reduction	
Developing Human Capital	Youth Development	4H and FFA Youth Development	Minimized Economic Losses	Enhanced Family/Personal Budget Management and Food Security
		Nutrition Education	Enhanced Community Wellbeing	
	Formal Education	K-12 STEM Student Experiences	Enhanced Youth Educational Performance	Enhanced Health of South Carolina Residents
		Undergraduate Education (Bachelor's)	Enhanced Youth Engagement/Citizenry	
	Lifelong Learning	Graduate Education (Master's and PhD)	Reduced Socioeconomic Costs	Reduced Healthcare Costs
		Master Training and Lifelong Learning	Improved Skills and Confidence	
			Expanded Educational Opportunities	Reduced Social Costs and Negative Externalities
			Continuous Skills Development	

Source: TEConomy Partners, LLC.

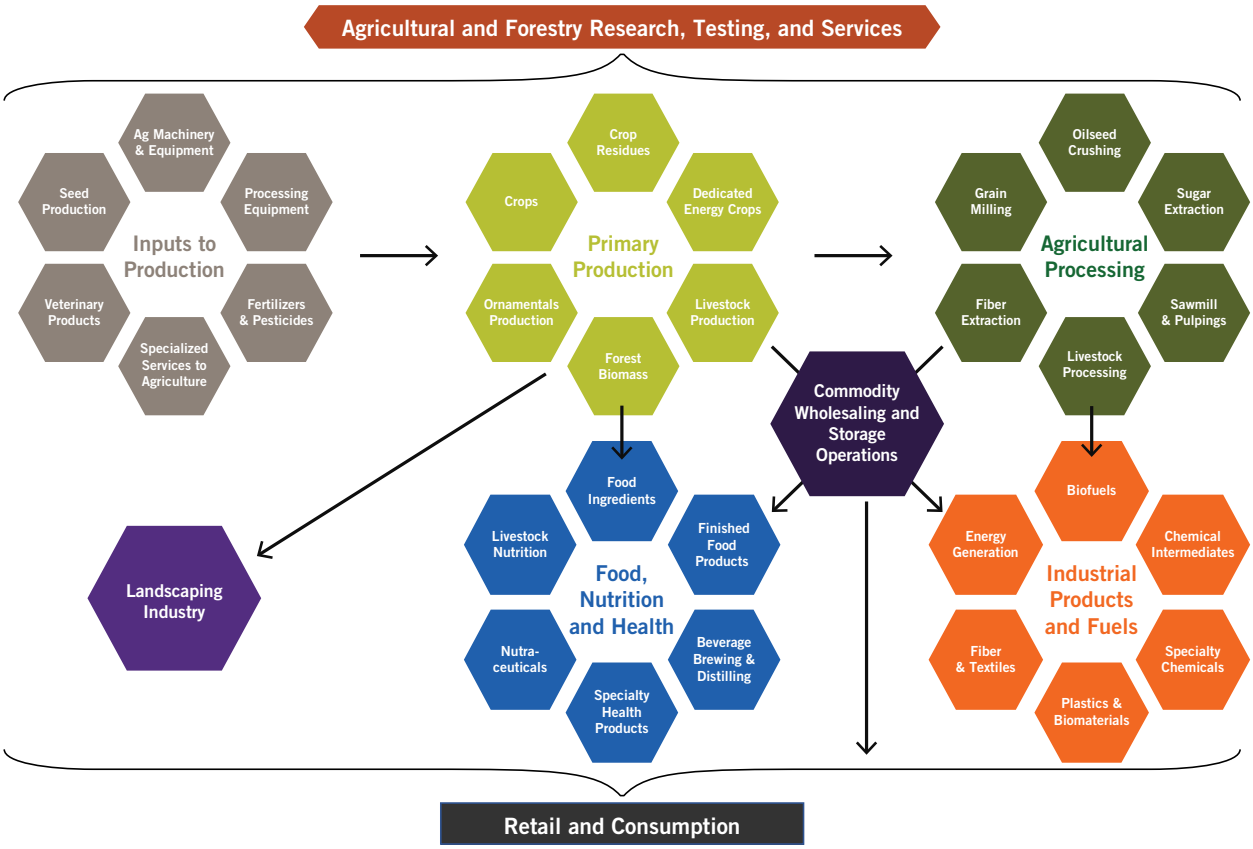
ADVANCING THE AGRICULTURE, AGRIBUSINESS, FORESTRY, AND FOREST PRODUCT INDUSTRIES OF SOUTH CAROLINA

Description

CAFLS's focused activities in agricultural research, higher education, and extension have been a constant thread throughout Clemson's history—present since its founding and representing a consistent, dedicated mission to enhance the practice of agriculture and forestry for the benefit of the economy and society of South Carolina.

In terms of agriculture and forestry, CAFLS works on behalf of a complex ecosystem of economic activities that span a complete value chain within the state (Figure 7). Basic and applied research is performed by CAFLS and translated into knowledge put to work across this value chain.

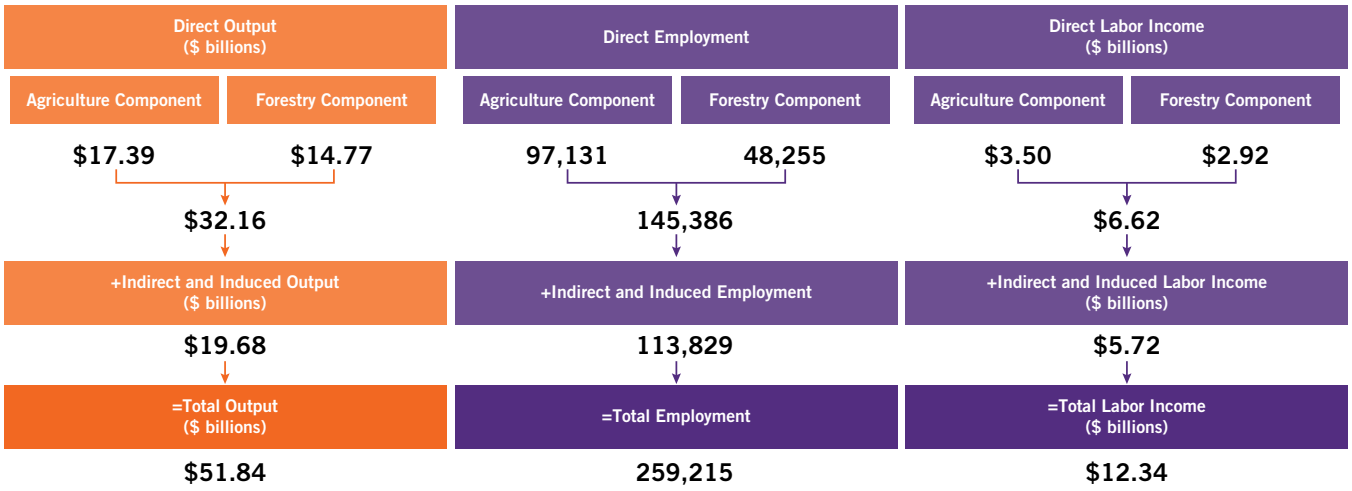
Figure 7: Overview of Key Agriculture and Forestry Value Chain Elements



Source: TEConomy Partners, LLC.

Given the statewide nature of agriculture and forestry in South Carolina and the major industries that further process and add value to agricultural and forest outputs, the ecosystem of activities generates large-scale economic impacts for the state. The overall impact of the agriculture, agribusiness, forestry, and forest products industries in South Carolina has been recently evaluated in work by Joseph C. Von Nessen for the South Carolina Department of Agriculture.[7] In his 2022 study, Von Nessen uses the term "agribusiness" to include the full value chain of primary agriculture and forestry production together with associated value-added processing industries. Using IMPLAN input-output analysis, the 2022 report finds the industry generating $32.2 billion in direct economic output and supporting 145,386 direct jobs in the state with a labor income of $6.6 billion. Figure 8 summarizes Von Nessen's 2022 impact findings, showing the agribusiness value-chain in South Carolina supporting **a total output in the state (direct + indirect + induced impacts) of $51.84 billion and total employment of 259,215 jobs with a combined labor income of $12.34 billion.**

Figure 8: Economic Impact of Agribusiness in South Carolina



Source: TEConomy analysis of Joseph C. Von Nessen. 2022. "The Economic Impact of Agribusiness in South Carolina."

Notably, the agribusiness sector, with a combined impact of $51.84 billion, supports 8.6 percent of the South Carolina economy.

Among the most important characteristic of this large-scale economic impact is that the **agribusiness sector has a presence in every South Carolina county**. It represents a widely distributed production and value-added economic development engine that benefits every county and has a positive impact on the economies of urban, suburban, small town, and rural South Carolina.

7 Von Nessen, J.C. (2022). *The Economic Impact of Agribusiness in South Carolina.* Darla Moore School of Business University of South Carolina, produced for the South Carolina Department of Agriculture.

The Need for CAFLS to Advance Industry

The agriculture and forestry work of CAFLS is diverse, covering research, extension, regulatory, and educational activities. The research work performed by CAFLS is particularly important because **it is effectively the R&D hub for South Carolina's agriculture and forestry industries.** In most industries, the research that improves products and productivity is conducted by the industry itself. In the automotive sector, metals manufacturing, software, electronics, aerospace, etc., industry research conducted by the producers themselves dominates. **This is not the case in agriculture.** As noted in a report by TEConomy for the USDA:

> *Unlike most other manufacturing or technology industry sectors, agriculture is almost entirely composed of small and midsize business enterprises in terms of primary production. Whereas the global automobile industry, for example, comprises circa two dozen or so major manufacturers, agricultural output in the United States alone stems from the work of 2.1 million individual farms. The national U.S. agricultural industry's output is the net result of literally hundreds of millions of individual decisions made by farmers across their growing seasons, with those decisions having to take into account an exceptional number of variables (weather, soil fertility, pathogens, pests, commodity prices, global competition, etc.) and the potential deployment of multiple technologies and solutions (such as specific crop varieties and cultivars to use, livestock health products to employ, type of tillage to deploy, and capital investments in new farming equipment, to name just some). The fact that American farmers and the R&D system that supports these farmers have together achieved [large scale] productivity increases in the face of the variable production environment and multivariate decision-making environment in which farmers operate is a splendid American success story, but one that goes underrecognized and underappreciated… Importantly, unlike many other industries, the primary production sector in agriculture, being made up of millions of small and midsize enterprises, has only a limited internal R&D capacity. Instead, innovations and productivity predominantly depend on R&D and knowledge transfer from agricultural inputs suppliers, the United States Department of Agriculture (USDA) Agricultural Research Service (ARS), and America's unique system of Land-Grant universities and Cooperative Extension Services.*[8]

Although South Carolina contains some very large farming operations (with 184 farms having sales in 2022 greater than $5 million), the plurality of farms in the state are "small" by USDA standards, with annual sales of less than $250,000. Indeed, out of the total of 22,633 South Carolina farms recorded in the 2022 Census of Agriculture, 7,577 (33.5 percent) had sales below $1,000.[9] More than two-thirds of farms in South Carolina had sales of less than $10,000. Only 4.4 percent of farms in South Carolina are in the largest category, having in excess of $1 million in annual sales (Table 12). Overall, the average value of sales for a South Carolina farm was $195,608 in 2022, so it is fair to say they are akin to "small businesses" in other industry sectors.

8 Tripp, S., et al. (2017). *National Evaluation of Capacity Programs.* TEConomy Partners, LLC. Prepared for the National Institute of Food and Agriculture (NIFA).
9 USDA, National Agricultural Statistics Service. (2022). *Economic Class of Farms by Market Value of Agricultural Products Sold and Government Payments.* 2022 Census of Agriculture—South Carolina State Data. Table 3. Accessed online at: https://www.nass.usda.gov/Publications/AgCensus/2022/Full_Report/Volume_1,_Chapter_1_State_Level/South_Carolina/

Table 12: Number of Farms in South Carolina, Classified by Value of Sales in 2022

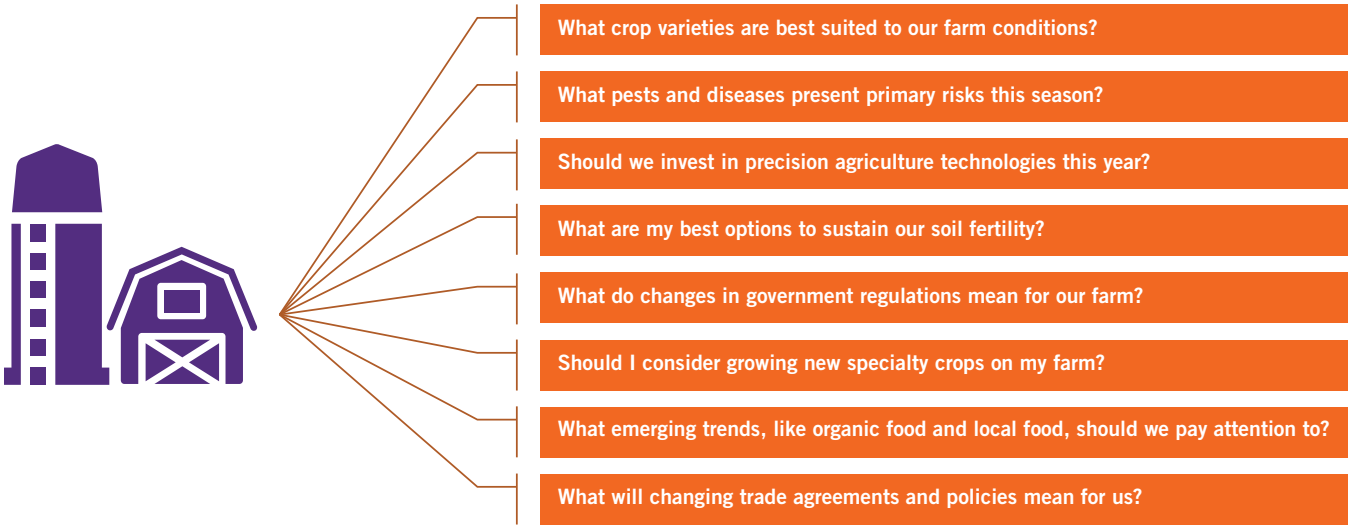
2022 Value of Sales	# of South Carolina Farms	% of South Carolina Farms
Less than $1,000	7,577	33.5%
$1,000 to $2,499	3,008	13.3%
$2,500 to $4,999	2,471	10.9%
$5,000 to $9,999	2,481	11.0%
$10,000 to $24,999	2,535	11.2%
$25,000 to $49,999	1,479	6.5%
$50,000 to $99,999	793	3.5%
$100,000 to $249,999	614	2.7%
$250,000 to $499,999	367	1.6%
$500,000 to $999,999	304	1.3%
$1,000,000 or more	1,004	4.4%
Totals	**22,633**	**100.0%**

Source: TEConomy summary of Number of Farms in South Carolina, Classified by Value of Sales in 2022. 2022 Census of Agriculture, USDA, National Agricultural Statistics Service, 2022. Assessed online at: https://www.nass.usda.gov/Publications/AgCensus/2022/Full_Report/Volume_1,_Chapter_1_State_Level/South_Carolina/.

Given their typically small size, South Carolina farms do not have the income to support R&D budgets of their own. Because of this, they depend on the R&D performed by others to solve challenges and sustain their productivity in the face of changing field conditions, technologies, competition, and market forces. CAFLS is the de facto go-to "research operation" for South Carolina's farms, and Clemson Cooperative Extension is the conduit for that research to reach farmers, working directly with producers to transfer research-based knowledge and practice recommendations. Cooperative Extension also works in the opposite direction, working to relay producers' needs, concerns, and challenges from the field to CAFLS researchers. The CAFLS system thus provides a uniquely powerful two-way information exchange, working with and in support of agriculture and forestry producers and value-added food and fiber industries.

The CAFLS system is called upon to help farmers, foresters, and others deal with a uniquely complex set of annual questions and decision-making events (Figure 9).

Figure 9: Some Examples of Complex Farm Questions and Challenges



Source: TEConomy Partners, LLC.

In the case of agriculture, **every farm is different**, with varying soils, topography, crop rotation history, available equipment, budgetary resources, and proximity to markets; there is no one-size-fits-all approach. CAFLS has to tailor its recommendations and solutions not just to the type of challenge presented but also to the specifics of the location where solution implementation will occur and to the characteristics of the implementer. **With its multiple Research and Education Centers (RECs) and with Clemson Cooperative Extension maintaining a statewide presence of offices and field staff in all 46 counties, the CAFLS system is uniquely positioned to respond to localized producer needs and provide the necessary access, knowledge, and connections to specific needs and challenges.**

CAFLS, through its research and extension operations, is a critically important provider of farming and forestry practice recommendations, improved crop varieties, technological innovations, etc., developed within CAFLS's labs and at its RECs. CAFLS also serves a vital role as a trusted independent evaluator of research-based products produced by industry (such as crop varieties, agricultural chemicals, livestock health products, and agricultural and forestry equipment). Producers are presented with an extremely large portfolio of agricultural inputs and equipment options for consideration in their farming and forestry operations. Clemson Cooperative Extension can cut through the marketing noise and provide reliable, evidence-based information to facilitate producer decision-making. This is especially important in today's fast-moving "Ag Tech" sector, where it is all too easy for producers to be overwhelmed by the new equipment, software systems, and advanced analytics and control systems (up to and including AI) that are driving precision and digital agriculture advancements. Opportunities to invest are many, but so too are opportunities to make a misstep, select the wrong solution, and lose money and resources. It's a potentially overwhelming situation for producers, but they have CAFLS to help them with research-based, best-practice solutions.

CAFLS operates as an integrated system with Cooperative Extension operations functionally intertwined with agricultural and forestry research. Cooperative Extension specialists are often faculty with research appointments, and the research enterprise benefits from input from producers directly and communicated through Cooperative Extension personnel. The work of Clemson Cooperative Extension, the RECs, and the Clemson research community is thus symbiotic, with each group informing the activities of the other. Cooperative Extension staff in the field can often provide a solution on the spot grounded in their own knowledge, education, and practical experience while also drawing upon the full expertise and research resources of the university when more complex or unusual questions or challenges are presented. Faculty performing research may also serve as Cooperative Extension Specialists, while Cooperative Extension educators in the field may be engaged in and supporting faculty research projects.

CAFLS is the state's gateway to nationwide expertise.

The advice, recommendations, and solutions that Clemson provides in South Carolina are not solely originated through Clemson's research. CAFLS is part of the interconnected national land-grant universities system and may draw from best-practices and program ming developed at peer institutions. In this re gard, CAFLS plays an important role for South Carolina as a gateway to the entire nationwide land-grant university system and its incredi bly broad base of evidence-based solutions, proven programming, and expertise.

The amount of research performed at Clemson in agricultural sciences, forestry, natural resources, and associated life science areas is substantial. National Science Foundation data report Clemson having $38.7 million in agricultural sciences, natural resources and conservation, and other life sciences research expenditures in 2022, a 27 percent increase over 2018's $30.5 million.[10]

These dollars fund a basic, thorough, applied research continuum across a wide variety of disciplines and subject matter areas. TEConomy analyzed Web of Science data on publications at Clemson for 2019 through 2023. For disciplines in and related to agriculture, forestry, and environmental sciences, a total of 3,306 publications with Clemson authors are identified in disciplines related to agricultural sciences, forestry, and environment and natural resources—this represents 37.8 percent of all Clemson-authored publications (16,663) over the period analyzed (Table 13). Peer-reviewed publications (as measured in the data) represent the gold standard for academic research, and the data help to illustrate the intense levels of expertise and subject matter coverage provided by Clemson faculty and research personnel. The data are sorted by the publications quotient which measures the relative degree of specialization in the subject matter versus all colleges and universities in the Web of Science database. It should be noted that each of the disciplines shown has a publications quotient[11] greater than 1.0 (which is the normative level representing parity in terms of subject-matter concentration with the nation). This is not unusual for a land-grant university. A high publications quotient in agricultural sciences and associated disciplines is to be expected at a land-grant university, given these institutions' unique legislated access to federal capacity (formula) funding and the fact that they were initially founded with an agricultural science mission.

10 TEConomy analysis of NSF HERD Data.
11 Publications quotient formula: (CU Publications in Discipline/CU Total Research Publications)/(U.S. Publications in Discipline/U.S. Total Publications).

Table 13: Publications by Clemson Authors in Agricultural Sciences, Forestry, and Environment and Natural Resources and Related Subjects (2019–2023). Sorted by Publications Quotient.

Web of Science Category	# of Publications	% of Clemson Publications	Publications Quotient
Horticulture	118	1.35	7.02
Entomology	159	1.82	4.15
Agronomy	174	1.99	3.94
Forestry	103	1.18	3.66
Agricultural Engineering	34	0.39	3.38
Plant Sciences	335	3.83	3.31
Soil Science	50	0.57	2.81
Food Science Technology	206	2.35	2.63
Biodiversity Conservation	127	1.45	2.60
Agriculture Dairy Animal Science	76	0.87	2.25
Water Resources	162	1.85	2.22
Ecology	318	3.63	2.13
Engineering Environmental	142	1.62	2.05
Agriculture Multidisciplinary	32	0.37	1.98
Evolutionary Biology	100	1.14	1.93
Green Sustainable Science and Technology	116	1.33	1.68
Genetics Heredity	206	2.35	1.53
Environmental Studies	78	0.89	1.53
Biotechnology Applied Microbiology	147	1.68	1.50
Fisheries	37	0.42	1.50
Environmental Sciences	494	5.64	1.49
Marine Freshwater Biology	82	0.94	1.45
Agricultural Economics Policy	10	0.11	1.07
	3,306	**37.77**	

Source: TEConomy analysis of data from the Clarivate Analytics' Web of Science publications analysis database

One of the unique characteristics of the integrated CAFLS system is that it is designed to ensure that the findings, discoveries, innovations, and practice advancements elucidated in its research do not only reside in the pages of academic journals or conference proceedings. Because of Clemson Cooperative Extension, CAFLS has a

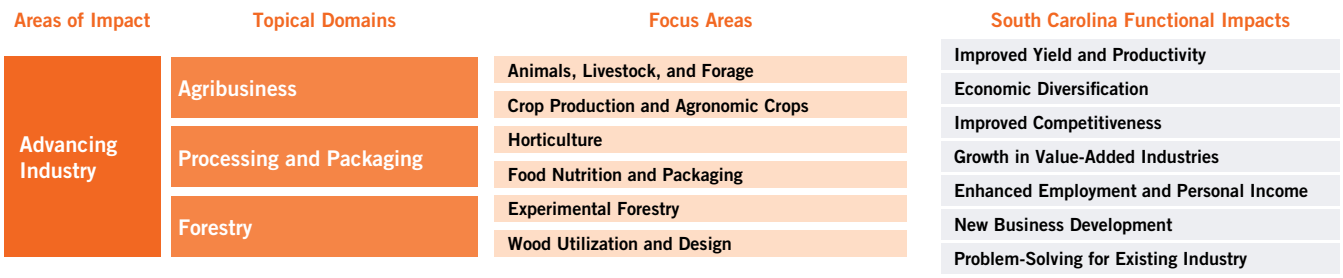
purpose-designed mechanism for translating research findings into pragmatic information and recommendations, and for transferring the knowledge to farmers, foresters, and others who can put that knowledge to work.

Clemson has served its role as a highly valued independent researcher and advisor for the agriculture and forestry industries in South Carolina for more than a century. Over that period, South Carolina has benefited from large-scale increases in row crop and horticultural crop yields, sustainable production practices, livestock nutrition and health improvements, improved food safety, and other innovative areas. These impacts have not occurred by serendipity—CAFLS has been purposefully there, year after year, working to proactively meet the needs of farmers, foresters, and other stakeholders for research-based solutions to identified needs. CAFLS assures that producers and industry stakeholders have access to the latest research and best practice recommendations, both from internal Clemson work and via the national land-grant university network. CAFLS helps to put this knowledge and innovation to work in industry for the betterment of South Carolina's economy and the people and families that depend upon it.

How CAFLS Generates Positive Impacts by Advancing the Agriculture, Agribusiness, Forestry, and Forest Product Industries of South Carolina

In support of agriculture, food, forestry, and natural resource industries, CAFLS works across a broad variety of disciplines and thematic areas. This work powers a variety of positive functional impacts (results) for South Carolina and its citizens. Figure 10 captures the primary focus areas for CAFLS work in agriculture, agribusiness, forestry, and forest product industries and the broad categories of functional impacts that result from work across these areas.

Figure 10: CAFLS Functional Impact Themes in Advancing the Agriculture, Agribusiness, Forestry, and Forest Product Industries of South Carolina



Source: TEConomy Partners, LLC.

Evident is the fact that CAFLS is focused on working across the full value chain. In production agriculture and forestry, CAFLS support is provided for operations of all scales, from small part-time operators to large operations with significant acreage, sophisticated operations, and more.

Functional Impact Examples: CAFLS Work for Industry

Discussing every program and activity undertaken by CAFLS in the areas of agricultural production, food processing and packaging, forestry, and natural resources would lead to an excessively long and complex report. Rather than attempting to produce an inventory or list of each and every activity, TEConomy in this (and other functional impact discussion areas) draws upon program examples to illustrate the types and range of important functional impacts generated by CAFLS's industry-focused programming. The following categories help to illustrate the type of high-impact work taking place.

Helping the Agricultural Production Industry

South Carolina has one of the most diverse agricultural production sectors in the nation. The state's favorable climate, available water resources, and diverse soil types provide a conducive production environment for a wide variety of row crops and horticultural crops, as well as suitable conditions for livestock and poultry operations. This diversity of production is reflected in the top ten agricultural commodities produced in the state: broilers, turkeys, greenhouse nurseries, cotton, corn, cattle, soybeans, peanuts, eggs, and wheat.[12]

The latest 2022 Census of Agriculture data show that livestock, poultry, and their products overall account for approximately two-thirds of the dollar sales of agricultural products from South Carolina farms, while crops account for one-third (Table 14).

Table 14: Animal Agriculture and Plant-Based Agriculture in South Carolina

Commodity	Number of Farms	2022 Value of Sales	Percent of Total Sales
Livestock, poultry, and their products	9,129	$2,812,541,000	63.5%
Crops	9,843	$1,614,663,000	36.5%

Source: USDA, National Agricultural Statistics Service. 2022 Census of Agriculture

Table 15 provides further perspective, with commodities listed in rank order by the total value of farm sales in 2022. Poultry and eggs stand out for their large-scale impact on agricultural commodity sales in the state. The nursery industry is ranked second, followed by a series of food and feed crops, which rank third through eighth, cattle and calf production in ninth place, and hogs and pigs in tenth.

12 South Carolina Farm Bureau. SC Farm Facts. https://www.scfb.org/ag-education/food-farm-facts

Table 15: South Carolina Agricultural Commodities Ranked by Sales in 2022

Commodity	# of Farms	2022 Sales	% of Total Sales
Poultry and eggs	2,995	$2,505,810,000	56.60%
Nursery, greenhouse, floriculture, and sod	713	$289,892,000	6.55%
Corn	2,076	$284,576,000	6.43%
Vegetables, melons, potatoes, and sweet potatoes	1,543	$222,082,000	5.02%
Cotton and Cottonseed	556	$214,788,000	4.85%
Soybeans	1,307	$214,747,000	4.85%
Fruits, tree nuts, and berries	1,363	$167,392,000	3.78%
Other crops and hay	5,044	$135,623,000	3.06%
Cattle and calves	4,602	$112,857,000	2.55%
Hogs and pigs	613	$87,159,000	1.97%
Wheat	560	$54,537,000	1.23%
Milk from cows	39	$44,450,000	1.00%
Aquaculture	64	$34,632,000	0.78%
Tobacco	48	$22,769,000	0.51%
Horses, ponies, mules, burros, and donkeys	826	$19,660,000	0.44%
Other animals and other animal products	811	$4,326,000	0.10%
Other grains, oilseeds, dry beans, and dry peas	213	$3,997,000	0.09%
Sheep, goats, wool, mohair, and milk	1,410	$3,655,000	0.08%
Sorghum	69	$2,836,000	0.06%
Cultivated Christmas trees and short rotation wood crops	76	$1,154,000	0.03%

Source: USDA, National Agricultural Statistics Service. 2022 Census of Agriculture

CAFLS emphasizes crops of economic interest to South Carolina in terms of its research enterprise. Clemson Cooperative Extension stands ready to address questions, needs, and issues across any and all farms and their diverse commodities. Table 16 ranks commodities by the number of farms engaged in their production, indicative of the potential Clemson Cooperative Extension "customer base" that is present in each of these commodities.

Table 16: South Carolina Agricultural Commodities Ranked by Number of Farms in 2022

Commodity	# of Farms	2022 Sales	% of Total Sales
Other crops and hay	5,044	$135,623,000	3.06%
Cattle and calves	4,602	$112,857,000	2.55%
Poultry and eggs	2,995	$2,505,810,000	56.60%
Corn	2,076	$284,576,000	6.43%
Vegetables, melons, potatoes, and sweet potatoes	1,543	$222,082,000	5.02%
Sheep, goats, wool, mohair, and milk	1,410	$3,655,000	0.08%
Fruits, tree nuts, and berries	1,363	$167,392,000	3.78%
Soybeans	1,307	$214,747,000	4.85%
Horses, ponies, mules, burros, and donkeys	826	$19,660,000	0.44%
Other animals and other animal products	811	$4,326,000	0.10%
Nursery, greenhouse, floriculture, and sod	713	$289,892,000	6.55%
Hogs and pigs	613	$87,159,000	1.97%
Wheat	560	$54,537,000	1.23%
Cotton and Cottonseed	556	$214,788,000	4.85%
Other grains, oilseeds, dry beans, and dry peas	213	$3,997,000	0.09%
Cultivated Christmas trees and short rotation wood crops	76	$1,154,000	0.03%
Sorghum	69	$2,836,000	0.06%
Aquaculture	64	$34,632,000	0.78%
Tobacco	48	$22,769,000	0.51%
Milk from cows	39	$44,450,000	1.00%

Source: USDA, National Agricultural Statistics Service. 2022 Census of Agriculture

Being able to respond to the R&D, production issues, information needs, and other requirements of such a wide variety of commodities and farm types means that CAFLS has to maintain expertise across the full scope of disciplines engaged in agricultural science that may have relevance in any given year—this requires expertise and access to specialist knowledge in areas such as those highlighted in Table 17.

Table 17: Examples of the Broad Range of Disciplinary Expertise Required to Cover Agricultural Research and Cooperative Extension Needs

Discipline	Description
Agricultural Economics	Analyzes the economic aspects of agriculture including resource use, production costs, and market trends.
Agricultural Engineering	Involves the design and improvement of farming equipment and machinery, irrigation, drainage, and other farm structures.
Agronomy	Focuses on crop science, soil management, and the sustainable production of food crops.
Animal Science	Studies livestock and poultry management, genetics, nutrition, and breeding.
Biochemistry and Molecular Biology	Investigates the chemical processes and substances that occur within living organisms relevant to agriculture.
Entomology	Examines the role of insects in agriculture, including pest control and pollination.
Environmental Science	Looks at the impact of farming on the environment and strategies for sustainable agricultural practices.
Genetics and Plant Breeding	Focuses on improving genetic traits of plants and animals to enhance productivity and resistance to diseases.
Horticulture	Deals with the cultivation of fruits, vegetables, flowers, and ornamental plants.
Plant Pathology	Studies diseases in plants and the means to prevent or control those diseases.
Soil Science	Explores soil composition, properties, and the management of soils for optimum agricultural productivity.

Within South Carolina, CAFLS is the preeminent organization that farmers can turn to for comprehensive capabilities and advice. It should be noted that, even in areas where large operators may use commercial "crop consultants" to cover some content, for the most part, those crop consultants were educated at Clemson University or another land-grant university, and they sustain their knowledge and credentials through working with the University and accessing Cooperative Extension programming and events.

As noted previously, it is not feasible to highlight every activity undertaken by CAFLS in support of agriculture. That work includes hundreds of research projects and thousands of contacts with producers via Cooperative Extension each year. However, a review of data and materials provided by CAFLS, together with interviews with CAFLS faculty and personnel, provide the ability to summarize some critical areas of work and provide examples of the range of positive functional impacts being achieved to advance agriculture and related industries in South Carolina. The case studies and impact examples included are divided into three broad program areas used by CAFLS:

- Animals, Livestock, and Forage
- Crop Production/Agronomic Crops
- Horticulture

Examples in the Animals, Livestock, and Forage Program Area

The livestock and poultry sector represents the most significant component of farm output in South Carolina, constituting 63.5 percent of total sales (Table 13). The total impact of the livestock and poultry sectors is greater still because a significant component of crop production in the state (e.g., hay, corn, sorghum, etc.) is cultivated as feed for livestock and poultry. CAFLS maintains significant expertise and purpose-designed programs to meet the needs of this large-scale integrated agriculture sector. Several examples show the depth of the activities undertaken.

Program Area: Animals, Livestock and Forage

Cattle Example

Cattle and calf production is one of the top two farm production activities in South Carolina in terms of the number of farms actively producing, with 4,602 farms across South Carolina engaged in this production activity. CAFLS provides a diverse range of programing specifically tailored to meeting the needs and challenges of this important industry:

- **Livestock forage** – South Carolina's favorable climate enables nearly year-round feeding of cattle on grazable forage. CAFLS provides an integrated system of high-yield forage evaluation (including the use of native grass forage) and workshops focused on high quality forage production systems. Participants in training on winter forage production report gains in profitability through reduced supplemental hay requirements.
- **Manure Management** – With mature cattle producing between 35 and 50 pounds of manure per day per animal, confined cattle operations have the potential to be the point source for largescale waste streams. CAFLS plays an important role in requirements under South Carolina Regulation R.61-43, which outlines specific requirements for manure management. In addition to providing research-based advice to producers, CAFLS is also the specific provider of manure management certificate training for producers. Without this certification (which was provided to 776 producers in 2022), producers would be unable to operate intensive cattle production operations.
- **Group Marketing of Feeder Calves** – Because many of the producers are small, part-time cattle and calf producers, their individual annual calf production numbers are comparatively small. Buyers prefer to pay a premium for large lots of calves, but small producers traditionally could realize this premium. A CAFLS-developed program has focused on helping multiple producers aggregate their calf production into full loads for auction with significant positive results obtained. Through coordinated off-farm feeder cattle group sales, participating producers have been able to realize a circa $0.20 per pound premium price, equivalent to a value increase of $134 per head. Post marketing analysis found that the program was associated with a $9,834 increase in revenue per participating farm.[13] The scale of this impact is particularly notable when compared to overall cattle and calf production and revenue statistics for South Carolina shown in Table 14, which illustrates that 4,602 cattle and calf producing farms generated $112,857,000 in combined revenues for 2022, equating to an average of $24,523 in cattle and calf annual revenues per farm.
- **Clemson University annual bull test and auction** – Under this program, producers consign their bulls to Clemson for grain and grass-fed scientifically controlled weight gain testing. This helps producers document the performance of their bull genetics for producing offspring with positive nutrition conversion characteristics. Having

13 South Carolina (Clemson University, South Carolina State University Combined) Annual Report – FY2022

the tests in hand helps the bull producers realize premium prices for their livestock and contributes to improving the overall performance of the cattle industry across South Carolina. CAFLS is also developing a similar program for heifers, directed at selecting animals that demonstrate feed conversion efficiency.

- **Beef Quality Assurance (BQA) Program** – The BQA is a national project that guides "producers towards continuous improvement using science-based production practices that assure cattle well-being, beef quality and safety." In South Carolina, the program is provided through CAFLS, covering best practices in cattle handling, herd health, facility management, cattle transportation, and good record keeping, which collectively result in better outcomes for BQA certified producers. Hundreds of producers are trained each year under this program. A 2019 study by Colorado State University demonstrated that cattle with BQA listed in their lot description command a premium of $16.80 per head.[14]

- **Disaster Response** – Natural disasters such as hurricanes and flooding can have a devastating impact on cattle producers. Pasture can be rendered unusable, stored feed lost, and livestock killed or injured. When these events occur, the CAFLS team steps in to assist in feed delivery and training and advice focused on carcass disposal and composting.

- **Beginning Producer Programs** – Because South Carolina is a fast-growing state, many people have acquired properties of 30 acres or less and then sought information on how to use their land to produce food and income. When these landowners are considering cattle production, CAFLS provides a range of programing focused on how to effectively manage small operations and balance production costs versus anticipated livestock sales.

- **Bovine Artificial Insemination (AI) School** – Focuses on how to physically breed a cow. The Advanced Reproductive Techniques Program specializes in AI instruction for producers. The school consists of 16 hours of classroom lectures and 16 hours of laboratories in breeding technique, semen handling, synchronization of estrus, and other aspects of artificial insemination.

Overall, the diverse programs of CAFLS focus on ensuring success across South Carolina's cattle and calf operations see high demand. CAFLS' Livestock and Forage Team in 2022 alone logged 17,000 direct contacts with producers (an average of over 65 per workday) and conducted 288 workshops and trainings.[15]

Key Impacts:

- An annual benefit for program participants is likely greater than 10 percent in increased realized value. With cattle and calf operations valued at $112,857,000 in 2022 in South Carolina, this would equate to a conservative **$11.3 million in increased value.**

14 National Cattlemen's Beef Association. Study Shows Premium in Cattle from BQA Certified Producers. https://www.bqa.org/Media/BQA/Docs/research-shows-premiums-from-bqa-certified-cattle.pdf.
15 South Carolina (Clemson University, South Carolina State University Combined) Annual Report – FY2022.

Program Area: Animals, Livestock and Forage

Animal Health Example

"Livestock, poultry, and their products" comprise the largest component of South Carolina's agricultural industry. Almost two-thirds of the farms in the state (63.6 percent) are engaged in livestock or poultry operations, and together they produce over $2.8 billion in direct output (Table 13). As living creatures, animals are of course at risk of illness and injury, and animal health is a central production concern for industry and critical to sustaining viable economics. CAFLS serves a multi-faceted role in livestock and poultry health across the state, with programs falling under the umbrella organization of Livestock and Poultry Health (LPH), a unit within CAFLS that focuses on enhancing the health and productivity of livestock and poultry and preventing losses to productivity associated with bacterial, viral, prion, and fungal-based infectious diseases, parasites, anti-nutritive forage, and other factors. Key components and activity areas of LPH include:

- **State Veterinarian –** LPH is home to the state veterinarian in South Carolina who serves a key role in ensuring the health and well-being of the state's animals. Tasked with disease control and prevention, the state veterinarian supervises the monitoring of livestock, poultry, and other animals to prevent the spread of diseases. They enforce animal health regulations, oversee emergency responses during disease outbreaks or natural disasters, and conduct inspections to uphold health and safety standards in animal-related businesses. Collaborating with stakeholders, they educate on disease prevention, biosecurity measures, and regulatory compliance, ultimately safeguarding both animal and public health in South Carolina.
- **State Veterinary Diagnostics Laboratory –** Each state has a state veterinary diagnostics laboratory that provides a broad suite of diagnostic services and specialized knowledge of diseases and conditions typically encountered across animal populations in their respective states. In South Carolina, the state diagnostics laboratory is operated and staffed by CAFLS under LPH.
- **South Carolina Meat and Poultry Inspection Department (SCMPID)** – SCMPID operates under state legislated mandates to "protect the health of consumers by providing a comprehensive inspection service to assure that meat and poultry products are safe, wholesome and accurately labeled." It is a proactive regulatory and inspection body dedicated to assuring food safety for South Carolinians.

The intensive and extensive daily work of CAFLS in livestock and poultry health is illustrated by the specific activities undertaken by the state veterinary diagnostics laboratory. The lab is on the front lines daily, working to prevent and respond to diseases and other health threats to the large-scale livestock and poultry sectors. The work undertaken is scientifically rigorous and extensive, including both clinical and anatomic pathology diagnostic lab services (testing body fluids and tissue samples for the presence of disease, toxins, and other health impacting agents). This work supports producers and their veterinarians in accurate diagnosis and determining cost-effective treatments. The state veterinarian and veterinary diagnostics lab also play a central role in enabling livestock and poultry trade to occur via conducting mandated testing of live animals prior to their intrastate and interstate transportation. The diagnostics lab is also engaged in preventing, monitoring, and addressing zoonotic diseases (diseases transmissible from animals to humans) and working with the SCMPID to ensure the prevention of food borne illnesses related to food animal or animal product consumption.

Overall, LPH at CAFLS acts as an integrated system, working to optimize the health of production animals in the state and the productivity and profitability of the livestock and poultry sectors. CAFLS activities also provide rapid response to disease challenges by tracking and helping to control diseases that may negatively impact animal ag-

riculture. They are also a key contributor to public health in the state. Economic impacts are high in each of these areas, with LPH on the frontline in preventing industry losses to diseases and sustaining agricultural productivity.

A major disease outbreak in livestock and poultry could be devastating to industry. In South Carolina, where the poultry sector is the number one agricultural production sector (Table 14), a disease such as avian influenza can have wide ranging ramifications. The avian influenza virus (AIV), which is a type A influenza virus specifically adapted to affect birds, can also, in rare cases, cause illness in humans and other animals. Two types of influenza (high pathogenic and low pathogenic) can occur in poultry with symptoms ranging from mild to deadly, and in all cases the productivity of the flock is negatively impacted. Since the required treatment is culling flocks, the potential economic impact of the disease to producers is high. When the disease is suspected, time is of the essence in limiting its spread beyond the confines of an infected flock, and the state veterinary diagnostics lab and state veterinarian serve central roles in rapidly diagnosing the disease and putting in place effective measures to prevent spread. The disease is very much on the minds of South Carolina poultry producers. In 2022, an outbreak in North Carolina impacted parts of South Carolina and the veterinary diagnostics lab worked over a weekend to rapidly diagnose the presence of the disease and identify its typology. Both low pathogen and high pathogen avian influenza has been detected in the state, and the CAFLS system is very much focused on containing the disease. As a zoonotic illness, avian influenza can also infect mammalian species, including humans, and it can cause illness that limits milk production in dairy cattle and dairy goats.

Measuring impacts associated with improved monitoring, control, diagnosis, and management of livestock and poultry diseases is challenging. A novel approach to the impact question was taken by researchers at Iowa State University (ISU) who surveyed veterinarians and producers to gather insights as to the value of the state veterinary diagnostics lab in Iowa to sustaining the livestock and poultry sector during both non-emergency and emergency operating conditions. The ISU research team concluded that veterinary diagnostics services are responsible for supporting 6.64 percent of livestock and poultry revenues during normal operations and 25.92 percent when emergencies (outbreaks) occur.[16]

Key Impacts:

- With livestock and poultry operations generating a direct $2.8 billion in output in South Carolina, application of the ISU findings on the value of veterinary diagnostics lab operations suggests a **direct impact to the industry in South Carolina of $185.9 million during normal operating conditions and $725.8 million during livestock health emergency conditions.**

16 Schultz, L., Hayes, D., Holtkamp, D., and Swenson, D. (2018). Economic Impact of University Veterinary Diagnostic Laboratories: A Case Study. *Preventive Veterinary Medicine* 151, 5-12.

Program Area: Animals, Livestock and Forage

Poultry Example

Reflecting the importance of the industry in South Carolina, CAFLS has long sustained research, extension, and teaching programs focused on poultry. The Morgan Poultry Center at the Piedmont REC has operated since the 1920s. At the present time, the Center contains two, +30-pens, large houses that can support broiler or layer studies, together with incubation, hatching, and brooding facilities and outdoor and large pen housing facilities. There is also an onsite feed mill for support of diet and nutrition studies. The veterinary diagnostics lab is also an approved lab for the national poultry improvement program with certification of "free" flocks through periodic testing and before bird movement.

