



The Economic and Functional Impact of North Carolina Cooperative Extension

NC

**COOPERATIVE
EXTENSION**



N.C. A&T
STATE UNIVERSITY

**NC STATE
UNIVERSITY**

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 **TECONOMY**
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Executive Summary

The United States, its individual states, and individual Americans compete in the global economy. To thrive in this economic reality requires:

- **Research**, to identify better ways to perform tasks, solve problems, innovate new technologies, and continuously improve output
- **Outreach**, to transfer the results of research, innovations, and practice advancements to those who can put knowledge-to-work to advance society and the economy
- **Education**, to develop individual capacity and skills required to access, understand, and implement productivity enhancements.

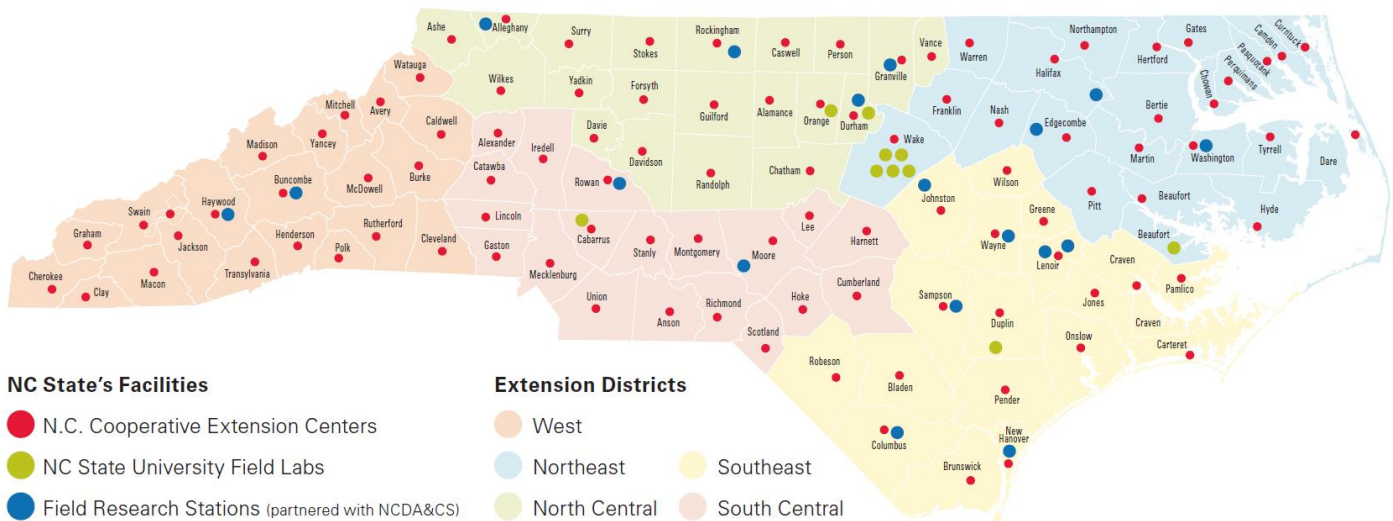
As each of us seeks to negotiate our way successfully in society and the economy, we draw upon information and knowledge. We do this either by recalling what we have already learned and deploying the skills we have developed, or by accessing informational resources and training to gain the new knowledge and skills we need. To both compete and progress, we must have access to reliable, trusted sources of validated information, and have the skills necessary to understand the information and put it to use. Today, information and knowledge are very much at the forefront of driving a knowledge economy and empowering economic and societal progress—both collectively and individually.

More than a century ago, far-sighted leaders in the national legislature developed a system specifically designed to proactively generate pragmatic research discoveries and to transfer research-based knowledge, advancements, innovations, and best practices to those best able to put the knowledge to work. Land-grant universities, which in North Carolina include North Carolina State University (NC State) and North Carolina Agricultural and Technical State University (NC A&T), are at the heart of this system. Like all research universities, they conduct basic through applied research and provide formal higher education. Of critical importance, however, is a third activity that is unique to the Land-grant universities—Cooperative Extension. Extension develops and deploys deliberate programmatic activities that transfer research-based knowledge and innovations out of the university and into the hands of those best equipped to translate knowledge into action to advance the economy and society. Extension ensures that agricultural producers, value-added industries, workers, community leaders, families, and individuals have access to the latest information and advancements they need to thrive, remain competitive, and be successful.