While important work has been able to be performed at the Morgan Poultry Center, the age of the facilities means that they no longer reflect the production environments experienced in industry. The facilities are also inadequate to support the volume of research project demand from faculty in nutrition, food safety, genetics, animal behavior and other relevant focus areas. The planned new facilities will be designed to replicate current commercial operations, allowing highly relevant research to be performed and training to occur in industry standard environments. As noted by CAFLS, the new center will include:

- Four poultry grower facilities for multidisciplinary research in nutrition, animal welfare, behavior, and stress physiology.
- An egg layer facility to support ongoing nutrition research and additional research in animal welfare, animal behavior and animal stress physiology.
- An animal health and intensive research facility equipped to allow researchers to conduct nutrient balance trials and other metabolism studies.[17]

All facilities will be fitted with state-of-the-art lighting, feeding and ventilation systems, which will allow for the simulation of a variety of current industry-relevant growing conditions. Having the new facilities will further encourage research supported by industry, commodity groups, and the USDA. A research partnership with IBM, for example, is already in development for research using computer vision to monitor bird behavior.

Although commercial poultry production is a key focus for CAFLS, it is not the only area of focus. The popularity of backyard birds as layers or as meat birds means there is a steady demand for CAFLS expertise and advice. Cooperative Extension programing for backyard flocks covers feeding, managing, poultry health, humane harvesting, and food safety. This work is supported by Clemson's "home processing and mobile demonstration trailer."

Key Impacts:

- Sustainability of the state's largest commodity in terms of total sales.
- Enhanced agricultural sector financial stability and profits.
- Increased economic output.
- It is anticipated that as the planned new facilities and equipment are brought on-line and the work is aligned with current commercial operations, the impact of poultry research and Cooperative Extension services will increase.

17 https://www.clemson.edu/public/budget-priorities/files/fy23-24-nonrecurring-1_psa_poultryscience_final.pdf

Examples in the Crop Production/Agronomic Crops Program Area

South Carolina's climate and diverse soils support a range of row crops, with a large number of farms engaged in their production. The 2022 Census of Agriculture lists 2,076 South Carolina farms growing corn, 1,307 soybean, 560 wheat, and 556 producing cotton and cottonseed. In support of this important farming sector, CAFLS undertakes a broad range of research, teaching, and extension work, with some examples including:

- Advanced plant improvement and development work
- Agronomic crop variety trials
- Precision and digital agriculture technology testing and demonstration
- Organic farming practices
- Climate-smart agriculture and carbon capture in crops
- Integrated pest management, and
- Cover crop practices.

CAFLS' work in agronomic crops is experiencing particularly high demand. As reported in 2022, Agronomic Extension Crop Agents had 11,672 direct contacts and conducted 103 workshops/ trainings.[18]

Through research and extension activities, CAFLS is able to sustain a continuum of work on crops and associated agronomy, from basic and applied science inquiry to hands-on knowledge dissemination to farmers regarding research-based innovations, best practices, and solutions to challenges. Because of the two-way flow of information, from the field to the university and from the university to the field, CAFLS is able to be highly responsive to the specific challenges and opportunities facing South Carolina agriculture. Some of the areas highlighted by CAFLS in recent annual reporting[19] serve to illustrate some of the diverse impacts being generated:

- CAFLS personnel have helped develop a market for switchgrass as a biofuel, leading to a $20 million annual contract for South Carolina growers to sell their crop to European power plants.

- CAFLS activities have resulted in an economic impact of more than $3 million for South Carolina peanut growers through increased yields and improved disease resistance.

- Research resulted in the development of precision agriculture technology that matches needs to specific zones, increasing crop yields and reducing water and fertilizer use, and reducing production costs up to 40 percent.

- Functional genomics research improved crop yields by addressing challenges such as resistance to drought and saltwater tolerance.

As TEConomy interviewed faculty and key leadership across CAFLS, several areas of work stood out as exemplars of the type of high impact work being performed to improve the production of row crops. This work is very much relevant to specific needs in South Carolina farming, but also has applicability to broader global food security issues.

18 South Carolina (Clemson University, South Carolina State University Combined) Annual Report – FY2022.
19 South Carolina (Clemson University, South Carolina State University Combined) Annual Report – FY2022.

Program Area: Crop Production/Agronomic Crops

Crop Management Example – Soybeans and Cotton

Soybean, in 2022, was a $214.7 million crop for South Carolina. Assuring farmers achieve high yields for their soybean crop is a challenge requiring constant attention, requiring producers to be armed with knowledge regarding variety choice for their growing conditions, optimization of inputs, pest and disease control strategies, and more. CAFLS works across all these areas of need, and the solutions it provides can engender robust economic impacts. An example of this is the work performed by CAFLS to address Asian soybean rust, a plant disease first detected in the U.S. in 2004. The rust is an aggressive pathogen with severe consequences, leading to losses of between 10 and 80 percent in infected fields. Clemson research has resulted in recommendations for early planting, disease monitoring, and optimized pesticide spraying that have had the benefit of saving crops from rust induced losses and reducing the volume of expensive pesticides applied. The impact of a Clemson best practice addressing Asian soybean rust Clemson has generated a net benefit to South Carolina producers estimated at $25 million annually. In addition, CAFLS scientists have identified benefits associated with reducing the seeding rate of soybeans, while sustaining yield, resulting in savings to producers estimated at $10 million annually. With a crop valued at over $214 million, achieving **production cost savings and loss prevention totaling $35 million** is clearly a significant contribution to overall successful soybean production economics for state producers.

Cotton has a long-standing history of production in South Carolina and its on-farm production feeds into a vertically integrated industry in the state that includes fiber processors (gins), cotton merchants, cotton seed oil mills, warehousing and distribution operations, and textile manufacturing. As with soybeans, CAFLS activity has made important contributions to crop protection, pest management, and optimal application recommendations for pesticides and other agricultural inputs. CAFLS also conducts variety trials and demonstrations to help producers make informed decisions regarding the varieties best suited to their individual growing conditions. Multiple field studies conducted at CAFLS RECs and with collaborating farms help to provide experimental coverage of the types of producer field environments in the state, allowing the evaluation of individual varieties and their response to various inputs and crop protection applications. The range of research undertaken at Clemson in cotton is broad, including fundamental genomics research and breeding research for plant improvement, cotton entomology and crop protection, and leading-edge work such as integration of spider silk genes into cotton and experiments with cotton in space with NASA.

Key Impacts:

- Improved weed and pest control (reduced losses) with estimated annual impact of $35 million to producers in South Carolina.
- Improved crop yields.
- Enhanced farm financial performance.

Program Area: Crop Production/Agronomic Crops

Advanced Plant Technology Program Example

The Advanced Plant Technology (APT) program ss a multidisciplinary, translational plant science program that brings together over 20 Clemson faculty and researchers focused on plant improvement and solving needs and challenges in crops of importance to South Carolina. Members are located on the main campus and at multiple RECs, providing coverage in fundamental plant sciences and applied plant science work in crop improvement, crop protection, and agronomy. The team is able to deploy state-of-the art Clemson resources in genomics and gene sequencing, CRSPR gene editing, plant breeding, molecular biology, and field phenotyping, together with special infrastructure contained across growth chambers, greenhouses, and varied REC field operations statewide, to tackle key issues facing industry.

As the graphic below illustrates, over the past decade the APT team has focused on crops of significant economic importance to South Carolina, with the largest number of studies focused on soybean, cotton, sorghum, peaches, peanut, and wheat. The topics vary across crops, with key foci in plant improvement for quality and yield characteristics, resistance to biotic and abiotic stress, and efficient use of inputs. The expertise of the APT program has attracted a broad variety of national and state level sponsors comprising government funding agencies, major commodity groups, and individual plant science companies and organizations engaged in the agricultural value chain.

CROPS

- Soybean
- Cotton
- Sorghum
- Peaches
- Peanut
- Wheat
- Cover Crops
- Sweet Potatoes
- Peppers
- Perrennial Grasses
- Strawberries
- Golden Camellia
- Plus, basic plant sciences inquiry relevant to multiple crops.

TOPICS

- Genomics and Plant Improvement
- Breeding
- Variety Evaluation
- Disease Management and Resistance
- Insect and Nematode Management and Resistance
- Weed Control
- Abiotic Stress Resistence
- Soil Health and Moisture
- Crop Quality and Associated Traits
- Input Use Efficiency
- Biofortification

SPONSORS

- Federal
  - USDA
  - Dept. of Energy
  - NSF
  - USAID
- Commodity Groups
  - United Soybean Board
  - Cotton Incorporated
  - National Peanut Board
  - SC Soybean Board
  - SC Fruit, Vegetable, and Specialty Crop Assn.
- Companies
  - Dow AgroSciences
  - Bayer (Monsanto)
  - Syngenta
  - Specialty Seed Co.
  - Titan Farms
  - Wells Fargo

Research sponsors and producers in South Carolina are able to turn to APT for research that leads to improved crop varieties and new commercial lines, existing varieties evaluated for specific characteristics, best management practice recommendations, and more in both row crops and horticulture crops of intense importance to South Carolina agriculture. Because environmental conditions in South Carolina mimic multiple international agricultural production locations, such as SE Asia, parts of Brazil, and sub-Saharan Africa, the work of APT also sees significant

application beyond South Carolina borders.

APT is also focused on educating students in the latest practices in plant improvement, with the Translational Genomics certificate program a key element of this, open to students from CAFLS and across the University. The certificate is a is a 12-credit-hour (for undergraduate students) or 14-credit-hour (graduate) program that builds student understanding and capabilities in genetics, genomics, and computational biology.

Key Impacts:

- Support for the development of enhanced crop lines able to achieve improved yield and suffer reduced losses through improved host-resistance to pests and pathogens.
- Education of students for entry into advanced plant science careers.

Program Area: Crop Production/Agronomic Crops

Sorghum as an Alternative Feed Ingredient for Poultry Example

Chicken feed may have different formulations depending on whether the feed targets layers, chicks, or meat birds, but typically the top three ingredients in chicken feeds are corn, soybean meal, and wheat. As major commodity crops used in a wide range of applications, these key ingredients can experience significant price variation based on demands outside of poultry feed. Because feed represents the leading input cost in the production of poultry, having alternative but equally nutritious feed options provide a potential pathway to cost control for producers. Grain sorghum represents a particularly promising alternative. It is a climate resilient crop and one that generally requires lesser inputs for production versus corn and soybean. "Because of its drought tolerance and nutrient efficiency, grain sorghum can lower farmers' seed cost and increases their profitability."[20]

Commercially available U.S. grain sorghum has the benefit of having similar metabolic and nutrition characteristics to corn in poultry diets. It is also tannin-free, avoiding the anti-nutritive issues associated with tannins. CAFLS scientists have evaluated varieties of sorghum for suitability to South Carolina growing conditions and appraise the economics of the crop for use as poultry feed. A key area of research also involves the testing of various sorghum varieties for their nutritional value for poultry and beneficial or negative impacts on weight gain, enteric diseases, gut microbiome characteristics, and other diet-related factors. CAFLS researchers are seeking to identify the plant-based metabolites that confer health benefits and are using the plant improvement and breeding expertise at Clemson to optimize sorghum for production of these beneficial metabolites. With South Carolina well-suited to the growth of grain sorghum and the presence of the large-scale poultry industry in the state, Clemson's sorghum improvement and sorghum feed nutrition research has the potential to improve the economics of a major vertically integrated agriculture industry in the state.

An interesting "offshoot" of CAFLS work in sorghum has been the creation of the commercial company, Carolina Seed Systems located in Florence. The company was founded by Clemson-trained experts to create grain sorghum seed hybrids particularly well-suited to production in the Southeast United States and to meeting market demand. The company mines natural crop diversity in combination with marker-assisted genomics technologies to develop

20 https://news.clemson.edu/clemson-bred-agricultural-technology-company-puts-down-roots-in-pee-dee-region/

resilient grain sorghum hybrids that are cost-effective for profitable production in South Carolina and beyond. In addition to its use as a feed crop, sorghum also holds promise as a feedstock for biofuels and biobased chemicals.

Key Impacts:

- Potential to reduce imports of corn and soybean feed products from outside of the state by providing a cost-effective new feed grain, sorghum, suited to South Carolina production.
- Contribution to the development of a new Clemson spin-out company, Carolina Feed Systems, to commercialize sorghum and provide solutions to producers.

Examples in the Horticulture Program Area

Horticulture is the science and practice of cultivating plants, including fruits, vegetables, flowers, and ornamentals – it represents a major component of South Carolina's agricultural industry. South Carolina is an important producer of fruits and vegetables, standing among the highest-ranked states in the production of a variety of produce, including those in Table 18.

Table 18: Leading Vegetables and Fruits Produced in South Carolina (National Ranking of 10th or Higher)[21]

South Carolina Rank	Fruit or Vegetable Crop
1st	Turnip Greens
2nd	Collard Greens, Kale, Mustard Greens, Peaches
5th	Okra
6th	Honeydew, Green Peas
7th	Broccoli
8th	Summer Squash, Sweet Potatoes, Watermelon
9th	Bell Peppers, Cantaloupe
10th	Tomatoes

Unlike the large-scale row crops of corn and soybeans, fruit and vegetable production tends to take place on smaller-scale farms, and the wide variety of growers means that Clemson serves a very important role in serving as the R&D and knowledge-transfer engine for these producers. Clemson's work in support of horticulture is undertaken by experts in a full range of associated disciplines, including plant science, plant breeding and genetics, plant pathology, entomology, and soil science.

CAFLS's horticulture research is also supported by two renowned REC locations, known for their expertise in fruit and vegetable R&D. The 240-acre Musser Fruit Farm at the Piedmont REC has a global reputation for excellence in fruit research, education, and associated Cooperative Extension programming. The Musser Fruit Farm has orchards of peaches, nectarines, apples, blackberries, blueberries, figs, and grapes to support its mission. The Coastal REC in Charleston is a leading hub of vegetables and specialty crop research. Consisting of 325 acres and co-located with the USDA's National Vegetable Lab, the Coastal REC stands among the leading centers for vegetable R&D and Cooperative Extension activity globally.

The scope of CAFLS's horticulture work ranges from assisting individual households and home gardeners to providing specialized support for professional producers in the commercial farming and horticulture sectors. Together with the USDA-ARS in Charleston, CAFLS is at the forefront of developing advanced new lines and varieties of vegetable and fruit crops and has especially deep expertise in crop protection and plant breeding of resistance traits. CAFLS is also proactive in meeting the training and certification needs of professional horticulturalists, providing continuing education programs and specific certifications required for activities such as pesticide application.

21 https://agriculture.sc.gov/about/

Program Area: Horticulture

Peaches Example

Peaches are a signature crop for South Carolina. Only California produces more, and South Carolina produces up to three times as many peaches as Georgia in a typical year.[22] With 18,000 acres of peach orchards in the state and 200 million pounds harvested in a typical year, the peach crop is a key component of South Carolina horticulture. It is also part of a vertically integrated value-added industry, with downstream processing of peaches performed in state (for example, at Palmetto Processing Solution's plant in Ridge Spring, which is an 88,000 square feet facility performing slicing, dicing, pureeing, packaging and cold storage of peaches and other fruit).

CAFLS work in peaches is extensive and of historic importance to the industry in the state. The main peach root stock, "Guardian," was developed by USDA and Clemson University in 1993, and it still generates intellectual property revenues for the university. Guardian was a critically important innovation by Clemson because it solved the challenge of peach tree short life (PTSL), which causes the early death of trees. The Guardian rootstock is more tolerant of the ring nematode that contributes to PTSL, and in trials, significantly outperformed the common alternative rootstocks, Lovell and Nemaguard. In comparison plantings in South Carolina, no Guardian rootstock trees succumbed to PTSL, whereas PTSL claimed 97 percent of Lovell and 95 percent of Nemaguard rootstock peach trees. As a result of this work, the large-scale losses threatening the industry from PTSL were dramatically curtailed, and Guardian has become the primary rootstock used across the Southeast United States peach orchards. Because peaches represent up to $80 million in annual sales for South Carolina producers, the ongoing protection provided by the Guardian rootstock (in combination with management best practices) has prevented hundreds of millions of dollars in losses in the three decades since its introduction.

PTSL is far from the only threat to peach production. CAFLS has continued to make important contributions to sustaining and growing the industry. A test and testing protocol developed for brown rot, for example, has helped producers tailor their fungicide use for maximum effectiveness and has allowed spray programs to be adjusted to assure that fungicide resistance doesn't develop and lead to crop loss. The implementation of this program **saved producers an estimated $7 to $10 million** in 2009 alone.[23]

Key Impacts:

- Estimated $10 million or higher annual impact through development and ongoing utilization of CAFLS-derived rootstocks and best-practice management recommendations.

22 https://agriculture.sc.gov/faq/peaches/
23 https://www.apsnet.org/members/give-awards/awards/Hutchins/Pages/GuidoSchnabel.aspx

Program Area: Horticulture

Vegetables Example

South Carolina is among the leading states in the nation in the production of a broad variety of vegetables. The state ranks first in the nation in turnip greens; second in collard greens, kale, and mustard greens; fifth in okra; and sixth in honeydew and green peas. It is also in the top 10 states for production of broccoli, summer squash, sweet potatoes, watermelon, bell peppers, cantaloupe, and tomatoes.[24] As with peaches, the vegetable industry in South Carolina supplies not only fresh market vegetables, but also feeds into an in-state, value-added processing and canning industry.

CAFLS Coastal REC in Charleston is internationally recognized for its ongoing contributions to vegetable crop improvement. Multiple large-scale projects focus on the development of vegetable varieties adapted to the hot and humid South Carolina production environment, South Carolina soils, and pest and pathogen pressures. Multiple high-impact innovations have resulted from this work, with examples including:

- Development, in collaboration with USDA ARS, of the Carolina Strongback watermelon, a rootstock for grafting that significantly improves management of fusarium and root-knot nematode. The technology was licensed to Syngenta. When tested in soils highly infested with fusarium and nematodes, Carolina Strongback performs well and maintains a high production level of harvested product.[25]
- Important work in multiple brassica crops. The recently released Carolina Broadleaf variety of mustard greens was developed to exhibit high levels of resistance to a bacterial leaf blight disease. Because South Carolina is among the largest producers of Brassica leafy greens, significant losses had occurred due to leaf blight, with reported losses of 24 percent (**valued at $1.7 million** in 2005 alone, in the one in-depth study examining such losses[26]).

A significant focus of CAFLS research in vegetables is in plant resistance to diseases and pests. Expertise in this regard attracts significant USDA and industry funding, and, in addition to the examples above, major programs have been focused on the improvement of broccoli, green beans, spinach, and cantaloupe. Small fruits are also receiving attention, with new work in strawberry improvement.

Key Impacts:

- Substantial, multi-million dollar impacts associated with improved vegetable varieties with resistance to diseases and pests.

24 Source: NASS. 2022 Census of Agriculture.
25 https://www.ars.usda.gov/news-events/news/research-news/2019/novel-watermelon-rootstock-knocks-out-disease-and-pests/
26 Smith, J.P. & Keinath, A.P. 2005 Crop profile for leafy greens and collards (Fresh Market) in South Carolina. USDA Southern Region Pest Management Center. 21 July 2016.

Program Area: Horticulture

Salt Tolerance Research Example

Soil salinity is a major abiotic stress factor that negatively impacts the performance of most crops. Globally, and in South Carolina where saltwater intrusion is an increasing problem, the negative impacts of rising soil salinity represent a significant challenge to food security and farm livelihoods. As noted by Shrivastava and Kumar:

> *It has been estimated that worldwide 20 percent of total cultivated and 33 percent of irrigated agricultural lands are afflicted by high salinity. Furthermore, the salinized areas are increasing at a rate of 10 percent annually for various reasons, including low precipitation, high surface evaporation, weathering of native rocks, irrigation with saline water, and poor cultural practices. It has been estimated that more than 50 percent of the arable land would be salinized by the year 2050.*[27]

Because of this challenge, the development of salt-tolerant crops is a very high priority, and Clemson is leading a major $10 million grant from USDA-NIFA to innovate approaches to improving the salt tolerance of crops. Important work is being advanced in vegetable crops and rice, with a key focus on the study of natural germplasm to screen for salt tolerance characteristics and to breed resistance into key crops. Field-based work benefits from the soils at the Coastal REC having a salt-gradient that is conducive to comparative field studies, and investment by the co-located USDA vegetables lab in controlled environment facilities is helping facilitate collaborative work with hydroponics companies seeking the ability to use water resources that contain salt.

Key Impacts:

- Ongoing advancement of salt-tolerant crops suited for field and controlled-environment production. Although plant releases have not occurred yet, the potential for large-scale impacts for South Carolina and the global farming community is extensive, given the scale of the growing salinity issue across regional and global agricultural production.

27 https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4336437/

Program Area: Horticulture

Home and Garden Information Center Example

If the adage "knowledge is power" holds true, then Clemson's Home and Garden Information Center is a statewide powerhouse. Unusual among extension services nationally, Clemson sustains a fully staffed, 4.5 FTE personnel call center that serves the information needs statewide for homeowners, individual gardeners, horticulturalists, and other diverse stakeholders. In 2023, the Center fielded over 26,000 telephone calls and email inquiries, and the accessible online resources at the Center's website led to it being the most visited website across the Clemson University system, with 6 million annual page views. The website contains more than 850 fact sheets on plant-related topics, nutrition, and food safety.

Valuing the impact of information provision is not an easy task; however, a reasonable estimate can be made based on national gardening activity statistics. In 2022, 80 percent of U.S. households took part in lawn and gardening activities, according to the National Gardening Association's 2023 National Gardening Survey, and spending on lawn and gardening activities averaged $616 per household in 2022. With South Carolina containing 2,136,000 households, average gardening expenditures would total an estimated $1.32 billion in the state. If the information provided by the Clemson Home and Garden Information Center helped to positively influence just 1 percent of the value of these expenditures, it would equate to an **annual direct impact of $13.2 million**. With 6 million page views, and over 26,000 direct inquiries fielded by phone and email annually, a 1 percent value figure is likely conservative. The Clemson team is helping South Carolinians maximize the benefits from their expenditures on gardening, landscaping and more—providing actionable information on what to grow, when to plant, best conditions for growth, management of pests and plant diseases, plant nutrition and soil health, healthy harvesting, food handling, food preparation, and much more.

Key Impacts:

- Conservative estimate of $13.2 million value of enhanced knowledge to South Carolina homeowners.

Crosscutting Areas of Work

Although much of CAFLS work is targeted at individual challenges, needs, and opportunities in specific areas (plant variety development, pest control in crops, etc.), relevant work is also performed that cuts across the full range of agricultural activities. In this regard, Clemson sustains multidisciplinary teams able to address large-scale needs relevant across most farm operations. Notable examples of crosscutting activities are discussed briefly in the following narrative.

Program Area: Crosscutting

Agribusiness Team Example

As noted earlier in this report, farmers are faced with an extensive range of challenges and make-or-break decisions every year. Many of these decisions are focused on crop or livestock related production options and issues, but equally important for South Carolina's 22,633 farms are the many business management and financial decisions that need to be addressed each year. Individual farms are small or midsize businesses that have to address typical business decisions (investment, labor costs, taxes, regulatory compliance, and insurance, for example.). CAFLS maintains a dedicated team at the Agribusiness Center focused on helping farmers and others in the agribusiness value chain better manage their business.

The Agribusiness Center houses the Extension Agribusiness Team of circa 15 personnel who provide research-based advice and best-practice solutions for farm businesses and firms in the agriculture and processing value chain. The team works on solutions and recommendations in marketing, financial controls and business planning, risk management, crop forecasting, production decisions, tax planning, labor management and more. The work includes both information and problem solving for farms in general, as well as special programs focused on the needs of farming subpopulations such as beginning farmers and women in farming. In addition to being responsive to any questions presented by participants in the agriculture sector across the state, among the core focus areas of the Agribusiness Team are:

- Feeding Innovation, a comprehensive technical assistance program designed to support entrepreneurs interested in developing or expanding healthy food businesses in food deserts or underserved areas of the state.
- Annie's Project and the South Carolina Women's Agricultural Network, consisting of multifaceted programing serving women in agriculture and forest land management. Program topics include risk assessments, business planning, financial statements, family and liability, insurance, farm programs, legal concerns, retirement and transition, personal development, and networking.
- The Center for Cooperative and Enterprise Development provides technical assistance to cooperatives, mutually owned businesses, and other small business within multiple industries, but with a strong focus on agricultural businesses.
- The Clemson Tax School provides workshops and training on income tax, farm tax, timber tax, and other special topics.
- The South Carolina New and Beginning Farmer program provides those getting started in farming with the foundational knowledge needed to structure and operate successful farm operations.

Key Impacts:

- Improvement of producer bottom-line financial performance and the resiliency of farming business operations across the state.

Program Area: Crosscutting

Ag Tech Example

Feeding the expanding global population, and doing so in a resilient and sustainable manner, is one of humankind's defining challenges. The impetus for applying scientific and technological innovations to address this grand challenge is intense, compelling multiple industries, scientific disciplines, and technological fields to converge around the complex challenge. This convergence is particularly evident in the broad and expanding domain of AgTech—an umbrella term that embraces the convergence of biological, physical, and digital technologies as assets for enhancing agricultural production and processing. A convergence of technologies in agricultural equipment, inputs, informatics, and advanced analytics has given rise to precision and digital agriculture, known as AgTech. CAFLS is working to position South Carolina to benefit from AgTech innovations by developing new AgTech and evaluating existing solutions suited to meet the needs and challenges of the state's varied environments. The signature initiative in AgTech at Clemson is the CU-CAT Center for Ag Technology, which is supported by a recurring $750,000 line item from the South Carolina General Assembly and founded with the vision to be "the hub for opportunities for Clemson Ag. Tech researchers and external parties to work together on developing, testing, and training on new technologies."[28] Under CU-CAT are two core initiatives:

- The Precision Agriculture program, headquartered at the Edisto Research and Education Center in Blackville, works to deliver data, products, and research in precision and digital agriculture. Here work is undertaken with new technologies such as advanced software/app development, field sensors, field robotics and remote sensing, and precision farming equipment platforms. The goal is to assure South Carolina producers understand the advantages of precision and digital agriculture and the various tech options available to meet production enhancement and cost savings goals.
- EATS (Ecosystem for Ag Tech Sharing) "is a community bringing public and private industry participants together to collaborate on agricultural technology solutions. EATS focuses on development, testing, training, deployment, and demonstration of precision agriculture technologies to farmers."[29]

Precision and digital agriculture technologies have the potential to impact productivity and cost of production efficiencies to the same degree that plant science innovations impacted agriculture through the Green Revolution. By assuring Clemson is on the frontlines in the exciting and fast-moving AgTech space, CU-CAT is a critically important initiative for the university, the state, and all engaged in the agricultural value chain in South Carolina. Founded in 2022, CU-CATS has quickly achieved significant traction in the state, both as an Extension resource for producers and others needing guidance on precision agriculture, and as a research-performing hub for new agtech innovation. Activities have included, for example:

- Web app development and digital solutions development. This has included the development of soil sampling apps, image analysis solutions, and software for enhanced management of center pivot irrigation.
- A major project in cotton and peanuts precision agriculture, incorporating in-cab tablets and automatic weighing systems.
- Fielding daily calls and questions from producers, and Extension's own agents, seeking input on precision and digital agriculture solutions.
- Over 110,000 page views of CU-CATS hosted web pages and app hosting pages.
- Informational podcast development.

28 https://www.clemson.edu/cafls/cu-cat/index.html
29 https://www.clemson.edu/cafls/cu-cat/initiatives/eats.html

Key Impacts:

- Provision of apps that enable producers to manage their operations more efficiently and save money through reduced application of inputs (agricultural chemicals and water resources).
- Provision of knowledge to producers regarding options in AgTech.

Program Area: Crosscutting

Clemson Tax School Example

Tax laws can be complex, and for many professionals without an accounting background, filing taxes can be a daunting task. There is a need for improved knowledge and skills to help individuals navigate these complexities while helping them stay compliant and still maximize potential refunds. This is especially true for farmers, foresters, and other agricultural producers who may be challenged by the complexities of reporting their agriculturally related income and self-employment taxes. As more and more USDA programs are linked to income tax returns, having reliable, accurate, and compliant tax information is critical.

For more than 60 years, the Clemson Tax School has provided South Carolina residents and tax professionals with educational services across a range of topics, including many related to agriculture. Today, the Tax School educates thousands of individuals each year on topics like Income Tax, Farm Tax, Timber Tax, and other special topics such as Tax Ethics. As one example, the Farm Tax Course covers topics ranging from farm and ranch tax elections, qualified easement contributions, expenses and depreciation, and conservation issues. In addition to offering this tax school for agricultural tax preparers, CAFLS also helps connect agricultural producers to resources and professionals, as necessary.

Clemson's Tax School reaches up to 1,500 participants through these various events, working with farmers, landowners, and others to help increase their skillset around taxes and provide them with management strategies. Clemson Tax School is especially beneficial for farmers. For example, CAFLS reports an estimated $3,500 per year for a farm in tax savings through their Farm Tax Course.

Key Impacts:

According to the IRS, there were approximately 3.3 million individual income tax and employment tax returns filed in Fiscal Year 2023 in South Carolina. Of these, 1.8 million refunds were issued, totaling approximately $5 billion in refunds—an average of $2,713 in refunds issued per filer receiving. **If Clemson's Tax School were able to increase the average tax refund by 0.1 percent, this could result in an additional $5 million in refunds delivered to taxpayers in the state as a result of increased educational understanding of tax savings.**

Other impacts related to this function include:

- Improved financial literacy and tax knowledge.
- More accurate and compliant tax filing.
- Increased confidence in managing personal and business taxes.

Program Area: Crosscutting and Collaborative

ACRE Program Example

South Carolina is home to a strong agricultural legacy, yet many challenges are facing today's generation of farmers and agricultural entrepreneurs. Whether it is demographic challenges, farm loss and consolidation, trade barriers, or regulatory uncertainty, the trials facing entrepreneurs are vast and make an already difficult job more challenging. At the same time, encouraging the next generation of agricultural entrepreneurs is necessary to grow and sustain this vital industry.

CAFLS is a key collaborator in the Agribusiness Center for Research & Entrepreneurship (ACRE), which was founded by the South Carolina Department of Agriculture to encourage new business development in the state's agricultural sector. Each fall, ACRE partners with CAFLS to offer a curriculum program to train and mentor beginning agricultural entrepreneurs and prepare them to seek additional funding. In particular, the program emphasizes the development of businesses in the state's rural areas.

Since 2017, ACRE has hosted agricultural workshops that have reached 2,550 state residents in all South Carolina counties.[30] More than 120 entrepreneurs have received intensive agribusiness training through the program, which has **awarded over $1,253,500 to 100 agricultural entrepreneurs**. ACRE has also funded 34 major industry-driven research projects and led dozens of business workshops throughout the state.

Key Impacts:

- Improved success rates of agricultural entrepreneurs.
- More educated entrepreneurs in the agribusiness sector.
- Increased follow-on funding for agricultural entrepreneurs.
- Improved industry-university partnerships.
- More vibrant rural areas due to entrepreneurship.

30 https://acre-sc.com/about/

The Economic Impact of a 1 Percent Increase in Agricultural Output in South Carolina

As illustrated through the case studies, CAFLS is sustaining and enhancing agriculture and agriculture-related economic activity in South Carolina. Through CAFLS various programs and initiatives, South Carolinians working in agriculture and related industries have access to research, education, information, and regulatory services. This access helps producers introduce new production practices, value-added products, and production technologies. It directly improves farm business performance and sustainability in the state.

To identify the collective impact of these programmatic efforts, TEConomy analyzed the effect that every 1 percent increase in total agricultural production would have on the State of South Carolina. Given the wide-range of programs provided by CAFLS to the agriculture sector, it is highly likely that its efforts generate considerably more than a 1 percent gain in agricultural output in the state on an annual basis—however, the use of a conservative 1 percent estimate serves as a baseline for considering the significant impacts of improving agricultural sector performance within the South Carolina economy.

Use of the IMPLAN I-O model for South Carolina enables TEConomy to quantify the total effect on the state's economic output, employment, and other variables of agricultural output (dollar value). The analysis details the impact of a 1 percent increase in output for the agricultural sector overall, comprising the subsectors livestock, poultry, crop, and horticulture production. **In terms of total agricultural production, a 1 percent increase generates the following impacts:**

- **$38.1 million in total South Carolina economic output, comprising direct, indirect, and induced impact components.**
- **$7.5 million in value added within the South Carolina economy.**
- **258 jobs supported.**
- **$4.5 million annually in labor income for South Carolina residents.**

It also should be noted that expanding the agricultural sector could benefit every county in the state. Agriculture production is distributed across the whole of South Carolina and, therefore, the direct and indirect effects of expansion in the sector are felt much more widely than would be the case with narrower, geographically focused sectors.

Helping Value-Added Food Processing and the Food Packaging Industry

Food packaging and value-added food processing are critical components of the food and agricultural value chain. With potential impacts on nutrition, safety, preservation, transportation, and convenience, advancements in food packaging and nutrition can help improve the livelihoods of humans worldwide. Through its educational, research, and outreach functions, CAFLS plays a unique role in supporting the food processing and packaging industries, not only in South Carolina but across the globe.

Packaging is one of the premier academic programs within CAFLS, and students have a nearly perfect placement rate, with many receiving multiple offers. As one of the few universities in the nation to offer undergraduate and graduate programs in packaging, CAFLS has developed unique educational programs inside and outside the classroom. All packaging science students complete a six-month co-op assignment with an approved industry partner. In addition, each summer, CAFLS offers Pack Camp, a program that helps high schoolers interested in packaging science learn how to design products and packages.

With numerous faculty members, research centers, and specialized facilities focused on advancing the packaging industry, CAFLS is responsible for conducting groundbreaking research, training the next generation of students, partnering with industry, and helping elevate the university's profile. Notable centers and labs include:

- The Sonoco Institute of Packaging Design and Graphics is a multidisciplinary center where Packaging and Graphic Communications students collaborate in packaging development.

- The Clemson University Center for Flexible Packaging (CEFPACK) is a membership organization that offers educational programming and industry-focused R&D services related to flexible packaging.

- The Cryovac Flavourmark Retort Laboratory, which has elevated Clemson's stature as a leader in the development of retort pouches, has helped guide the packaging industry's emphasis on this technology in recent years.

- The Clemson Package Dynamics Lab simulates how package distribution through various shipping environments (ground, air, and sea) impacts products and informs their potential redesign.

CAFLS's Food, Nutrition and Packaging Sciences Department is also home to food science and human nutrition research and education programs. In addition to offering a bachelor's in food science and human nutrition, CAFLS offers master's degrees that link food and nutrition with culinary sciences and a doctoral degree that links food and nutrition with packaging. The hallmark of CAFLS's Food Science facilities is the Culinary Research Lab, a state-of-the-art facility that features sensory analysis, consumer focus groups, a bench-top laboratory for developing new culinary applications, an animal co-products center, a retail test market center, and regulatory-approved pilot manufacturing for frozen products. Within its Sensory Lab, CAFLS provides an array of sensory evaluation services, from focusing the study design through recruiting and training panelists, preparing the evaluation, extracting tests, and conducting analysis. For students, these spaces are used for a variety of classes, labs, and student projects, such as undergraduate Creative Inquiry teams.

CAFLS maintains significant expertise and purpose-designed programs to meet the needs of this large-scale integrated sector. Several examples show the depth of the activities undertaken.

Program Area: Value-Added Food Processing and Food Packaging

Center for Flexible Packaging (CEFPACK) Example

CAFLS established the Center for Flexible Packaging (CEFPACK) in 2004 to provide support to the packaging industry for product development from film extrusion, lamination, pouch making, and filling, as well as through testing and shelf-life studies. CEFPACK is an extension of the flexible packaging activities carried out by the Department of Food Nutrition and Packaging Sciences within CAFLS. Activities conducted by CEFPACK are done under collaboration between the Department, industrial members of the CEFPACK organization, and other University organizations affiliated with CEFPACK.

CEFPACK activities align with the university's teaching, research, and service missions. Research projects at CEFPACK focus primarily on developing and understanding flexible packaging materials, structures, and packages. Educational experiences using the lab are available for undergraduate and graduate students in packaging science, and every undergraduate takes the Converting for Flexible Packaging course using the CEFPACK facilities.

Importantly, CEFPACK offers a broad range of support services available to industry. These activities include the film/laminate/package preparation, testing and evaluation, permeability testing, training and equipment demonstration, materials/structures analysis, thermal processing, transportation testing, and sensory and shelf-life labs. CEFPACK uses a membership model that provides the Center with a reliable cash flow to enhance its ability to hire staff and maintain equipment while also providing members with discounted services. CEFPACK membership is available to any company or organization associated with the converting or packaging industries and costs $30,000 for a three-year membership. In addition to receiving a credit for the Center's services up to the amount of the membership fee, CEFPACK also offers assistance with equipment, analytical services, phone consultations, and training and short courses held on the main campus of Clemson University.

Key Impacts:

- New innovation in flexible packaging.
- Enhanced partnerships between students and researchers with the flexible packaging industry.
- Improved student access to latest technologies related to flexible packaging.

Program Area: Value-Added Food Processing and Food Packaging

Sonoco Institute of Packaging Design and Graphics Example

The Sonoco Institute of Packaging Design and Graphics is a unique center focused on education, research, and industry collaboration around the sustainable printing and packaging innovation value chains. As a research and outreach center, CAFLS researchers at the Institute offer services such as print trials, customized training programs, consulting and audits, packaging design projects, virtual reality experiences, and CUshop, a state-of-the-art consumer tracking lab.

Student engagement is a critical function within the Sonoco Institute. In 2022, the Institute hosted nearly 550 undergraduate and graduate students from multiple departments, including packaging science, computer science, architecture, engineering, and graphic communications. Students regularly compete in packaging-related competitions such as the 48HOUR REPACK, TAGA Journal, Phoenix Challenge and AICC Student Packaging Design Competition.

The BrownBox Agency is one notable student program operated within the Institute. As a student-run packaging solutions service provider, the BrownBox Agency offers rapid, individualized prototypes for industry partners. Staffed with undergraduate students working alongside design professors and prototyping lab interns, these projects help industry partners rapidly brainstorm, iterate, and deliver unique structural solutions.

Key Impacts:

- Improved connectivity between students and researchers with the packaging industry.
- Enhanced student access to latest prototyping technologies.

Program Area: Value-Added Food Processing and Food Packaging

Clemson Ice Cream and the '55 Exchange Example

Ice cream has long been tied to Clemson's agricultural identity. A 1919 issue of *The Ice Cream Trade Journal* highlights Clemson's role in training men "in the manufacturing of ice cream as well as in the management of ice cream plants."[31] In 2001, Clemson created a new micro creamery on campus that allows students to receive hands-on experience in ice cream development. Today, ice cream is considered one of Clemson's most pronounced traditions and is a common destination for university visitors, whether they are prospective students or TV crews.[32]

In 2006, a generous gift from the Class of 1955 funded the opening of a new retail store and developed a model where all revenues generated by this student-led entrepreneurial center go to support Clemson students and academic programs. The '55 Exchange is a student-run business enterprise that designs, manufactures, sells, and serves Clemson's ice cream, as well as other products like shakes, coffee chillers, fresh cold brew coffee, smoothies, and blue cheese—which Clemson has been producing since 1941.

Clemson ice cream is made by students at the university, who participate in everything from flavor creation to scooping pints. In addition to its more adventurous signature flavors (Wild Tiger), Clemson also offers original flavors that represent the programs' agricultural heritage. These original flavors represent traditions like the Great Ice Cream Military Hoax, Military Heritage, Howard's Rock, and the Clemson Family.

Key Impacts:

- Enhanced reputation of university.
- Improved understanding of value-added food manufacturing.
- Applied learning experiences in food sciences, packaging, nutrition, and design.

31 https://clemson.world/archive/sweet-swindle/
32 https://news.clemson.edu/solid-orange-2-bills-and-clemson-ice-cream-a-look-at-the-biggest-tiger-traditions/

The Economic Impact of a 1 Percent Increase in the Food Packaging Industry in South Carolina

The packaging industry is broad, but one area where its impacts are especially important is food products. Innovation in food packaging has a direct impact on food safety, preservation, transportation, and convenience. Across the sector, advancements in new technologies like eco-friendly materials, advanced sensors and analytics, and innovative designs that extend shelf life are helping to improve productivity and safety.

CAFLS plays a unique role in supporting the food packaging industry, not only in South Carolina but across the nation. As home to one of the country's select few undergraduate degree programs in packaging sciences, CAFLS is pivotal in supporting talent development in the sector. The program is a core strength for the State of South Carolina with numerous faculty members, research centers, and specialized facilities focused on advancing the packaging industry.

To understand the potential impacts of packaging science efforts within CAFLS, TEConomy used the IMPLAN I-O model for South Carolina to model a potential 1 percent increase in the output of the state's food packaging industry. This sector is a vital component of the food and agricultural value chain and includes notable manufacturing subclusters related to innovation in boxes, bags, containers, bottles, and cans.

TEConomy's analysis of the food packaging industry finds that these combined sectors significantly contribute to the State of South Carolina's economy, accounting for nearly 6,000 jobs and $3.7 billion in economic output in 2022. **If Clemson's research, education, and outreach activities could improve production by just 1 percent, this would result in an estimated $37.0 million in economic impacts for the state. Other impacts would include an estimated 60 jobs supported, $6.3 million in labor income for South Carolina residents, and $11.0 million in value-added within the South Carolina economy.** With an understanding that Clemson packaging faculty work not only in South Carolina but also globally, it is likely that a 1 percent estimate is conservative.

Helping the Forestry and Forest Products Industry

South Carolina has 12.9 million acres of forests, which make up roughly 67 percent of the state's total land area.[33] Eighty-seven percent of South Carolina's forests are privately owned, 63 percent of which are family-owned.[34] Once trees are planted, a landowner can expect to complete a commercial thinning at age 16 to 18, a second thinning at age 25 to 28, and a final harvest at age 30 to 35, assuming favorable market conditions.[35] There are over 2,000 products derived from trees, ranging from the more obvious, such as lumber and paper, to the less obvious, such as polyester, chemicals in soda production, and dishwashing liquid.

As a result of the complexity of forest land management, the decisions that forest landowners make can have positive or negative impacts that will last for decades. A forest landowner must grapple with decisions related to:

- Timber: when to cut and at what value.
- Supply Chain: access to various types of mills/geographic proximity.
- Impact of climate change: how the forest will change and how to adapt.
- Wildlife habitat: protection and improvement of wildlife habitat.
- Wetlands and stream sides: development, restoration, and protection of them.
- Fisheries: how streams and ponds will be handled on the property.
- Cultural/historic features: structures or sites on the land that have cultural or historic significance and must be protected.
- Geological and natural features: unique features on the land that need protection.
- Long-term interest of family or heirs.

The complexity of the forestry industry was further impacted by the Great Recession of 2007, triggered by a housing slump that led to a global financial crisis. Home values and housing-related financial instruments declined, and housing starts hit a record low in 2009. These factors, along with tightening credit and an oversupply of foreclosed homes, made 2009–2011 the worst years for home building and wood products markets since the Great Depression and from which many of South Carolina's landowners are still working to recover. Long-term effects included significant mill closures driven by underutilization of capacity caused by decreased prices.

Within this environment, CAFLS seeks to support the forest industry sector of South Carolina both in terms of advancements in forest management and in the identification of alternative wood markets to increase demand. The following two examples provide evidence of the important work being undertaken.

33 https://www.nrcs.usda.gov/conservation-basics/conservation-by-state/south-carolina/forestry-in-south-carolina
34 https://www.scforestry.org/PDFs/FORESTRY-FACTS-NOV-2019.pdf
35 https://www.nrcs.usda.gov/conservation-basics/conservation-by-state/south-carolina/forestry-in-south-carolina

Program Area: Forestry and Forest Products

Clemson Experimental Forest Example

The Clemson Experimental Forest (CEF) was founded almost 100 years ago and represents a slice of 20th century American history in the context of ecological recovery. Ninety years ago, the Upstate of South Carolina displayed textbook examples of farms rendered virtually valueless by unscientific land use. Land was abandoned or purchased by the Federal government and turned over to Clemson University. CAFLS played a central role in restoration of the landscape through its outreach and education programs, and by example through management of the CEF and related lands.

Through careful management over decades, the CEF has become a vibrant forested ecosystem, replacing acres of eroded and depleted farmland with abundant forest resources. Generations of students and faculty have engaged in wide-ranging studies in natural resources management, biology, engineering, landscape design, recreation management, environmental conservation, and other arts and sciences.

The Forest is an abundant resource for the surrounding communities. Tens of thousands of visitors annually hike, bike, boat, horseback ride, hunt, fish, and otherwise recreate in the CEF. Recreational use creates the opportunity for demonstration of management practices and outreach on a variety of forest-related topics. Ongoing research by CAFLS faculty uses cell phone data to document the number of visitors and their locations in the Forest and surrounding communities, thereby enabling estimates of economic impact on communities.

The CEF also directly impacts the local economy through the management and sale of timber resources. Through private contractors, timber is harvested and marketed to local mills.

The CEF provides free ecosystem services such as water filtration and storage, which is important given that the CEF is a large part of the watershed supplying local drinking water; biodiversity including game and non-game species; carbon sequestration and storage; and wild foods collected by local inhabitants.

Through an extensive data management system, the CEF is improving its capacity to demonstrate to South Carolina landowners several important principles: spatial optimization of land use; Climate Smart Forestry; and payments for ecosystem services.

The CEF is a venue for grant-funded research projects that generate local revenue through the hiring of staff, purchasing of materials and services, and information.

Key Impacts:

- Improved understanding of forest management.
- Applied learning experiences in forest management.

Program Area: Forestry and Forest Products

Wood Utilization + Design Institute Example

The Great Recession significantly impacted the wood products industry, with home building experiencing precipitous declines that forced many sawmills out of business. In 2013, in an effort to identify and create new markets for the wood that South Carolinian landowners grow, CAFLS's Wood Utilization + Design Institute (WU+D) was created as an interdisciplinary research institute focusing on advanced wood design and construction The WU+D Institute began with the idea that using sustainably managed forests to produce wood products is key to a better future and a better built environment.

Today, WU+D is making significant strides in transforming how municipalities, institutions, and the construction and design community perceive the benefits of wood, wood products, and alternative wood markets. Since the inception of the Institute, the forest products industry has experienced significant changes, including changes to public policy, increased funding opportunities, and the greening of the built environment that have all affected the growth of the industry sector.

By fostering collaboration between students, professors, foresters, and building industry stakeholders, WU+D's Institute promotes the diverse use of innovative wood-based materials to compete with steel, concrete, and other currently used materials in the construction of buildings and other structures.

WU+D seeks to create new markets by:

- Drawing new business and industry to South Carolina.
- Providing education and training, research and development, and direct marketing of wood-based technical solutions.
- Developing forest management protocols to grow trees with higher quality fiber.
- Engineering groundbreaking manufacturing and construction processes for wood-based products, resins, adhesives, and fasteners.

WU+D also seeks to enhance the educational and career opportunities of Clemson students by:

- Preparing the next generation of architects, engineers, foresters, and material and wood scientists.
- Creating an experiential learning environment where students test products they have developed through installation in prototype buildings.
- Attracting undergraduate Creative Inquiry teams to engineer innovative wood products that meet the needs of the building construction industry.

A significant focus of WU+D is mass timber. Mass timber comprises multiple solid, load-bearing wood panels bound together to create extraordinary strength and stability. Panels can be bound together through various methods, including nailing, gluing, or using dowels. Mass timber provides exceptional fire resistance, strength, and stability, offering a low carbon alternative to concrete and steel.

WU+D initiatives are specifically exploring the use of native woods in cross-laminated timber (CLT), a type of mass timber. In its work, WU+D is developing forest management protocols to grow trees with higher quality fiber and provide direct marketing of wood-based solutions. This includes groundbreaking manufacturing and construction processes for wood-based products, resins, adhesives, and fasteners. The WU+D team has also been active in exploring applications of CLT in low- and mid-rise buildings on and off campus, developing and promoting mass timber noise barriers for highways, and using mass timber construction in high-velocity wind zones.

In addition to the research and education the Institute leads and supports, WU+D has catalyzed Clemson to become a demonstration site for the mass timber and alternative wood products industry. In 2019, southern yellow pine CLT was used to construct Clemson University's Andy Quattlebaum Outdoor Education Center, which serves as a showpiece for promoting wood buildings. In 2023, Clemson broke ground on construction of its new Alumni and Visitors Center. Once completed in the Fall of 2024, the 100,000 square-foot facility will feature Southern Yellow Pine mass timber. In 2024, Clemson broke ground on a new home for its Department of Forestry and Environmental Conservation (FEC) and, from a broader view, on a new era of stewardship for South Carolina's natural resources. Upon completion in 2026, the 85,000-square-foot building will display the use of wood products in construction with many spaces having exposed ceilings or suspended wood ceilings, and highly visible public spaces will showcase wood in the structure, flooring, walls and ceilings.

Key Impacts:

- Creation of new markets for South Carolina's forest industry.
- Technological advancements in mass timber applications and products.
- Attraction of industry investment.

The Economic Impact of a 1 Percent Increase in Forestry Output in South Carolina

As demonstrated by the case studies, CAFLS plays a crucial role in sustaining and enhancing forestry-related economic activity in South Carolina. The organization's diverse programs and initiatives provide South Carolinians in the forestry and related industries with access to vital research, education, and information. This access empowers producers to introduce new production practices, value-added products, and production technologies, thereby directly improving forest-related business performance and sustainability in the state.

To identify the collective impact of these programmatic efforts, TEConomy analyzed the effect that every 1 percent increase in total forestry production would have on the State of South Carolina. Given the range of programs provided by CAFLS to the forestry sector, it is highly likely that its efforts generate considerably more than a 1 percent gain in forestry output in the state on an annual basis—however, the use of a conservative 1 percent estimate serves as a baseline for considering the significant impacts of improving forestry sector performance within the South Carolina economy.

Using the IMPLAN I-O model for South Carolina enables TEConomy to quantify the total effect on the state's economic output, employment, and other variables of forestry output (dollar value). The analysis details the impact of a 1 percent increase in output for the forestry sector overall. **In terms of total forestry production, a 1 percent increase generates the following impacts:**

- **$4.9 million in total South Carolina economic output, comprising direct, indirect, and induced impact components.**
- **$3.1 million in value-added within the South Carolina economy.**
- **Forty-eight jobs supported.**
- **$2.6 million annually in labor income for South Carolina residents.**

ENCOURAGING HEALTHY BEHAVIORS

Description

A defining feature of the original Smith-Lever Act was the "development of practical applications of research knowledge and giving of instruction and practical demonstrations of existing or improved practices or technologies in…home economics…and subjects relating thereto."[36] Beyond providing education for agricultural practitioners, Cooperative Extension has long played a role for Americans, their families, and their communities. As noted by Virginia Tech researchers in the *Journal of Public Health Management and Practice*:

> *Extension's rich history has paved a firm foundation to impact the lives of Americans. This national system was designed for, and has been shown to be successful at, disseminating and facilitating behavior change for more than a century…Taken together, Extension's mission aligns with the overall objective of health promotion researchers and practitioners across the world: to disseminate and implement evidence-based research to improve the health of communities.*[37]

Today, CAFLS programs focus on sustaining healthy individuals, families, and communities. To accomplish this, CAFLS personnel and programs deliver programs across South Carolina centered around health, food nutrition, food safety, healthy families, and vibrant communities.

The Need for CAFLS to Help Encourage Healthy Behaviors

Although the United States provides its people with many opportunities and represents the largest and most diverse economy among nations, there is no hiding that it is also a country where tens of millions of residents face significant problems and challenges. Nearly 38 million Americans presently live in poverty[38], and U.S. life expectancy is just 60th among all nations.[39] Furthermore, 17 million U.S. households, or 12.8 percent of families, are food insecure.[40]

36 https://www.law.cornell.edu/uscode/text/7/342
37 Thomas E Strayer, et al. 2019. Partnering for Successful Dissemination. J*ournal of Public Health Management and Practice*. DOI: http://dx.doi.org/10.1097/PHH.0000000000001025
38 Source: U.S. Census Bureau, Current Population Survey, Annual Social and Economic Supplement
39 https://data.worldbank.org/indicator/SP.DYN.LE00.IN
40 https://www.ers.usda.gov/topics/food-nutrition-assistance/food-security-in-the-u-s/key-statistics-graphics/#:~:text=Food%2Dinsecure%20households%20include%20those,at%20some%20time%20during%202022

These and similar issues are felt acutely in South Carolina, where persistent poverty, food insecurity, chronic disease, and other socioeconomic challenges affect large numbers of South Carolinians. The need for solutions to these human challenges is significant because of the following:

- With the 42nd highest poverty rate in the nation, 13.8 percent of South Carolinians live in poverty—nearly 700,000 people[41]—with:
  - 19.4 percent of children, or nearly one in five, living below the poverty level and
  - 23.1 percent of African Americans, or nearly one in four, living in poverty.
  - Nearly 1 in 8 South Carolinians are food insecure, meaning at some point during the year, they experienced difficulty providing enough food for an active, healthy lifestyle. In South Carolina, 197,310 are children, leaving 1 in 6 children to face food insecurity.[42]
  - Twenty-eight percent of children in South Carolina have parents who lack secure employment.[43]

CAFLS works to understand the key social and behavioral factors that impact quality of life and to teach the skills necessary for positive lifestyle choices that improve the health of individuals, families, and communities. It also works to identify the community and societal factors that facilitate negative or inhibit positive lifestyle choices, and then address these through programs targeted at behavior influencers.

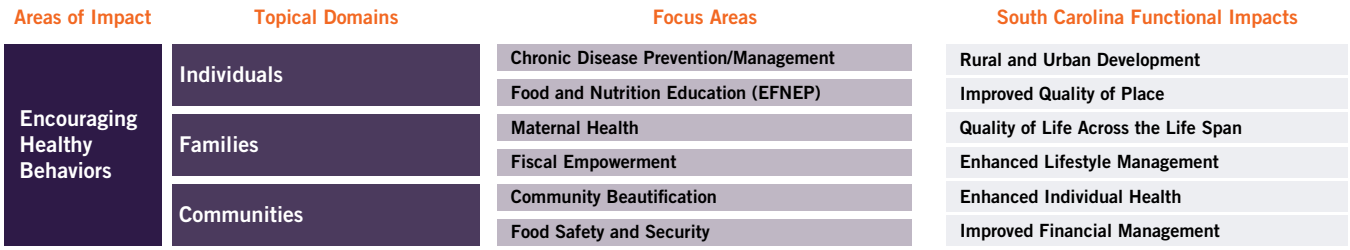
CAFLS professionals use their unique experiences and understanding of local circumstances and specific issues to help more people share their perspectives. As noted in a 2019 *Journal of Family & Consumer Sciences*, "Extension agents help guide conversations about participants' values regarding an issue, sort through the costs and benefits of alternative courses of action and come to common ground that leads to positive change."[44] These authors later note that the services of Extension professionals can be especially helpful in bridging challenges related to social issues, a condition that can be particularly prevalent in areas where there are long distances between homes and communities, limited transportation, and few opportunities for engagement. Extension professionals can use their contacts, creativity, and deliberative skill set to develop committed, caring, and engaged citizens.[45]

41 https://talkpoverty.org/state-year-report/south-carolina-2020-report/index.html.
42 https://www.feedingamerica.org/hunger-in-america/south-carolina.
43 https://datacenter.aecf.org/data/tables/5043-children-whose-parents-lack-secure-employment?loc=42&loct=2#detailed/2/42/false/1095,2048,1729,37,871,870,573,869,36,868/any/11452,11453
44 https://www.researchgate.net/profile/Bonnie-Braun/publication/331677412_Loneliness_and_Social_Isolation-A_Private_Problem_A_Public_Issue/links/5c92445d92851cf0ae8a037d/Loneliness-and-Social-Isolation-A-Private-Problem-A-Public-Issue.pdf
45 https://www.researchgate.net/profile/Bonnie-Braun/publication/331677412_Loneliness_and_Social_Isolation-A_Private_Problem_A_Public_Issue/links/5c92445d92851cf0ae8a037d/Loneliness-and-Social-Isolation-A-Private-Problem-A-Public-Issue.pdf

How CAFLS Generates Positive Impacts by Encouraging Healthy Behaviors

For decades, Clemson has supported the health and vitality of South Carolina by offering indispensable research and counsel to those in the state who need it most. The state has made great strides in improving healthcare and nutrition, and these improvements stem from concerted efforts from CAFLS's committed faculty and staff and their ongoing partnerships with community stakeholders. As seen in Figure 11, CAFLS offers programs that positively impact the health of individuals, families, and communities across the state.

Figure 11: CAFLS Functional Impact Themes in Encouraging Healthy Behaviors



Source: TEConomy Partners, LLC.

Functional Impact Examples: CAFLS Work to Encourage Healthy Behaviors

As noted previously, it is not feasible to highlight every activity undertaken by CAFLS in support of sustaining healthy individuals, families, and communities. Rather than attempting to produce an inventory or list of each and every activity, TEConomy in this (and other functional impact discussion areas) draws upon program examples to illustrate the types and range of important functional impacts generated by CAFLS's industry-focused programming. The following categories illustrate the high-impact work taking place.

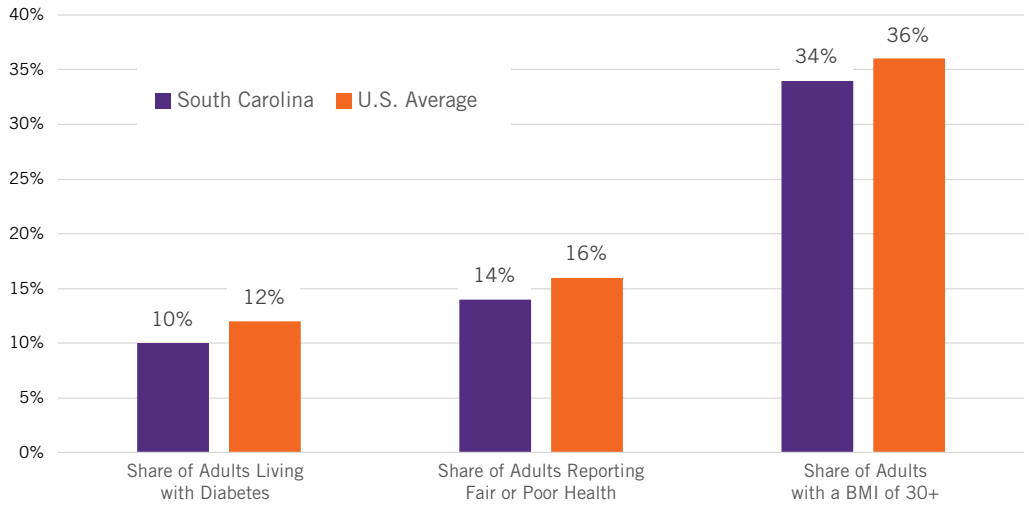
Encouraging Healthy Individuals

Across South Carolina, high rates of chronic diseases, poor nutrition, and struggles with mental health and substance abuse are plaguing the health of the state's citizens. Addressing these health-related challenges is crucial to improving well-being, reducing inequities, and enhancing the long-term economic development potential of South Carolina. The critical work of CAFLS helps sustain the livelihoods of individuals across the state who are impacted by these conditions.

As noted in Figure 12, South Carolina residents are more likely to be living with diabetes, report fair or poor health, and are more likely to be considered obese. These represent just a small set of the various health conditions and factors where the state lags behind national averages. The economic impacts of obesity and chronic illnesses are stark. For example, a recent study by SC Bio found that obesity and related conditions reduced economic activity in South Carolina by $7.4 billion in 2022, a result of reduced labor force participation, lower earnings, higher medical costs, and earlier deaths.[46]

46 https://www.scbio.org/globaldata-report-highlights-staggering-economic-costs-for-south-carolina-of-7-4-billion-due-to-obesity/

Figure 12: Health Factors for South Carolina Compared to USA



Source: TEConomy analysis of County Health Rankings

The health conditions of South Carolinians are made more complicated by limited access to healthcare in the state (higher ratios of population-to-care providers) and by limited access to parks or recreation facilities.[47] Although an average of 84 percent of Americans live close to parks and recreation facilities, this share is just 68 percent in South Carolina. In some counties in the state, fewer than 20 percent of adults report living close to parks and recreation facilities.

Ultimately, a combination of poor health and poor accessibility to recreation and care leads to a low life expectancy for the state, and South Carolina ranks near the bottom of states in terms of life expectancy. With a life expectancy of 74.8 years in 2020, South Carolina ranks 41st among states.[48] Like many health factors and outcomes, these figures are highly variable across counties: from less than 68 years of life expectancy in Dillon County to more than 80 years in Beaufort County. Even within South Carolina's counties and its cities, research from the South Carolina Department of Health Environmental Control (SDHEC) shows that life expectancies are variable.[49] In cities across the state, a matter of zip code could be the difference in years of life. Perhaps unsurprisingly, incomes and economic opportunity play an important role in determining one's life expectancy.[50] This suggests that economic development opportunities, in addition to healthy behaviors, are needed in order to help sustain healthy individuals, families, and communities across the state.

One significant issue facing the state's population is the lack of awareness about health challenges and approaches to dealing with these difficulties. Notable gaps include building trust in the medical system, educating individuals on treatment/prevention approaches, and empowering them to make informed and accurate decisions. This highlights the need for trusted educators, such as those found at CAFLS, to disseminate valuable information, promote preventative measures, and empower communities to make informed health decisions.

47 https://www.countyhealthrankings.org/health-data/south-carolina?year=2024
48 National Center for Health Statistics, National Vital Statistics System, 2018, 2019 and 2020 data.
49 http://scdhec.gov/sites/default/files/Library/CR-012234.pdf
50 https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4866586/

Through the programmatic efforts described in the following examples, CAFLS seeks to educate individuals regarding the proactive choices they can make to improve healthy lifestyles.

Program Area: Healthy Individuals

Chronic Disease Prevention Examples

Chronic disease prevention and management are critically important for the State of South Carolina and its residents. In 2022, nearly 1,800 people died from diabetes in South Carolina, the eighth most common cause of death in the state.[51]

To address chronic health conditions in South Carolina, Clemson Extension Rural Health and Nutrition Agents offer the "Know Diabetes by Heart," the "Health Extension for Diabetes," and the Hypertension Management programs.

The **"Health Extension for Diabetes" program** is a diabetes self-management support program offered by Clemson Extension Rural Health and Nutrition Agents. Targeting adult residents of South Carolina who have been diagnosed with either type 1 or type 2 diabetes, the program features eight unique sessions along with intermittent support groups. Educational topics included in the program feature understanding diabetes, healthy eating habits with diabetes, physical activity, medications and monitoring, problem solving and resource navigation, healthy coping, and reducing risks. Over the course of approximately 4 months, the program offers relevant materials and weekly follow-ups that help participants navigate the important resources that can help them reach their healthy lifestyle goals.

According to CAFLS reporting data, from March 2018 to September 2023, a total of 1,185 participants across 150 cohorts were involved in the Health Extension for Diabetes program, including 65 cohorts in Greenville County, and 60 statewide cohorts. Of these participants, approximately three-quarters had hypertension and/or a family history of diabetes. Roughly 15 percent of participants enrolled came from at-risk or distressed zip codes, approximately 25 percent had a high school diploma or less, and nearly 25 percent made less than $25,000 annually.

The Health Extension for Diabetes program has received significant accolades. In November 2022, Clemson Cooperative Extension received a State Impact Award for its commitment to supporting actions under the Live Healthy plan and for using collaborative approaches for state improvement. The program has also led to three peer-reviewed manuscripts that have been published in various journals, along with dozens of posters and oral presentations. In 2020, the program was recognized by the American Diabetes Association as a practice-tested diabetes management program, the only one of its kind in South Carolina.

Through a related program, participants in the **"Know Diabetes by Heart"** (KDBH) program are provided with a general overview of diabetes and its correlation to heart disease, as well as an assessment tool to determine their risk of developing prediabetes. For those who are newly diagnosed, the assessment can be used by participants as a starting point for talking to their doctors. Sponsored by the American Diabetes Association and American Heart Association, this program is free to participants and is offered in-person or online. With a focus on helping participants better understand the link between diabetes and heart disease, participants learn more about risks related to diabetes and heart disease, how to manage risks, and how to navigate community and clinical resources. Offered statewide, anyone is eligible to participate in this program. As of July 2023, approximately 1,816 participants have completed KDBH, including all HED participants.

51 https://www.cdc.gov/nchs/pressroom/states/southcarolina/sc.htm

CAFLS also offer **The Hypertension Management Program**. This is an 8-session education and support program, generally with a 2-month time commitment, for people who have been diagnosed with high blood pressure. The Hypertension Management Program is an evidence-based program that is designed to give participants the knowledge and support needed to incorporate healthy lifestyle changes.

Key Impacts:

- Increased knowledge of chronic conditions.
- Improved physical and mental health.
- Enhanced self-care and self-efficacy.
- Increased likelihood of healthy behaviors.
- Reduced weights and BMIs.

Program Area: Healthy Individuals

Expanded Food and Nutrition Education Program (EFNEP) Example

Effective nutrition and healthy living are severely lacking across South Carolina. According to the South Carolina Department of Health and Environmental Control (DHEC), two out of three South Carolina adults and one out of three South Carolina children are either overweight or obese. In 2022, this crisis has created medical care costs of over $7 billion per year.[52] Although the state is working to address these issues, the main risk factors remain poor nutritional education and a lack of physical activity.

The **Expanded Food and Nutrition Education Program (EFNEP)** offered by CAFLS is aimed at providing practical, hands-on nutrition education in four core areas:

- Diet quality and physical activity
- Food resource management
- Food safety
- Food security

CAFLS provides food education to low-income adults and youths primarily through nutritional education, but also includes physical education and food distribution networks. Nutrition Educators provide not only education, but also directions and guidance in finding and utilizing food access programs for low-income families to gain direct access to fruits and vegetables. Participants learn to choose and eat an adequate variety of nutritious foods as well as how to remain physically active to improve health over time. Education opportunities also cover practical food-related habits, including safe food handling, food purchasing and portion management, and the ability to identify and use both emergency and nonemergency food assistance programs.

In the 2022-2023 reporting period, EFNEP served 20 counties and delivered youth and adult programs that reached 512 adults directly and 1,162 family members indirectly. Also, EFNEP reached 3,558 children and youth with a graduation rate of 89 percent. More than two-thirds of adults served were from communities of color. Notably, the EFNEP Behavior Changes report showed:

- 95 percent of adults and 91 percent of youth improved nutrition practices.
- 88 percent of adults and 50 percent of youth improved food resource management practices.
- 66 percent of adults and 68 percent of youth improved physical activity practices.
- 68 percent of adults and 57 percent of youth improved food safety practices.

Key Impacts:

South Carolina's obesity crisis has created medical care costs of over $7 billion per year.[53] **If the activities of CAFLS were able to reduce obesity by 1 percent in the state, this could have a $70 million in estimated impacts for the South Carolina economy.** Other impacts include:

- Decreased chronic diseases.
- Decreased healthcare costs.
- Increased community knowledge of nutrition.

52 https://scdhec.gov/health/nutrition-obesity-physical-health
53 https://scdhec.gov/health/nutrition-obesity-physical-health

Program Area: Healthy Individuals

WalkSC, Practical Strength, Yoga for Everybody Examples

Approximately 26 percent of South Carolina residents report being physically inactive, a share that is greater than the U.S. average (23 percent) and ranks 40th among states. According to the Centers for Disease Control and Prevention (CDC), increasing physical activity helps prevent or manage four of the five most costly chronic conditions among adults.

CAFLS offers three primary programs that seek to encourage physical activity among individuals of all ages, experience levels, and mobility levels. From walking to physical fitness to yoga, CAFLS helps improve the livelihoods of individuals from across the state by supporting their physical health goals.

WalkSC is a virtual program where participants complete weekly step challenges to virtually cross South Carolina's Palmetto Trail. Through this program, CAFLS' Rural Health and Nutrition Extension Agents provide weekly walking challenges and other weekly interactions with participants. Each of these weeks corresponds to a section of the South Carolina Palmetto Trail and offers other health education and physical activity resources to help participants meet their steps and wellness goals.

Through the **Practical Strength Program**, certified fitness instructors teach participants in live, weekly classes that focus on functional fitness and improving physical activity—regardless of skill level. Modifications are offered to suit all ages and mobility levels and include seated or standing options.

Yoga For Everybody is a weekly yoga class that provides consistent practice opportunities for participants along with reduced stress, improved strength and flexibility, and other health benefits. Similar to other Clemson Extension Rural Health and Nutrition programs, this activity targets individuals from all experiences, and beginners are strongly encouraged to join.

Key Impacts:

- Improved physical and mental well-being through accessible activities.
- Reduced chances of injuries related to improper techniques.
- Improved healthy lifestyles associated with fitness engagement.

The Functional Impact Associated with a 1 Percent Decrease in Chronic Disease Incidence

CAFLS helps sustain health individuals, families, and communities across the state. As noted in the highlighted examples, Cooperative Extension staff play an important role in assisting individuals to manage their chronic diseases, prevent obesity and poor-nutrition, and improve physical activity. This work (and other related efforts by the university) reaches thousands of participants across South Carolina each year. Beyond the obvious benefits to quality of life that come from improving the health of South Carolinians, there are also tangible savings in terms of healthcare costs.

TEConomy analyzed the effect that a 1 percent reduction in 25 diseases and health disorders associated with diet and exercise would have on the South Carolina economy. It is likely that Extension's services generate more than a 1 percent benefit in terms of public health cost saving, but this estimate acts as a conservative baseline to better understand CAFLS' impacts.

To highlight the potential economic impacts of healthcare improvement, TEConomy used input-output analysis to model the effect on South Carolina of a reduction in several diseases and health disorders associated with diet and exercise. This modeled scenario estimates the impact of a 1 percent decrease in the total number of hospital inpatient visits for 25 selected conditions related to diet and exercise and derives a dollar savings estimated from data on the mean cost of visits. Data are derived from state statistics from HCUP State Inpatient Databases [2021], recorded by the Agency for Healthcare Research and Quality (AHRQ).

Based on the analysis, TEConomy finds that a 1 percent decrease in hospital inpatient visits in South Carolina (for diseases that are associated with poor diet and/or lack of exercise) would result in $10.2 million in cost savings to the state. This figure represents a ballpark estimate of the potential impact of CAFLS health and nutrition programs targeting population and individual health benefits. Based on EFNEP and Rural Health and Nutrition program contacts by Extension alone, a 1 percent estimate for impacts is likely conservative.

Encouraging Healthy Families

CAFLS encourages families to make proactive choices to improve family health, mental stress, and financial well-being in an effort to help build and sustain healthy families.

Program Area: Healthy Families

Mother's Milk Bank of South Carolina and Breast Feeding 101 Example

Research shows numerous benefits of breast milk, including reduced risks of sudden infant death syndrome, asthma, obesity and Type 1 diabetes, and protective effects against the disorder and promotes neurological development.[54] The American Academy of Pediatrics recommends that very low birth weight infants be given donor milk when a mother's milk is unavailable.[55]

For many mothers who are unable to breast feed for any reason, donor milk can be an invaluable resource. However, it can also be cost-prohibitive and out of reach for many, especially those who may be uninsured or under-resourced. One tool to address this issue is Milk Banks, a voluntary program that helps distribute human milk to those children who need it most.

South Carolina's Mother's Milk Bank program is a unique initiative that promotes the health of the state's babies by providing mothers with access to safe, pasteurized, donor human milk. Through this program, breastfeeding mothers with a surplus milk supply can become milk donors and provide pasteurized milk to infants whose mother's milk supply is limited. The milk bank initially provides milk to all South Carolina hospitalized and very low-birth-weight infants.

CAFLS plays an important role in supporting The Mother's Milk Bank and by educating expectant mothers on best practices in breastfeeding. The Mother's Milk Bank utilizes Clemson Health Extension offices to house milk depots throughout the state. To help further encourage health and wellness for new and expectant mothers, CAFLS also offers Breastfeeding 101, a single session program that is instructed by a Certified Lactation Consultant. This program provides information about the benefits, basic techniques, and information on overcoming possible problems of breastfeeding.

Key Impacts:

The Mother's Milk Bank collected over 116,000 ounces of donor milk in 2023. Estimates from the NIH suggest that human donor milk from milk banks costs up to $3-5 per ounce, and a baby can consume between 32 and 48 ounces of milk per day. Based on midpoints of these figures ($4 per ounce), it can be extrapolated that the **Mother's Milk Bank led to a total of $464,000 dollars in cost savings for mothers** who would have had to find other sources for breast milk if they are unable to produce.

Other key impacts from this function include:

- Improved infant health through safe donor milk access.
- Improved maternal and child well-being.
- Enhanced education on benefits associated with breastfeeding best practices.

54 https://www.ncsl.org/state-legislatures-news/details/donor-human-milk-more-valuable-than-gold
55 https://publications.aap.org/pediatrics/article/150/1/e2022057988/188347/Policy-Statement-Breastfeeding-and-the-Use-of?autologincheck=redirected?nfToken=00000000-0000-0000-0000-000000000000

Program Area: Healthy Families

Farm Stress Mental Health Network Example

Caring for crops and animals is high-stress work, and farmers often overlook their own health and wellness when they are focused on their fields. However, mental health can be critically important to the overall well-being of workers and their families in this sector. To that end, the CAFLS' Agribusiness Team works closely with the agricultural community to offer resources and evidence-based education programs that help support the mental health needs of these families.

The South Carolina AgriWellness program is a collaborative effort between Clemson Cooperative Extension, the South Carolina Farm Bureau, and the South Carolina Department of Agriculture. Through this program, anyone who is part of the South Carolina agricultural industry can call a 1-800 council crisis hotline and receive at least three free counseling sessions. Importantly, this counseling is completely anonymous and has trained counselors familiar with rural issues. The program provides various educational resources made available through Cooperative Extension's nationwide collections. Through the support of the South Carolina Farm Bureau, Clemson Cooperative Extension also provides in-person workshops and presentations on farm stress and mental health.

Key Impacts:

- Improved mental health resources and support networks for farmers and agribusiness workers.
- Improved awareness of mental health challenges facing farmers and other agribusiness workers.
- Reduced stigma surrounding mental health challenges.
- Improved access to counseling and coping strategies to address stressors.

Encouraging Healthy Communities

Economic and community development activities are important to supporting the vitality of South Carolina's places, and in turn, the health of its people. Beyond programs that encourage health, nutrition, and physical activity, many CAFLS' activities are focused on the community at large. Examples of activities to sustain healthy communities include programs that support community gardens, entrepreneurship, food security, fiscal empowerment, and other economic development support activities.

Program Area: Healthy Communities

Food Safety ServSafe Example

Foodborne illnesses can cause great personal suffering and loss as well as economic impacts. For example, one study by researchers at the Johns Hopkins Bloomberg School of Public Health estimated that the cost of a single foodborne illness outbreak at a fast-casual establishment cost between $6,330 and $2.1 million, depending on the severity of the outbreak, the amount of lawsuits, fines and legal fees, and the number of employees and guests

impacted by the incident.[56] According to the CDC, the most common locations of foodborne outbreaks occurred at sit-down dining restaurants (48 percent of all outbreaks), followed by catering or banquet facilities (14 percent) and private homes (10 percent).[57]

CAFLS provides training and education opportunities to help protect consumers from foodborne illnesses. One approach to encouraging food safety is through the ServSafe training program for restaurant workers. The ServSafe program is a national certification program designed to teach safe handling practices to foodservice employees and others who handle and serve food to the public. Clemson Extension Food Systems and Safety Agents provide this training numerous times each year, resulting in a significant number of contact hours of education, training, and tools focusing on risk factors known to be the most critical in preventing foodborne illness. Examples of individuals served by this education include restaurant owners, line cooks, culinary arts students, and educators. The ServSafe program was offered by CAFLS in the Midlands region of South Carolina, and 30 food industry managers were in attendance.

Post-session surveys of participants indicated an increase in knowledge and skills of best food safety practices. Participants reported they intend to wash their hands, check food temperatures, and use food thermometers more often; and they are more cautious of cross contamination and other risks. Of the participants completing the post survey, many also indicated they plan to use what they learned at work and/or at home.

Key Impacts:

A study from Pew Trusts found that the annual health-related costs of foodborne illness for South Carolina residents can be costly, reaching an estimated $2.3 billion in total costs (consisting of $142 million in medical costs, $1.4 billion in quality-of-life losses, and $738 million in lost life expectancy).[58] **If CAFLS' work reduces the impact of foodborne illness by 1 percent, its ServSafe training could save the State of South Carolina $23 million**. Other impacts include:

- Improved consumer safety, health, and wellness.
- Fewer large-scale, food-borne illnesses spread.
- Fewer food establishment shutdowns.

56 https://publichealth.jhu.edu/2018/a-foodborne-illness-outbreak-could-cost-a-restaurant-millions-study-suggests
57 https://www.cdc.gov/fdoss/pdf/2017_FoodBorneOutbreaks_508.pdf.
58 https://www.pewtrusts.org/-/media/legacy/uploadedfiles/phg/content_level_pages/reports/pspscharff20v9pdf.pdf

Program Area: Healthy Communities

School-Based Wellness (Boeing Center for Children's Wellness) Example

K-12 schools can play a critical role in promoting the health and safety of children by helping to establish healthy behaviors. Research by the National Academies of Sciences finds that healthy students are better learners, and that higher academic grades are associated with more positive health behaviors among high school students.[59] On the other hand, risky behaviors such as lack of physical activity, unhealthy diets, and alcohol/drug/tobacco usage are consistently linked to poor grades/scores and lower educational attainment.

Healthy Me – Healthy SC (HMHSC) is a collaborative program between the Medical University of South Carolina (MUSC) and CAFLS that is designed to improve health care access and health inequities in rural and underserved areas of South Carolina. Through HMHSC, the MUSC Boeing Center for Children's Wellness and CAFLS partner together on The School-Based Wellness initiative, which supports K-12 school communities in creating healthy learning environments. The program includes three components: the school wellness checklist, an active school wellness committee, and ongoing Extension Agent support.

Through the School-Based Wellness Initiative, participating schools receive resources and training for school garden projects, connections to community partners focused on health and wellness, and guidance from Rural Health and Nutrition Extension Agents who are trained in best practices on school wellness. Together, these agents provide training and guidance to the participating schools. With a focus on improving nutrition and increasing physical activity, the Agents also serve as integrators who help connect schools with the resources needed to develop their own wellness strategies.

In 2023, 20 school districts comprised of 265 schools and 165,000 students from across South Carolina were impacted by the work of the Boeing Center for Children's Wellness.

Key Impacts:

- Healthier schools and students.
- Improved physical activity among students.
- Improved understanding of school gardening.

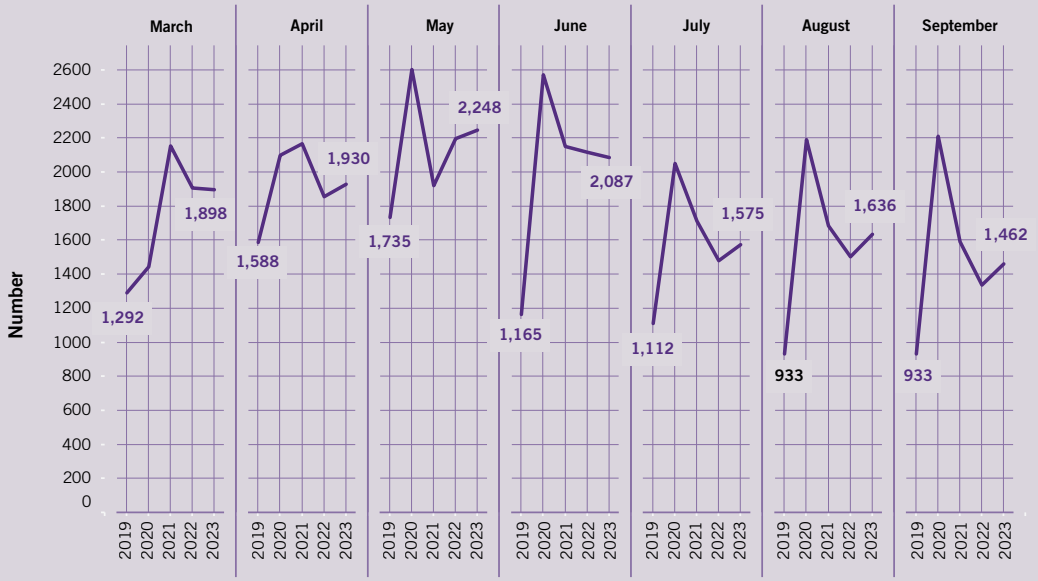
59 National Academies of Sciences, Engineering, and Medicine. *Promoting Positive Adolescent Health Behaviors and Outcomes: Thriving in the 21st Century.* Washington, DC: The National Academies Press. 2020. https://doi.org/10.17226/25552.

Program Area: Healthy Communities

Home and Garden Information Center Example

During the COVID-19 pandemic, the work of the CAFLS Home & Garden Information Center (HGIC) became indispensable for home gardeners across the state. As illustrated in Figure 13, there were significant spikes in calls and emails during the growing season starting in 2020. Although 2019 participation in the HGIC was high in its own right, these figures took off in the Spring of 2020 as more and more home gardeners began utilizing the Center. In May and June 2020, total calls and emails surpassed 2,600—rates more than twice as high as in 2019. Although these numbers have dropped in recent years, they are still higher than their 2019 figures across all growing months. This is a testament to the valuable support that Extension Agents offer to those in need.

Figure 13: Change in Total Calls/Emails to HGIC During Growing Months (2019-2023)



Source: TEConomy Analysis of HGIC Data

HGIC's program content has a wide reach, allowing the university's expertise to be shared with home gardeners across the nation and around the world. In addition to serving South Carolinians, the HGIC's website is commonly frequented by users in metro areas such as Atlanta, Chicago, Dallas, Charlotte, and New York. The HGIC's newsletter, which is delivered each Friday morning and features the Center's most recent web content, also has a global reach. The newsletter has more than 14,000 subscribers, featuring countries from all over the world, including Australia, Asia (South Korea, Singapore, Japan, Iran, Pakistan), Europe (Netherlands, France, Finland Spain, UK, Switzerland, Ireland, Austria, Italy), The Americas (Mexico, Peru, Canada, Chile, Honduras), and Africa (Zambia, Morocco).

HGIC delivers unbiased, research-based information to South Carolina residents via their website (which received more than six million page views in 2023) and by phone or email (answering nearly 18,000 calls and emails in 2023). Notably, these figures indicate calls and emails where Extension Agents actually gave answers to questions – the amount of calls handled and emails received was far greater. The number of page views makes the HGIC website the most visited across the entire Clemson.edu domain.

Gardens are an important element of healthy communities and are an increasingly common activity to encourage everything from community beautification to food security. Although a growing number of home gardeners are interested in developing new or existing gardens, many say that there are challenges related to caring for their plants. The Clemson team is helping South Carolinians maximize the impacts from their expenditures on gardening, landscaping and more – providing actionable information on what to grow, when to plant, best conditions for growth, management of pests and plant diseases, plant nutrition and soil health, healthy harvesting, food handling, and food preparation and much more.

Key Impacts:

- Empowered and informed homeowners with more knowledge of gardening and agriculture.
- Improved aesthetic of communities as a result of more home and community gardens.
- Healthier individuals.

Program Area: Healthy Communities

FoodShare Program Example

A barrier to healthy lifestyles in rural communities is food insecurity. There is a need to help ensure that there is access to fresh, healthy food options for communities across the state. To that end, CAFLS works with local organizations across the state to promote food security.

The FoodShare Program partners Clemson Extension Rural Health and Nutrition Agents with local organizations to offer fresh foods to residents in under-resourced communities. For example, the FoodShare Program, in partnership with Greenville-based community organization Feed & Seed, offers an affordable Fresh Food Box program that makes it easier for families to eat healthy on a daily basis.[60] Boxes are filled with a variety of fruits and vegetables, and available for pick-up twice monthly at various locations. Boxes can be purchased for $20 each with credit/debit or $5 each with SNAP/EBT.

Key Impacts:

- Improved food security.
- Healthier communities.
- Improved likelihood of eating fruits and vegetables.

60 https://feedandseedsc.com/foodshare/

Program Area: Healthy Communities

Example: Food2Market

In 2012, a grassroots group of home bakers in South Carolina worked with the state's legislature to begin a series of collaborative policy conversations around home-based food production, otherwise known as "cottage foods." Over the next decade, the state worked to expand home-based food production and allow for products to be sold online and in retail markets. This bill became effective in May 2022. Although food entrepreneurship is undoubtedly important, it is also necessary that these home-based food operations prepare food that is not hazardous to the customers they're serving. CAFLS plays a valuable role in communicating the policies behind home-based food production, as well as working with food entrepreneurs to ensure they are compliant with regulations, food safety protocols, and food business best practices.

Food2Market is a Clemson Cooperative Extension program focused on helping food-related entrepreneurs with the various food safety regulations that are necessary to prepare food products for sale. Through this program, Clemson faculty and staff offer their extensive knowledge in food safety, food processing and packaging, and the federal and state regulations that are necessary in South Carolina to produce and market products for sale. The food safety workshop for food entrepreneurs is delivered in two segments: an 8-week online study and a 1-day, in-person workshop in Columbia.

The program offers numerous educational services for food entrepreneurs by guiding them through the appropriate steps needed to begin the production of a food product. CAFLS faculty and staff assist entrepreneurs with product compliance in all local, state, and federal regulations. They also provide food entrepreneurs with assistance in food safety (e.g., product testing, and product packaging), and offer a variety of educational opportunities for food entrepreneurs to assist with a business startup as well as continuing education to help make their product(s) successful. Importantly, the program also helps provide connections to helpful governmental, professional, and educational resources to assist entrepreneurs.

Key Impacts:

- Growth in food businesses and entrepreneurship.
- More successful food businesses and entrepreneurs.
- More connections made to assist food entrepreneurs.

Program Area: Healthy Communities

Sonoco FRESH Example

Recycling, reducing litter, conserving resources, minimizing pollution, and working toward zero waste are crucial elements of maintaining a beautiful campus community. The FRESH initiative is engaged in encouraging recycling and environmentally-friendly behaviors on Clemson's campus through the Fresh Zero Waste Creative Inquiry team, along with other student-led organizations. The FRESH initiative drives advancements in sustainability across the school's campus by holistically evaluating the circular food value chain and empowering cross-disciplinary voices to identify challenges in the food value chain and develop bottom-up approaches to reducing waste. One area where these efforts have been particularly impactful is in encouraging recycling on campus.

As a result of student-led efforts, Clemson has received national recognition for its recycling programs. Four times in the last decade—in 2014, 2016, 2018, and 2021—it won the Gameday Recycling Challenge for recycling more waste per capita than any other university. In 2021, for example, in a game against UConn, Clemson recycled and composted more than 43,000 pounds of bottles, cans, glass, cardboard, paper and food waste, amounting to more than half a pound per game attendee.

Clemson is also nationally recognized for its own mechanical and organics recycling capabilities, which is relatively unique for a university. In 2014, the University collected 215,000 pounds of plastic bottles, aluminum cans, and glass—but by 2018, this number had more than doubled to 460,000 pounds-plus of recyclable materials.

These efforts to encourage recycling and a healthy campus community are critical components of the FRESH initiative, which is engaging students in relevant research projects through the Creative Inquiry program. As a combination of engaged learning and undergraduate research, these team-based investigations explore various issues pertaining to the food value chain. The initiative also includes an array of research projects organized around the food value chain. This includes faculty researchers focused on agricultural production, handling and processing, packaging, transportation and distribution, wholesale and retail, consumer attitudes and behaviors, and recycling, recover, and reuse.

Seeded by philanthropic support from the Sonoco Foundation, the FRESH initiative was established to involve academic expertise across every step of the food value chain. The initiative focuses on unifying various departments across the university and working closely with external partners. The primary activities include faculty-sponsored research, student projects, and the FRESH annual Food, Packaging and Sustainability Summit.