North Carolina Cooperative Extension

Programs at NC State and NC A&T combine to comprise “North Carolina Cooperative Extension” (abbreviated to N.C. Cooperative Extension, or just Extension, throughout this report). N.C. Cooperative Extension county centers, located at a county level throughout the State of North Carolina (Figure ES-1), house Extension faculty and staff 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. These county-level operations are supported by Area Specialized Agents, versed in the needs of the state’s diverse regions, and Extension Specialists—university faculty with deep subject matter expertise.

The personnel and activities of N.C. Cooperative Extension are supported by federal, state, and local (primarily county-level) funding. The USDA’s National Institute of Food and Agriculture (NIFA) is the federal partner, providing annual Congressionally appropriated formula-based funding (also known as “capacity funding”) that is then leveraged by matching state and county funding supports.

Figure ES-1: N.C. Cooperative Extension: Serving Every North Carolina County

Extension is structured to carry the know-how, knowledge, innovations, and research findings of NC State and NC A&T to benefit all North Carolinians. It also operates as a portal to the universities' research resources, whereby challenges and needs can be brought to the universities to be addressed through research. It is thus a two-way system—responding to needs from the field and carrying new knowledge from the universities to those best equipped to put the knowledge into practice to benefit the state and its citizens.

Functional Impacts of N.C. Cooperative Extension

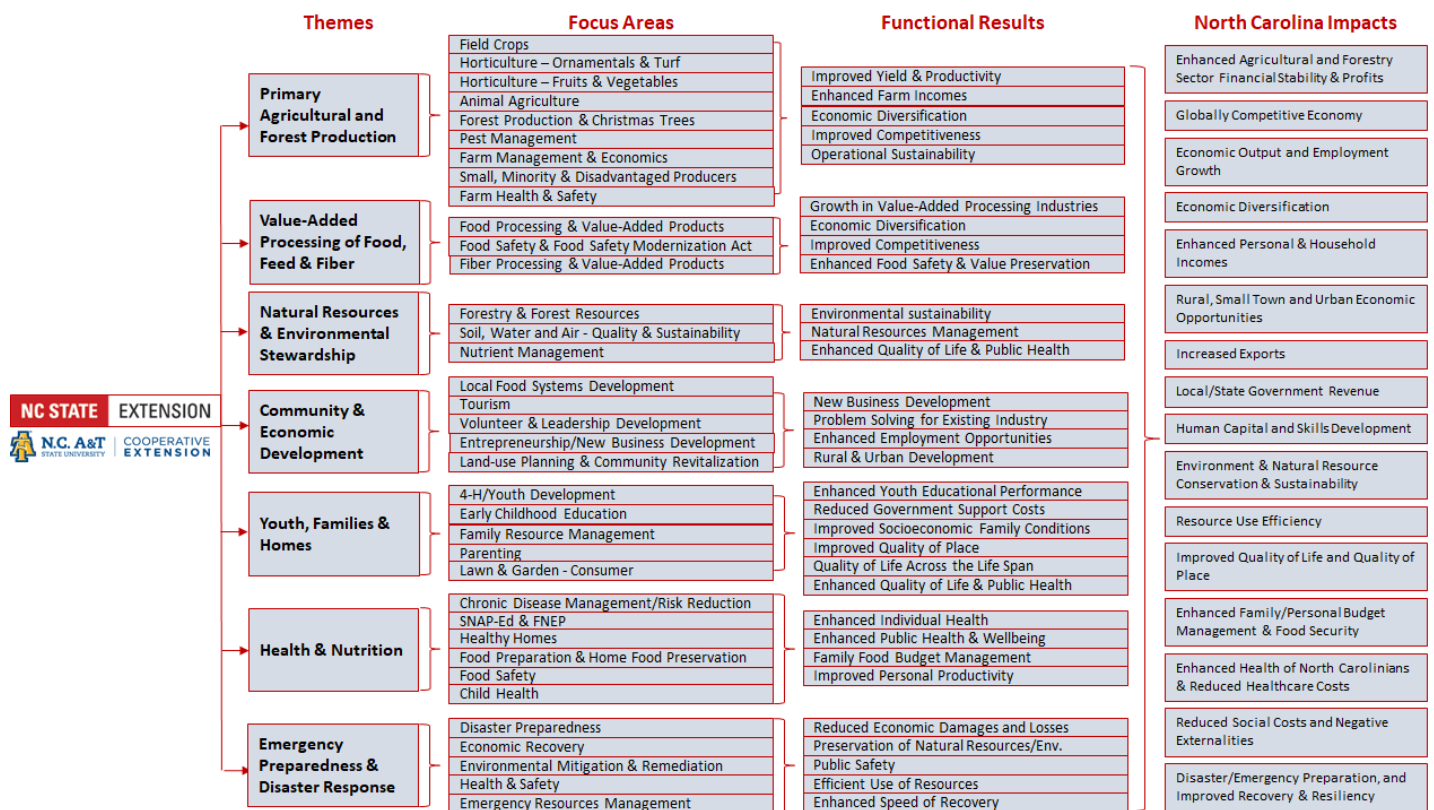
While perhaps best known for work in support of farming and forestry and associated rural development, Extension's work and influence is felt far more broadly. N.C. Cooperative Extension has a much more expansive mission, seeking to advance not only improvements in specific sectors of the economy but also to provide knowledge that enables better governance, enhanced family well-being, improved health for North Carolinians, and a broad range of other activities. The activities conducted by Extension and the results obtained are termed "functional impacts". The core focus areas or "themes" under which Extension undertakes its work are highlighted in Figure ES-2, while the extent and variety of functional impacts generated through Extension are illustrated in Figure ES-3.

Table ES-2: Core Themes for N.C. Cooperative Extension Programmatic Activities

NC Extension Programmatic Themes	Primary Agricultural & Forest Production	Comprising Extension's work on enhancing and sustaining North Carolina's commercial agriculture (row crops, horticultural crops, animal agriculture, etc.) and forestry production.
	Value-Added Processing of Food, Feed & Fiber	Comprising Extension's work to build, sustain and enhance the development of North Carolina's downstream value-added processing industries that use agricultural and forest inputs.
	Natural Resources & Environmental Stewardship	Helping assure resiliency and sustainability in land and natural resources assets that sustain North Carolina's economy, ecosystems and quality of life.
	Community & Economic Development	Working to provide knowledge and programs that assist both rural and urban communities in their ongoing community and economic development.
	Homes, Families & Youth	Bringing research-based, knowledge and programing to individuals and families that enhances educational and personal development outcomes, personal productivity, employability, financial security and quality-of-life.
	Health & Nutrition	Empowering individuals with the knowledge and skills to make informed decisions regarding their health, nutrition, food intake, and safe food preparation and preservation.
	Emergency Preparedness & Disaster Response	Comprising Extension's work to empower individuals, agencies and key decision makers with proven solutions to build resiliency in the face of natural disasters, mitigate negative impacts and speed post-disaster recovery.