Key Impacts:

Research from the South Carolina Department of Health and Environmental Controls indicated that each year recycling generates $13.6 billion in economic impacts, roughly $2.7 billion in labor income, and more than $551 million in total state and local taxes.[61] **If Sonoco FRESH activities related to encouraging recycling and reuse positively impacted just 1 percent of this activity, an estimated $13.6 million in total economic impacts would be generated for the State of South Carolina.**

Other impacts include:

- Improved awareness of recycling's importance.
- Broader recognition for university activities.
- Student participation in food systems research projects.
- Improved coordination of university expertise.

61 https://issuu.com/sccommerce123/docs/2023_recycling_economic_impact_study

CONSERVING THE ENVIRONMENT

Description

The landscape of South Carolina has been actively shaped by human activity. Both economic and social activities impact the environment through natural resource consumption, construction of infrastructure and buildings, waste outputs, and agricultural and forest land use. Roads and urban development make a checkerboard of the landscape, with their hard surfaces and drainage systems restructuring natural water flow and human activities consuming natural resources. Human use and reshaping of the landscape generate profound impacts on ecosystems and biodiversity, natural resource availability, landscape aesthetics, water quality, water flows, and shorelines. Global movement of goods and people has resulted in the redistribution of natural organisms and introduced invasive species that can dramatically impact native species.

Stewardship of the environment and natural resource conservation is required at a local level. People can be concerned and engaged in global issues, but it is at home, at work, in their communities and home states where daily impacts and improvements can be achieved. With a population of approximately 5.3 million people, major population centers, and extensive industrial, agricultural, forestry, and other commercial activity, the landscape, ecology, and natural resources of South Carolina are under pressure daily.

The Need for CAFLS to Conserve the Environment

Long-term, the one permanent asset that South Carolina has is the land it occupies. Covering 20.5 million acres, South Carolina comprises 12.9 million acres of forestland, 4.8 million acres of farmland, and 2,876 miles of tidal shoreline. To better protect and sustain this invaluable asset, work is required to understand the ways in which human activities impact the environment, find better ways to accomplish those activities with more limited impacts, and mitigate the adverse effects that have already occurred. Understanding and paying attention to environmental impacts and natural resource sustainability increases the ability to stop land degradation, depletion of resources, loss of ecosystem services, and generation of pollutants that impact health and quality of life.

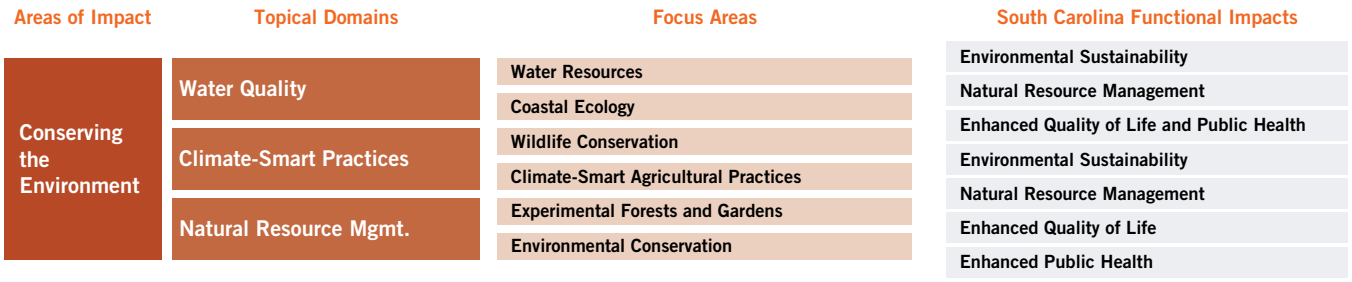
CAFLS is a crucial hub for research, extension, regulation, and education in environmental science and natural resource management. CAFLS is able to carry forward the knowledge, best practice innovations, and recommendations emanating from research in environmental stewardship and natural resource conservation to individuals and organizations across South Carolina who can put this information to work to conserve the environment.

It should also be noted that Cooperative Extension professionals working in communities across the state observe or have presented to them challenges occurring relating to the environment and natural resources that need solutions. Cooperative Extension relays these needs to CAFLS's research and regulatory community to help address these challenges. Cooperative Extension effectively works as the key interface between the knowledge contained and produced within the academic research community and public and private landowners, resource managers, and private citizens who need fact-based information and expertise to sustain resources and be good environmental stewards.

How CAFLS Generates Positive Impacts by Conserving the Environment

In its efforts to promote environmental stewardship and natural resource conservation, CAFLS works across a wide variety of disciplines and thematic areas. This work powers a variety of positive functional impacts (results) for South Carolina and its citizens. Figure 14 captures the primary focus areas for CAFLS' work in conserving the environment and the broad categorizations of functional impacts that result from work across these areas.

Figure 14: CAFLS Functional Impact Themes in Conserving the Environment



Source: TEConomy Partners, LLC.

Functional Impact Examples: CAFLS Work to Conserve the Environment

As previously noted, it is not feasible to highlight every activity undertaken by CAFLS in its efforts to help conserve the environment. Rather than attempting to produce an inventory or list of each and every activity, TEConomy in this (and other functional impact discussion areas) draws upon program examples to illustrate the types and range of important functional impacts generated by CAFLS's programming. The following categories help to illustrate the kind of high-impact work taking place.

Program Area: Water Quality and Sustainability

Water Resource Examples

South Carolina is blessed with abundant freshwater resources and receives an average of 48 inches of water a year from precipitation. These water resources are available to support energy production, agriculture, industrial and domestic uses, as well as meet natural ecosystem demands across the state. Despite robust water resources, conserving the availability and quality of freshwater remains a priority because the state is experiencing large-scale population growth. Other trends and challenges also impact water availability. For example, saltwater intrusion into freshwater aquifers is becoming an issue in some coastal areas, and some significant drought events have occurred—notably in 2008, which was a record drought for the state, and in 2011 when drought reached a "severe" level across multiple South Carolina counties. South Carolina water resource managers also have to consider the rights and needs of neighboring states because three out of the state's four river basins are shared with North Carolina and Georgia.

CAFLS serves a multifaceted role in informing the efficient use of water resources, assuring the use of best practices in water management, and training multiple stakeholders in water conservation and water quality. Work performed by CAFLS is diverse in service to the state and its professional water resource managers, farmers, foresters, developers, and homeowners. Examples of this diverse programing by CAFLS include:

- Carolina Clear – a focused program that partners with local governments and education providers to facilitate regional education consortiums across the state. The Carolina Clear program is particularly focused on educating stakeholders in the best practices of reducing stormwater runoff and associated pollutants.
- The Water Resources Team, which includes Extension specialists, associates, and agents delivering research-based solutions and educational programing in stream improvement, shoreline protection, and septic tank maintenance and management.
- The Clemson Center Pivot Irrigation Test (CPIT), whereby CAFLS personnel work with farmers using center pivot irrigation to maximize the water use efficiency of their irrigation systems using measures of irrigation uniformity and system management procedures to maximize crop productivity while avoiding water waste and overuse.
- The South Carolina Water Resources Center (SCWRC), operated by CAFLS, is one of 54 institutes established by the U.S. Congress. Integrating expertise across a range of disciplines, the SCWRC is research focused, addressing needs and issues in water management, water policy, water quality and pollution issues; techniques for surveying and monitoring water resources; and approaches to managing water resources under population growth pressures.
- The James C. Kennedy Waterfowl and Wetlands Conservation Center, located at the Belle W. Baruch Institute of Coastal Ecology and Forest Science in Georgetown, is a research and education center focused on the management and protection of wetlands and the wildlife that inhabit wetland ecosystems.

By working to deliver the programs highlighted above, CAFLS is contributing to the economic activity of a state economy that depends on water—supporting agricultural production, energy generation, industrial water uses, and more. It is also contributing to sustaining the state's natural resource and outdoor recreation economy. A study performed by the South Carolina Department of Natural Resources[62] concluded that "The overall effect, or total economic contribution, of fishing, hunting, and wildlife viewing to South Carolina is $2.74 billion and 31,958

62 "The Economic Contribution of Natural Resources to South Carolina's Economy." Accessed at: https://www.dnr.sc.gov/economic/index.html

jobs," which are activities supported by the state's 1.3 million acres of surface water and 11,000 miles of rivers and streams. **Just 1 percent of the impacts sustained through the diverse work of CAFLS in water resources would equate to a $27.4 million economic impact and 320 jobs supported in South Carolina.**

CAFLS also operates an important series of professional certification and homeowner-oriented "master" programs that provide education and training in multiple water resource areas. For professionals, the training and certification provided by Cooperative Extension is crucial to their work and to engendering demand for their services. Certification and training programs include:

- Certified Erosion Prevention and Sediment Control Inspector (CEPSCI) – a program required by the SC DOT that educates professionals on the proper installation, maintenance, and inspection of erosion prevention and sediment control measures at all construction sites in the state. Each year, 1,800 inspectors are certified, and CEPSCI-certified inspectors account for approximately $85 million in salaries.
- Certified Stormwater Plan Reviewer – a program that "educates personnel on the proper design and review of stormwater and sediment control plans for development sites in order to meet regulatory and environmental requirements."[63]
- Master Pond Manager – a program providing a valuable professional certification for contractors and other professionals working with ponds for recreational and stormwater management purposes. The program also has a track for homeowners and others who wish to better manage ponds and associated resources.
- Master Rain Gardener – a program that similarly provides valuable professional certification for designers, contractors, and other professionals developing water-efficient rain gardens. The program also has a track for homeowners.

A common impetus across CAFLS work in water resources is recognition that the state is experiencing high growth and needs to plan for the future. Hard surfaces associated with development need to be appropriately planned, and the growth of industrial and farming uses for water needs to be well-managed. By being proactive, CAFLS is helping the state, and all its stakeholders, avoid limits to consumption and plan appropriate resource use and storage management, given a typical rainfall budget.

Key Impacts:

- Major contributions to sustaining economic activity and natural ecosystems associated with, and dependent upon, water resources statewide.
- Education for stakeholders and professionals in water resource management and the prevention of negative environmental externalities related to stormwater runoff and other issues.

63 https://www.clemson.edu/extension/cspr/index.html

Program Area: Climate-Smart Practices

Climate-Smart Grown in SC Example

In the Fall of 2022, the USDA awarded Clemson University, in partnership with the State of South Carolina, a $70 million grant to provide incentives to South Carolina farmers to enable them to implement selected climate-smart production practices. The pilot program seeks to build and expand market opportunities for commodities produced using climate-smart practices. The grant:

- Provides assistance to producers to implement climate-smart production practices on working lands.
- Pilots innovative and cost-effective methods for quantification, monitoring, reporting and verification of greenhouse gas benefits.
- Develops markets and promotes the resulting climate-smart commodities.

The goal of the pilot project is to increase the acreage and number of farmers using cover crops, prescribed grazing, reduced tillage, and other conservation practices that will not only reduce greenhouse gases but also improve water quality, biodiversity, and increase the productivity and well-being of surrounding communities.

Over the five-year grant period, CAFLS will provide ongoing technical and financial support to farmers, including small-scale and underserved producers, to facilitate the adoption of climate-smart practices. This project focuses on four commodities:

- Peanuts
- Leafy greens
- Forages for beef cattle, and
- Forest products.

A support team of field associates, researchers, and technicians are working with participants to implement climate-smart practices and monitor changes in carbon and other greenhouse gases associated with these practices. A market development team is also working with producers to explore new markets for the resulting climate-smart commodities.

Key Impacts:

- Major contributions to advancing climate-smart agricultural and forestry practices.
- Education for stakeholders and professionals in climate-smart management techniques.
- Development of new climate-smart products.

Program Area: Natural Resource Management

Clemson Experimental Forest Example

As previously noted, the Clemson Experimental Forest, a 17,500-acre forest surrounding Clemson University, is a natural resource laboratory dedicated to education, research, and demonstration in order to better understand and manage forest resources for the benefit of society. Although significant research is undertaken related to commercial forest management and the downstream value chain, additional research focuses on environmental stewardship. Comprising more than 90 species of trees, bountiful and diverse wildlife, and numerous types of flora and fauna, the Clemson Experimental Forest supports biodiversity maintenance and conservation. With its proximity to the main campus, hundreds of research projects are annually conducted utilizing the forest. From analyzing how forest growth sequesters and stores carbon, to understanding how forest ecosystems produce and conserve soil and stabilize stream flows and water runoff (preventing land degradation and desertification), to the study of plant and wildlife species, the Experimental Forest is a one-of-a-kind laboratory for understanding the ecosystem services provided by forests.

The trail system provides miles of trails for public recreation use, as well as for teaching, research, and extension education for natural resource management. The trail system allows for the study and improvement in construction design and maintenance of recreational use. It also allows for the evaluation of user attitudes and study of the impacts of recreation on the ecosystem.

The Clemson Experimental Forest's close proximity to Clemson University allows the forest to serve as an outdoor laboratory for many academic disciplines. It also provides an opportunity for volunteer service to be completed, which fosters community involvement and the development of a land ethic. Close to 1,000 people came out to support the inaugural Forest Fest in the Clemson Experimental Forest. At the fun and family-friendly event, people were able to "choose their own adventure" from a variety of activities, games, demonstrations and more. The primary goal of this event is to bring people together to better understand natural resource management.

Key Impacts:

- Improved understanding of nature and the forest ecosystem.
- Access to unrestricted natural resource.

Program Area: Natural Resource Management

South Carolina Botanical Garden Example

The South Carolina Botanical Garden (SCBG) is a 295-acre sanctuary for diversity that attempts to re-engage South Carolinians with nature and the living ecosystem surrounding the University. The Garden serves as a holistically managed landscape that functions as an interdisciplinary resource focusing on teaching, research, and outreach to raise awareness and understanding of plants, animals, minerals, and culture. SCBG's stated goal is to become a regionally recognized demonstration site for best practices in horticulture and conservation through natural resource stewardship, sustainable practices, and visitor engagement.

The Garden is open 365 days a year and does not charge for access to the grounds. In 2022, the Garden offered 67 educational programs, with 1,412 educational program attendees. Interns and students worked a total of 2,480 hours and, along with volunteers, donated 4,617 hours of community service. This work translated directly into 904 pounds of fresh produce donated to Clemson Community Cares over the course of the year.

In 2022, the Garden saw 1,047 garden tour attendees. In total, that same year, the Botanical Garden had more than 350,000 visitors, sold more than 9,000 plants, and obtained $216,760 in donations.

The SCBG actively contributes to the ecosystem by promoting native southeastern plants and takes tangible measures to combat invasive species. The Botanical Garden is also affiliated with other natural resource-focused entities at Clemson, including the Clemson Experimental Forest, the Bob Campbell Geology Museum, the Home and Garden Information Center, and the Clemson University Herbarium.

Key Impacts:

- Improved understanding of nature.
- Donations contributed to the community.
- Access to unrestricted natural resources.

Program Area: Natural Resource Management

Master Naturalist Program Example

The Master Gardener program has established an excellent track record in South Carolina for leveraging the power of volunteers, combined with the knowledge of the university, to provide robust statewide subject-matter expertise and responsiveness to needs. This same model has been adapted to form the Master Naturalist program, which educates and trains adult volunteers to provide evidence-based natural resource information and best practices to the public and other land stewards to assist with conservation restoration activities in their community and across the assets they manage. Master Naturalists are available to provide a range of important services across the state:

- Assisting in the management of local natural areas.
- Completing natural resource–related office work with special interest groups or with not-for-profit agencies
- Teaching adults and children about natural areas.
- Giving demonstrations and presentations to local groups.
- Serving as a liaison between natural resource agencies and the public.
- Serving as a resource person to groups in need of natural resource assistance.

Since the program's inception in 2000, more than 2,100 South Carolinians have been certified as Master Naturalists and are now donating their time and knowledge across the state.[64]

Key Impacts:

- Enhanced South Carolina environmental stewardship and natural resource conservation.
- Improved communities and quality of life.

64 Guynn, S. T., Blake, J. H., Nemire, N., & Bible, J. (2024). South Carolina Master Naturalist Program Evaluation: A Mixed Methods Approach. *The Journal of Extension*, 62(1), Article 12. https://doi.org/10.34068/joe.62.01.12

Program Area: Natural Resource Management

Bob Campbell Geology Museum Example

Geological and paleontological history are important parts of the Clemson story. Long before he lent his name to the university, Thomas Green Clemson was a geologist who studied in Paris, worked in mines across the United States, and named a variety of minerals called Seybertite.[65] Meanwhile, the first vertebrate fossils recorded from North America were found in South Carolina. Clemson has been home to a repository of rocks and minerals within its Geology Department for decades until 1990, when the university's collection began to require larger facilities. In September 1998, the Bob Campbell Geology Museum opened to the public on the grounds of the South Carolina Botanical Gardens.

The Bob Campbell Geology Museum (BCGM) is home to more than 10,000 minerals, rocks, and fossils from locations in South Carolina and across the world. Featuring a wide variety of geological and paleontological exhibits, this museum is an invaluable resource for anyone interested in exploring Earth's history, including students, teachers, and researchers. Notable exhibits include a skeleton of a saber-tooth tiger, the skull of a T-Rex, and some of the Southeast's largest collections of gemstones and fluorescent minerals.

The museum offers various services and resources to encourage investigation in natural resources conservation. For example, the museum provides free-of-charge specimen identifications of rocks, minerals and fossils collected in the state, or by residents of the state. The museum also offers guided museum tours, special events, and other educational programs.

Key Impacts:

- Improved understanding of geology and paleontology.
- Resources available for science teachers and researchers.
- Conservation of natural resources.

65 https://www.clemson.edu/public/geomuseum/sc_geology.html

PROTECTING AGRICULTURAL HEALTH

Description

Pesticides and other agricultural chemicals are a critical and necessary part of the state's agricultural industry. However, if these substances are not used correctly, they can be risky for health and the environment. As a response to a wide range of historical, economic, environmental, and social factors that have led to their development, regulatory services that monitor the usage of agricultural chemicals are now a critical part of the global industry. Across the State of South Carolina, CAFLS plays a critical role through its regulatory services in conserving public health, building trust with consumers, promoting sustainable agricultural practices, and helping local businesses avoid legal challenges.

Public health is perhaps the most important reason for agricultural regulation. It is important to safeguard the public against the improper use of pesticides and other agricultural chemicals. This can help ensure that there are minimal risks to humans as a result of the unplanned spread of potential contaminants.

Another valuable role for regulatory services is promoting sustainable agricultural practices. Quality assurance in agriculture has a deep connection to environmental health: there are many potential risks associated with the inappropriate usage of chemicals such as pesticides, rodenticides, and fertilizers. By placing appropriate monitors on the usage of these necessary but impactful products, the state's regulatory services agency can serve as both a regulatory monitor and a provider of quality assurance.

Building trust with producers and with consumers is another important element of regulatory services. Regulations offer producers clear guidelines and requirements, and a regulatory service function can help them navigate complex legal frameworks. This navigation can also help businesses and producers avoid costly penalties or lawsuits. By providing transparency and accountability in the industry, regulatory services can help reassure both producers and consumers that the products they are purchasing are safe and accurately labeled. Upholding standards around regulations helps foster trust between producers, consumers, and regulatory bodies.

The Need for CAFLS to Protect Agricultural Health

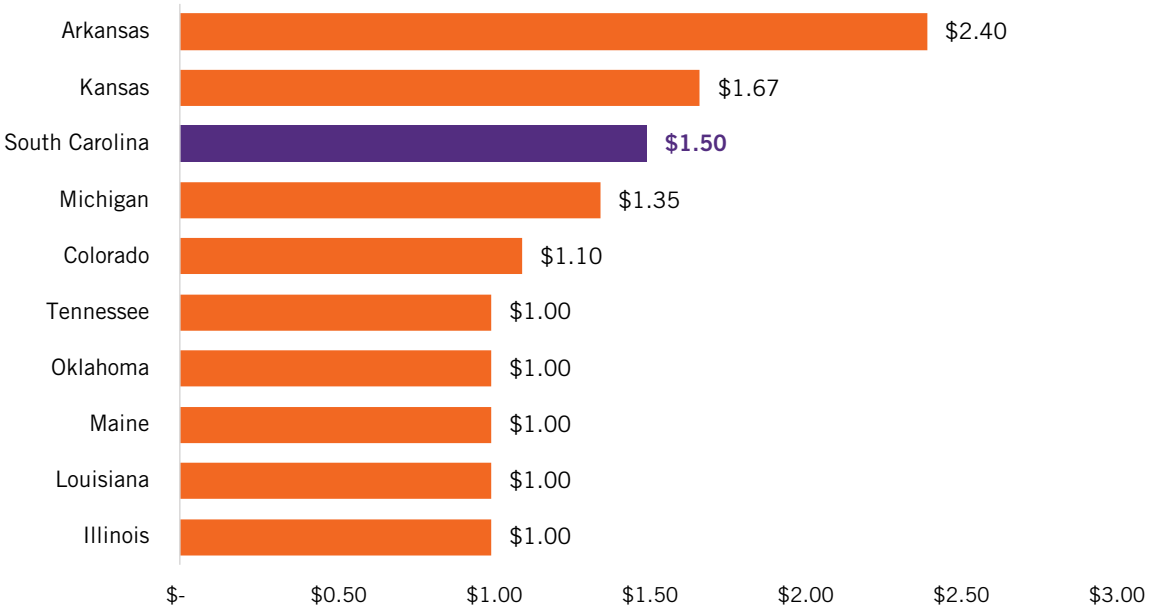
Support for the state's agricultural sector has been an essential role for Clemson for as long as the university has existed, and regulatory functions have long been a part of this task. As noted by university historians: "Even before Clemson's educational program had begun, the institution was working to meet the agricultural needs of the state, with an establishment of an agricultural experiment station and fertilizer inspection service."[66]

66 http://www.nationalregister.sc.gov/MPS/MPS001.pdf

For more than 130 years, regulatory functions have been part of the university's operations. As noted by an 1893 article in the Greenville Mountaineer, "the Clemson College will take the place of the State Agricultural Department, recently operated at Columbia. It will receive the income from the privilege tax of twenty-five cents a ton on fertilizer, the Hatch Fund, half of the Morrill Fund and the Land Script Fund from the national government, in addition to direct annual appropriation from the state."[67]

Today, the fertilizer tonnage fee remains an important part of supporting CAFLS and its services to the state's agricultural industry. South Carolina has a comparatively high tonnage fee for fertilizer inspection—$1.50 per ton, which ranks third among all states (Figure 15).[68] This fee allows CAFLS to fund laboratory services and provide additional benefits to the state's agriculture industry. Having their own physical labs to service the state's agricultural industry is a critical component of CAFLS' efforts. If the state had to rely on external testing sources, they would not be nearly as effective. In addition, the high tonnage fee enables CAFLS to better serve the public through increased staffing capacity. The state can sample and capture more information than other states. While other states are spread thin with their testing, CAFLS is able to capture much more collective intelligence for the betterment of the state.

Figure 15: States with Largest Farm Fertilizer Inspection Fees



Source: The Fertilizer Institute

With a specific focus on analytical testing, Clemson's Agricultural Services Lab offers an array of testing services for field and truck crops, nursery growers, home gardens, and turf grasses. The lab provides testing on soils, feed and forage, plant tissues, irrigation water, animal waste, and compost. Any of these services are open to any individual, and the lab also partners directly with Clemson Cooperative Extension and analyzes samples

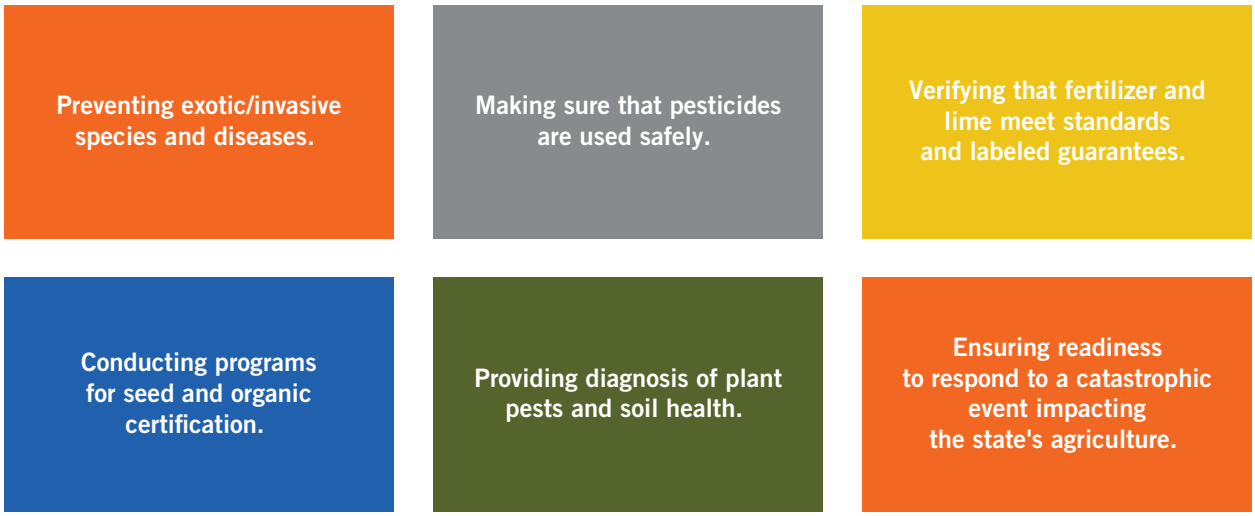
67 http://www.nationalregister.sc.gov/MPS/MPS001.pdf
68 https://www.fertton.com/state-fertilizer-inspection-fees

gathered by agents and sent for testing. The tonnage fee supports the state's lab, which allows for the cost of soil sampling to be less expensive. More people are able to send more samples for a smaller price than in other states. This saves consumers money and helps provide a valuable service for the state. Notably, CAFLS's Experiment Stations also receive a small share from the tonnage fee to support soil health research. CAFLS has used this in the past to support graduate students who are researching soil health.

Since the lab began in 1938, the bulk of its testing has been soil samples. This service is very important to farmers before planting season so they know what types of amendments (fertilizers) they might need to get the optimum crop yield. The laboratory analyzes approximately 50,000 soil samples annually for up to 20,000 individual clients across the state.

In addition to the efforts of Clemson's Agricultural Services Lab, the Regulatory Services unit within CAFLS also works to help maintain the quality of the state's agricultural and natural resources through a variety of means. As a result of state regulations, CAFLS has specific authority over crop pests and boll weevil eradication, while other statutory authority is given to CAFLS related to fertilizer, pesticide, and chemical regulation. Through these efforts, the state benefits in a variety of ways (Figure 16).

Figure 16: Functional Impacts to South Carolina from Regulatory Services



Source: TEConomy Partners analysis of CAFLS' Regulatory Services Activities

Preventing exotic/invasive species and diseases: CAFLS plays a significant role in protecting the state's native plants and fauna from threats from exotic/invasive species and diseases. Examples of invasive species being monitored and prevented by the work of CAFLS include insects such as the yellow-legged hornet, Asian long-horned beetle, and spotted lanternfly and invasive plants like ornamental cotton, cogongrass, Bradford pear, and *Elaeagnus umbellata* (also known as Autumn olive or Japanese silverberry).

The primary ways CAFLS prevents exotic and invasive species and diseases is through inspection programs (to prevent invasion from beginning) and through state quarantines (to manage spread). Nursery and dealer

inspections are the backbone of this service area, as the highest risk pathway for invasive pests is through the movement of nursery stocks. This movement is the primary reason why the state's regulatory functions around inspections were created. The program allows CAFLS to understand how all nurseries in the state are working and what their risks might be. CAFLS also can inspect periodically and make sure that nurseries are averting risk.

Ensuring that pesticides are used safely: Pesticide regulation is a critical function of CAFLS' regulatory services program. Through the Department of Pesticide Regulation, CAFLS helps to provide certification and licensing for pesticide use to individuals, professionals, and businesses. CAFLS' team of 14 field investigators and 2 program managers helps complete routine and for-cause inspections on pesticide use (and misuse) throughout the state. The Department works cooperatively with the U.S. Environmental Protection Agency (EPA) to ensure pesticides are used in a lawful manner that minimizes health risks. The Department also partners with other state and federal entities like the South Carolina Department of Agriculture to provide regulation through education.

Verifying that fertilizer and lime meet standards and labeled guarantees: CAFLS is home to six full-time inspectors who are out every day and pulling inspections to ensure that the state's producers are receiving fertilizer and lime that meet their labeled standards and guarantees. Approximately 1,000 fertilizer and lime samples were analyzed by Clemson's fertilizer lab this year. Through this lab, university researchers analyze based on the guarantee, and if it does not meet these standards, they issue large fines to ensure industry integrity and protect consumers. CAFLS does not typically identify many problems, but when there are issues with mislabeling, they are often able to work with companies on these issues. CAFLS approves up to 7,000 labels for fertilizer and lime per year.

Conducting programs for seed and organic certification: Although seed certification services are not a regulatory program, this function fits into their line of work as it helps sustain the state's agricultural sector. The biggest program within seed certification is related to turfgrass, which is treated similarly to other crops but is a seed. CAFLS checks three times per year to ensure that turfgrass seeds are free from contaminants and that they are appropriately labeled. This helps to protect consumers and make sure they are receiving what they are paying for. Other certification programs include the Solar Pollinator Certification and the NAISMA Weed Free Forage program for those who are purchasing hay from western states.

Providing diagnosis of plant pests and soil health: CAFLS operates various laboratories and clinics to support producers in diagnosing issues related to plant pests and soil health. The Agricultural Service Laboratory offers considerable soil sampling and testing services to assist producers in making informed management decisions around the application of fertilizers and other treatments. The Plant & Pest Diagnostic Clinic is an interdisciplinary program that provides diagnoses and management recommendations for plant and turf problems. The Clinic diagnoses diseases of all plant types, and if any insects or cultural problems are found, these are also investigated. Laboratories within this clinic include the Commercial Turfgrass Clinic, the Molecular Plant Pathogen Detection Lab, and the Nematode Assay Lab.

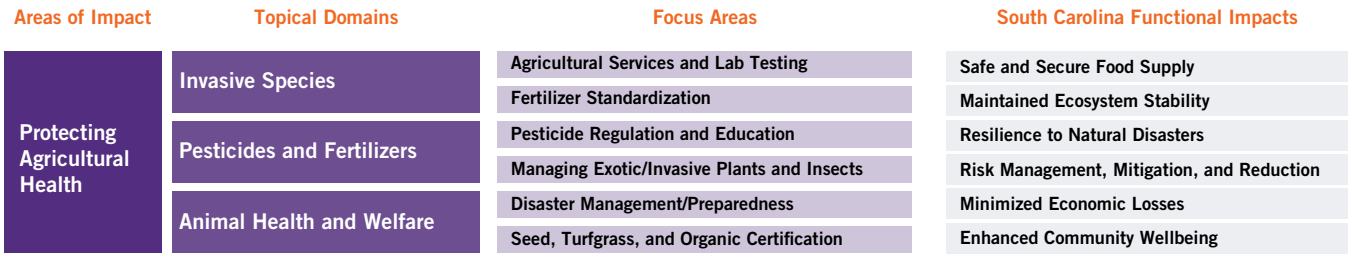
Ensuring readiness to respond to a catastrophic event impacting the state's agriculture: Among CAFLS's many responsibilities is helping to coordinate responses to catastrophic events such as hurricanes, flooding, or nuclear

incidents. When confronted with emergency situations, South Carolina turns to CAFLS for its ability to lead, organize, and implement coordinated responses. This is especially important in assisting the state's agricultural sector during challenging times.

How CAFLS Generates Positive Impacts by Protecting Agricultural Health

In its efforts to protect agricultural health, CAFLS works across various disciplines and thematic areas. This work powers a variety of positive functional impacts (results) for South Carolina and its citizens. Figure 17 captures the primary focus areas for CAFLS's work in protecting agricultural health and the broad categorizations of functional impacts that result from work across these areas.

Figure 17: CAFLS Functional Impact Themes in Protecting Agricultural Health



Source: TEConomy Partners, LLC.

Functional Impact Examples: Protecting Agricultural Health

Having a regulatory body associated with a university has many benefits. First and foremost is the sense of trust associated with CAFLS and an understanding that regulations are coming from a well-intentioned place.

This sense of trust is driven, in part, by the close relationship between Regulatory Services and Cooperative Extension that leads to multiple benefits for the state. By being close to the researchers and regulators, Cooperative Extension can support regulation through education. With a focus on educating first, CAFLS is able to avoid some of the challenges that other states face in enforcing regulations.

As the following examples show, CAFLS' efforts to protect agricultural health have led to numerous functional impacts for the State of South Carolina.

Program Area: Exotic/Invasive Species Prevention

Preventing the Spread of Invasive Plants Example

Invasive plant species can be extremely harmful to natural ecosystems and the industries that depend on natural resources to support the state's economy. As an invasive perennial grass, cogon grass is considered one of the world's worst weeds. Cogon grass is especially prominent in open areas like golf courses, roadsides, pastures, and natural areas where it displaces native plant species. When it spreads into forests, Cogon grass infestations can reduce pine survival and growth, and in fire situations, may result in complete mortality of overstory trees due to flammable oils in the grass blades raising the intensity and severity of prescribed burns. Over time cogon grass may significantly impact management and productivity of pines on infested sites. Cogon grass control measures can be very costly, so it is important to identify them as soon as possible.

Clemson Cooperative Extension Agents educate residents across the state about the threats related to cogon grass and teach them to identify it on their property or at nurseries (where it can sometimes be sold under the common name Japanese blood grass). By preventing the spread of cogon grass, CAFLS is able to avoid potential costs to the industry. In some states, such as Florida, cogon grass has spread to more than a million acres. However, CAFLS's successful regulatory and education efforts have been able to control Cogon grass better than in nearby states. South Carolina is home to fewer than 5,000 acres of Cogon grass and its spread is under control.

As another example of the university's approach to managing and preventing the spread of invasive species, Clemson Cooperative Extension and the South Carolina Forestry Commission partner on the Bradford Pear Bounty. Bradford pears are exotic to the United States but are widespread throughout the state. This program gives homeowners the option to replace their Bradford pear trees with a native tree in order to reduce the number of seeds that can ultimately grow into Callery pears, one of the worst invasive species in the Southeast. This program also helps diversify the state's urban landscapes. Property owners are eligible to exchange up to five of their Bradford pear trees for an equal number of healthy, native, young replacement trees—all at no cost.

Key Impacts:

Although it is difficult to assign an economic impact figure to these control measures, an economic input-output analysis by the University of Florida revealed that Cogon grass control costs resulted in total economic losses of $35 million annually to the forestry industry and related business sectors throughout Florida.[69] To date, **CAFLS' work to reduce Cogon grass spread has been successful in stemming large-scale losses such as those seen in Florida, whose agricultural sector is roughly 2.6 times the size of South Carolina's. Based on a comparison of the two state's agricultural economies, it could be estimated that CAFLS's efforts in Cogon grass prevention could save the state from $13.2 million annually in total economic losses such as those seen in nearby states.**

Other key impacts include:

- Reduced spread of native and invasive species.
- Better protected native ecosystems.
- Improved education on identification and eradication methods.
- Fewer lost crops related to quarantine or other control efforts.

69 Divate, N., Solis, D., Thomas, M., Alvarez, S., & Harding, D. (2017). An Economic Analysis of the Impact of Cogongrass among Nonindustrial Private Forest Landowners in Florida. *Forest Science*, 63. 201–208. https://doi.org/10.5849/forsci.16-079.

Program Area: Exotic/Invasive Species Prevention

Managing Invasive Insects Example

Invasive and exotic species can pose great threats to South Carolina's natural ecosystems. Invasive insect species—otherwise known as pests—can be especially damaging to the industries reliant on natural resources, such as agriculture, forestry, and horticulture. These pests can wreak havoc on ecosystems through a series of cascading consequences. As a result, it is critical to focus on both invasive species prevention, which is the most effective approach, as well as on invasive species management.

CAFLS' Plant Industry Team plays an important role in helping the state prevent and manage its exotic and invasive species. Before a pest can become established, CAFLS helps with monitoring and early detection to help catalyze a rapid response from the necessary stakeholders best suited to eradicate and control pest infestation. This is not a role limited to CAFLS, but instead one that requires awareness, participation, and support from stakeholders across South Carolina. Plant pest surveys are an important tool used by CAFLS to detect invasive species and ultimately protect the state from pest introductions. Three examples of exotic and invasive insects that South Carolina is managing through the help of CAFLS include the Asian longhorned beetle, the sweet potato weevil, and the emerald ash borer.

Asian Longhorned Beetle: Weakening and ultimately killing tree structures by tunnelling through them, this invasive insect can cause significant economic loses for forests and nurseries. Because there is no cure for a beetle infestation, the state's best approach to managing Asian longhorned beetles is to be vigilant through tracking, reporting, and managing. South Carolina first had a detection during the COVID-19 pandemic in the Charleston area; it is suspected that the beetle came through a boat at the city's port. CAFLS was able to successfully establish a quarantine, and the state is working collaboratively with USDA, which has funded seven positions at the University to focus on management and eradication.

Sweet Potato Weevil: This invasive insect can be disruptive to sweet potato production, and its spread can also be harmful to the marketability of crops produced from unaffected fields. For a long time, CAFLS has been successful at managing this pest. The eradication of the sweet potato weevil encouraged a large-scale processing facility to locate in Florence County, which is able to can sweet potatoes grown in the state. Currently the counties of Beaufort, Berkeley, Charleston, Colleton, Dorchester, and Jasper are under quarantine for the sweet potato weevil, as are the entire states of Florida and Georgia.

Emerald Ash Borer (EAB): First detected in Michigan in the early 2000's, this invasive insect is a forest-pest that can devastate the environment and lead to massive economic costs if not controlled. Each year since 2008, CAFLS has placed hundreds of traps across high-risk sites across the state (e.g., parks, lumber companies, nurseries, garden centers) to identify and ultimately control EAB spread. Unfortunately, EAB was found in the state in August 2017, and as of 2021 it is present in Pickens, Oconee, Anderson, Greenville, Spartanburg, and York Counties.[70] Today, CAFLS works with stakeholders across the state, as well as in Georgia and beyond, to constantly this invasive pest.

Key Impacts:

- Prevented spread of invasive pests.
- Improved surveillance and control measures to halt infestations.
- Better educated communities on early detection and eradication strategies.

70 https://hgic.clemson.edu/factsheet/emerald-ash-borer/

Program Area: Safe Pesticide Usage

Pesticide Regulation and Education Example

Pesticides play an invaluable role in controlling pests that can threaten crops and public health, and in doing so, they can help ensure food security and reduce potential economic losses from agricultural damage. However, pesticide usage cannot be performed with reckless abandon. Pesticide regulation and education are needed to mitigate the potential risks associated with pesticide usage, ensure the safe application practices, help protect the environment, and inform decision-makers and pesticide users on necessary approaches.

In order to ensure that pesticides are used in an appropriate, safe, and healthy way, CAFLS is responsible for regulating and educating the public. Notably, CAFLS is home to the Department of Pesticide Regulation (DPR), which is the state's lead agency responsible for regulating the distribution, sale, and usage of pesticides in the state. Beyond regulating pesticides, Clemson Cooperative Extension also plays an important role in educating pesticide users on proper application methods. The goal of the Clemson Cooperative Extension Pesticide Safety and Education Program (PSEP) is to provide pesticide information and training to pesticide applicators. As a result, this helps protect the environment and public health from the misuse of pesticides. Common pesticides with trainings offered include dicamba trainings (e.g., XtendiMax, Engenia, Tavium), as well as trainings for paraquat applicators.[71]

Key Impacts:

As a result of the information they receive from CAFLS testing and education, farmers benefit by saving money in not over-spraying pesticide applications. South Carolina farmers spent $146.1 million in 2022 on pesticides.[72] **If the work of CAFLS leads to a 1 percent reduction in the amount of pesticides purchased by producers, farmers in the state save, every year, $1.46 million.**

Other impacts related to this function include:

- Fewer health risks related to pesticide-exposure and other related illnesses.
- Improved and conserved ecosystems as a result of reduced pesticide runoff and contamination.
- More awareness on responsible pesticide usage.

71 https://www.clemson.edu/extension/pest-ed/index.html
72 https://data.ers.usda.gov/reports.aspx?ID=17834#P86334487a26f457f81c31494fdbfde85_2_150iT0R0x40

Program Area: Safe Pesticide Usage

Bobcat Guardian Program Example

Rodents and other pests can pose a significant challenge for residents and businesses, especially those in South Carolina's Sea Islands like Kiawah Island and Seabrook Island. In these locations, owners of high-priced coastal real estate looking to deter pests and rodents have become reliant on local pest control services. However, the use of second-generation anticoagulant rodenticides (SGAs) has led to severe consequences for local wildlife, particularly smaller predators and apex predators like bobcats.

Working with Clemson Cooperative Extension, the Towns of Seabrook Island and Kiawah Island have advocated for alternative rodent control methods in order to address the detrimental effects of SGAs on the local bobcat population. A primary focus has been educating the pest control industry about this issue. Because these locations are growing in population and demanding pest control services, there is not a desire to curtail this industry. However, there is a shared desire among many in the state to avoid further consequences to local wildlife, such as bobcats.

The initiation of the Bobcat Guardian Program by the Town of Seabrook Island aims to educate residents and businesses about the harmful effects of SGAs on local bobcats. The Bobcat Guardian Program empowers residents to speak with their own pest control operators about the importance of using alternative rodenticides. This includes citizen courses to understand Integrated Pest Management strategies and advocate for the use of less toxic chemicals such as Cholecalciferol and Bromethalin, as well as tamper-resistant bait stations to ensure safety for pets.

Several hundred residents have signed up to participate in this program, and roughly 30 pest control companies have agreed to use alternative methods as part of this program. By raising awareness and encouraging the adoption of alternative rodent control measures, the program seeks to mitigate bobcat deaths attributed to the ingestion of contaminated prey, ultimately fostering a healthier ecosystem on the islands.

Historically, the Sea Islands were home to a population of roughly 35 bobcats. However, the increased usage of harmful rodenticides led to this population dwindling to roughly 10 bobcats. In recent years, the population of bobcats has stabilized at roughly 20—a healthy number of the ecosystem. There have been no issues with bobcat mortality in recent years.

Key Impacts:

It is extremely difficult to place an economic value on a bobcat. An analysis by researchers with the conservation group Panthera estimates the economic impact of a bobcat at roughly $300,000.[73] This estimate is generated based on the expenditures of a group of wildlife photographers focused on bobcats. Notably, this figure represents a thousand-fold increase from the value of a bobcat's pelt ($300 at the time of study). Based on this estimate, it could be extrapolated that the conservation of 20 bobcats in the Sea Islands bobcats could have a potential economic impact of $6 million for the State of South Carolina ($300,000 per bobcat). Given the close relationships fostered by Clemson Cooperative Extension to help prevent bobcat mortality, it could be expected that the work of CAFLS was responsible for at least 10 percent of this impact. In turn, **this would result in more than $600,000 in estimated economic impacts delivered to the state due to bobcat conservation.**

Other key impacts related to this function include:

- Fewer issues with bobcat mortality in recent years.
- Healthier ecosystems on the islands.

73 https://link.springer.com/article/10.1007/s10531-017-1397-6?no-access=true

Program Area: Fertilizer Standardization

Fertilizer Regulation Example

In order to grow healthy crops, farmers need to ensure they have healthy soil. Fertilizer is an essential part of modern agriculture by helping add important nutrients like nitrogen, phosphorus, and potassium into soil mixtures, which helps with plant growth. Inspecting fertilizers is important to ensure they meet safety standards and contain the right balance of nutrients. This helps prevent potential harm to the environment and human health, while also maximizing their effectiveness and reducing waste.

Analyzing and regulating fertilizer to ensure that it is correctly labeled for nutrients and weight is an important part of maximizing plant growth and crop yields. In order to ensure that producers and other growers across South Carolina are receiving the quality agricultural chemicals they need, CAFLS conducts various regulatory and certification services related to fertilizer.

The Department of Fertilizer Regulatory and Certification Services (FRCS) is an amalgamation of several regulatory and nonregulatory programs. The most notable program is the Fertilizer Regulatory Program, which enforces Section 46-25-10 of the South Carolina Code of Laws pertaining to the manufacturing and selling of all commercial fertilizers in South Carolina. Through this program, any person or company desiring to become a distributor of a fertilizer, lime, or landplaster in South Carolina must apply for a permit. Furthermore, these materials are subject to a tonnage inspection fee if they are distributed in South Carolina. Each company guaranteeing commercial fertilizer offered for sale, sold, or distributed in South Carolina must be registered with the Department of FRCS.

Critically, through the work of Clemson's Agricultural Services Lab and its regulatory services agents, South Carolina farmers and growers can save money up front and not waste any unnecessary fertilizer based on information received in testing. This is important because expenditures on fertilizer, lime, and soil conditioners by South Carolina farmers have nearly doubled in recent years, growing 92 percent from $149.3 million in 2020 to $286.2 million in 2022.[74] As a result of this increase, producers are especially sensitive to the amount of wasted fertilizer that could come through overuse, improper labeling, or poor standards.

Key Impacts:

The activities of CAFLS help to reduce waste through regulatory and certification services related to fertilizers, as well as through inspection and analysis services. **If the work of CAFLS could lead to a 1 percent reduction in the amount of fertilizer, lime, and soil conditioners purchased by producers, this could account for cost savings of $2.86 million annually for producers in the state.**

Other key impacts related to this function include:

- Higher quality fertilizer for effective crop nutrition and growth.
- Fewer environmental impacts from unregulated application practices.
- Enhanced consumer confidence in agricultural products.
- Improved transparency within certification standards and regulations.

74 https://data.ers.usda.gov/reports.aspx?ID=17834#P86334487a26f457f81c31494fdbfde85_2_150iT0R0x40

Program Areas: Plant Pest Diagnosis, Safe Pesticide Usage, and Invasive Species Prevention

State Entomologist Example

Insects are a critical but an often-overlooked component of natural and agricultural ecosystems. There are more than 100,000 insect species in South Carolina, yet many individuals lack a full understanding of these creatures and their impacts.[75] By serving as an authority figure and spokesperson for the insects and arthropods of South Carolina, the State Entomologist plays an important role in providing current and unbiased information on research and scientific inquiries related to insects. Importantly, the State Entomologist also serves as a primary point person for organizations across the state who have questions related to entomology.

Beginning in 2019, the Office of the State Entomologist was established as a separate position within Clemson Regulatory Services. The main function of this position is to collaborate with Clemson Cooperative Extension on regulatory issues related to pest insects in South Carolina. Other functions of the role include assisting with pollinator protection issues (especially as it relates to pesticide usage), identifying and confirming pest insects that have quarantine or economic importance within the state, and preparing pesticide exemptions or special needs requests. When there is a need to implement a quarantine for exotic and invasive insect pests, the State Entomologist's office assists the with this task.

Extension and outreach are important parts of the role of State Entomologist. As part of this position, presentations are routinely given in South Carolina and other states related to state and federal pesticide issues, laws, pests, and health and safety. Examples of groups for whom outreach is conducted include the SC Mosquito Control Association, SC Horticultural Industries, SC Beekeepers Association, SC Arborist Association, SC Aquatic Plant Management Association, Pest Control Associations, and others.

Key Impacts:

- Reduced spread of invasive or exotic insect pests.
- Reduced harm to pollinators due to pesticide usage.
- Improved awareness on ecosystem issues related to insects.

75 https://www.myrtlebeachonline.com/news/local/article277743323.html

Program Area: Catastrophic Event Preparedness and Readiness

Coordinating Nuclear Preparedness Plans to Support Agricultural Resilience Example

South Carolina is one of the nation's leading producers of nuclear energy, with four fixed nuclear power plants and one federal facility. Nuclear power accounts for roughly 56 percent of the state's electrical energy, which ranks third among all states, according to the U.S. Energy Information Administration.[76] Although the risks of nuclear power are often exaggerated considering the high levels of safeguards in modern plants, these remote yet potential occurrences continue to capture the minds and attention of those living close to nuclear power plants. In a worst-case scenario, a nuclear catastrophe could lead to death, illness, and economic ruin as far as 50 miles away.

Various entities within CAFLS, including Clemson University Livestock Poultry Health, Clemson Cooperative Extension, and Clemson Regulatory Services, assist the state with the preparation for planning exercises focused on the worst-case scenarios related to nuclear accidents. Each of these agencies has a role in protecting South Carolina agriculture in the event of a radiation accident.

Every 8 years, each of the 30 states that contain fixed nuclear facilities is required by the federal government to "plan for the worst." As a participating state, Clemson Cooperative Extension has hosted an Ingestion Pathway Exercise (IPX), where the nuclear industry, state and county emergency management teams, radiation experts, and several federal agencies developed plans on how to deal with nuclear releases. Held in Florence, the IPX has a particular focus on how such a nuclear disaster would affect the food and agricultural communities within a 50-mile radius from a plant. Workshop participants included county emergency management directors, state and federal regulatory agencies, and a representative from the nuclear plant in Florence.

Key Impacts:

- Ensured agricultural resilience in the event of nuclear emergencies.
- Better coordinated response strategies to help minimize potential risks.
- Better educate stakeholders on safety measures and contamination mitigation techniques.

76 https://www.eia.gov/todayinenergy/detail.php?id=43256

Program Area: Catastrophic Event Preparedness and Readiness

Supporting Animal/Agriculture Emergency Response Example

South Carolina's Atlantic Coast has long been prone to hurricane risks. For example, research from the state's Department of Natural Resources finds that South Carolina ranks fifth among the states for having the most significant hurricane impacts over the entire historical record for Atlantic hurricanes stretching back to 1851.[77] In particular, the PeeDee area of South Carolina has been the target of hurricane-related flooding in recent years. When there are hurricanes and floods, a common concern is what happens with animals, including agricultural livestock and people's pets. This can be made even more complicated by the limited capacity of many county animal control departments, where some have staffs of just two individuals.

Clemson Livestock Poultry Health (LPH) officials are responsible for designing and implementing the state's Emergency Support Function-17, which focuses on Animal/Agriculture Emergency Response. This section of the state's emergency operations plan designates how several agencies and organizations can coordinate resources in response to pet, farm, and wildlife animal care needs (as well as plant and crop industry issues). These responses are intended to be implemented before, during, and after a disaster.

In advance of hurricanes, Clemson LPH works with partners to build evacuation shelters and stables for horses and other animals. Clemson LPH can also suspend certain legal requirements in order to assist neighboring states evacuate animals to South Carolina. In partnership with the South Carolina Association of Veterinarians (SCAV), Clemson LPH agents help train the SCAV volunteers who can assist people with emergency event-related animal or agriculture-related issues.

Once the state has weathered the disaster, CAFLS personnel play an important role in helping farmers report and recover financial losses. Equipping the state to be more prepared and ready for potential catastrophic events is an important way in which Clemson's regulatory services and livestock poultry health functions support the state.

Key Impacts:

- Improved animal welfare during hurricane emergencies from proactive planning.
- More available shelter and care options for livestock and pets in case of emergencies.
- Better educated owners on proper procedures and disaster preparedness for animals.

77 tps://www.dnr.sc.gov/climate/sco/hurricanes/pdfs/SCHurricanesExecutiveSummary.pdf

DEVELOPING HUMAN CAPITAL

Description

Clemson University was founded in the late 19th century. At that time, economic prosperity was primarily driven by industrialization and natural resources. Communities thrived on the back of manufacturing, mining, and agriculture. The focus was on physical labor and the production of tangible goods. However, the economic landscape has drastically transformed since then. The mid-20th century marked the rise of the service economy and technological advancements. The post-World War II era saw a boom in higher education and the establishment of research institutions, which fueled innovation and economic growth. Skills and knowledge were becoming more valued, laying the groundwork for the modern economy.

In the 21st century, prosperity is increasingly driven by the knowledge economy, which in turn requires enhancements to training across the education continuum. Technological advancements and globalization have created a demand for highly skilled workers who can navigate complex systems, think critically, and innovate, requiring a workforce that is both educated and adaptable.

Investing in human capital development is not just a baseline necessity but a strategic imperative for the economic prosperity of communities. By focusing on education and skills training, communities can build a robust and adaptable workforce that drives sustainable prosperity in the 21st century. Historical shifts have shown that the drivers of prosperity evolve; today, it is education that holds the key to economic success and social well-being.

Developing this human capacity is especially crucial for South Carolina's economy for several reasons. Foundationally, investing in the human capital and skills development of the state results in increased economic contribution in growing industries, but human capacity can also generate much broader impacts. A well-educated and skilled workforce is more likely to innovate and generate new ideas, which generates economic growth by creating new products, services, and industries, leading to increased productivity and competitiveness on a global scale.[78] These educated workers also benefit local and state budgets, as higher-income workers contribute more through taxes throughout their lifetimes. At the same time, reskilling, education, and community engagement foster social cohesion and stability by promoting social mobility and reducing inequality. When individuals have access to opportunities for advancement (and opportunities to engage with their peers and neighbors), they are more likely to feel invested in South Carolina's success and regional societies.[79]

78 https://www.epi.org/publication/states-education-productivity-growth-foundations/
79 https://files.eric.ed.gov/fulltext/ED566248.pdf

The Need for CAFLS to Develop Human Capital

In our modern, knowledge-driven economy, people need to be equipped with the solid educational fundamentals necessary to meet increasingly complex job requirements and the ability to participate in life-long learning to upgrade their skills as the world of work changes and evolves.

Today and into the foreseeable future, it is hard to overstate the importance of education, especially higher education, to South Carolina's economic and societal progress. Education facilitates productivity and efficiency gains across the economy, and it also provides a positive return on investment for individuals and society, thereby adding additional economic impacts. The following statements by researchers examining the importance of education ably make these points:

> "The face of American agriculture is changing. Nearly 10 percent of U.S. jobs are related to agriculture and the increasingly complex nature of production requires more training and education in science, technology, engineering and mathematics—the STEM fields—to stay competitive and meet the needs of a growing world for food, fuel and fiber. This is a great opportunity for smart, young people to start careers in a field that addresses some of the world's most pressing challenges."
>
> U.S. Agriculture Secretary
> Tom Vilsack

- "An educated populace is a key source of economic growth both directly, through improved labor productivity, and indirectly, by spurring innovation and speeding the diffusion of advanced technologies."[80]

- "The most important elements in the quest for a competitive advantage in commerce, be it at the micro, or firm, level or at the macro, or national, level, are the skills and initiative of its workforce."[81]

- "Higher education provides extensive benefits to students, including higher wages, better health, and a lower likelihood of requiring disability payments. A population that is more highly educated also confers wide-ranging benefits to the economy, such as lower rates of unemployment and higher wages even for workers without college degrees."[82]

CAFLS's human capital development programs and initiatives are diverse. In addition to the formal degree programs offered through the College for undergraduate and graduate education, programmatic efforts to ensure life-long learning include the following:

- **Career exploration and work readiness for youth**—providing 4-H and FAA participants with skills in communication, leadership, teamwork, and problem-solving and introducing them to career pathways in science, technology, engineering, agriculture, and mathematics (STEAM) and other high-demand opportunity areas.

- **Job skills for frontline workers**—improving productivity in agriculture through the provision of new knowledge, skills, and best practices for the agricultural production workforce and frontline customer service skills in other industry sectors.

80 Goldin, C. and Katz, L. (2009). The Future of Inequality: The Other Reason Education Matters so Much. *The Milken Economic Review*.
81 Gray, K. and Herr, E. (1998). Workforce Education: The Basics. Allyn & Bacon, Needham Heights, Massachusetts.
82 Schanzenbach, D. W., Bauer, L., and Breitwieser, A. (2017). "Eight Economic Facts on Higher Education. The Brookings Institution. Washington, DC.

- **Provision of formal training programs**—serving workers who require specific training courses and certifications to perform their work (e.g., pesticide applicator training, Food Safety Modernization Act training, etc.).

- **Leadership and management training** (e.g., Livestock Management Training, Farm Business Management Training, etc.).

- **Building the volunteer workforce**—using a train-the-trainer approach to build widespread volunteer capacity across South Carolina (e.g., Master Gardener and Master Naturalists).

How CAFLS Generates Positive Impacts by Developing Human Capital

In support of human capital development, CAFLS is helping South Carolinians become ready for work, qualified to work, and more skilled in their work. Human capital development programs meet multiple individual and societal needs and hold numerous advantages for participants:

- Ensuring individual capabilities keep pace with the current standards of others in the same field.
- Providing a competitive edge for career advancement, job mobility, and increased earnings.
- Increasing job security, with higher levels of education tending to link to better job security, and credentials earned staying with individuals for life.
- Enhancing confidence and satisfaction in the workplace.

CAFLS programming offers numerous human capital development opportunities for South Carolinians throughout their lifetime. By offering youth development programs, formal academic education, and post-academic offerings, CAFLS provides lifelong learning opportunities for all South Carolinians that result in significant impact (Figure 18).

Figure 18: CAFLS Functional Impact Themes in Developing Human Capital

Areas of Impact	Topical Domains	Focus Areas	South Carolina Functional Impacts
Developing Human Capital	Youth Development	4H and FFA Youth Development	Enhanced Youth Educational Performance
		Nutrition Education	Enhanced Youth Engagement/Citizenry
	Formal Education	K-12 STEM Student Experiences	Reduced Socioeconomic Costs
		Undergraduate Education (Bachelor's)	Improved Skills and Confidence
	Lifelong Learning	Graduate Education (Master's and PhD)	Expanded Educational Opportunities
		Master Training and Lifelong Learning	Continuous Skills Development

Source: TEConomy Partners, LLC.

Functional Impact Examples: CAFLS Work to Develop Human Capital

Similar to other functional impact sections, discussing every program and activity undertaken by CAFLS in the areas of human capital development would lead to an excessively long and complex report. Rather than attempting to produce an inventory or list of each and every activity, TEConomy draws upon program examples to illustrate the types and range of important functional impacts generated by CAFLS's programming. The following categories help to illustrate the type of high-impact work taking place.

Youth Development

CAFLS's efforts in youth development are primarily delivered through a collaborative effort between 4-H and the Future Farmers of America (FFA). 4-H serves community needs by providing education on a "learn-by-doing" basis through experiential learning models. FFA, in a complementary manner, is an intra-curricular program that works with members to provide leadership training and career development through industry engagement. South Carolina is unique in that, unlike in other states, the 4-H and FFA programs work in a combined system, serving youth members as they transition from general education to career-focused training, rather than competing for members across the same region.

Positive youth development (PYD) programs have long been viewed as a positive influence on youths and their communities. In a recent National 4-H study that encompassed 2,185 youths from 14 state 4-H programs the study found significant benefits to 4-H participation[83], including the following:

- 82 percent of 4-H members reported that 4-H helped them explore career options.
- 58 percent reported that 4-H helped them with college decision-making.
- 50 percent reported that 4-H inspired them to volunteer in their community.
- 42 percent reported that they learned about healthy food choices in 4-H.
- 69 percent reported that 4-H helped them see how science can be used to solve everyday problems.

4-H participants also ranked the programs extremely positively in terms of youth development. On a seven-point scale, study participants ranked the following program experience results:

- Explored personal "sparks": 5.6/7
- Developed a growth mindset: 6.0/7
- Maintained high personal standards: 5.0/7
- Cultivated personal responsibility: 5.9/7

It is clear that 4-H programming is effective in generating both tangible impacts (e.g., college decision-making) and internal development goals (e.g., independence and leadership). Especially at an age in which children struggle to formulate self-actualization, development groups can play a guiding role in fostering curiosity, passion, and determination.[84]

Although comparable in member size, the Future Farmers of America (FFA) programs do not maintain a similarly comprehensive impact study. However, studies on Positive Youth Development (PYD) programming as a general deployed activity do exist, the most comprehensive of which is a long-term study on African American PYD program

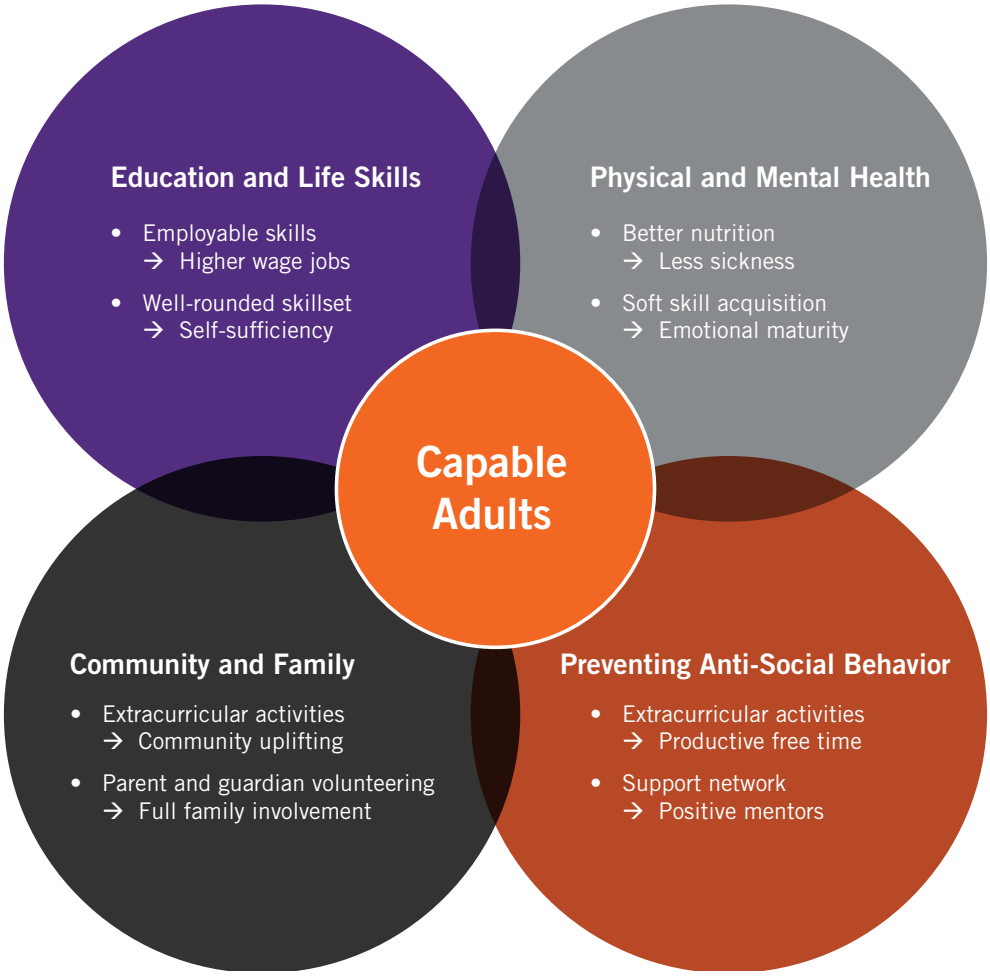
83 https://www.4-h.org/wp-content/uploads/2024/01/23154256/230707-2022-4H-National-Index-Study-FNL.pdf
84 https://charleskochfoundation.org/stories/sam-staley-why-self-actualization-is-good-for-students-and-society/

participants, with a follow-up time of approximately 17 years after program participation. This study, published by BMC Public Health, found that almost all forms of PYD programming have a positive correlation with reduced poverty in adulthood, increased college graduation rate, and higher rates of end-of-month savings.[85]

In addition, PYD programs combat antisocial behavior by actively involving young people in productive and constructive activities that recognize and work to improve their individual abilities. By offering opportunities, fostering positive relationships, and providing necessary support, these programs promote positive outcomes for individuals and their communities.[86]

As a result, youth development programs are important components in the creation of healthy, well-adjusted, and educated adults (Figure 19).

Figure 19: The Impact of Youth Development Programming on Generating Capable Adults



Source: TEConomy Partners, LLC

85 https://bmcpublichealth.biomedcentral.com/articles/10.1186/s12889-022-13016-z
86 https://youth.gov/youth-topics/effectiveness-positive-youth-development-programs#_ftn5

Clemson Cooperative Extension 4-H programs use a learn-by-doing approach to help youths gain the knowledge and skills to be responsible, productive, and contributing members of society. This is accomplished by creating safe and inclusive learning environments, the involvement of caring adults, and utilizing the expertise and resources of Clemson University and the nationwide land-grant university system.

4-H clubs offer numerous programs across the state, utilizing a county-based system that broadly covers five program topics:

- Agriculture and Animal
- STREAM (Science, Technology, Reading, Engineering, Art/Agriculture, Math)
- Civic Engagement and Leadership
- Healthy Lifestyles
- Natural Resources

These programs vary from county to county, prioritizing nonstandardized content to ensure youth engagement and personalized individual involvement. This includes an emphasis on the importance of education and long-term employability. 4-H programming's most popular activities are their STREAM-dedicated workshops, such as engineering presentations, team competitions for coding, and robotics. Other well-received programs include Journey to Mars, "Elf Trapping," embryology, pollination, plant identification, and zoonotic diseases, all of which operate in a "fun-focused," hands-on environment.

Clemson Extension 4-H also partners with other University departments to expand knowledge dissemination. The School and Community Garden Program is one such partnership project between 4-H and Horticulture as a "train-the-trainer" course to interact with community and school members to deliver seeds, provide expertise, and match volunteer resources. 4-H also hosts numerous events, including dairy shows, state horse shows, and a state fair.

In 2022, the Clemson Extension 4-H Youth Development program engaged 69,271 youth through 4,690 programs, of which 72 percent reported that they were able to apply the practices they learned during the programs to real-life situations. Certain 4-H programs, such as the Pinckney Leadership program, do not require 4-H membership for participation, thereby reaching even more students.

Clemson University's FFA (Future Farmers of America) program is designed to cultivate the next generation of leaders in agriculture, food, and natural resources. The program aims to develop students' potential for premier leadership, personal growth, and career success through agricultural education. It provides students with opportunities to engage in hands-on learning experiences, Career and Leadership Development Events (CDEs and LDEs), and community service projects. Although named for its agricultural roots, FFA teaches numerous other disciplines, including biology, chemistry, veterinary sciences, engineering, and entrepreneurship.

Leadership development is a core component of FFA programming, with students participating in events such as public speaking contests, leadership conferences, and officer training sessions. These activities help build communication, teamwork, and problem-solving skills essential for future career success. Industry engagement also persists as a consistent theme, with every regional event and competition sponsored by a business or industry (e.g., South Carolina Green sponsored the FFA's most recent greenhouse competition in 2023). Demand is extremely high for these events; all camps have waiting lists, and CDE competitions are beyond maximum capacity.

Additionally, Clemson's FFA program encourages students to engage in supervised agricultural experiences (SAEs), where they undertake individual projects or work-based learning opportunities that provide practical, hands-on experience in their areas of interest. Clemson Extension Agriculture Education Agents, who manage the SAEs and personalized community programming, oversaw 100 high school and 90 middle school agricultural education programs. In 2022, these SAEs garnered over 577,000 volunteer hours and 772,000 paid hours, which is estimated at the equivalent of more than $5.3 million in earned wages.

The FFA has established a robust presence throughout South Carolina, reaching 44 of the state's 46 counties. In 2023, FFA attained a record number of student members, reaching more than 11,800. This unprecedented growth underscores CAFLS's pivotal role in youth development. Additionally, the FFA has extended its educational influence beyond its members, providing instruction to over 16,000 South Carolinians through its comprehensive career and technical education (CTE) programs. These programs have been recognized as some of the top CTE offerings in South Carolina, highlighting their effectiveness in equipping participants with valuable skills and knowledge pertinent to the agricultural sector.

It is worth noting that in other states, 4-H and FFA are not managed by the same entity; the programs are often viewed as competing, and 4-H tends to focus on younger children, starting at age 8, while FFA is primarily offered at the high school level. That is not the case in South Carolina, where CAFLS oversees both 4-H programming and FFA development events, encouraging a strong overlap in the ages of the youth members served. This creates a uniquely productive youth development environment for participating youths. By managing both programs, CAFLS can provide a more comprehensive and holistic approach to youth development, covering more topics through more varied events. Oversight by a single institution also allows for more efficient use of resources, including funding, facilities, and educational materials. This efficiency can help maximize the impact of both programs, especially through easier collaboration and smoother transitions for members between the programs as they grow older.

Investing in the youth of South Carolina means building and supporting a stake in the future human potential of the state and its communities. By creating more responsible, educated, independent, innovative, emotionally mature, and community-minded individuals, CAFLS is directly impacting not just the economy but the interpersonal culture of its industries. The following examples convey the breadth of CAFLS's efforts in this regard.

Program Area: Youth Development

4-H Pinckney Leadership Program Example

Noncognitive skills, defined as skills relating to thoughts, feelings, and behaviors, are undertaught in schools across the country. These skills are vital components of effective leaders, productive workers, and high earners, in ways that traditional academic measures do not always correlate with.[87] However, schools continue to struggle with supporting long-term skills such as leadership, independence, and emotional maturity. As a result, students may be lacking in the necessary skills to function and respond to a rapidly changing job market.

Cooperative Extension's 4-H Pinckney Leadership program is an initiative designed to cultivate leadership skills and civic engagement among South Carolina's youth. Named in honor of Senator Clementa Pinckney, the program provides participants with opportunities to develop their leadership abilities, learn about government and public service, and engage in community service projects. Through workshops, hands-on activities, and mentorship, the program encourages young people to become active, informed citizens who are committed to making positive contributions to their communities. The 4-H Pinckney Leadership program emphasizes the values of character, citizenship, and resilience, inspiring youth to lead with integrity and purpose.

The program is intended for middle and high school students looking to develop leadership and civic engagement skills, with focuses on the following areas:

- Youth development
- Youth leadership
- Social and emotional development

The program prioritizes the development of youths before college, creating well-rounded, emotionally intelligent students that understand their personal career paths by targeting skill gaps seen in Gen Z students. This includes communication, relationship building, initiative, and critical thinking. These career paths are explored through primarily its Leadership Camp, Leadership Conference, and its Leadership Roundup, which each target a distinct age group and skill focus.

Students are also being tracked from their entry point in middle school to the college they decide to attend, their major, and their performance. In 2022, the program released $44,000 in scholarships to college-attending members. These monetary efforts are complemented by three yearly leadership conferences, attended by primarily rural and minority students from 35 of South Carolina's 46 counties, which have sold out completely in 2023.

Key Impacts:

- Improved student leadership capabilities.
- Increased interest in higher education.
- Enhanced noncognitive skills (e.g., self-direction, emotional intelligence).

87 https://jscholarship.library.jhu.edu/server/api/core/bitstreams/e7ed674e-6fab-4339-95e2-50c0d78e6833/content

Program Area: Youth Development

Cooking Capable Example

Persons with disabilities suffer from two separate fronts of simultaneous food insecurity: they face difficulties in securing stable employment and in obtaining and preparing food. When access to sufficient amounts of nutritious food becomes uncertain, many people will resort to skipping meals entirely or consuming only processed foods and snacks, leaving them vulnerable to malnutrition and disease.[88]

Cooking Capable is a series of workshops to teach differently abled middle and high school youth to prepare simple, affordable, nutritious, and delicious meals, and was developed by 11th grader Ivy Prince. After attending a South Carolina 4-H Healthy Habits Summit in Columbia, she sought career guidance from Clemson Cooperative Extension Food Systems and Safety members. After developing the teaching program in her house and bringing it directly into others' homes, her success was rewarded with a $10,000 national grant to grow the teaching program.

Not only does the program provide recipes and the ability to cook, but Cooking Capable also serves to provide people living with disabilities confidence and a main life skill to fall on during difficult times. This confidence and individual empowerment can lead directly to improved self-esteem and an overall higher quality of life, which in turn contributes to a more inclusive community. Ivy Prince and her parents credit fully her membership in 4-H as the driving force behind the creation of Cooking Capable and Ivy's personal development.

Key Impacts:

- Assistance and confidence building for disabled persons.
- National media exposure for social issues and 4-H.
- Increased confidence for independent youth activists.

88 https://idronline.org/article/diversity-inclusion/the-food-related-challenges-faced-by-people-with-disabilities/

Program Area: Youth Development

Garrison Ag Expo Arena Example

The face of agriculture is changing. Total farm acreage has been dropping, exacerbated by the disappearance of smaller farms and the rapid aging of current farmers. Senior farmers heavily outnumber younger entrants, with more than six times more farmers over the age of 65 than below 34.[89] Fewer and fewer young farmers are entering the agricultural sector, which is likely to put an intense strain on the industry in the future. As a result, education and programs encouraging young students to engage in agriculture work are vital for the future of the farming industry in South Carolina.

The Garrison Ag Expo Arena is a premier multipurpose livestock facility located at Clemson University, renowned as the largest of its kind in South Carolina and a leading venue in the Southeast. As the state's only full-service public facility dedicated to promoting the billion-dollar livestock industry, it plays a crucial role in supporting the agricultural community. The Arena caters to the increasing interest in raising and showing horses, cattle, and other livestock by providing ample opportunities for shows and exhibits. This not only serves the citizens of South Carolina and neighboring regions but also attracts thousands of visitors, boosting tourism and contributing significantly to the economic development of the Upstate Region and the entire State of South Carolina.

The Arena hosts both agriculture and agribusiness programs, providing educational information and resources, as well as technical assistance on productions and practices to build sustainable communities and businesses. It accomplishes this by showcasing a variety of livestock exhibitions, providing opportunities for producers to meet with county and industry agents, and hosting educational training events through expos and agricultural association meetings and conventions. By organizing events that bring together farmers, agribusiness professionals, students, and the general public, the Arena promotes knowledge sharing and collaboration within the various agriculture communities in South Carolina.

The Arena also provides youth-level camps and shows that allow participants to compete and learn in a youth-friendly environment. It also showcases facilities used to illustrate various aspects of agribusiness operations and marketing. Youths in local communities have the additional free opportunity to experience different faces of the livestock industry, exposing them to different potential hobbies and careers in the industry. Additionally, teachers are allowed to showcase the Garrison Arena to students to experience the facility firsthand.

Key Impacts:

- Exposure to agribusiness facilities and operations.
- Engagement in livestock shows and exhibitions.
- Provided opportunities to establish key industry networks.

89 https://countychronicle.org/2641/perspectives/inadequate-agricultural-education-in-public-schools-is-affecting-the-future-of-american-farms/

Program Area: Youth Development

Seeds to Shoreline Example

From Seeds to Shoreline (S2S) is South Carolina's educational salt marsh restoration program designed for K-12 students and teachers. The year-long program engages participating schools with cultivating and transplanting Spartina alterniflora (smooth cord grass, a key floral component of the marshes) to designated areas along the state's coastline. Students participate in growing and transplanting the key salt marsh grass from seeds to mature plants. This hands-on approach helps students understand plant biology, ecology, and the importance of coastal ecosystems. Involvement in real-world environmental restoration projects also fosters a sense of responsibility and connection to their local environment. Students gain practical skills that go beyond theoretical knowledge, allowing them to apply their experiences to personal conservation efforts.

The program also hosts one-day training Educator Workshops that provide a chance to explore, network, and discover new education tools. These newly trained educators can then bring knowledge and experience back to their students and their communities, growing the conservation effort within local regions and educating those who would otherwise be unaware of the importance of natural stewardship. By focusing on local environmental issues, the program fosters a sense of community and encourages students to contribute positively to their local economy and environment. Students also gain exposure to potential career paths in marine science, which will help guide their educational and professional choices.

Key Impacts:

- Direct involvement in environmental sustainability.
- Increased environmental awareness.
- Enhanced educator capabilities.

The Functional Impact Associated with Increased Educational Attainment on Future Earnings

By deploying a variety of youth development initiatives, including 4-H and FFA, CAFLS supports youth and encourages the attainment of higher education. For example, research has shown that, in addition to increases in general feelings of self-worth, social skills, and academic performance, students who have participated in 4-H programming are significantly more likely to attend college. Adults who attend and graduate from college enjoy greater median earnings on average, benefitting not only themselves but the regions they contribute to via increased tax revenues.

Under even an exceedingly conservative estimate, it is reasonable to assume that at least a portion of the 69,271 youths reached by 4-H programming and the 11,820 youth members that participated in FFA programming in 2022 developed the confidence, personal abilities, and connections necessary to pursue higher education in their lifetime. While there must be mention of the obvious correlation between participating members and those who already intended to obtain higher education, research is clear that participation in PYD programming is itself a significant indicator of college graduation. With participants in 4-H and FFA programming ranging in age from 8 to 18, the cadre of 81,091 youth engaged with PYD programming takes approximately a decade to pass through the system to their high school graduation. Put another way, approximately 10 percent of the 81,091 youth can be considered as candidates to go to college in any given year (8,109). Using a very conservative assumption that 5 percent of South Carolina's youth participants were encouraged directly by their experiences to seek higher education and obtain a bachelor's degree rather than ending their formal education after receiving their high school diploma, this would equate to 405 additional bachelor's degrees being granted annually. Using the South Carolina Education Oversight Committee's estimation that college graduates earn approximately $800,000 more over their lifetime than high school graduates in South Carolina, or $17,778 per year over a 45-year career, **this equates to approximately $7.2 million in increased annual earnings directly contributable to CAFLS's youth development programming, or more than $324 million in increased earnings over the course of these students' careers.**

The Functional Economic Impact of Reduced Substance Abuse

Substance abuse is rampant across the United States. According to the Surgeon General, 27 million Americans were current users of illicit drugs or misused prescription drugs and nearly a quarter of adults and adolescents reported binge drinking in the past month. The societal cost of substance abuse is staggering. The annual economic impact of substance misuse is estimated to be $249 billion for alcohol misuse and $193 billion for illicit drug use. The average individual cost of substance abuse is estimated to be approximately $35,000 per year.

Research suggests that substance abuse in late childhood and early adolescence leads to greater involvement with drugs later in life. Because most illicit drugs use begins during the teenage years, it is therefore vital that effective interventions are implemented in childhood and adolescence to inhibit the development of unhealthy behaviors related to alcohol, tobacco, and illicit and prescription drugs.

As previously illustrated, positive youth development programs such as 4-H and FFA play an important role in providing structure in the lives of youth, particularly in areas that are economically disadvantaged or places with limited opportunities for extracurricular activities. Studies show that PYD programs have lifelong positive impacts on participants' self-confidence and promote positive youth development beyond that of other extracurricular activities. Most importantly, PYD programs teach youth valuable life skills that empower them to make healthy choices and offers drug prevention education to educate participants on the dangers and risks of substance abuse.

If South Carolina youth who participate in 4-H and FFA face the same lifetime chances of having a substance abuse disorder as the national population, then roughly 8,100 (10 percent) of the 81,071 participants are at-risk for substance abuse at some point in their lives. **If 4-H and FFA youth development programs can prevent even 5 percent of these 8,100 youths from developing a substance abuse problem later in life, these preventive efforts could save more than $14 million for each year that those 405 individuals do not have a substance abuse disorder. This amounts to $280 million in savings over 20 years. Small decreases in the rate of substance abuse can have a dramatic impact on the societal costs of these disorders due to large losses in productivity and the high costs of criminal justice and health care.**

Formal Academic Education

The attainment of higher education is strongly associated with many large-scale and far-reaching impacts for individuals, communities, and society at large.[90] For individuals, obtaining higher education credentials, including formal degrees or vocational certifications, leads to substantial financial advantages, such as significantly increased income and employment benefits, along with personal gains like improved job satisfaction, happiness, health, and longevity. Similarly, higher education directly benefits government, industries, and society by boosting the economic productivity of the workforce, promoting economic growth, raising government revenues, and reducing costs associated with social programs and negative externalities (such as crime and other antisocial behavior). Additionally, society benefits from a more educated population through higher levels of civic engagement, volunteerism, improved child welfare, and various other positive factors. Large numbers of studies are in strong agreement that higher education is the path to productivity, employability, safety, high earnings, and societal participation.

Higher education is not simply a global good; education attainment is a vital component of South Carolina's future workforce. According to the South Carolina Education Oversight Committee, almost 60 percent of all jobs in South Carolina require a post-secondary degree or certificate, and, of these jobs, STEM job openings are growing nearly twice as fast as in other fields.[91]

Agricultural education is of critical importance to the State of South Carolina. The scope of agricultural jobs has changed rapidly over recent decades. In 2022 agribusiness (agriculture and forestry combined) accounted for 259,215 jobs and $51.8 billion in annual economic impact in South Carolina.[92] Even this does not tell the full story, however. As technology has continued to rapidly evolve, agricultural sectors have become increasingly STEM-oriented. The increasingly complex nature of food production and manufacturing necessitates more workers who are skilled in science, engineering, and other STEM fields in order to remain globally competitive and sustain increasing global demand. As Sonny Perdue, the U.S. 31st Secretary of Agriculture, said in 2019:

> *STEM education is really a vital component of agricultural education. We know that it takes science – we're dealing with biological organisms and plants and animals. That's the biology part, that's the science part. There's a lot of mechanical in there, as well. We have a lot of engineering and mechanical and technology. All that, irrespective of what area of agriculture you go in, those are four foundational needs of good education to be successful in the career of agriculture. … I hope FFA members will understand, in their pursuit of education, they not back away from those tough courses, really welcome and receive those, knowing that will be part of their future.*

Thus, the role of CAFLS is not only to provide higher education for the sake of individual betterment and worker employability but also to support and evolve South Carolina's largest industry and economic contributor.

CAFLS offers twelve undergraduate majors and eleven graduate programs and maintains several attractive characteristics. For example, 56 percent of CAFLS courses have 20 or fewer students, suggesting that its faculty can work far more effectively than in classrooms that maintain the national average of 38 students per classroom.[93] CAFLS also provides not only classroom education but also funds learning experiences outside the

90 https://eric.ed.gov/?id=ED528724
91 https://expectmoresc.com/the-impact-of-education/
92 https://agriculture.sc.gov/about/
93 https://publicuniversityhonors.com/2015/10/20/estimated-class-sizes-more-than-90-national-universities/

classroom for certain students, which directly develops critical thinking skills and exposes students to possible career paths. Students are also active, with more than 30 CAFLS-related student organizations on campus.[94]

Table 19 showcases CAFLS's program offerings by field of study with a brief description of their goals. Note that, for the purposes of analysis and clarity, TEConomy has consolidated several degree programs, so exact titles may not match in name or number to Clemson University's official websites.

Table 19: CAFLS Program Offerings by Field of Study

Degree Program	Brief Description
Food, Nutrition, and Packaging Sciences	Blends many disciplines—biology, chemistry, physics, engineering, health and more—to not only help people live healthier but help private industry deliver safely packaged food to a growing global population.
Animal and Veterinary Sciences	Teaches students fundamental knowledge of physiology, biochemistry, nutrition, management, and offers hands-on experiences with farm animal species.
Environmental and Natural Resources	Confronts present-day environmental issues, including protecting rare and endangered species, conserving forests, restoring degraded ecosystems, and balancing resource demands.
Wildlife and Fisheries Biology	Focuses on the practices and policies that affect animals, and examines the health, environmental and ecological risks of wildlife species with declining population and overpopulation.
Agricultural and Applied Economics	Applies economic theory, designs experiments or surveys, estimates econometric models, and tests hypotheses with inferential statistics to analyze human behavior, business practice, or government policy.
Plant Sciences	Offers educational, research and outreach programs in agronomy, entomology, environmental sciences, horticulture, turfgrass, plant pathology and soil and water sciences.
Agricultural Education	Hands-on teacher preparation degree for middle and high school agricultural classroom instruction.

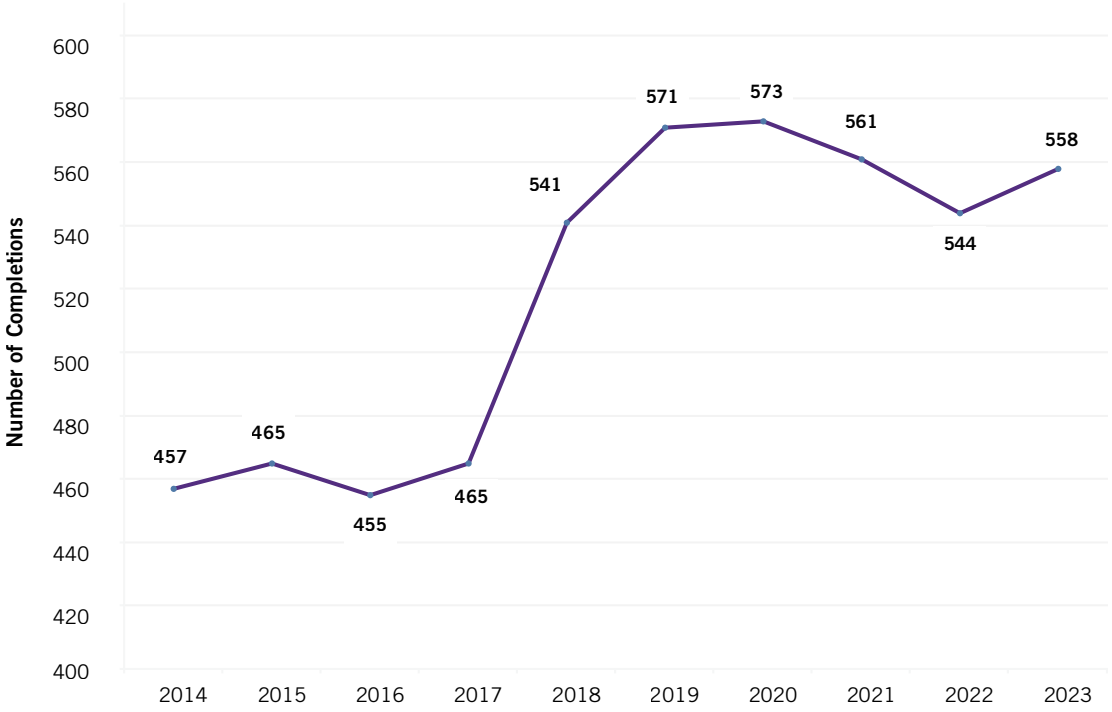
Source: Clemson University Degree Programs

In 2023, CAFLS awarded 558 degrees across its certificate, undergraduate, graduate, and doctorate degree programs (see Figure 20). This follows a sharp uptick in degree completions beginning in 2018, implying an increase in admissions around 2014. The 2023 graduating year was made up of the following degrees:

- 410 baccalaureate degrees
- 117 master's degrees
- 27 doctoral degrees
- 4 certificates

94 https://www.clemson.edu/cafls/about/index.html

Figure 20: Total Number of CAFLS Degrees Completions per Academic Year



Source: TEConomy analysis of Clemson University graduation data

As the number of CAFLS graduates increases, more skilled workers will become available to the burgeoning industries throughout not just the agricultural sectors of South Carolina but also the technical skills-oriented industries like packaging, applied economics, and veterinary sciences. CAFLS is also producing educators well-versed in agricultural topics, which are vital to closing the significant agriculture teacher gap shortage, where, nationwide, there are not enough agriculture teachers to meet the demand.[95]

Since 2014, CAFLS degrees have grown more than 20 percent, driven mainly by increases in graduate degree completions (Table 20). This is especially impressive compared to national graduations, which have only increased by 10.4 percent since 2014.[96] CAFLS's relative high growth in degree completions contributes directly to increasing the relative concentration of college graduates and agriculturally oriented degree holders in South Carolina. This increased concentration will, in turn, lead to relatively higher increases in economic growth, competitiveness, and innovation.

95 https://www.naae.org/about/overview/what-is-agricultural-education/
96 https://educationdata.org/number-of-college-graduates

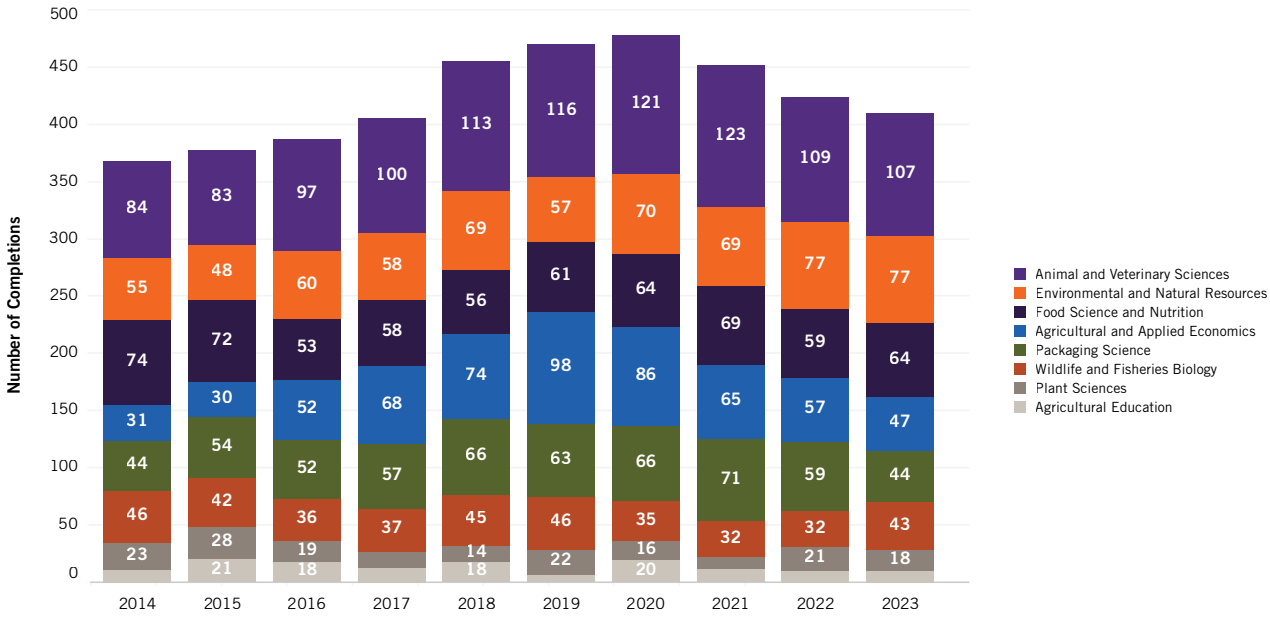
Table 20: CAFLS Degree Completions by Field, Total

Degree Type	2023 Completions	2014-23 Change (%)
Food, Nutrition, and Packaging Sciences	126	-7%
Animal and Veterinary Sciences	119	+37%
Environmental and Natural Resources	113	+35%
Wildlife and Fisheries Biology	102	+73%
Agricultural and Applied Economics	56	+12%
Plant Sciences	27	+4%
Agricultural Education	15	-6%
TOTAL	**558**	**+22%**

Source: TEConomy analysis of Clemson University graduation data

However, the trend in increasing degree completions obscures a worrisome decline in undergraduate awards. Despite an increase in CAFLS undergraduate degree completions from 2014 (368 degrees) to 2023 (410 degrees), 2023 has seen the lowest number of completions since a peak in 2020 (478 degree completions) and is lower than even the number of degree completions in 2018 (455 degree completions) (see Figure 21).

Figure 21: CAFLS Degree Completions by Field (Baccalaureate Only)



Source: TEConomy analysis of Clemson University graduation data
Note: For BA/BS degrees only, "Food, Nutrition, and Packing Science" is separated into "Food Science and Nutrition" and "Packaging Science"

Table 21 provides degree completions by major and indicates that only three of the eight offered degree programs[97] have seen positive growth since 2014:

- Agricultural and Applied Economics
- Environmental and Natural Resources
- Animal and Veterinary Sciences

Table 21: CAFLS Degree Completions by Field (BA/BS Only)

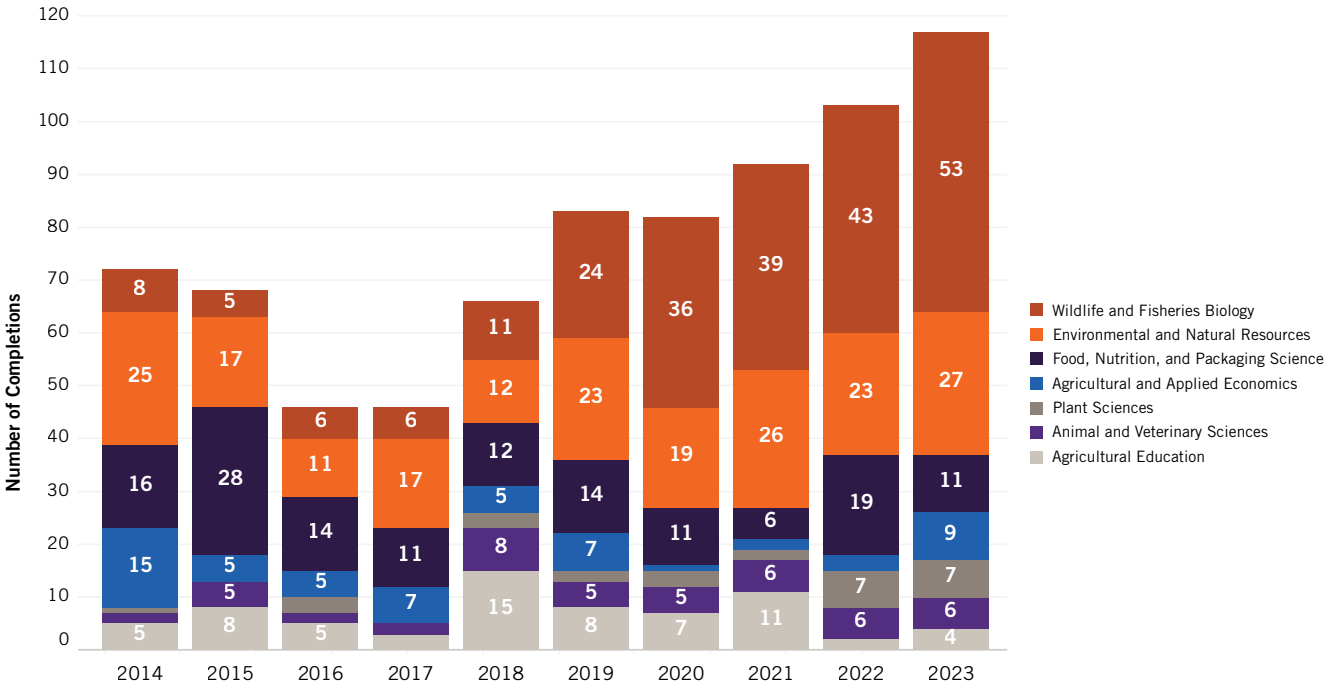
Degree Type	2023 Completions	2014-23 Change (%)
Animal and Veterinary Sciences	107	+27%
Environmental and Natural Resources	77	+40%
Food Science and Nutrition	64	-14%
Agricultural and Applied Economics	47	+52%
Packaging Science	44	+0%
Wildlife and Fisheries Biology	43	-7%
Plant Sciences	18	-22%
Agricultural Education	10	-9%
TOTAL	410	+11%

Source: TEConomy analysis of Clemson University graduation data

Master's degree completions have grown significantly and relatively steadily over the time period, from 72 completions in 2014 to 117 completions in 2023 (see Figure 22). The growth in graduate degree completions is encouraging and suggests that post-secondary education remains an attractive goal for many South Carolina students. These students contribute not just to the economy, but to academia and society through their research and experimentation.

97 When discussing majors, TEConomy has chosen to consolidate several program titles, combining programs whose names have changed over the last decade and combining major categories that require the same minimum qualifications. In this case, one program (Food, Nutrition, and Packaging Sciences) was separated to provide explicit emphasis on the unique nature of the Packaging Sciences degree.

Figure 22: CAFLS Degree Completions by Field (Master's Degrees Only)



Source: TEConomy analysis of Clemson University graduation data

This growth has been driven primarily by a disproportionately large increase in the Wildlife and Fisheries Biology degree programming, growing more than 550 percent (from 8 to 53) over the time period and nearly singlehandedly drove the high growth in master's degree completions since 2014. The Environmental and Natural Resources major also saw slight overall growth from 2014-2023, but three other majors saw declines. Smaller programs, like Plant Sciences and Animal & Veterinary Sciences have also seen relatively high growth but are limited in their impact by the small total number of completed degrees (Table 22).

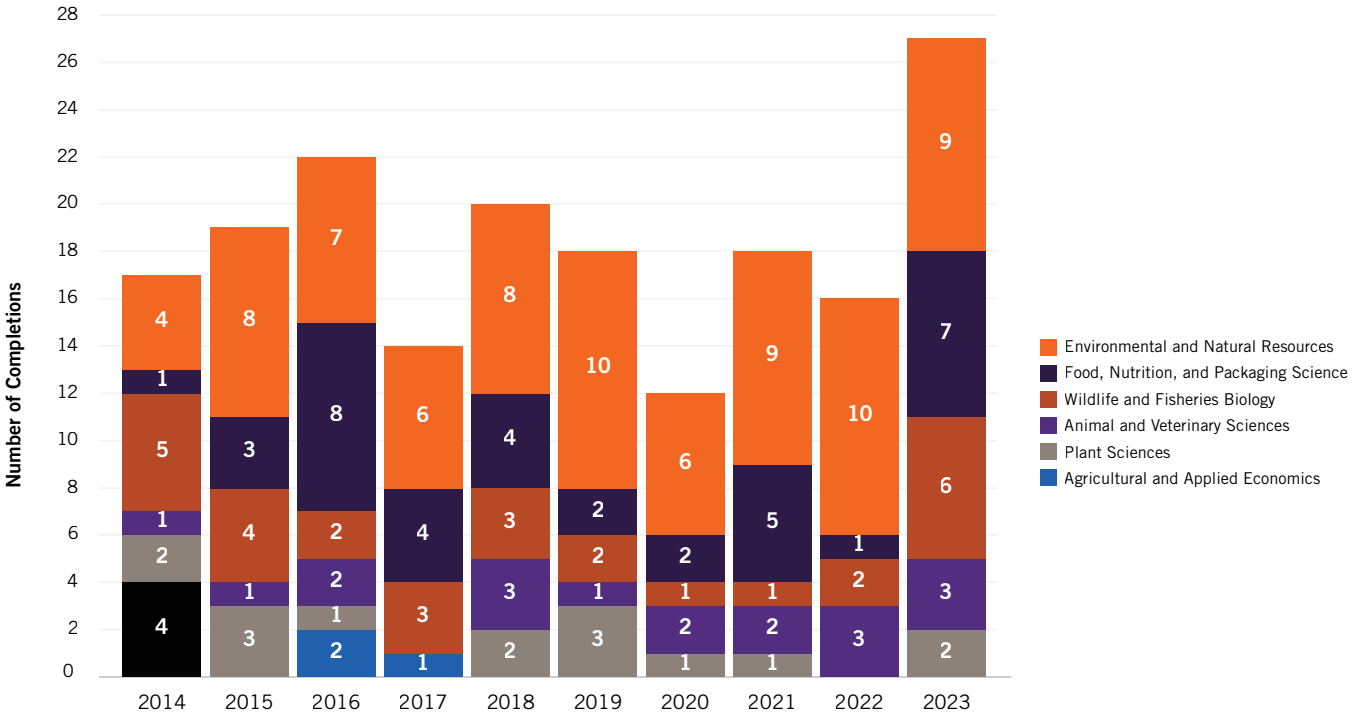
Table 22: CAFLS Degree Completions by Field (MA/MS Only)

Degree Type	2023 Completions	2014-2023 Change (%)
Wildlife and Fisheries Biology	53	+563%
Environmental and Natural Resources	27	+8%
Food, Nutrition, and Packaging Sciences	11	-31%
Agricultural and Applied Economics	9	-40%
Plant Sciences	7	+600%
Animal and Veterinary Sciences	6	+200%
Agricultural Education	4	-20%
TOTAL	**117**	**+63%**

Source: TEConomy analysis of Clemson University graduation data

The number of PhD completions remained stagnant from 2014-2022 (hovering around an average of 18 completions per year) but jumped significantly in 2023 to 27 completions (Figure 23). Completions by major are generally inconsistent from 2014-2023, but Environmental and Natural Resources and Food, Nutrition, and Packaging Sciences tend to make up the largest shares (Table 23).

Figure 23: CAFLS Degree Completions by Field (Doctorate Degrees Only)



Source: TEConomy analysis of Clemson University graduation data
Note: The "Environmental and Natural Resources" major is combined with Forest Management, contributing to a higher share of majors

Table 23: CAFLS Degree Completions by Field (PhD Only)

Degree Type	2023 Completions	2014-2023 Change (%)
Environmental and Natural Resources	9	+125%
Food, Nutrition, and Packaging Sciences	7	+600%
Wildlife and Fisheries Biology	6	+20%
Animal and Veterinary Sciences	3	+200%
Plant Sciences	2	+0%
Agricultural and Applied Economics	0	-100%
TOTAL	**27**	**+59%**

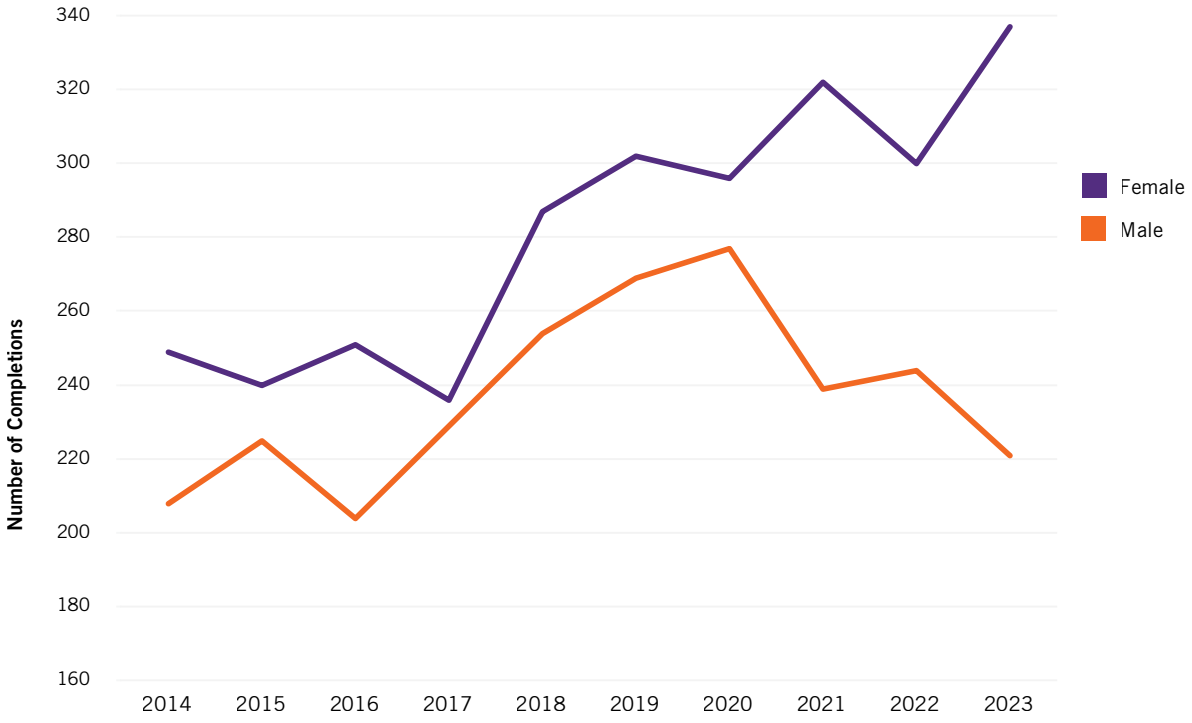
Source: TEConomy analysis of Clemson University graduation data

Doctorate degrees have a significant impact on a state's economy, regardless of whether the talent is able to be retained. Doctorate holders often engage in cutting-edge research, pushing the boundaries of knowledge in their fields. This research can lead to new technologies, processes, and products that drive economic growth. PhDs also frequently contribute to patentable inventions and innovations, especially in STEM fields, which can be commercialized, leading to new businesses and industries. Additionally, many PhD graduates become educators, training the next generation of professionals and researchers, thereby sustaining a highly skilled workforce that South Carolina hopes to maintain.

The demographic makeup of CAFLS graduates also warrants discussion. Purdue Global writes that diversity "can help people develop empathy, build meaningful relationships, expand their worldviews, and become more innovative through collaboration."[98] This diversity can better inform innovations, encourage new ideas, and engage communities across other cultural gaps. Looking at the makeup of graduating classes provides a "first look" at the young adults who will be forming the backbone of management teams within the next decades. With regard to gender disparities, the divide between female and male graduates has increased dramatically since 2014, with approximately 50 percent more female degree completions than male degree completions (see Figure 24).

98 https://www.purdueglobal.edu/blog/student-life/why-diversity-in-colleges-universities-matters/

Figure 24: CAFLS Degree Completions by Sex

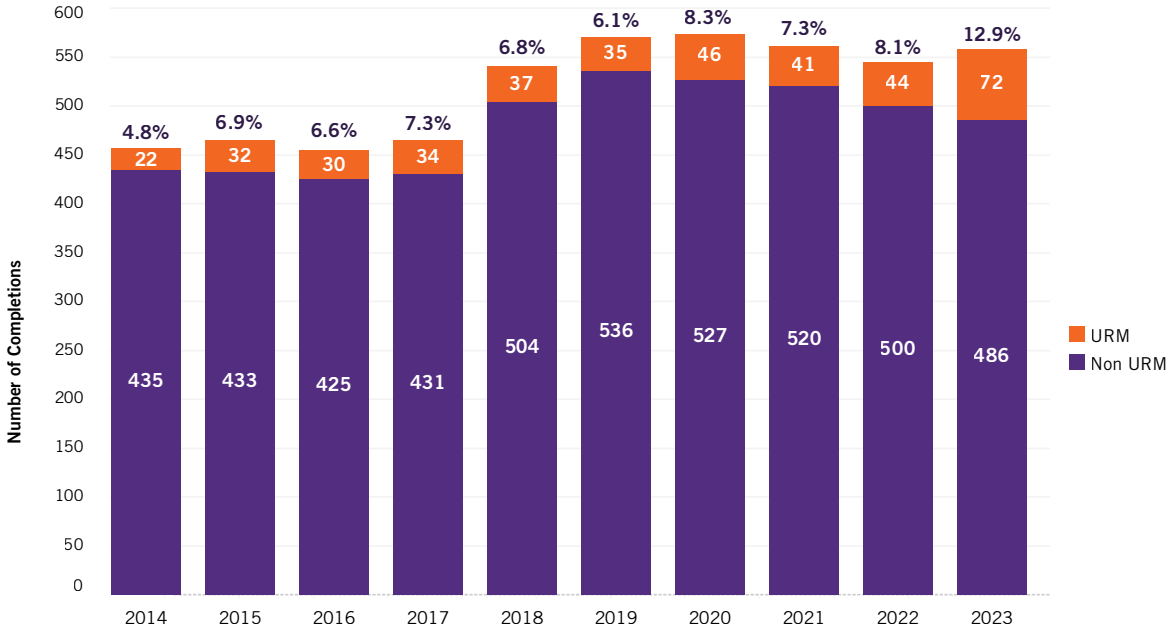


Source: TEConomy analysis of Clemson University graduation data

CAFLS degree completions have historically been dominated by non-minority students (see Figure 25). Clemson University uses a definition of Underrepresented Minority (URM) to refer to students whose Race/Ethnicity is "Hispanic," "African American," "American Indian," "Pacific Islander," or "Two or More Races" (excluding Asian and White Only).[99] Relative minority graduation rates have increased from 2014 (4.8 percent) to 2023 (12.9 percent). This ratio, while improving, remains disproportionate to the state's general demographics, which are approximately 61.6 percent White versus 12.4 percent African American, 18.7 percent Hispanic, and 6 percent Asian.[100]

99 https://www.clemson.edu/institutional-effectiveness/oir/factbook/
100 https://www.census.gov/library/stories/state-by-state/south-carolina-population-change-between-census-decade.html

Figure 25: CAFLS Degree Completions by Minority Status



Source: TEConomy analysis of Clemson University graduation data

As a result, the data suggests that CAFLS degrees are becoming increasingly diverse, with a considerably larger share going to women and URM recipients since 2014. Additionally, 25 countries are represented in CAFLS's enrolled student body.[101] This diversity will serve to bolster new ideas and perspectives throughout South Carolina's industries, as well as encourage more previously marginalized demographics to engage with the agribusiness industry.

According to the South Carolina Education Oversight Committee, South Carolina college graduates earn nearly $800,000 more than high school graduates over their lifetimes and earn approximately $1,200,000 more than high school dropouts over their lifetimes. Since 2014, CAFLS has awarded 5,190 total degrees across all of its programs and degree levels. Compared to a scenario in which each of those degree holders completed high school but did not continue to college, CAFLS has created an economic impact of approximately $4.2 billion over the lifetimes of its degree holders since 2014. **When considering just the 558 students who graduated with a CAFLS degree in 2023, this estimated lifetime earnings exceeds $464 million, or $9.9 million annualized over the course of their careers (45 years).** This economic contribution is likely understated, given that its pipeline to STEM- and degree-heavy jobs within the agricultural industry is a vital source of talent.

Additionally, attainment of formal education through CAFLS provides more than a monetary impact to graduates. Multiple studies have illustrated a clear correlation between education attainment and a drop in crime, an increase in life expectancy, reduced burdens resulting from chronic illnesses, and overall decreases in antisocial

101 https://www.clemson.edu/cafls/about/index.html

behavior. [102,103,104] Educated members of society are also more likely to give to charity and engage with their communities, making education not just an individual good but an activity that benefits society at large. CAFLS is producing highly skilled, competitive workers who are more likely to contribute to their jobs, the economy, their communities, their families, and themselves.

Lifelong Learning/Master Training Programs

CAFLS also offers several Master Training Programs that operate using a "train-the-trainer" method. Members and students are educated on a topic, and as part of their training, then educate others, proliferating the knowledge and reinforcing the experience (Table 24). Courses are given in a hybrid format, utilizing a combination of online lessons, quizzes, and presentations with in-person experiences, trainings, and projects.

Table 24: CAFLS Master Training Programs

Program Title	Program Description	Skills and Topics Taught
Master Gardener	Trains, selects, and utilizes knowledgeable volunteers to facilitate the educational work of the local Horticulture Agent by delivering research-based information to the citizens of the state.	• Plant nutrition • Entomology • Lawn management • Plant pathology • Problem solving
Master Food Preserver	Works to extend Clemson Extension's food preservation educational programs to adults and youth by providing research-based non-bias information from Clemson Cooperative Extension Service and USDA.	• Food safety • Canning • Jams and jellies • Pickling • Fermentation
Master Naturalist	Provides nature-based education that inspires citizen volunteers to promote environmental stewardship within their communities.	• Geology • Local flora and fauna • Data collection
Master Pond Manager	Teaches participants a wide range of pond management knowledge and skills.	• Pond design • Water quality • Fish management
Master Rain Gardener	Provides design standards and the knowledge-based skill set necessary to install rain gardens and rainwater harvesting systems on a residential scale.	• Site assessment • Soil analysis • Plant selection • Maintenance
Master Tree Farmer	Provides scientific and practical knowledge to manage forested land to best suit ecological, economical, and recreational forest resources.	• Harvesting • Pine management • Forest health • Timber taxes

102 https://record.umich.edu/articles/public-school-investment-reduces-adult-crime-study-shows/
103 https://ajph.aphapublications.org/doi/10.2105/AJPH.2019.305506
104 https://publichealth.tulane.edu/blog/social-determinant-of-health-education-is-crucial/

These programs target topics and skills that are traditionally underserved by formal education institutions, including individual efforts toward self-sufficiency and sustainability. Communities that can grow their own food, manage their natural resources, and conserve their ecosystems are more resilient to food shortages or price fluctuations.[105] Especially in poorer, more rural areas of the state, resiliency against external shocks to food supply and price are important aspects of food security at both the individual and community levels. These programs also emphasize sustainable practices that benefit the environment, which fosters a sense of environmental stewardship that leads to healthier ecosystems and habitats.

These knowledge-sharing practices serve not only to create a ripple effect that spreads valuable skills and information throughout local communities but also to increase engagement between community members. When knowledge and experience are fostered amongst peers, rather than limiting learning to rigid academic environments, opportunities for growth become collective.

Program Area: Master Training Programs

Master Gardener Program Example

The South Carolina Master Gardener Program trains, selects, and utilizes knowledgeable volunteers to facilitate educational horticulture work by delivering research-based information to South Carolina's residents. Throughout 27 of South Carolina's counties, the program works to leverage these volunteers to create a large-scale base of expertise to serve the needs of South Carolina's diverse communities. The Cooperative Extension Master Gardener program is designed to not only enhance individual gardening expertise but also to extend the reach of university-based agricultural knowledge to the broader community, thereby promoting sustainable and successful gardening practices.

In the Master Gardener Program, participants receive a minimum of 40 hours of practical horticulture training covering topics such as plant nutrition, entomology, plant pathology, vegetable gardening, lawn management, woody ornamental culture, and problem solving. Once a certification is earned after the initial training, South Carolina Master Gardeners are required to complete 20 hours of educational service and 10 hours of continuing education per year to maintain their title.

Key Impacts:

In 2022, South Carolina's program had 919 active Master Gardeners both undergoing and providing comprehensive educational training in various aspects of horticulture. As part of their training, the Master Gardeners commit to volunteering at various community service projects that both encourage learning and serve to better the local region. In 2022, the program reached 184,210 adults and 24,256 youths. **The estimated value of the volunteer time given through the Master Gardener program is approximately $2.1 million.**[106]

Other impacts include:

- Enhanced community education.
- Increased volunteer engagement.
- Improved local horticulture practices.

105 https://www.intechopen.com/chapters/81975
106 https://www.clemson.edu/extension/mg/about.html

Program Area: Clemson University Master Training Programs

Master Food Preserver Example

Food insecurity, once on a steady downtrend, rose in 2022 as a result of globally higher food prices and international conflict. Although food prices are predicted to stabilize or decline within the next ten years, the insecurity crisis around the world continues to be exacerbated by international wars and disputes that can cause shortages in energy, fertilizer, and fuel.[107]

The Master Food Preserver program is a comprehensive educational initiative designed to equip participants with advanced knowledge and skills in food preservation. This program aims to promote safe and effective methods of preserving food through various techniques such as canning, freezing, drying, and fermenting. Participants also receive in-depth training on food safety, proper preservation methods, and the science behind food preservation to ensure quality and safety.

Certification requires a two-phase educational cycle of online self-paced study and 30 hours of volunteer service. The volunteer work required varies by county, but generally involves extending Clemson Extension's good preservation educational programs to both youths and adults. Activities include assisting food preservation workshops, providing information at markets, preparing educational displays, and hosting presentations for community groups or schools. Once complete, Master Food Preservers are required to complete 20 hours of educational service and 10 hours of continuing education per year to maintain their title.

The Master Food Preserver is a recent addition to Clemson Extension's portfolio of community outreach, with the pilot program beginning in 2022. By February 2023, 36 South Carolina residents had graduated from the first class in the program. Multiple graduates have expressed their desire to bring this newfound knowledge back to their families and their communities, proliferating the knowledge throughout the state.[108]

Key Impacts:

- Improved food safety and food safety knowledge.
- Increased community outreach and education.
- Promotion of self-sufficiency and sustainability.

107 https://www.ers.usda.gov/amber-waves/2022/november/global-food-insecurity-grows-in-2022-amid-backdrop-of-higher-prices-black-sea-conflict/
108 https://www.morningagclips.com/s-c-residents-become-master-food-preservers/

CONCLUSION

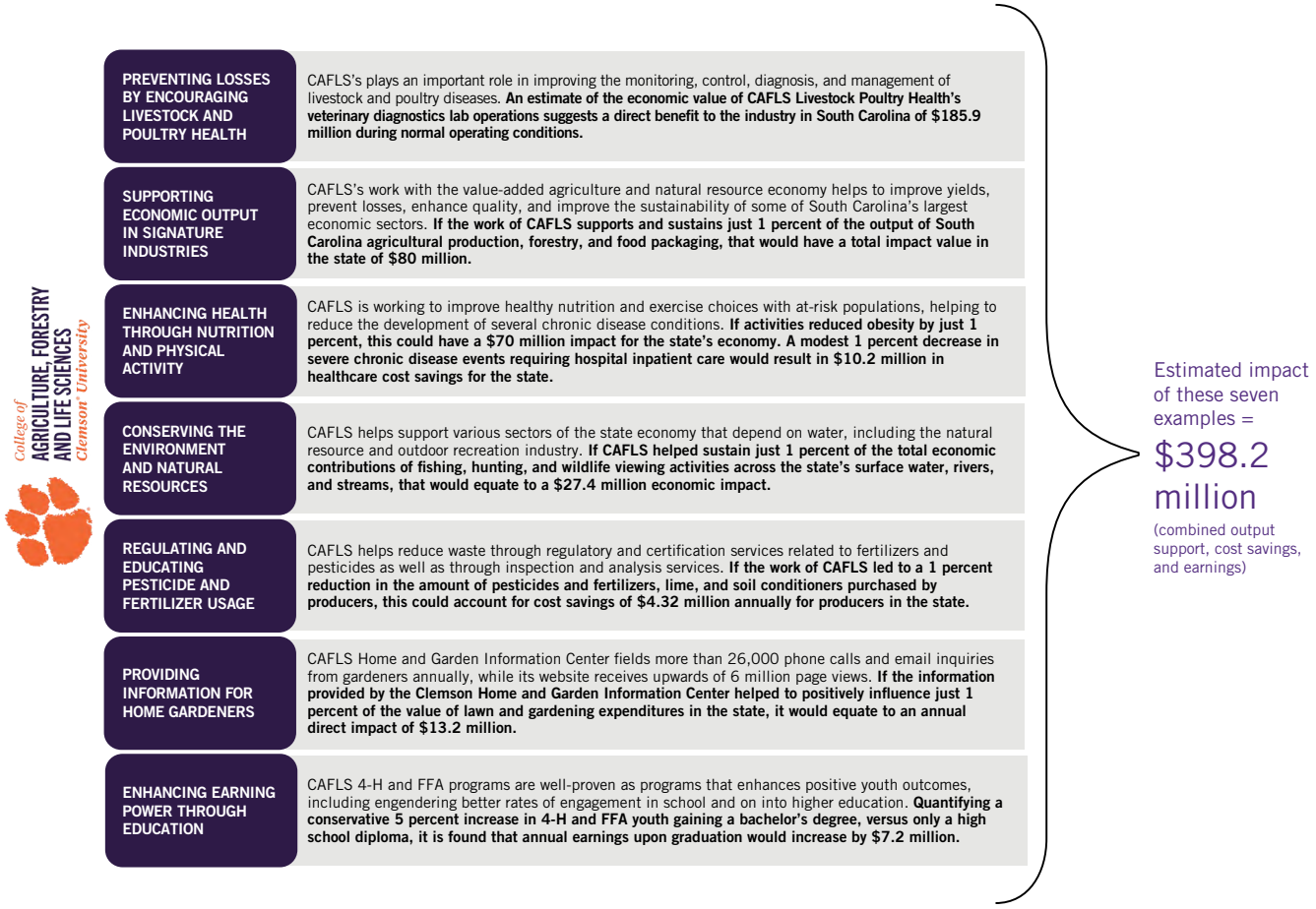
CAFLS is a significant economic catalyst for the State of South Carolina. Simply in terms of expenditure impacts, CAFLS generates a total output impact of $278 million in the South Carolina economy on an annual basis and supports 2,756 jobs with labor income totaling $128 million. These expenditure impacts are, however, eclipsed in their importance by the impacts accruing to the state through the wide array of services provided through CAFLS's network of programs and initiatives. The work of CAFLS can be understood as taking place under five major thematic areas that are highlighted in Figure 26 and detailed in the previous chapter.

Figure 26: Key Themes for CAFLS's Programming and Activities

Source: TEConomy Partners, LLC.

These impacts are categorized by economists as "forward-linkage impacts," which, rather than being related to institutional spending, are related to institutional mission and function. It is these impacts that are making a difference in the everyday lives of South Carolinians in every county across the state. Figure 27 highlights just a few of the case studies and estimations used in this report to assess the functional impacts across thematic areas.

Figure 27: Examples of CAFLS's Functional Impacts



Source: TEConomy Partners, LLC.

Overall, the funding for CAFLS clearly provides strong benefits and positive impacts in return for the investment. For an annual total investment of $157.3 million (all sources of funding in fiscal year 2023), CAFLS's programs are generating wide-ranging returns. The total output impacts of the operation's expenditures ($278 million), when combined with the agricultural output, cost savings, and increased income generated from just the seven programs illustrated in Figure 28 ($398.2 million), combine for $676.2 million (both expenditure impacts and functional impacts combined) in an average year, an amount that is four times higher than the annual investment in the system.

The bottom line is that **CAFLS generates strong economic returns for the federal, state, and county investments it receives.** These returns occur through direct expansion of the economy through the improved performance of

key agriculture, forestry, and value-added processing industries as well as through a broad-suite of additional benefits and cost savings that CAFLS efforts make possible. **Into the future, CAFLS's unique quaternary-part mission of education, research, extension, and regulation will remain exceptionally relevant to securing a successful, healthy, and productive South Carolina.**

APPENDIX A: CAFLS COUNTY-LEVEL IMPACTS

Abbeville County CAFLS Expenditure-Based Impacts

The following data captures the operational expenditures of CAFLS and the resultant economic impact of these expenditures in Abbeville County, including CAFLS-generated intercounty/intrastate impacts. The economic impact models estimate and treat purchases from entities outside of a specific geography as imports (or economic leakages) which are not captured in the total impacts.

It is important to note that the principal impacts of CAFLS are generated through the mission-oriented programs and activities that are delivered by faculty, staff, and field agents throughout the county—these functional impacts are discussed in the main report.

Table A provides the operational details of CAFLS Abbeville County operations. In FY 2023, CAFLS employed 5 workers, all in Cooperative Extension, with combined personnel and operating expenditures of nearly $420,000.

Table A: Operational Metrics for CAFLS Activities in Abbeville County, SC (FY 2023)

County	FY 2023 CAFLS Headcount	FY 2023 CAFLS Expenditures		
		Personnel	Operating	Capital
Abbeville	5	$332,024	$87,894	

Source: Clemson University CAFLS

As a result of the FY 2023 expenditures and employment, CAFLS generated the following economic impacts in Abbeville County:

- Total expenditure-based economic impact (as measured by total output impacts) of more than $635,000.
- 6.3 total jobs supported in the County receiving more than $374,000 in total compensation.

Further details regarding CAFLS-generated expenditure-based impacts in Abbeville County are shown in Table B.

Table B: Economic Impact of CAFLS Activities in Abbeville County (FY 2023)

Impact Type	Employ-ment	Labor Income	Value Added	Output	County/ Local Tax Revenue	State Tax Revenue	Federal Tax Revenue
Direct Effect	5.0	$332,024	$332,024	$419,918	$419	$5,134	$75,913
Indirect Effect	0.5	$16,441	$25,694	$70,270	$1,190	$1,132	$4,000
Induced Effect	0.9	$25,989	$81,249	$144,942	$7,180	$5,567	$8,085
Total Impacts	6.3	$374,454	$438,968	$635,129	$8,789	$11,833	$87,998
Multiplier	***1.27***	***1.13***	***1.32***	***1.51***			

Source: TEConomy analysis, South Carolina IMPLAN MRIO Model

Aiken County CAFLS Expenditure-Based Impacts

The following data captures the operational expenditures of CAFLS and the resultant economic impact of these expenditures in Aiken County, including CAFLS-generated intercounty/intrastate impacts. The economic impact models estimate and treat purchases from entities outside of a specific geography as imports (or economic leakages) which are not captured in the total impacts.

It is important to note that the principal impacts of CAFLS are generated through the mission-oriented programs and activities that are delivered by faculty, staff, and field agents throughout the county—these functional impacts are discussed in the main report.

Table A provides the operational details of CAFLS Aiken County operations. In FY 2023, CAFLS employed 5 workers, all in Cooperative Extension, with combined personnel and operating expenditures of nearly $350,000.

Table A: Operational Metrics for CAFLS Activities in Aiken County, SC (FY 2023)

County	FY 2023 CAFLS Headcount	FY 2023 CAFLS Expenditures		
		Personnel	Operating	Capital
Aiken	5	$264,830	$84,344	

Source: Clemson University CAFLS

As a result of the FY 2023 expenditures and employment, CAFLS generated the following economic impacts in Aiken County:

- Total expenditure-based economic impact (as measured by total output impacts) of more than $1.390 million.
- 12.7 total jobs supported in the County receiving more than $617,000 in total compensation.

Further details regarding CAFLS-generated expenditure-based impacts in Aiken County are shown in Table B.

Table B: Economic Impact of CAFLS Activities in Aiken County (FY 2023)

Impact Type	Employment	Labor Income	Value Added	Output	County/ Local Tax Revenue	State Tax Revenue	Federal Tax Revenue
Direct Effect	5.0	$264,830	$264,830	$349,174	$175	$4,545	$52,995
Indirect Effect	5.5	$263,920	$362,283	$701,481	$4,768	$10,029	$56,438
Induced Effect	2.2	$89,016	$203,735	$344,184	$12,035	$13,719	$22,322
Total Impacts	12.7	$617,766	$830,848	$1,394,839	$16,978	$28,293	$131,755
Multiplier	***2.53***	***2.33***	***3.14***	***3.99***			

Source: TEConomy analysis, South Carolina IMPLAN MRIO Model

Allendale County CAFLS Expenditure-Based Impacts

The following data captures the operational expenditures of CAFLS and the resultant economic impact of these expenditures in Allendale County, including CAFLS-generated intercounty/intrastate impacts. The economic impact models estimate and treat purchases from entities outside of a specific geography as imports (or economic leakages) which are not captured in the total impacts.

It is important to note that the principal impacts of CAFLS are generated through the mission-oriented programs and activities that are delivered by faculty, staff, and field agents throughout the county—these functional impacts are discussed in the main report.

Table A provides the operational details of CAFLS Allendale County operations. In FY 2023, CAFLS employed 3 workers, all in Cooperative Extension, with combined personnel and operating expenditures of more than $290,000.

Table A: Operational Metrics for CAFLS Activities in Allendale County, SC (FY 2023)

County	FY 2023 CAFLS Headcount	FY 2023 CAFLS Expenditures		
		Personnel	Operating	Capital
Allendale	3	$270,630	$23,238	

Source: Clemson University CAFLS

As a result of the FY 2023 expenditures and employment, CAFLS generated the following economic impacts in Allendale County:

- Total expenditure-based economic impact (as measured by total output impacts) of more than $380,000.
- 3.5 total jobs supported in the County receiving more than $284,000 in total compensation.

Further details regarding CAFLS-generated expenditure-based impacts in Allendale County are shown in Table B.

Table B: Economic Impact of CAFLS Activities in Allendale County (FY 2023)

Impact Type	Employ-ment	Labor Income	Value Added	Output	County/ Local Tax Revenue	State Tax Revenue	Federal Tax Revenue
Direct Effect	3.0	$270,630	$270,630	$293,868	$220	$3,780	$48,698
Indirect Effect	0.2	$4,674	$20,206	$37,170	$8,793	$3,333	$2,000
Induced Effect	0.3	$9,583	$30,124	$50,700	$3,295	$1,572	$2,775
Total Impacts	3.5	$284,887	$320,960	$381,738	$12,309	$8,684	$53,473
Multiplier	***1.16***	***1.05***	***1.19***	***1.30***			

Source: TEConomy analysis, South Carolina IMPLAN MRIO Model

Anderson County CAFLS Expenditure-Based Impacts

The following data captures the operational expenditures of CAFLS and the resultant economic impact of these expenditures in Anderson County, including CAFLS-generated intercounty/intrastate impacts. The economic impact models estimate and treat purchases from entities outside of a specific geography as imports (or economic leakages) which are not captured in the total impacts.

It is important to note that the principal impacts of CAFLS are generated through the mission-oriented programs and activities that are delivered by faculty, staff, and field agents throughout the county—these functional impacts are discussed in the main report.

Table A provides the operational details of CAFLS Anderson County operations, including part of the CAFLS main campus. In FY 2023, CAFLS employed 166 workers, including 72 in Cooperative Extension, 51 in Regulatory, and 36 in Research & Experiment Stations, with combined personnel, operating, and capital expenditures of more than $15.6 million.

Table A: Operational Metrics for CAFLS Activities in Anderson County, SC (FY 2023)

County	FY 2023 CAFLS Headcount	FY 2023 CAFLS Expenditures		
		Personnel	Operating	Capital
Anderson	166	$8,787,574	$4,340,923	$2,515,767

Source: Clemson University CAFLS

As a result of the FY 2023 expenditures and employment, CAFLS generated the following economic impacts in Anderson County:

- Total expenditure-based economic impact (as measured by total output impacts) of more than $26.7 million.
- 240 total jobs supported in the County receiving more than $11.7 million in total compensation.

Further details regarding CAFLS-generated expenditure-based impacts in Anderson County are shown in Table B.

Table B: Economic Impact of CAFLS Activities in Anderson County (FY 2023)

Impact Type	Employment	Labor Income	Value Added	Output	County/ Local Tax Revenue	State Tax Revenue	Federal Tax Revenue
Direct Effect	166.0	$8,787,574	$8,787,574	$15,644,265	$6,105	$160,220	$1,862,106
Indirect Effect	30.7	$1,276,167	$1,972,861	$4,522,537	$86,888	$131,372	$291,434
Induced Effect	43.3	$1,656,098	$3,906,971	$6,710,531	$234,083	$323,265	$441,555
Total Impacts	240.0	$11,719,839	$14,667,407	$26,877,333	$327,075	$614,857	$2,595,094
Multiplier	***1.45***	***1.33***	***1.67***	***1.72***			

Source: TEConomy analysis, South Carolina IMPLAN MRIO Model

Bamberg County CAFLS Expenditure-Based Impacts

The following data captures the operational expenditures of CAFLS and the resultant economic impact of these expenditures in Bamberg County, including CAFLS-generated intercounty/intrastate impacts. The economic impact models estimate and treat purchases from entities outside of a specific geography as imports (or economic leakages) which are not captured in the total impacts.

It is important to note that the principal impacts of CAFLS are generated through the mission-oriented programs and activities that are delivered by faculty, staff, and field agents throughout the county—these functional impacts are discussed in the main report.

Table A provides the operational details of CAFLS Bamberg County operations. In FY 2023, CAFLS employed 6 workers, 5 in Cooperative Extension and 1 in Regulatory, with combined personnel and operating expenditures of over $523,000.

Table A: Operational Metrics for CAFLS Activities in Bamberg County, SC (FY 2023)

County	FY 2023 CAFLS Headcount	FY 2023 CAFLS Expenditures		
		Personnel	Operating	Capital
Bamberg	6	$466,170	$56,972	

Source: Clemson University CAFLS

As a result of the FY 2023 expenditures and employment, CAFLS generated the following economic impacts in Bamberg County:

- Total expenditure-based economic impact (as measured by total output impacts) of more than $974,000.
- 8.9 total jobs supported in the County receiving nearly $556,000 in total compensation.

Further details regarding CAFLS-generated expenditure-based impacts in Bamberg County are shown in Table B.

Table B: Economic Impact of CAFLS Activities in Bamberg County (FY 2023)

Impact Type	Employ-ment	Labor Income	Value Added	Output	County/ Local Tax Revenue	State Tax Revenue	Federal Tax Revenue
Direct Effect	6.0	$466,170	$466,170	$523,142	$512	$8,249	$101,878
Indirect Effect	1.3	$36,991	$79,314	$213,821	$10,375	$7,352	$9,943
Induced Effect	1.6	$52,606	$130,454	$237,694	$11,271	$8,594	$14,903
Total Impacts	8.9	$555,767	$675,939	$974,656	$22,158	$24,195	$126,724
Multiplier	***1.48***	***1.19***	***1.45***	***1.86***			

Source: TEConomy analysis, South Carolina IMPLAN MRIO Model

Barnwell County CAFLS Expenditure-Based Impacts

The following data captures the operational expenditures of CAFLS and the resultant economic impact of these expenditures in Barnwell County, including CAFLS-generated intercounty/intrastate impacts. The economic impact models estimate and treat purchases from entities outside of a specific geography as imports (or economic leakages) which are not captured in the total impacts.

It is important to note that the principal impacts of CAFLS are generated through the mission-oriented programs and activities that are delivered by faculty, staff, and field agents throughout the county—these functional impacts are discussed in the main report.

Table A provides the operational details of CAFLS Barnwell County operations. In FY 2023, CAFLS employed 102 workers in Barnwell County with 87 in Research & Experiment Stations and 15 in Cooperative Extension, with combined personnel, operating, and capital expenditures of more than $8.5 million.

Table A: Operational Metrics for CAFLS Activities in Barnwell County, SC (FY 2023)

County	FY 2023 CAFLS Headcount	FY 2023 CAFLS Expenditures		
		Personnel	Operating	Capital
Barnwell	102	$4,722,351	$2,260,239	$1,527,524

Source: Clemson University CAFLS

As a result of the FY 2023 expenditures and employment, CAFLS generated the following economic impacts in Barnwell County:

- Total expenditure-based economic impact (as measured by total output impacts) of more than $12.1 million.
- 127.7 total jobs supported in the County receiving over $5.4 million in total compensation.

Further details regarding CAFLS-generated expenditure-based impacts in Barnwell County are shown in Table B.

Table B: Economic Impact of CAFLS Activities in Barnwell County (FY 2023)

Impact Type	Employment	Labor Income	Value Added	Output	County/ Local Tax Revenue	State Tax Revenue	Federal Tax Revenue
Direct Effect	102.0	$4,722,351	$4,722,351	$8,510,114	$3,917	$90,743	$1,133,279
Indirect Effect	15.7	$417,903	$651,277	$2,140,568	$34,950	$47,808	$103,833
Induced Effect	10.0	$287,767	$793,565	$1,484,976	$51,858	$65,454	$87,331
Total Impacts	127.7	$5,428,021	$6,167,194	$12,135,659	$90,726	$204,004	$1,324,443
Multiplier	***1.25***	***1.15***	***1.31***	***1.43***			

Source: TEConomy analysis, South Carolina IMPLAN MRIO Model

Beaufort County CAFLS Expenditure-Based Impacts

The following data captures the operational expenditures of CAFLS and the resultant economic impact of these expenditures in Beaufort County, including CAFLS-generated intercounty/intrastate impacts. The economic impact models estimate and treat purchases from entities outside of a specific geography as imports (or economic leakages) which are not captured in the total impacts.

It is important to note that the principal impacts of CAFLS are generated through the mission-oriented programs and activities that are delivered by faculty, staff, and field agents throughout the county—these functional impacts are discussed in the main report.

Table A provides the operational details of CAFLS Beaufort County operations. In FY 2023, CAFLS employed 7 workers, 6 in Cooperative Extension and 1 in E&G, with combined personnel and operating expenditures of more than $675,000.

Table A: Operational Metrics for CAFLS Activities in Beaufort County, SC (FY 2023)

County	FY 2023 CAFLS Headcount	FY 2023 CAFLS Expenditures		
		Personnel	Operating	Capital
Beaufort	7	$449,755	$226,100	

Source: Clemson University CAFLS

As a result of the FY 2023 expenditures and employment, CAFLS generated the following economic impacts in Beaufort County:

- Total expenditure-based economic impact (as measured by total output impacts) of nearly $1.5 million.
- 11.5 total jobs supported in the County receiving nearly $635,000 in total compensation.

Further details regarding CAFLS-generated expenditure-based impacts in Beaufort County are shown in Table B.

Table B: Economic Impact of CAFLS Activities in Beaufort County (FY 2023)

Impact Type	Employ-ment	Labor Income	Value Added	Output	County/ Local Tax Revenue	State Tax Revenue	Federal Tax Revenue
Direct Effect	7.0	$449,755	$449,755	$675,855	$577	$8,740	$94,777
Indirect Effect	2.6	$98,615	$218,374	$483,658	$5,652	$6,185	$22,500
Induced Effect	1.9	$86,299	$185,403	$309,352	$11,346	$9,282	$19,722
Total Impacts	11.5	$634,669	$853,532	$1,468,865	$17,575	$24,207	$136,999
Multiplier	***1.64***	***1.41***	***1.90***	***2.17***			

Source: TEConomy analysis, South Carolina IMPLAN MRIO Model

Berkeley County CAFLS Expenditure-Based Impacts

The following data captures the operational expenditures of CAFLS and the resultant economic impact of these expenditures in Berkeley County, including CAFLS-generated intercounty/intrastate impacts. The economic impact models estimate and treat purchases from entities outside of a specific geography as imports (or economic leakages) which are not captured in the total impacts.

It is important to note that the principal impacts of CAFLS are generated through the mission-oriented programs and activities that are delivered by faculty, staff, and field agents throughout the county—these functional impacts are discussed in the main report.

Table A provides the operational details of CAFLS Berkeley County operations. In FY 2023, CAFLS employed 3 workers, all in Cooperative Extension, with combined personnel and operating expenditures of nearly $285,000.

Table A: Operational Metrics for CAFLS Activities in Berkeley County, SC (FY 2023)

County	FY 2023 CAFLS Headcount	FY 2023 CAFLS Expenditures		
		Personnel	Operating	Capital
Berkeley	3	$209,700	$75,240	

Source: Clemson University CAFLS

As a result of the FY 2023 expenditures and employment, CAFLS generated the following economic impacts in Berkeley County:

- Total expenditure-based economic impact (as measured by total output impacts) of nearly $2.0 million.
- 11.5 total jobs supported in the County receiving nearly $670,000 in total compensation.

Further details regarding CAFLS-generated expenditure-based impacts in Berkeley County are shown in Table B.

Table B: Economic Impact of CAFLS Activities in Berkeley County (FY 2023)

Impact Type	Employ-ment	Labor Income	Value Added	Output	County/ Local Tax Revenue	State Tax Revenue	Federal Tax Revenue
Direct Effect	3.0	$209,700	$209,700	$284,940	$116	$2,948	$38,988
Indirect Effect	3.5	$241,777	$365,473	$769,499	$7,707	$11,720	$50,435
Induced Effect	5.0	$218,515	$527,887	$907,737	$32,707	$34,685	$53,375
Total Impacts	11.5	$669,992	$1,103,060	$1,962,176	$40,530	$49,352	$142,798
Multiplier	***3.84***	***3.19***	***5.26***	***6.89***			

Source: TEConomy analysis, South Carolina IMPLAN MRIO Model

Calhoun County CAFLS Expenditure-Based Impacts

The following data captures the operational expenditures of CAFLS and the resultant economic impact of these expenditures in Calhoun County, including CAFLS-generated intercounty/intrastate impacts. The economic impact models estimate and treat purchases from entities outside of a specific geography as imports (or economic leakages) which are not captured in the total impacts.

It is important to note that the principal impacts of CAFLS are generated through the mission-oriented programs and activities that are delivered by faculty, staff, and field agents throughout the county—these functional impacts are discussed in the main report.

Table A provides the operational details of CAFLS Calhoun County operations. In FY 2023, CAFLS employed 2 workers, all in Cooperative Extension, with combined personnel and operating expenditures of more than $145,000.

Table A: Operational Metrics for CAFLS Activities in Calhoun County, SC (FY 2023)

County	FY 2023 CAFLS Headcount	FY 2023 CAFLS Expenditures		
		Personnel	Operating	Capital
Calhoun	2	$126,003	$19,606	

Source: Clemson University CAFLS

As a result of the FY 2023 expenditures and employment, CAFLS generated the following economic impacts in Calhoun County:

- Total expenditure-based economic impact (as measured by total output impacts) of more than $660,000.
- 5.2 total jobs supported in the County receiving more than $242,000 in total compensation.

Further details regarding CAFLS-generated expenditure-based impacts in Calhoun County are shown in Table B.

Table B: Economic Impact of CAFLS Activities in Calhoun County (FY 2023)

Impact Type	Employ-ment	Labor Income	Value Added	Output	County/ Local Tax Revenue	State Tax Revenue	Federal Tax Revenue
Direct Effect	2.0	$126,003	$126,003	$145,609	$47	$1,166	$21,211
Indirect Effect	2.8	$103,105	$144,057	$433,278	$5,358	$4,566	$19,349
Induced Effect	0.4	$13,154	$49,993	$83,082	$4,187	$2,885	$3,980
Total Impacts	5.2	$242,262	$320,053	$661,970	$9,591	$8,617	$44,540
Multiplier	***2.59***	***1.92***	***2.54***	***4.55***			

Source: TEConomy analysis, South Carolina IMPLAN MRIO Model

Charleston County CAFLS Expenditure-Based Impacts

The following data captures the operational expenditures of CAFLS and the resultant economic impact of these expenditures in Charleston County, including CAFLS-generated intercounty/intrastate impacts. The economic impact models estimate and treat purchases from entities outside of a specific geography as imports (or economic leakages) which are not captured in the total impacts.

It is important to note that the principal impacts of CAFLS are generated through the mission-oriented programs and activities that are delivered by faculty, staff, and field agents throughout the county—these functional impacts are discussed in the main report.

Table A provides the operational details of CAFLS Charleston County operations. In FY 2023, CAFLS employed 88 workers, including 50 in Research and Experiment Stations, 22 in Cooperative Extension, 14 in Regulatory, and 2 in Livestock Poultry Health with combined personnel, operating, and capital expenditures of more than $10.0 million.

Table A: Operational Metrics for CAFLS Activities in Charleston County, SC (FY 2023)

County	FY 2023 CAFLS Headcount	FY 2023 CAFLS Expenditures		
		Personnel	Operating	Capital
Charleston	88	$4,342,900	$4,420,590	$1,328,691

Source: Clemson University CAFLS

As a result of the FY 2023 expenditures and employment, CAFLS generated the following economic impacts in Charleston County:

- Total expenditure-based economic impact (as measured by total output impacts) of more than $22.8 million.
- 154.3 total jobs supported in the County receiving $8.5 million in total compensation.

Further details regarding CAFLS-generated expenditure-based impacts in Charleston County are shown in Table B.

Table B: Economic Impact of CAFLS Activities in Charleston County (FY 2023)

Impact Type	Employ-ment	Labor Income	Value Added	Output	County/ Local Tax Revenue	State Tax Revenue	Federal Tax Revenue
Direct Effect	88.0	$4,342,900	$4,342,900	$10,092,181	$4,263	$65,661	$788,774
Indirect Effect	47.0	$3,016,842	$4,770,558	$9,105,041	$149,095	$152,749	$609,265
Induced Effect	19.3	$1,140,206	$2,206,357	$3,633,043	$128,467	$101,933	$247,211
Total Impacts	154.3	$8,499,949	$11,319,815	$22,830,265	$281,825	$320,343	$1,645,250
Multiplier	***1.75***	***1.96***	***2.61***	***2.26***			

Source: TEConomy analysis, South Carolina IMPLAN MRIO Model

Cherokee County CAFLS Expenditure-Based Impacts

The following data captures the operational expenditures of CAFLS and the resultant economic impact of these expenditures in Cherokee County, including CAFLS-generated intercounty/intrastate impacts. The economic impact models estimate and treat purchases from entities outside of a specific geography as imports (or economic leakages) which are not captured in the total impacts.

It is important to note that the principal impacts of CAFLS are generated through the mission-oriented programs and activities that are delivered by faculty, staff, and field agents throughout the county—these functional impacts are discussed in the main report.

Table A provides the operational details of CAFLS Cherokee County operations. In FY 2023, CAFLS employed 3 workers, all in Cooperative Extension, with combined personnel and operating expenditures of nearly $166,000.

Table A: Operational Metrics for CAFLS Activities in Cherokee County, SC (FY 2023)

County	FY 2023 CAFLS Headcount	FY 2023 CAFLS Expenditures		
		Personnel	Operating	Capital
Cherokee	3	$128,406	$37,434	

Source: Clemson University CAFLS

As a result of the FY 2023 expenditures and employment, CAFLS generated the following economic impacts in Cherokee County:

- Total expenditure-based economic impact (as measured by total output impacts) of nearly $287,000.
- 3.6 total jobs supported in the County receiving more than $154,000 in total compensation.

Further details regarding CAFLS-generated expenditure-based impacts in Cherokee County are shown in Table B.

Table B: Economic Impact of CAFLS Activities in Cherokee County (FY 2023)

Impact Type	Employ-ment	Labor Income	Value Added	Output	County/ Local Tax Revenue	State Tax Revenue	Federal Tax Revenue
Direct Effect	3.0	$128,406	$128,406	$165,841	$88	$2,185	$26,698
Indirect Effect	0.3	$14,290	$20,353	$70,374	$633	$954	$3,188
Induced Effect	0.3	$11,549	$29,737	$50,583	$1,925	$2,340	$3,163
Total Impacts	3.6	$154,245	$178,496	$286,797	$2,646	$5,479	$33,049
Multiplier	***1.21***	***1.20***	***1.39***	***1.73***			

Source: TEConomy analysis, South Carolina IMPLAN MRIO Model

Chester County CAFLS Expenditure-Based Impacts

The following data captures the operational expenditures of CAFLS and the resultant economic impact of these expenditures in Chester County, including CAFLS-generated intercounty/intrastate impacts. The economic impact models estimate and treat purchases from entities outside of a specific geography as imports (or economic leakages) which are not captured in the total impacts.

It is important to note that the principal impacts of CAFLS are generated through the mission-oriented programs and activities that are delivered by faculty, staff, and field agents throughout the county—these functional impacts are discussed in the main report.

Table A provides the operational details of CAFLS Chester County operations. In FY 2023, CAFLS employed 5 workers, all in Cooperative Extension, with combined personnel and operating expenditures of more than $250,000.

Table A: Operational Metrics for CAFLS Activities in Chester County, SC (FY 2023)

County	FY 2023 CAFLS Headcount	FY 2023 CAFLS Expenditures		
		Personnel	Operating	Capital
Chester	5	$188,875	$63,330	

Source: Clemson University CAFLS

As a result of the FY 2023 expenditures and employment, CAFLS generated the following economic impacts in Chester County:

- Total expenditure-based economic impact (as measured by total output impacts) of more than $333,000.
- 5.4 total jobs supported in the County receiving more than $205,000 in total compensation.

Further details regarding CAFLS-generated expenditure-based impacts in Chester County are shown in Table B.

Table B: Economic Impact of CAFLS Activities in Chester County (FY 2023)

Impact Type	Employ-ment	Labor Income	Value Added	Output	County/ Local Tax Revenue	State Tax Revenue	Federal Tax Revenue
Direct Effect	5.0	$188,875	$188,875	$252,204	$336	$2,727	$35,257
Indirect Effect	0.1	$7,241	$12,220	$30,656	$344	$406	$1,552
Induced Effect	0.3	$9,628	$29,021	$50,963	$2,053	$1,806	$2,615
Total Impacts	5.4	$205,744	$230,115	$333,824	$2,733	$4,940	$39,424
Multiplier	***1.09***	***1.09***	***1.22***	***1.32***			

Source: TEConomy analysis, South Carolina IMPLAN MRIO Model

Chesterfield County CAFLS Expenditure-Based Impacts

The following data captures the operational expenditures of CAFLS and the resultant economic impact of these expenditures in Chesterfield County, including CAFLS-generated intercounty/intrastate impacts. The economic impact models estimate and treat purchases from entities outside of a specific geography as imports (or economic leakages) which are not captured in the total impacts.

It is important to note that the principal impacts of CAFLS are generated through the mission-oriented programs and activities that are delivered by faculty, staff, and field agents throughout the county—these functional impacts are discussed in the main report.

Table A provides the operational details of CAFLS Chesterfield County operations. In FY 2023, CAFLS employed 4 workers, 3 in Cooperative Extension and 1 on Livestock Poultry Health, with combined personnel and operating expenditures of more than $367,000.

Table A: Operational Metrics for CAFLS Activities in Chesterfield County, SC (FY 2023)

County	FY 2023 CAFLS Headcount	FY 2023 CAFLS Expenditures		
		Personnel	Operating	Capital
Chesterfield	4	$297,366	$70,093	

Source: Clemson University CAFLS

As a result of the FY 2023 expenditures and employment, CAFLS generated the following economic impacts in Chesterfield County:

- Total expenditure-based economic impact (as measured by total output impacts) of more than $531,000.
- 5.1 total jobs supported in the County receiving more than $336,000 in total compensation.

Further details regarding CAFLS-generated expenditure-based impacts in Chesterfield County are shown in Table B.

Table B: Economic Impact of CAFLS Activities in Chesterfield County (FY 2023)

Impact Type	Employ-ment	Labor Income	Value Added	Output	County/ Local Tax Revenue	State Tax Revenue	Federal Tax Revenue
Direct Effect	4.0	$297,366	$297,366	$367,459	$211	$4,603	$60,598
Indirect Effect	0.3	$12,126	$17,356	$45,002	$879	$969	$2,642
Induced Effect	0.7	$27,100	$67,614	$118,622	$4,893	$4,852	$7,168
Total Impacts	5.1	$336,593	$382,336	$531,084	$5,983	$10,424	$70,409
Multiplier	***1.26***	***1.13***	***1.29***	***1.45***			

Source: TEConomy analysis, South Carolina IMPLAN MRIO Model

Clarendon County CAFLS Expenditure-Based Impacts

The following data captures the operational expenditures of CAFLS and the resultant economic impact of these expenditures in Clarendon County, including CAFLS-generated intercounty/intrastate impacts. The economic impact models estimate and treat purchases from entities outside of a specific geography as imports (or economic leakages) which are not captured in the total impacts.

It is important to note that the principal impacts of CAFLS are generated through the mission-oriented programs and activities that are delivered by faculty, staff, and field agents throughout the county—these functional impacts are discussed in the main report.

Table A provides the operational details of CAFLS Clarendon County operations. In FY 2023, CAFLS employed 5 workers, 4 in Cooperative Extension and 1 in Regulatory, with combined personnel and operating expenditures of more than $364,000.

Table A: Operational Metrics for CAFLS Activities in Clarendon County, SC (FY 2023)

County	FY 2023 CAFLS Headcount	FY 2023 CAFLS Expenditures		
		Personnel	Operating	Capital
Clarendon	5	$302,458	$61,764	

Source: Clemson University CAFLS

As a result of the FY 2023 expenditures and employment, CAFLS generated the following economic impacts in Clarendon County:

- Total expenditure-based economic impact (as measured by total output impacts) of more than $560,000.
- 6.3 total jobs supported in the County receiving more than $400,000 in total compensation.

Further details regarding CAFLS-generated expenditure-based impacts in Clarendon County are shown in Table B.

Table B: Economic Impact of CAFLS Activities in Clarendon County (FY 2023)

Impact Type	Employ-ment	Labor Income	Value Added	Output	County/ Local Tax Revenue	State Tax Revenue	Federal Tax Revenue
Direct Effect	5.0	$302,458	$302,458	$364,222	$744	$5,507	$77,025
Indirect Effect	0.2	$7,342	$13,299	$37,417	$1,841	$1,834	$2,015
Induced Effect	1.1	$33,855	$85,211	$158,673	$6,725	$7,168	$10,419
Total Impacts	6.3	$343,655	$400,968	$560,312	$9,310	$14,509	$89,459
Multiplier	***1.26***	***1.14***	***1.33***	***1.54***			

Source: TEConomy analysis, South Carolina IMPLAN MRIO Model

Colleton County CAFLS Expenditure-Based Impacts

The following data captures the operational expenditures of CAFLS and the resultant economic impact of these expenditures in Colleton County, including CAFLS-generated intercounty/intrastate impacts. The economic impact models estimate and treat purchases from entities outside of a specific geography as imports (or economic leakages) which are not captured in the total impacts.

It is important to note that the principal impacts of CAFLS are generated through the mission-oriented programs and activities that are delivered by faculty, staff, and field agents throughout the county—these functional impacts are discussed in the main report.

Table A provides the operational details of CAFLS Colleton County operations. In FY 2023, CAFLS employed 5 workers, 4 in Cooperative Extension and 4 in Regulatory, with combined personnel and operating expenditures of more than $468,000.

Table A: Operational Metrics for CAFLS Activities in Colleton County, SC (FY 2023)

County	FY 2023 CAFLS Headcount	FY 2023 CAFLS Expenditures		
		Personnel	Operating	Capital
Colleton	5	$411,905	$56,636	

Source: Clemson University CAFLS

As a result of the FY 2023 expenditures and employment, CAFLS generated the following economic impacts in Colleton County:

- Total expenditure-based economic impact (as measured by total output impacts) of more than $783,000.
- 7.0 total jobs supported in the County receiving $486,000 in total compensation.

Further details regarding CAFLS-generated expenditure-based impacts in Colleton County are shown in Table B.

Table B: Economic Impact of CAFLS Activities in Colleton County (FY 2023)

Impact Type	Employ-ment	Labor Income	Value Added	Output	County/ Local Tax Revenue	State Tax Revenue	Federal Tax Revenue
Direct Effect	5.0	$411,905	$411,905	$468,541	$541	$8,013	$97,764
Indirect Effect	0.8	$25,362	$41,695	$114,695	$1,590	$1,789	$6,353
Induced Effect	1.3	$48,699	$114,347	$199,937	$8,274	$7,163	$13,877
Total Impacts	7.0	$485,966	$567,947	$783,173	$10,404	$16,964	$117,994
Multiplier	***1.41***	***1.18***	***1.38***	***1.67***			

Source: TEConomy analysis, South Carolina IMPLAN MRIO Model

Darlington County CAFLS Expenditure-Based Impacts

The following data captures the operational expenditures of CAFLS and the resultant economic impact of these expenditures in Darlington County, including CAFLS-generated intercounty/intrastate impacts. The economic impact models estimate and treat purchases from entities outside of a specific geography as imports (or economic leakages) which are not captured in the total impacts.

It is important to note that the principal impacts of CAFLS are generated through the mission-oriented programs and activities that are delivered by faculty, staff, and field agents throughout the county—these functional impacts are discussed in the main report.

Table A provides the operational details of CAFLS Darlington County operations. In FY 2023, CAFLS employed 8 workers, 7 in Cooperative Extension and 1 in Research and Experiment Stations, with combined personnel and operating expenditures of more than $607,000.

Table A: Operational Metrics for CAFLS Activities in Darlington County, SC (FY 2023)

County	FY 2023 CAFLS Headcount	FY 2023 CAFLS Expenditures		
		Personnel	Operating	Capital
Darlington	8	$507,846	$99,722	

Source: Clemson University CAFLS

As a result of the FY 2023 expenditures and employment, CAFLS generated the following economic impacts in Darlington County:

- Total expenditure-based economic impact (as measured by total output impacts) of more than $1.1 million.
- 11.4 total jobs supported in the County receiving nearly $648,000 in total compensation.

Further details regarding CAFLS-generated expenditure-based impacts in Darlington County are shown in Table B.

Table B: Economic Impact of CAFLS Activities in Darlington County (FY 2023)

Impact Type	Employ-ment	Labor Income	Value Added	Output	County/ Local Tax Revenue	State Tax Revenue	Federal Tax Revenue
Direct Effect	8.0	$507,846	$507,846	$607,568	$801	$9,143	$106,591
Indirect Effect	0.6	$26,801	$44,778	$97,103	$1,909	$2,214	$6,421
Induced Effect	2.8	$113,300	$257,580	$445,117	$18,166	$18,075	$30,508
Total Impacts	11.4	$647,947	$810,204	$1,149,789	$20,877	$29,432	$143,520
Multiplier	***1.42***	***1.28***	***1.60***	***1.89***			

Source: TEConomy analysis, South Carolina IMPLAN MRIO Model

Dillon County CAFLS Expenditure-Based Impacts

The following data captures the operational expenditures of CAFLS and the resultant economic impact of these expenditures in Dillon County, including CAFLS-generated intercounty/intrastate impacts. The economic impact models estimate and treat purchases from entities outside of a specific geography as imports (or economic leakages) which are not captured in the total impacts.

It is important to note that the principal impacts of CAFLS are generated through the mission-oriented programs and activities that are delivered by faculty, staff, and field agents throughout the county—these functional impacts are discussed in the main report.

Table A provides the operational details of CAFLS Dillon County operations. In FY 2023, CAFLS employed 3 workers, all in Cooperative Extension, with combined personnel and operating expenditures of more than $123,000.

Table A: Operational Metrics for CAFLS Activities in Dillon County, SC (FY 2023)

County	FY 2023 CAFLS Headcount	FY 2023 CAFLS Expenditures		
		Personnel	Operating	Capital
Dillon	3	$76,520	$46,700	

Source: Clemson University CAFLS

As a result of the FY 2023 expenditures and employment, CAFLS generated the following economic impacts in Dillon County:

- Total expenditure-based economic impact (as measured by total output impacts) of nearly $237,000.
- 3.7 total jobs supported in the County receiving more than $104,000 in total compensation.

Further details regarding CAFLS-generated expenditure-based impacts in Dillon County are shown in Table B.

Table B: Economic Impact of CAFLS Activities in Dillon County (FY 2023)

Impact Type	Employ-ment	Labor Income	Value Added	Output	County/ Local Tax Revenue	State Tax Revenue	Federal Tax Revenue
Direct Effect	3.0	$76,520	$76,520	$123,221	$55	$1,435	$17,363
Indirect Effect	0.2	$9,005	$15,251	$36,816	$460	$843	$2,251
Induced Effect	0.5	$19,275	$44,337	$76,901	$2,349	$3,669	$5,324
Total Impacts	3.7	$104,800	$136,107	$236,938	$2,864	$5,947	$24,938
Multiplier	***1.24***	***1.37***	***1.78***	***1.92***			

Source: TEConomy analysis, South Carolina IMPLAN MRIO Model

Dorchester County CAFLS Expenditure-Based Impacts

The following data captures the operational expenditures of CAFLS and the resultant economic impact of these expenditures in Dorchester County, including CAFLS-generated intercounty/intrastate impacts. The economic impact models estimate and treat purchases from entities outside of a specific geography as imports (or economic leakages) which are not captured in the total impacts.

It is important to note that the principal impacts of CAFLS are generated through the mission-oriented programs and activities that are delivered by faculty, staff, and field agents throughout the county—these functional impacts are discussed in the main report.

Table A provides the operational details of CAFLS Dorchester County operations. In FY 2023, CAFLS employed 6 workers, all in Cooperative Extension, with combined personnel and operating expenditures of nearly $447,000.

Table A: Operational Metrics for CAFLS Activities in Dorchester County, SC (FY 2023)

County	FY 2023 CAFLS Headcount	FY 2023 CAFLS Expenditures		
		Personnel	Operating	Capital
Dorchester	6	$353,957	$92,856	

Source: Clemson University CAFLS

As a result of the FY 2023 expenditures and employment, CAFLS generated the following economic impacts in Dorchester County:

- Total expenditure-based economic impact (as measured by total output impacts) of more than $1.3 million.
- 11.4 total jobs supported in the County receiving more than $553,000 in total compensation.

Further details regarding CAFLS-generated expenditure-based impacts in Dorchester County are shown in Table B.

Table B: Economic Impact of CAFLS Activities in Dorchester County (FY 2023)

Impact Type	Employ-ment	Labor Income	Value Added	Output	County/ Local Tax Revenue	State Tax Revenue	Federal Tax Revenue
Direct Effect	6.0	$353,957	$353,957	$446,813	$220	$4,816	$72,891
Indirect Effect	1.3	$54,509	$100,290	$243,260	$4,376	$4,994	$12,825
Induced Effect	4.1	$144,642	$362,281	$647,981	$24,834	$25,194	$38,633
Total Impacts	11.4	$553,108	$816,528	$1,338,054	$29,430	$35,005	$124,349
Multiplier	***1.90***	***1.56***	***2.31***	***2.99***			

Source: TEConomy analysis, South Carolina IMPLAN MRIO Model

Edgefield County CAFLS Expenditure-Based Impacts

The following data captures the operational expenditures of CAFLS and the resultant economic impact of these expenditures in Edgefield County, including CAFLS-generated intercounty/intrastate impacts. The economic impact models estimate and treat purchases from entities outside of a specific geography as imports (or economic leakages) which are not captured in the total impacts.

It is important to note that the principal impacts of CAFLS are generated through the mission-oriented programs and activities that are delivered by faculty, staff, and field agents throughout the county—these functional impacts are discussed in the main report.

Table A provides the operational details of CAFLS Edgefield County operations. In FY 2023, CAFLS employed 3 workers, all in Cooperative Extension, with combined personnel and operating expenditures of nearly $239,000.

Table A: Operational Metrics for CAFLS Activities in Edgefield County, SC (FY 2023)

County	FY 2023 CAFLS Headcount	FY 2023 CAFLS Expenditures		
		Personnel	Operating	Capital
Edgefield	3	$215,051	$23,661	

Source: Clemson University CAFLS

As a result of the FY 2023 expenditures and employment, CAFLS generated the following economic impacts in Edgefield County:

- Total expenditure-based economic impact (as measured by total output impacts) of more than $320,000.
- 3.5 total jobs supported in the County receiving more than $231,000 in total compensation.

Further details regarding CAFLS-generated expenditure-based impacts in Edgefield County are shown in Table B.

Table B: Economic Impact of CAFLS Activities in Edgefield County (FY 2023)

Impact Type	Employ-ment	Labor Income	Value Added	Output	County/ Local Tax Revenue	State Tax Revenue	Federal Tax Revenue
Direct Effect	3.0	$215,051	$215,051	$238,711	$108	$3,191	$48,405
Indirect Effect	0.1	$3,389	$4,413	$12,758	$135	$174	$732
Induced Effect	0.4	$12,882	$40,461	$68,574	$2,884	$2,565	$3,976
Total Impacts	3.5	$231,321	$259,924	$320,044	$3,127	$5,931	$53,112
Multiplier	***1.17***	***1.08***	***1.21***	***1.34***			

Source: TEConomy analysis, South Carolina IMPLAN MRIO Model

Fairfield County CAFLS Expenditure-Based Impacts

The following data captures the operational expenditures of CAFLS and the resultant economic impact of these expenditures in Fairfield County, including CAFLS-generated intercounty/intrastate impacts. The economic impact models estimate and treat purchases from entities outside of a specific geography as imports (or economic leakages) which are not captured in the total impacts.

It is important to note that the principal impacts of CAFLS are generated through the mission-oriented programs and activities that are delivered by faculty, staff, and field agents throughout the county—these functional impacts are discussed in the main report.

Table A provides the operational details of CAFLS Fairfield County operations. In FY 2023, CAFLS employed 3 workers, all in Cooperative Extension, with combined personnel and operating expenditures of nearly $179,000.

Table A: Operational Metrics for CAFLS Activities in Fairfield County, SC (FY 2023)

County	FY 2023 CAFLS Headcount	FY 2023 CAFLS Expenditures		
		Personnel	Operating	Capital
Fairfield	3	$160,021	$18,828	

Source: Clemson University CAFLS

As a result of the FY 2023 expenditures and employment, CAFLS generated the following economic impacts in Fairfield County:

- Total expenditure-based economic impact (as measured by total output impacts) of more than $255,000.
- 3.4 total jobs supported in the County receiving more than $177,000 in total compensation.

Further details regarding CAFLS-generated expenditure-based impacts in Fairfield County are shown in Table B.

Table B: Economic Impact of CAFLS Activities in Fairfield County (FY 2023)

Impact Type	Employ-ment	Labor Income	Value Added	Output	County/ Local Tax Revenue	State Tax Revenue	Federal Tax Revenue
Direct Effect	3.0	$160,021	$160,021	$178,849	$230	$1,868	$28,786
Indirect Effect	0.2	$9,418	$14,516	$30,563	$1,156	$480	$1,913
Induced Effect	0.3	$8,145	$27,834	$46,147	$3,044	$1,127	$2,304
Total Impacts	3.4	$177,584	$202,371	$255,559	$4,430	$3,474	$33,003
Multiplier	***1.15***	***1.11***	***1.26***	***1.43***			

Source: TEConomy analysis, South Carolina IMPLAN MRIO Model

Florence County CAFLS Expenditure-Based Impacts

The following data captures the operational expenditures of CAFLS and the resultant economic impact of these expenditures in Florence County, including CAFLS-generated intercounty/intrastate impacts. The economic impact models estimate and treat purchases from entities outside of a specific geography as imports (or economic leakages) which are not captured in the total impacts.

It is important to note that the principal impacts of CAFLS are generated through the mission-oriented programs and activities that are delivered by faculty, staff, and field agents throughout the county—these functional impacts are discussed in the main report.

Table A provides the operational details of CAFLS Florence County operations. In FY 2023, CAFLS employed 96 workers, 74 in Research and Experiment Stations, 20 in Cooperative Extension, and 2 in Regulatory with combined personnel, operating, and capital expenditures of more than $8.8 million.

Table A: Operational Metrics for CAFLS Activities in Florence County, SC (FY 2023)

County	FY 2023 CAFLS Headcount	FY 2023 CAFLS Expenditures		
		Personnel	Operating	Capital
Florence	96	$5,072,280	$3,398,702	$407,327

Source: Clemson University CAFLS

As a result of the FY 2023 expenditures and employment, CAFLS generated the following economic impacts in Florence County:

- Total expenditure-based economic impact (as measured by total output impacts) of more than $15.1 million.
- 132.6 total jobs supported in the County receiving more than $7 million in total compensation.

Further details regarding CAFLS-generated expenditure-based impacts in Florence County are shown in Table B.

Table B: Economic Impact of CAFLS Activities in Florence County (FY 2023)

Impact Type	Employ-ment	Labor Income	Value Added	Output	County/ Local Tax Revenue	State Tax Revenue	Federal Tax Revenue
Direct Effect	96.0	$5,072,350	$5,072,350	$8,878,409	$3,536	$93,974	$1,058,824
Indirect Effect	19.2	$1,130,129	$1,618,233	$3,390,240	$37,804	$70,324	$254,684
Induced Effect	17.4	$801,266	$1,707,676	$2,894,805	$88,134	$125,955	$207,466
Total Impacts	132.6	$7,003,746	$8,398,259	$15,163,455	$129,474	$290,253	$1,520,974
Multiplier	***1.38***	***1.38***	***1.66***	***1.71***			

Source: TEConomy analysis, South Carolina IMPLAN MRIO Model

Georgetown County CAFLS Expenditure-Based Impacts

The following data captures the operational expenditures of CAFLS and the resultant economic impact of these expenditures in Georgetown County, including CAFLS-generated intercounty/intrastate impacts. The economic impact models estimate and treat purchases from entities outside of a specific geography as imports (or economic leakages) which are not captured in the total impacts.

It is important to note that the principal impacts of CAFLS are generated through the mission-oriented programs and activities that are delivered by faculty, staff, and field agents throughout the county—these functional impacts are discussed in the main report.

Table A provides the operational details of CAFLS Georgetown County operations. In FY 2023, CAFLS employed 70 workers, with more than 60 in Research and Experiment Stations, with combined personnel, operating, and capital expenditures of more than $6 million.

Table A: Operational Metrics for CAFLS Activities in Georgetown County, SC (FY 2023)

County	FY 2023 CAFLS Headcount	FY 2023 CAFLS Expenditures		
		Personnel	Operating	Capital
Georgetown	70	$3,190,977	$1,340,624	$1,493,841

Source: Clemson University CAFLS

As a result of the FY 2023 expenditures and employment, CAFLS generated the following economic impacts in Georgetown County:

- Total expenditure-based economic impact (as measured by total output impacts) of more than $9.6 million.
- 93.0 total jobs supported in the County receiving more than $4.2 million in total compensation.

Further details regarding CAFLS-generated expenditure-based impacts in Georgetown County are shown in Table B.

Table B: Economic Impact of CAFLS Activities in Georgetown County (FY 2023)

Impact Type	Employment	Labor Income	Value Added	Output	County/ Local Tax Revenue	State Tax Revenue	Federal Tax Revenue
Direct Effect	70.0	$3,190,977	$3,190,977	$6,025,442	$4,638	$53,792	$672,760
Indirect Effect	14.5	$638,738	$968,224	$2,249,280	$27,002	$32,291	$139,348
Induced Effect	8.5	$373,696	$814,002	$1,390,246	$50,864	$43,458	$90,559
Total Impacts	93.0	$4,203,411	$4,973,203	$9,664,968	$82,505	$129,541	$902,667
Multiplier	***1.33***	***1.32***	***1.56***	***1.60***			

Source: TEConomy analysis, South Carolina IMPLAN MRIO Model

Greenville County CAFLS Expenditure-Based Impacts

The following data captures the operational expenditures of CAFLS and the resultant economic impact of these expenditures in Greenville County, including CAFLS-generated intercounty/intrastate impacts. The economic impact models estimate and treat purchases from entities outside of a specific geography as imports (or economic leakages) which are not captured in the total impacts.

It is important to note that the principal impacts of CAFLS are generated through the mission-oriented programs and activities that are delivered by faculty, staff, and field agents throughout the county—these functional impacts are discussed in the main report.

Table A provides the operational details of CAFLS Greenville County operations. In FY 2023, CAFLS employed 16 workers, 13 in Cooperative Extension, 1 in E&G, 1 in Livestock Poultry Health, and 1 in Research and Experiment Stations, with combined personnel, operating, and capital expenditures of more than $1.6 million.

Table A: Operational Metrics for CAFLS Activities in Greenville County, SC (FY 2023)

County	FY 2023 CAFLS Headcount	FY 2023 CAFLS Expenditures		
		Personnel	Operating	Capital
Greenville	16	$1,040,239	$295,271	$329,810

Source: Clemson University CAFLS

As a result of the FY 2023 expenditures and employment, CAFLS generated the following economic impacts in Greenville County:

- Total expenditure-based economic impact (as measured by total output impacts) of more than $17.4 million.
- 103.5 total jobs supported in the County receiving more than $6.5 million in total compensation.

Further details regarding CAFLS-generated expenditure-based impacts in Greenville County are shown in Table B.

Table B: Economic Impact of CAFLS Activities in Greenville County (FY 2023)

Impact Type	Employment	Labor Income	Value Added	Output	County/ Local Tax Revenue	State Tax Revenue	Federal Tax Revenue
Direct Effect	16.0	$1,053,858	$1,053,858	$1,665,320	$968	$17,977	$201,171
Indirect Effect	55.4	$3,891,598	$5,350,570	$10,276,817	$157,030	$238,770	$794,565
Induced Effect	32.1	$1,642,651	$3,205,758	$5,481,266	$149,899	$195,173	$377,146
Total Impacts	103.5	$6,588,108	$9,610,187	$17,423,404	$307,897	$451,921	$1,372,882
Multiplier	***6.47***	***6.25***	***9.12***	***10.46***			

Source: TEConomy analysis, South Carolina IMPLAN MRIO Model

Greenwood County CAFLS Expenditure-Based Impacts

The following data captures the operational expenditures of CAFLS and the resultant economic impact of these expenditures in Greenwood County, including CAFLS-generated intercounty/intrastate impacts. The economic impact models estimate and treat purchases from entities outside of a specific geography as imports (or economic leakages) which are not captured in the total impacts.

It is important to note that the principal impacts of CAFLS are generated through the mission-oriented programs and activities that are delivered by faculty, staff, and field agents throughout the county—these functional impacts are discussed in the main report.

Table A provides the operational details of CAFLS Greenwood County operations. In FY 2023, CAFLS employed 5 workers, all in Cooperative Extension, with combined personnel and operating expenditures of nearly $420,000.

Table A: Operational Metrics for CAFLS Activities in Greenwood County, SC (FY 2023)

County	FY 2023 CAFLS Headcount	FY 2023 CAFLS Expenditures		
		Personnel	Operating	Capital
Greenwood	5	$332,024	$87,894	

Source: Clemson University CAFLS

As a result of the FY 2023 expenditures and employment, CAFLS generated the following economic impacts in Greenwood County:

- Total expenditure-based economic impact (as measured by total output impacts) of more than $580,000.
- 5.5 total jobs supported in the County receiving more than $327,000 in total compensation.

Further details regarding CAFLS-generated expenditure-based impacts in Greenwood County are shown in Table B.

Table B: Economic Impact of CAFLS Activities in Greenwood County (FY 2023)

Impact Type	Employ-ment	Labor Income	Value Added	Output	County/ Local Tax Revenue	State Tax Revenue	Federal Tax Revenue
Direct Effect	4.0	$265,005	$265,005	$320,716	$212	$4,626	$52,106
Indirect Effect	0.5	$21,396	$36,598	$98,859	$1,221	$1,745	$4,778
Induced Effect	1.1	$41,186	$92,802	$161,194	$5,733	$6,869	$10,199
Total Impacts	5.5	$327,587	$394,405	$580,769	$7,167	$13,240	$67,084
Multiplier	***1.39***	***1.24***	***1.49***	***1.81***			

Source: TEConomy analysis, South Carolina IMPLAN MRIO Model

Hampton County CAFLS Expenditure-Based Impacts

The following data captures the operational expenditures of CAFLS and the resultant economic impact of these expenditures in Hampton County, including CAFLS-generated intercounty/intrastate impacts. The economic impact models estimate and treat purchases from entities outside of a specific geography as imports (or economic leakages) which are not captured in the total impacts.

It is important to note that the principal impacts of CAFLS are generated through the mission-oriented programs and activities that are delivered by faculty, staff, and field agents throughout the county—these functional impacts are discussed in the main report.

Table A provides the operational details of CAFLS Hampton County operations. In FY 2023, CAFLS employed 4 workers, all in Cooperative Extension, with combined personnel and operating expenditures of nearly $118,000.

Table A: Operational Metrics for CAFLS Activities in Hampton County, SC (FY 2023)

County	FY 2023 CAFLS Headcount	FY 2023 CAFLS Expenditures		
		Personnel	Operating	Capital
Hampton	4	$82,169	$35,684	

Source: Clemson University CAFLS

As a result of the FY 2023 expenditures and employment, CAFLS generated the following economic impacts in Hampton County:

- Total expenditure-based economic impact (as measured by total output impacts) of nearly $234,000.
- 4.7 total jobs supported in the County receiving more than $116,000 in total compensation.

Further details regarding CAFLS-generated expenditure-based impacts in Hampton County are shown in Table B.

Table B: Economic Impact of CAFLS Activities in Hampton County (FY 2023)

Impact Type	Employ-ment	Labor Income	Value Added	Output	County/ Local Tax Revenue	State Tax Revenue	Federal Tax Revenue
Direct Effect	4.0	$82,169	$82,169	$117,853	$160	$1,523	$18,081
Indirect Effect	0.3	$21,833	$35,741	$62,930	$1,693	$1,526	$5,304
Induced Effect	0.4	$12,258	$30,138	$53,109	$2,542	$1,860	$3,379
Total Impacts	4.7	$116,261	$148,048	$233,892	$4,394	$4,909	$26,764
Multiplier	***1.17***	***1.41***	***1.80***	***1.98***			

Source: TEConomy analysis, South Carolina IMPLAN MRIO Model

Horry County CAFLS Expenditure-Based Impacts

The following data captures the operational expenditures of CAFLS and the resultant economic impact of these expenditures in Horry County, including CAFLS-generated intercounty/intrastate impacts. The economic impact models estimate and treat purchases from entities outside of a specific geography as imports (or economic leakages) which are not captured in the total impacts.

It is important to note that the principal impacts of CAFLS are generated through the mission-oriented programs and activities that are delivered by faculty, staff, and field agents throughout the county—these functional impacts are discussed in the main report.

Table A provides the operational details of CAFLS Horry County operations. In FY 2023, CAFLS employed 13 workers, 11 in Cooperative Extension, 1 in Livestock Poultry Health, and 1 in Regulatory, with combined personnel and operating expenditures of more than $1.2 million.

Table A: Operational Metrics for CAFLS Activities in Horry County, SC (FY 2023)

County	FY 2023 CAFLS Headcount	FY 2023 CAFLS Expenditures		
		Personnel	Operating	Capital
Horry	13	$965,335	$239,006	

Source: Clemson University CAFLS

As a result of the FY 2023 expenditures and employment, CAFLS generated the following economic impacts in Horry County:

- Total expenditure-based economic impact (as measured by total output impacts) of more than $3.3 million.
- 24.8 total jobs supported in the County receiving more than $1.4 million in total compensation.

Further details regarding CAFLS-generated expenditure-based impacts in Horry County are shown in Table B.

Table B: Economic Impact of CAFLS Activities in Horry County (FY 2023)

Impact Type	Employ-ment	Labor Income	Value Added	Output	County/ Local Tax Revenue	State Tax Revenue	Federal Tax Revenue
Direct Effect	13.0	$965,335	$965,335	$1,204,341	$1,789	$19,539	$231,181
Indirect Effect	4.9	$193,740	$409,835	$953,078	$12,442	$16,479	$51,706
Induced Effect	6.9	$321,588	$675,510	$1,157,891	$40,585	$42,393	$87,961
Total Impacts	24.8	$1,480,663	$2,050,680	$3,315,309	$54,815	$78,411	$370,848
Multiplier	***1.91***	***1.53***	***2.12***	***2.75***			

Source: TEConomy analysis, South Carolina IMPLAN MRIO Model

Jasper County CAFLS Expenditure-Based Impacts

The following data captures the operational expenditures of CAFLS and the resultant economic impact of these expenditures in Jasper County, including CAFLS-generated intercounty/intrastate impacts. The economic impact models estimate and treat purchases from entities outside of a specific geography as imports (or economic leakages) which are not captured in the total impacts.

It is important to note that the principal impacts of CAFLS are generated through the mission-oriented programs and activities that are delivered by faculty, staff, and field agents throughout the county—these functional impacts are discussed in the main report.

Table A provides the operational details of CAFLS Jasper County operations. In FY 2023, CAFLS employed 4 workers, 3 in Cooperative Extension and 1 in Livestock Poultry Health, with combined personnel and operating expenditures of more than $277,000.

Table A: Operational Metrics for CAFLS Activities in Jasper County, SC (FY 2023)

County	FY 2023 CAFLS Headcount	FY 2023 CAFLS Expenditures		
		Personnel	Operating	Capital
Jasper	4	$244,119	$33,188	

Source: Clemson University CAFLS

As a result of the FY 2023 expenditures and employment, CAFLS generated the following economic impacts in Jasper County:

- Total expenditure-based economic impact (as measured by total output impacts) of more than $362,000.
- 4.5 total jobs supported in the County receiving nearly $266,000 in total compensation.

Further details regarding CAFLS-generated expenditure-based impacts in Jasper County are shown in Table B.

Table B: Economic Impact of CAFLS Activities in Jasper County (FY 2023)

Impact Type	Employ-ment	Labor Income	Value Added	Output	County/ Local Tax Revenue	State Tax Revenue	Federal Tax Revenue
Direct Effect	4.0	$244,119	$244,119	$277,307	$240	$2,364	$43,666
Indirect Effect	0.1	$6,466	$11,920	$25,991	$686	$701	$1,366
Induced Effect	0.3	$15,314	$34,833	$59,418	$2,283	$2,262	$3,520
Total Impacts	4.5	$265,899	$290,873	$362,717	$3,209	$5,327	$48,552
Multiplier	***1.12***	***1.09***	***1.19***	***1.31***			

Source: TEConomy analysis, South Carolina IMPLAN MRIO Model

Kershaw County CAFLS Expenditure-Based Impacts

The following data captures the operational expenditures of CAFLS and the resultant economic impact of these expenditures in Kershaw County, including CAFLS-generated intercounty/intrastate impacts. The economic impact models estimate and treat purchases from entities outside of a specific geography as imports (or economic leakages) which are not captured in the total impacts.

It is important to note that the principal impacts of CAFLS are generated through the mission-oriented programs and activities that are delivered by faculty, staff, and field agents throughout the county—these functional impacts are discussed in the main report.

Table A provides the operational details of CAFLS Kershaw County operations. In FY 2023, CAFLS employed 6 workers, 4 in Cooperative Extension and 2 in E&G, with combined personnel and operating expenditures of nearly $514,000.

Table A: Operational Metrics for CAFLS Activities in Kershaw County, SC (FY 2023)

County	FY 2023 CAFLS Headcount	FY 2023 CAFLS Expenditures		
		Personnel	Operating	Capital
Kershaw	6	$343,433	$170,541	

Source: Clemson University CAFLS

As a result of the FY 2023 expenditures and employment, CAFLS generated the following economic impacts in Kershaw County:

- Total expenditure-based economic impact (as measured by total output impacts) of more than $912,000.
- 8.5 total jobs supported in the County receiving more than $444,000 in total compensation.

Further details regarding CAFLS-generated expenditure-based impacts in Kershaw County are shown in Table B.

Table B: Economic Impact of CAFLS Activities in Kershaw County (FY 2023)

Impact Type	Employ-ment	Labor Income	Value Added	Output	County/ Local Tax Revenue	State Tax Revenue	Federal Tax Revenue
Direct Effect	6.0	$343,433	$343,433	$513,974	$247	$6,306	$79,796
Indirect Effect	0.8	$31,693	$45,647	$118,389	$1,109	$2,403	$7,427
Induced Effect	1.8	$69,540	$165,068	$279,824	$7,736	$13,627	$19,214
Total Impacts	8.5	$444,666	$554,148	$912,186	$9,092	$22,336	$106,437
Multiplier	***1.42***	***1.29***	***1.61***	***1.77***			

Source: TEConomy analysis, South Carolina IMPLAN MRIO Model

Lancaster County CAFLS Expenditure-Based Impacts

The following data captures the operational expenditures of CAFLS and the resultant economic impact of these expenditures in Lancaster County, including CAFLS-generated intercounty/intrastate impacts. The economic impact models estimate and treat purchases from entities outside of a specific geography as imports (or economic leakages) which are not captured in the total impacts.

It is important to note that the principal impacts of CAFLS are generated through the mission-oriented programs and activities that are delivered by faculty, staff, and field agents throughout the county—these functional impacts are discussed in the main report.

Table A provides the operational details of CAFLS Lancaster County operations. In FY 2023, CAFLS employed 5 workers, all in Cooperative Extension, with combined personnel and operating expenditures of more than $424,000.

Table A: Operational Metrics for CAFLS Activities in Lancaster County, SC (FY 2023)

County	FY 2023 CAFLS Headcount	FY 2023 CAFLS Expenditures		
		Personnel	Operating	Capital
Lancaster	5	$317,098	$107,131	

Source: Clemson University CAFLS

As a result of the FY 2023 expenditures and employment, CAFLS generated the following economic impacts in Lancaster County:

- Total expenditure-based economic impact (as measured by total output impacts) of more than $1.2 million.
- 9.1 total jobs supported in the County receiving nearly $674,000 in total compensation.

Further details regarding CAFLS-generated expenditure-based impacts in Lancaster County are shown in Table B.

Table B: Economic Impact of CAFLS Activities in Lancaster County (FY 2023)

Impact Type	Employ-ment	Labor Income	Value Added	Output	County/ Local Tax Revenue	State Tax Revenue	Federal Tax Revenue
Direct Effect	5.0	$317,098	$317,098	$424,229	$192	$4,474	$64,309
Indirect Effect	2.9	$297,554	$332,806	$564,977	$4,581	$8,330	$59,904
Induced Effect	1.2	$59,207	$135,137	$217,913	$8,851	$8,141	$14,728
Total Impacts	9.1	$673,859	$785,041	$1,207,120	$13,624	$20,945	$138,942
Multiplier	***1.82***	***2.13***	***2.48***	***2.85***			

Source: TEConomy analysis, South Carolina IMPLAN MRIO Model

Laurens County CAFLS Expenditure-Based Impacts

The following data captures the operational expenditures of CAFLS and the resultant economic impact of these expenditures in Laurens County, including CAFLS-generated intercounty/intrastate impacts. The economic impact models estimate and treat purchases from entities outside of a specific geography as imports (or economic leakages) which are not captured in the total impacts.

It is important to note that the principal impacts of CAFLS are generated through the mission-oriented programs and activities that are delivered by faculty, staff, and field agents throughout the county—these functional impacts are discussed in the main report.

Table A provides the operational details of CAFLS Laurens County operations. In FY 2023, CAFLS employed 8 workers, 5 in Cooperative Extension, 1 in E&G, 1 in Livestock Poultry Health, and 1 in Regulatory, with combined personnel and operating expenditures of more than $448,000.

Table A: Operational Metrics for CAFLS Activities in Laurens County, SC (FY 2023)

County	FY 2023 CAFLS Headcount	FY 2023 CAFLS Expenditures		
		Personnel	Operating	Capital
Laurens	8	$376,038	$72,502	

Source: Clemson University CAFLS

As a result of the FY 2023 expenditures and employment, CAFLS generated the following economic impacts in Laurens County:

- Total expenditure-based economic impact (as measured by total output impacts) of more than $726,000.
- 9.7 total jobs supported in the County receiving more than $441,000 in total compensation.

Further details regarding CAFLS-generated expenditure-based impacts in Laurens County are shown in Table B.

Table B: Economic Impact of CAFLS Activities in Laurens County (FY 2023)

Impact Type	Employ-ment	Labor Income	Value Added	Output	County/ Local Tax Revenue	State Tax Revenue	Federal Tax Revenue
Direct Effect	8.0	$376,038	$376,038	$448,540	$375	$5,605	$74,990
Indirect Effect	0.6	$26,124	$35,670	$101,246	$776	$1,213	$5,543
Induced Effect	1.1	$39,291	$100,028	$176,259	$6,291	$6,976	$10,372
Total Impacts	9.7	$441,453	$511,736	$726,045	$7,442	$13,795	$90,904
Multiplier	***1.21***	***1.17***	***1.36***	***1.62***			

Source: TEConomy analysis, South Carolina IMPLAN MRIO Model

Lee County CAFLS Expenditure-Based Impacts

The following data captures the operational expenditures of CAFLS and the resultant economic impact of these expenditures in Lee County, including CAFLS-generated intercounty/intrastate impacts. The economic impact models estimate and treat purchases from entities outside of a specific geography as imports (or economic leakages) which are not captured in the total impacts.

It is important to note that the principal impacts of CAFLS are generated through the mission-oriented programs and activities that are delivered by faculty, staff, and field agents throughout the county—these functional impacts are discussed in the main report.

Table A provides the operational details of CAFLS Lee County operations. In FY 2023, CAFLS employed 4 workers, all in Cooperative Extension, with combined personnel and operating expenditures of more than $385,000.

Table A: Operational Metrics for CAFLS Activities in Lee County, SC (FY 2023)

County	FY 2023 CAFLS Headcount	FY 2023 CAFLS Expenditures		
		Personnel	Operating	Capital
Lee	4	$327,878	$57,789	

Source: Clemson University CAFLS

As a result of the FY 2023 expenditures and employment, CAFLS generated the following economic impacts in Lee County:

- Total expenditure-based economic impact (as measured by total output impacts) of more than $487,000.
- 4.6 total jobs supported in the County receiving more than $350,000 in total compensation.

Further details regarding CAFLS-generated expenditure-based impacts in Lee County are shown in Table B.

Table B: Economic Impact of CAFLS Activities in Lee County (FY 2023)

Impact Type	Employ-ment	Labor Income	Value Added	Output	County/ Local Tax Revenue	State Tax Revenue	Federal Tax Revenue
Direct Effect	4.0	$327,878	$327,878	$385,668	$201	$4,950	$70,570
Indirect Effect	0.2	$5,398	$9,534	$25,460	$761	$547	$1,319
Induced Effect	0.5	$17,512	$45,478	$76,138	$3,965	$2,753	$4,879
Total Impacts	4.6	$350,788	$382,890	$487,266	$4,927	$8,250	$76,768
Multiplier	***1.16***	***1.07***	***1.17***	***1.26***			

Source: TEConomy analysis, South Carolina IMPLAN MRIO Model

Lexington County CAFLS Expenditure-Based Impacts

The following data captures the operational expenditures of CAFLS and the resultant economic impact of these expenditures in Lexington County, including CAFLS-generated intercounty/intrastate impacts. The economic impact models estimate and treat purchases from entities outside of a specific geography as imports (or economic leakages) which are not captured in the total impacts.

It is important to note that the principal impacts of CAFLS are generated through the mission-oriented programs and activities that are delivered by faculty, staff, and field agents throughout the county—these functional impacts are discussed in the main report.

Table A provides the operational details of CAFLS Lexington County operations. In FY 2023, CAFLS employed 16 workers, 10 in Cooperative Extension, 4 in Livestock Poultry Health, and 2 in Regulatory, with combined personnel and operating expenditures of more than $1.6 million.

Table A: Operational Metrics for CAFLS Activities in Lexington County, SC (FY 2023)

County	FY 2023 CAFLS Headcount	FY 2023 CAFLS Expenditures		
		Personnel	Operating	Capital
Lexington	16	$1,220,337	$402,541	

Source: Clemson University CAFLS

As a result of the FY 2023 expenditures and employment, CAFLS generated the following economic impacts in Lexington County:

- Total expenditure-based economic impact (as measured by total output impacts) of more than $4.2 million.
- 31.7 total jobs supported in the County receiving more than $1.9 million in total compensation.

Further details regarding CAFLS-generated expenditure-based impacts in Lexington County are shown in Table B.

Table B: Economic Impact of CAFLS Activities in Lexington County (FY 2023)

Impact Type	Employment	Labor Income	Value Added	Output	County/ Local Tax Revenue	State Tax Revenue	Federal Tax Revenue
Direct Effect	16.0	$1,220,337	$1,220,337	$1,622,879	$1,212	$19,643	$235,556
Indirect Effect	4.9	$256,129	$423,826	$860,080	$13,405	$18,594	$55,662
Induced Effect	10.8	$488,116	$1,035,830	$1,799,227	$57,968	$68,036	$115,794
Total Impacts	31.7	$1,964,582	$2,679,994	$4,282,185	$72,585	$106,273	$407,012
Multiplier	***1.98***	***1.61***	***2.20***	***2.64***			

Source: TEConomy analysis, South Carolina IMPLAN MRIO Model

Marion County CAFLS Expenditure-Based Impacts

The following data captures the operational expenditures of CAFLS and the resultant economic impact of these expenditures in Marion County, including CAFLS-generated intercounty/intrastate impacts. The economic impact models estimate and treat purchases from entities outside of a specific geography as imports (or economic leakages) which are not captured in the total impacts.

It is important to note that the principal impacts of CAFLS are generated through the mission-oriented programs and activities that are delivered by faculty, staff, and field agents throughout the county—these functional impacts are discussed in the main report.

Table A provides the operational details of CAFLS Marion County operations. In FY 2023, CAFLS employed 8 workers, 7 in Cooperative Extension and 1 in Livestock Poultry Health, with combined personnel and operating expenditures of more than $460,000.

Table A: Operational Metrics for CAFLS Activities in Marion County, SC (FY 2023)

County	FY 2023 CAFLS Headcount	FY 2023 CAFLS Expenditures		
		Personnel	Operating	Capital
Marion	8	$401,639	$58,996	

Source: Clemson University CAFLS

As a result of the FY 2023 expenditures and employment, CAFLS generated the following economic impacts in Marion County:

- Total expenditure-based economic impact (as measured by total output impacts) of more than $729,000.
- 9.7 total jobs supported in the County receiving more than $455,000 in total compensation.

Further details regarding CAFLS-generated expenditure-based impacts in Marion County are shown in Table B.

Table B: Economic Impact of CAFLS Activities in Marion County (FY 2023)

Impact Type	Employ-ment	Labor Income	Value Added	Output	County/ Local Tax Revenue	State Tax Revenue	Federal Tax Revenue
Direct Effect	8.0	$401,639	$401,639	$460,635	$296	$8,264	$96,967
Indirect Effect	0.5	$14,573	$25,568	$82,361	$1,007	$1,284	$3,908
Induced Effect	1.2	$39,550	$97,345	$186,355	$6,939	$7,294	$11,867
Total Impacts	9.7	$455,763	$524,553	$729,352	$8,242	$16,842	$112,741
Multiplier	***1.21***	***1.13***	***1.31***	***1.58***			

Source: TEConomy analysis, South Carolina IMPLAN MRIO Model

Marlboro County CAFLS Expenditure-Based Impacts

The following data captures the operational expenditures of CAFLS and the resultant economic impact of these expenditures in Marlboro County, including CAFLS-generated intercounty/intrastate impacts. The economic impact models estimate and treat purchases from entities outside of a specific geography as imports (or economic leakages) which are not captured in the total impacts.

It is important to note that the principal impacts of CAFLS are generated through the mission-oriented programs and activities that are delivered by faculty, staff, and field agents throughout the county—these functional impacts are discussed in the main report.

Table A provides the operational details of CAFLS Marlboro County operations. In FY 2023, CAFLS employed 2 workers, all in Cooperative Extension, with combined personnel and operating expenditures of more than $149,000.

Table A: Operational Metrics for CAFLS Activities in Marlboro County, SC (FY 2023)

County	FY 2023 CAFLS Headcount	FY 2023 CAFLS Expenditures		
		Personnel	Operating	Capital
Marlboro	2	$130,049	$19,393	

Source: Clemson University CAFLS

As a result of the FY 2023 expenditures and employment, CAFLS generated the following economic impacts in Marlboro County:

- Total expenditure-based economic impact (as measured by total output impacts) of more than $208,000.
- 2.4 total jobs supported in the County receiving over $143,000 in total compensation.

Further details regarding CAFLS-generated expenditure-based impacts in Marlboro County are shown in Table B.

Table B: Economic Impact of CAFLS Activities in Marlboro County (FY 2023)

Impact Type	Employ-ment	Labor Income	Value Added	Output	County/ Local Tax Revenue	State Tax Revenue	Federal Tax Revenue
Direct Effect	2.0	$130,049	$130,049	$149,442	$101	$2,418	$27,663
Indirect Effect	0.1	$2,198	$4,688	$9,970	$132	$179	$561
Induced Effect	0.3	$10,796	$29,985	$48,982	$1,972	$2,000	$3,040
Total Impacts	2.4	$143,044	$164,722	$208,394	$2,206	$4,597	$31,264
Multiplier	***1.19***	***1.10***	***1.27***	***1.39***			

Source: TEConomy analysis, South Carolina IMPLAN MRIO Model

McCormick County CAFLS Expenditure-Based Impacts

The following data captures the operational expenditures of CAFLS and the resultant economic impact of these expenditures in McCormick County, including CAFLS-generated intercounty/intrastate impacts. The economic impact models estimate and treat purchases from entities outside of a specific geography as imports (or economic leakages) which are not captured in the total impacts.

It is important to note that the principal impacts of CAFLS are generated through the mission-oriented programs and activities that are delivered by faculty, staff, and field agents throughout the county—these functional impacts are discussed in the main report.

Table A provides the operational details of CAFLS McCormick County operations. In FY 2023, CAFLS employed 4 workers, all in Cooperative Extension, with combined personnel and operating expenditures of $255,000.

Table A: Operational Metrics for CAFLS Activities in McCormick County, SC (FY 2023)

County	FY 2023 CAFLS Headcount	FY 2023 CAFLS Expenditures		
		Personnel	Operating	Capital
McCormick	4	$209,585	$45,413	

Source: Clemson University CAFLS

As a result of the FY 2023 expenditures and employment, CAFLS generated the following economic impacts in McCormick County:

- Total expenditure-based economic impact (as measured by total output impacts) of nearly $314,000.
- 4.4 total jobs supported in the County receiving more than $219,000 in total compensation.

Further details regarding CAFLS-generated expenditure-based impacts in McCormick County are shown in Table B.

Table B: Economic Impact of CAFLS Activities in McCormick County (FY 2023)

Impact Type	Employ-ment	Labor Income	Value Added	Output	County/ Local Tax Revenue	State Tax Revenue	Federal Tax Revenue
Direct Effect	4.0	$209,585	$209,585	$254,998	$117	$2,088	$60,592
Indirect Effect	0.2	$4,813	$8,664	$27,954	$589	$368	$1,321
Induced Effect	0.2	$5,228	$17,727	$31,034	$1,683	$915	$1,784
Total Impacts	4.4	$219,626	$235,976	$313,986	$2,389	$3,371	$63,697
Multiplier	***1.09***	***1.05***	***1.13***	***1.23***			

Source: TEConomy analysis, South Carolina IMPLAN MRIO Model

Newberry County CAFLS Expenditure-Based Impacts

The following data captures the operational expenditures of CAFLS and the resultant economic impact of these expenditures in Newberry County, including CAFLS-generated intercounty/intrastate impacts. The economic impact models estimate and treat purchases from entities outside of a specific geography as imports (or economic leakages) which are not captured in the total impacts.

It is important to note that the principal impacts of CAFLS are generated through the mission-oriented programs and activities that are delivered by faculty, staff, and field agents throughout the county—these functional impacts are discussed in the main report.

Table A provides the operational details of CAFLS Newberry County operations. In FY 2023, CAFLS employed 4 workers, all in Cooperative Extension, with combined personnel and operating expenditures of more than $428,000.

Table A: Operational Metrics for CAFLS Activities in Newberry County, SC (FY 2023)

County	FY 2023 CAFLS Headcount	FY 2023 CAFLS Expenditures		
		Personnel	Operating	Capital
Newberry	4	$379,078	$49,715	

Source: Clemson University CAFLS

As a result of the FY 2023 expenditures and employment, CAFLS generated the following economic impacts in Newberry County:

- Total expenditure-based economic impact (as measured by total output impacts) of more than $616,000.
- 5.4 total jobs supported in the County receiving more than $421,000 in total compensation.

Further details regarding CAFLS-generated expenditure-based impacts in Newberry County are shown in Table B.

Table B: Economic Impact of CAFLS Activities in Newberry County (FY 2023)

Impact Type	Employ-ment	Labor Income	Value Added	Output	County/ Local Tax Revenue	State Tax Revenue	Federal Tax Revenue
Direct Effect	4.0	$379,078	$379,078	$428,793	$353	$6,273	$75,921
Indirect Effect	0.4	$12,980	$19,246	$49,042	$902	$905	$2,839
Induced Effect	0.9	$29,457	$79,058	$138,478	$6,482	$5,486	$8,001
Total Impacts	5.4	$421,515	$477,381	$616,312	$7,737	$12,665	$86,761
Multiplier	***1.34***	***1.11***	***1.26***	***1.44***			

Source: TEConomy analysis, South Carolina IMPLAN MRIO Model

Oconee County CAFLS Expenditure-Based Impacts

The following data captures the operational expenditures of CAFLS and the resultant economic impact of these expenditures in Oconee County, including CAFLS-generated intercounty/intrastate impacts. The economic impact models estimate and treat purchases from entities outside of a specific geography as imports (or economic leakages) which are not captured in the total impacts.

It is important to note that the principal impacts of CAFLS are generated through the mission-oriented programs and activities that are delivered by faculty, staff, and field agents throughout the county—these functional impacts are discussed in the main report.

Table A provides the operational details of CAFLS Oconee County operations. In FY 2023, CAFLS employed 28 workers, 22 in Research and Experiment Stations, 5 in Cooperative Extension, and 1 in E&G, with combined personnel and operating expenditures of nearly $1.7 million.

Table A: Operational Metrics for CAFLS Activities in Oconee County, SC (FY 2023)

County	FY 2023 CAFLS Headcount	FY 2023 CAFLS Expenditures		
		Personnel	Operating	Capital
Oconee	28	$1,009,709	$714,153	

Source: Clemson University CAFLS

As a result of the FY 2023 expenditures and employment, CAFLS generated the following economic impacts in Oconee County:

- Total expenditure-based economic impact (as measured by total output impacts) of more than $5.6 million.
- 49.5 total jobs supported in the County receiving more than $1.9 million in total compensation.

Further details regarding CAFLS-generated expenditure-based impacts in Oconee County are shown in Table B.

Table B: Economic Impact of CAFLS Activities in Oconee County (FY 2023)

Impact Type	Employ-ment	Labor Income	Value Added	Output	County/ Local Tax Revenue	State Tax Revenue	Federal Tax Revenue
Direct Effect	28.0	$1,009,709	$1,009,709	$1,723,862	$1,078	$19,106	$224,396
Indirect Effect	7.2	$336,135	$622,527	$1,462,054	$25,809	$31,675	$84,181
Induced Effect	14.3	$593,295	$1,448,403	$2,428,620	$90,729	$97,610	$164,515
Total Impacts	49.5	$1,939,140	$3,080,639	$5,614,536	$117,616	$148,391	$473,092
Multiplier	***1.77***	***1.92***	***3.05***	***3.26***			

Source: TEConomy analysis, South Carolina IMPLAN MRIO Model

Orangeburg County CAFLS Expenditure-Based Impacts

The following data captures the operational expenditures of CAFLS and the resultant economic impact of these expenditures in Orangeburg County, including CAFLS-generated intercounty/intrastate impacts. The economic impact models estimate and treat purchases from entities outside of a specific geography as imports (or economic leakages) which are not captured in the total impacts.

It is important to note that the principal impacts of CAFLS are generated through the mission-oriented programs and activities that are delivered by faculty, staff, and field agents throughout the county—these functional impacts are discussed in the main report.

Table A provides the operational details of CAFLS Orangeburg County operations. In FY 2023, CAFLS employed 13 workers, 10 in Cooperative Extension and 3 in Livestock Poultry Health, with combined personnel and operating expenditures of $8.0 million.

Table A: Operational Metrics for CAFLS Activities in Orangeburg County, SC (FY 2023)

County	FY 2023 CAFLS Headcount	FY 2023 CAFLS Expenditures		
		Personnel	Operating	Capital
Orangeburg	13	$828,790	$7,179,063	

Source: Clemson University CAFLS

As a result of the FY 2023 expenditures and employment, CAFLS generated the following economic impacts in Orangeburg County:

- Total expenditure-based economic impact (as measured by total output impacts) of more than $13.8 million.
- 55.4 total jobs supported in the County receiving more than $2.3 million in total compensation.

Further details regarding CAFLS-generated expenditure-based impacts in Orangeburg County are shown in Table B.

Table B: Economic Impact of CAFLS Activities in Orangeburg County (FY 2023)

Impact Type	Employ-ment	Labor Income	Value Added	Output	County/ Local Tax Revenue	State Tax Revenue	Federal Tax Revenue
Direct Effect	13.0	$828,790	$828,790	$8,007,853	$1,289	$16,390	$186,685
Indirect Effect	36.3	$1,294,019	$1,832,827	$4,997,652	$68,710	$75,030	$308,709
Induced Effect	6.2	$207,471	$466,406	$831,446	$38,378	$30,695	$57,077
Total Impacts	55.4	$2,330,280	$3,128,023	$13,836,951	$108,377	$122,115	$552,472
Multiplier	***4.27***	***2.81***	***3.77***	***1.73***			

Source: TEConomy analysis, South Carolina IMPLAN MRIO Model

Pickens County CAFLS Expenditure-Based Impacts

The following data captures the operational expenditures of CAFLS and the resultant economic impact of these expenditures in Pickens County, including CAFLS-generated intercounty/intrastate impacts. The economic impact models estimate and treat purchases from entities outside of a specific geography as imports (or economic leakages) which are not captured in the total impacts.

It is important to note that the principal impacts of CAFLS are generated through the mission-oriented programs and activities that are delivered by faculty, staff, and field agents throughout the county—these functional impacts are discussed in the main report.

Table A provides the operational details of CAFLS Pickens County operations that includes a majority of the CAFLS main campus. In FY 2023, CAFLS employed 1,164 workers, with 569 (49%) in E&G, 301 (26%) in Research & Experiment Stations, and 279 (24%) in Cooperative Extension in Pickens County. CAFLS Pickens County operations have combined personnel, operating, and capital expenditures of more than $69 million.

Table A: Operational Metrics for CAFLS Activities in Pickens County, SC (FY 2023)

County	FY 2023 CAFLS Headcount	FY 2023 CAFLS Expenditures		
		Personnel	Operating	Capital
Pickens	1,164.0	$ 45,829,950	$ 21,093,370	$ 2,106,473

Source: Clemson University CAFLS

As a result of the FY 2023 expenditures and employment, CAFLS generated the following economic impacts in Pickens County:

- Total expenditure-based economic impact (as measured by total output impacts) of more than $101 million.
- 1,364.0 total jobs supported in the County receiving more than $53.0 million in total compensation.

Further details regarding CAFLS-generated expenditure-based impacts in Pickens County are shown in Table B.

Table B: Economic Impact of CAFLS Activities in Pickens County (FY 2023)

Impact Type	Employment	Labor Income	Value Added	Output	County/ Local Tax Revenue	State Tax Revenue	Federal Tax Revenue
Direct Effect	1,164.0	$45,829,950	$45,829,950	$69,029,793	$25,539	$631,551	$8,608,425
Indirect Effect	103.0	$4,120,817	$6,535,854	$16,855,556	$163,814	$259,664	$851,770
Induced Effect	97.0	$3,631,210	$8,782,676	$15,171,482	$504,259	$615,588	$884,201
Total Impacts	1,364.0	$53,581,977	$61,148,480	$101,056,831	$693,612	$1,506,803	$10,344,396
Multiplier	***1.17***	***1.17***	***1.33***	***1.46***			

Source: TEConomy analysis, South Carolina IMPLAN MRIO Model

Richland County CAFLS Expenditure-Based Impacts

The following data captures the operational expenditures of CAFLS and the resultant economic impact of these expenditures in Richland County, including CAFLS-generated intercounty/intrastate impacts. The economic impact models estimate and treat purchases from entities outside of a specific geography as imports (or economic leakages) which are not captured in the total impacts.

It is important to note that the principal impacts of CAFLS are generated through the mission-oriented programs and activities that are delivered by faculty, staff, and field agents throughout the county—these functional impacts are discussed in the main report.

Table A provides the operational details of CAFLS Richland County operations. In FY 2023, CAFLS employed 81 workers, 43 in Livestock Poultry Health, 26 in Cooperative Extension, 8 in Research and Experiment Stations, 3 in Regulatory and 1 in E&G, with combined personnel, operating, and capital expenditures of $10.2 million.

Table A: Operational Metrics for CAFLS Activities in Richland County, SC (FY 2023)

County	FY 2023 CAFLS Headcount	FY 2023 CAFLS Expenditures		
		Personnel	Operating	Capital
Richland	81	$6,110,322	$3,280,290	$808,594

Source: Clemson University CAFLS

As a result of the FY 2023 expenditures and employment, CAFLS generated the following economic impacts in Richland County:

- Total expenditure-based economic impact (as measured by total output impacts) of $19.0 million.
- 129.3 total jobs supported in the County receiving more than $9.0 million in total compensation.

Further details regarding CAFLS-generated expenditure-based impacts in Richland County are shown in Table B.

Table B: Economic Impact of CAFLS Activities in Richland County (FY 2023)

Impact Type	Employment	Labor Income	Value Added	Output	County/ Local Tax Revenue	State Tax Revenue	Federal Tax Revenue
Direct Effect	81.0	$6,153,695	$6,153,695	$10,199,205	$5,332	$89,763	$1,080,681
Indirect Effect	23.9	$1,588,003	$2,362,455	$4,597,212	$74,114	$87,101	$308,955
Induced Effect	24.3	$1,276,106	$2,458,682	$4,198,545	$134,287	$128,710	$272,537
Total Impacts	129.3	$9,017,804	$10,974,832	$18,994,962	$213,733	$305,574	$1,662,173
Multiplier	***1.60***	***1.47***	***1.78***	***1.86***			

Source: TEConomy analysis, South Carolina IMPLAN MRIO Model

Saluda County CAFLS Expenditure-Based Impacts

The following data captures the operational expenditures of CAFLS and the resultant economic impact of these expenditures in Saluda County, including CAFLS-generated intercounty/intrastate impacts. The economic impact models estimate and treat purchases from entities outside of a specific geography as imports (or economic leakages) which are not captured in the total impacts.

It is important to note that the principal impacts of CAFLS are generated through the mission-oriented programs and activities that are delivered by faculty, staff, and field agents throughout the county—these functional impacts are discussed in the main report.

Table A provides the operational details of CAFLS Saluda County operations. In FY 2023, CAFLS employed 6 workers, 4 in Cooperative Extension and 2 in Livestock Poultry Health, with combined personnel and operating expenditures of more than $442,000.

Table A: Operational Metrics for CAFLS Activities in Saluda County, SC (FY 2023)

County	FY 2023 CAFLS Headcount	FY 2023 CAFLS Expenditures		
		Personnel	Operating	Capital
Saluda	6	$403,643	$38,899	

Source: Clemson University CAFLS

As a result of the FY 2023 expenditures and employment, CAFLS generated the following economic impacts in Saluda County:

- Total expenditure-based economic impact (as measured by total output impacts) of more than $556,000.
- 6.7 total jobs supported in the County receiving more than $422,000 in total compensation.

Further details regarding CAFLS-generated expenditure-based impacts in Saluda County are shown in Table B.

Table B: Economic Impact of CAFLS Activities in Saluda County (FY 2023)

Impact Type	Employ-ment	Labor Income	Value Added	Output	County/ Local Tax Revenue	State Tax Revenue	Federal Tax Revenue
Direct Effect	6.0	$403,643	$403,643	$442,541	$332	$6,414	$79,710
Indirect Effect	0.1	$3,672	$6,222	$23,918	$443	$286	$808
Induced Effect	0.6	$15,571	$47,911	$90,242	$4,316	$2,517	$4,264
Total Impacts	6.7	$422,886	$457,776	$556,701	$5,092	$9,217	$84,782
Multiplier	***1.11***	***1.05***	***1.13***	***1.26***			

Source: TEConomy analysis, South Carolina IMPLAN MRIO Model

Spartanburg County CAFLS Expenditure-Based Impacts

The following data captures the operational expenditures of CAFLS and the resultant economic impact of these expenditures in Spartanburg County, including CAFLS-generated intercounty/intrastate impacts. The economic impact models estimate and treat purchases from entities outside of a specific geography as imports (or economic leakages) which are not captured in the total impacts.

It is important to note that the principal impacts of CAFLS are generated through the mission-oriented programs and activities that are delivered by faculty, staff, and field agents throughout the county—these functional impacts are discussed in the main report.

Table A provides the operational details of CAFLS Spartanburg County operations. In FY 2023, CAFLS employed 11 workers, 8 in Cooperative Extension, 2 in Regulatory, and 1 in Livestock Poultry Health, with combined personnel and operating expenditures of more than $816,000.

Table A: Operational Metrics for CAFLS Activities in Spartanburg County, SC (FY 2023)

County	FY 2023 CAFLS Headcount	FY 2023 CAFLS Expenditures		
		Personnel	Operating	Capital
Spartanburg	11	$581,711	$234,341	

Source: Clemson University CAFLS

As a result of the FY 2023 expenditures and employment, CAFLS generated the following economic impacts in Spartanburg County:

- Total expenditure-based economic impact (as measured by total output impacts) of more than $2.2 million.
- 18.5 total jobs supported in the County receiving nearly $1.0 million in total compensation.

Further details regarding CAFLS-generated expenditure-based impacts in Spartanburg County are shown in Table B.

Table B: Economic Impact of CAFLS Activities in Spartanburg County (FY 2023)

Impact Type	Employ-ment	Labor Income	Value Added	Output	County/ Local Tax Revenue	State Tax Revenue	Federal Tax Revenue
Direct Effect	11.0	$581,711	$581,711	$816,052	$778	$9,695	$113,394
Indirect Effect	4.0	$260,489	$381,601	$878,812	$14,876	$21,331	$55,538
Induced Effect	3.5	$155,741	$344,417	$562,517	$18,075	$23,909	$38,504
Total Impacts	18.5	$997,941	$1,307,728	$2,257,382	$33,729	$54,934	$207,436
Multiplier	***1.69***	***1.72***	***2.25***	***2.77***			

Source: TEConomy analysis, South Carolina IMPLAN MRIO Model

Sumter County CAFLS Expenditure-Based Impacts

The following data captures the operational expenditures of CAFLS and the resultant economic impact of these expenditures in Sumter County, including CAFLS-generated intercounty/intrastate impacts. The economic impact models estimate and treat purchases from entities outside of a specific geography as imports (or economic leakages) which are not captured in the total impacts.

It is important to note that the principal impacts of CAFLS are generated through the mission-oriented programs and activities that are delivered by faculty, staff, and field agents throughout the county—these functional impacts are discussed in the main report.

Table A provides the operational details of CAFLS Sumter County operations. In FY 2023, CAFLS employed 8 workers, all in Cooperative Extension, with combined personnel, operating, and capital expenditures of more than $617,000.

Table A: Operational Metrics for CAFLS Activities in Sumter County, SC (FY 2023)

County	FY 2023 CAFLS Headcount	FY 2023 CAFLS Expenditures		
		Personnel	Operating	Capital
Sumter	8	$530,292	$79,883	$7,243

Source: Clemson University CAFLS

As a result of the FY 2023 expenditures and employment, CAFLS generated the following economic impacts in Sumter County:

- Total expenditure-based economic impact (as measured by total output impacts) of more than $1.0 million.
- 10.8 total jobs supported in the County receiving more than $649,000 in total compensation.

Further details regarding CAFLS-generated expenditure-based impacts in Sumter County are shown in Table B.

Table B: Economic Impact of CAFLS Activities in Sumter County (FY 2023)

Impact Type	Employ-ment	Labor Income	Value Added	Output	County/ Local Tax Revenue	State Tax Revenue	Federal Tax Revenue
Direct Effect	8.0	$530,292	$530,292	$617,418	$383	$10,256	$105,537
Indirect Effect	0.7	$35,179	$48,581	$115,611	$1,175	$1,896	$7,453
Induced Effect	2.1	$83,626	$180,874	$313,134	$10,840	$12,291	$20,377
Total Impacts	10.8	$649,097	$759,746	$1,046,163	$12,398	$24,443	$133,366
Multiplier	***1.35***	***1.22***	***1.43***	***1.69***			

Source: TEConomy analysis, South Carolina IMPLAN MRIO Model

Union County CAFLS Expenditure-Based Impacts

The following data captures the operational expenditures of CAFLS and the resultant economic impact of these expenditures in Union County, including CAFLS-generated intercounty/intrastate impacts. The economic impact models estimate and treat purchases from entities outside of a specific geography as imports (or economic leakages) which are not captured in the total impacts.

It is important to note that the principal impacts of CAFLS are generated through the mission-oriented programs and activities that are delivered by faculty, staff, and field agents throughout the county—these functional impacts are discussed in the main report.

Table A provides the operational details of CAFLS Union County operations. In FY 2023, CAFLS employed 5 workers, 4 in Cooperative Extension and 1 in Livestock Poultry Health, with combined personnel and operating expenditures of more than $389,000.

Table A: Operational Metrics for CAFLS Activities in Union County, SC (FY 2023)

County	FY 2023 CAFLS Headcount	FY 2023 CAFLS Expenditures		
		Personnel	Operating	Capital
Union	5	$346,309	$43,183	

Source: Clemson University CAFLS

As a result of the FY 2023 expenditures and employment, CAFLS generated the following economic impacts in Union County:

- Total expenditure-based economic impact (as measured by total output impacts) of more than $501,000.
- 5.7 total jobs supported in the County receiving more than $370,000 in total compensation.

Further details regarding CAFLS-generated expenditure-based impacts in Union County are shown in Table B.

Table B: Economic Impact of CAFLS Activities in Union County (FY 2023)

Impact Type	Employ-ment	Labor Income	Value Added	Output	County/ Local Tax Revenue	State Tax Revenue	Federal Tax Revenue
Direct Effect	5.0	$346,309	$346,309	$389,493	$267	$5,588	$74,183
Indirect Effect	0.2	$8,169	$11,228	$28,741	$302	$369	$1,833
Induced Effect	0.5	$15,783	$47,716	$83,064	$3,761	$3,082	$4,562
Total Impacts	5.7	$370,261	$405,253	$501,298	$4,330	$9,039	$80,577
Multiplier	***1.14***	***1.07***	***1.17***	***1.29***			

Source: TEConomy analysis, South Carolina IMPLAN MRIO Model

Williamsburg County CAFLS Expenditure-Based Impacts

The following data captures the operational expenditures of CAFLS and the resultant economic impact of these expenditures in Williamsburg County, including CAFLS-generated intercounty/intrastate impacts. The economic impact models estimate and treat purchases from entities outside of a specific geography as imports (or economic leakages) which are not captured in the total impacts.

It is important to note that the principal impacts of CAFLS are generated through the mission-oriented programs and activities that are delivered by faculty, staff, and field agents throughout the county—these functional impacts are discussed in the main report.

Table A provides the operational details of CAFLS Williamsburg County operations. In FY 2023, CAFLS employed 6 workers, 4 in Cooperative Extension and 2 in Livestock Poultry Health, with combined personnel, operating, and capital expenditures of more than $636,000.

Table A: Operational Metrics for CAFLS Activities in Williamsburg County, SC (FY 2023)

County	FY 2023 CAFLS Headcount	FY 2023 CAFLS Expenditures		
		Personnel	Operating	Capital
Williamsburg	6	$337,946	$163,411	$135,000

Source: Clemson University CAFLS

As a result of the FY 2023 expenditures and employment, CAFLS generated the following economic impacts in Williamsburg County:

- Total expenditure-based economic impact (as measured by total output impacts) of more than $908,000.
- 8.0 total jobs supported in the County receiving nearly $395,000 in total compensation.

Further details regarding CAFLS-generated expenditure-based impacts in Williamsburg County are shown in Table B.

Table B: Economic Impact of CAFLS Activities in Williamsburg County (FY 2023)

Impact Type	Employ-ment	Labor Income	Value Added	Output	County/ Local Tax Revenue	State Tax Revenue	Federal Tax Revenue
Direct Effect	6.0	$337,946	$337,946	$636,356	$255	$5,707	$63,766
Indirect Effect	0.9	$22,792	$35,397	$103,886	$2,972	$2,503	$4,879
Induced Effect	1.1	$34,175	$95,738	$168,411	$8,539	$6,762	$9,165
Total Impacts	8.0	$394,913	$469,080	$908,653	$11,766	$14,973	$77,810
Multiplier	***1.33***	***1.17***	***1.39***	***1.43***			

Source: TEConomy analysis, South Carolina IMPLAN MRIO Model

York County CAFLS Expenditure-Based Impacts

The following data captures the operational expenditures of CAFLS and the resultant economic impact of these expenditures in York County, including CAFLS-generated intercounty/intrastate impacts. The economic impact models estimate and treat purchases from entities outside of a specific geography as imports (or economic leakages) which are not captured in the total impacts.

It is important to note that the principal impacts of CAFLS are generated through the mission-oriented programs and activities that are delivered by faculty, staff, and field agents throughout the county—these functional impacts are discussed in the main report.

Table A provides the operational details of CAFLS York County operations. In FY 2023, CAFLS employed 6 workers, 4 in Cooperative Extension and 2 in Livestock Poultry Health, with combined personnel and operating expenditures of more than $543,000.

Table A: Operational Metrics for CAFLS Activities in York County, SC (FY 2023)

County	FY 2023 CAFLS Headcount	FY 2023 CAFLS Expenditures		
		Personnel	Operating	Capital
York	6	$378,196	$165,249	

Source: Clemson University CAFLS

As a result of the FY 2023 expenditures and employment, CAFLS generated the following economic impacts in York County:

- Total expenditure-based economic impact (as measured by total output impacts) of more than $1.5 million.
- 11.4 total jobs supported in the County receiving more than $765,000 in total compensation.

Further details regarding CAFLS-generated expenditure-based impacts in York County are shown in Table B.

Table B: Economic Impact of CAFLS Activities in York County (FY 2023)

Impact Type	Employ-ment	Labor Income	Value Added	Output	County/ Local Tax Revenue	State Tax Revenue	Federal Tax Revenue
Direct Effect	6.0	$378,196	$378,196	$543,445	$333	$6,200	$71,522
Indirect Effect	3.3	$288,737	$363,990	$668,598	$8,166	$11,777	$56,986
Induced Effect	2.2	$98,889	$219,138	$369,621	$12,935	$12,916	$23,463
Total Impacts	11.4	$765,822	$961,324	$1,581,664	$21,434	$30,894	$151,971
Multiplier	***1.90***	***2.02***	***2.54***	***2.91***			

Source: TEConomy analysis, South Carolina IMPLAN MRIO Model

TECONOMY
PARTNERS LLC