Source: TEconomy Partners, LLC

Figure ES-3: Functional Activities and Impacts of N.C. Cooperative Extension

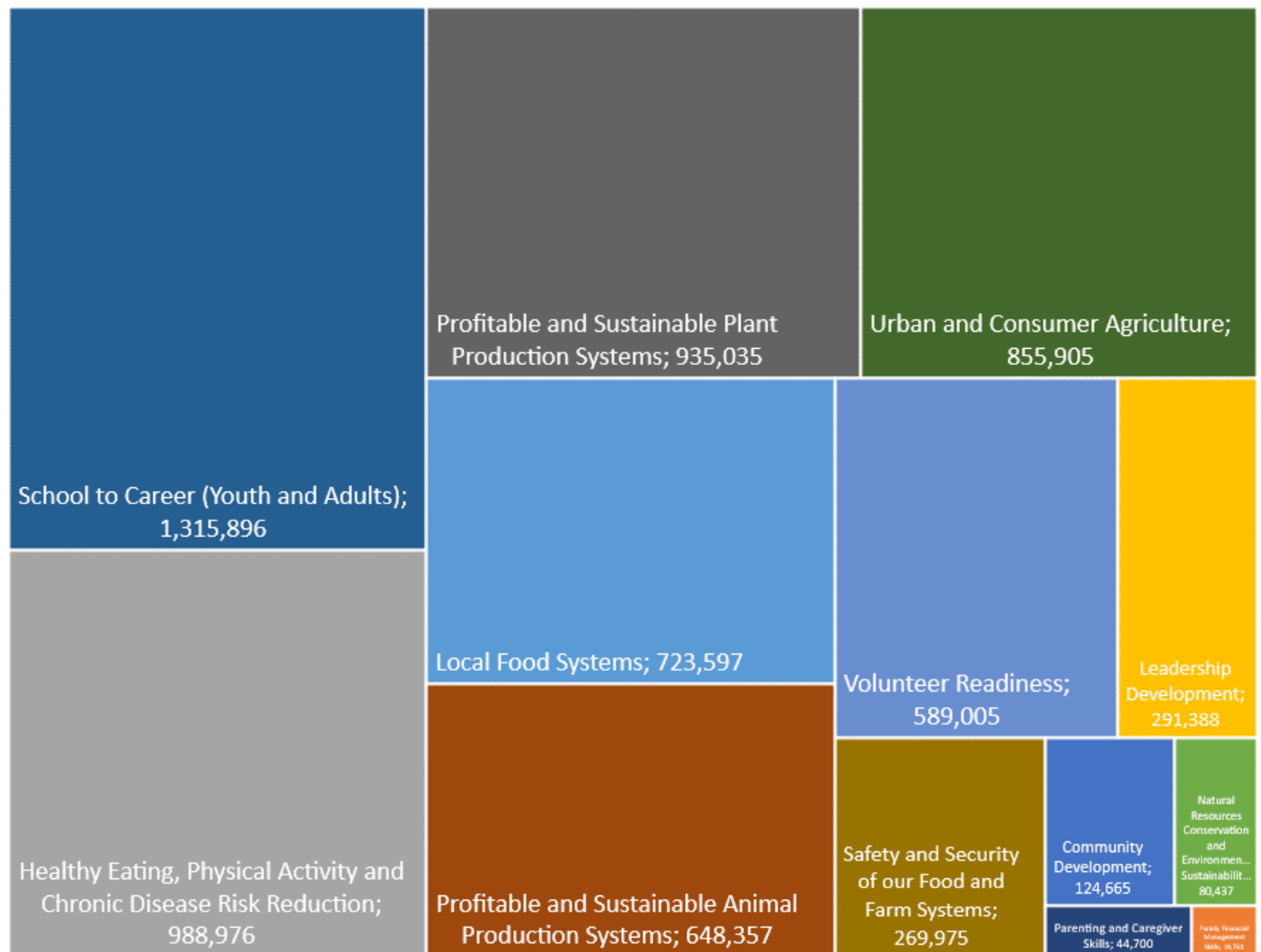


Source: TEconomy Partners, LLC

The annual reach of N.C. Cooperative Extension into communities, industries, and families across the state, through all its programs, is extremely large. As measured by “contacts”, Extension recorded over 1.84 million direct contacts, and (via train the trainer, web contacts, publications access, etc.) generated an additional 5 million indirect contacts in 2017 alone. Combining direct and indirect contacts for 2017 shows N.C. Cooperative Extension having 6.89 million contacts annually. With North Carolina’s total 2017 population at 10.3 million, it is evident that in any given year, N.C. Cooperative Extension is providing services to a very high percentage of the State’s population.

NC State Extension tracks contacts by key area of programing. Figure ES-4 summarizes the total contacts (comprising both direct and indirect contacts) for 2017 across major program areas.

Figure ES-4: Total Contacts (Direct + Indirect) in 2017 by N.C. Cooperative Extension Program Category



It is evident from the data that Extension's contacts are quite evenly divided between agricultural systems related contacts¹ and youth, family and community support programs². Total contacts in the agriculture domain summed to 3,341,765 in 2017, and youth, family, and community program contacts totaled 3,257,729.

With over 13,000 individual program activities and 1.84 million direct contacts with North Carolinians in 2017 alone, it is simply not feasible to provide a full accounting of each and every program and the multi-faceted impacts of each. Indeed, while many of the impacts generated by N.C. Cooperative Extension have financial impacts associated with them (for example, generating improved agricultural yields, helping to expand value-added industries, etc.), others work to a different purpose, such as strengthening families, enhancing food security, or building more engaged and prepared youth. Impacts may manifest themselves in a multitude of ways, for example in terms of educational performance gains, positive behavior changes, negative issues averted, and other benefits that do not lend themselves to quantitative financial impact measurement. What is possible, however, and performed in this report, is to provide a well-rounded suite of examples of "Extension's work in action"—a series of program vignettes and summaries that serve to illustrate and highlight core areas of functional impact.

What is discovered through this process is that N.C. Cooperative Extension's economic and functional impacts on the state are large in scale—with benefits of Extension financially eclipsing the cost of operations by many multiples. In a 2014 analysis, performed by TEconomy, it was concluded that the combined effect of research and Extension activity by NC State in support of soybean agriculture would have conservatively generated between a 12.5 percent to 17.5 percent benefit in terms of improved yield. These yield benefits were generated through multiple activities in variety development, variety testing, production practice recommendations, pest and disease prevention and diagnostics, soil nutrient studies and recommendations, and multiple other recommendations, practice advancements and business supports. Extrapolating those impacts to more recent 2017 production of soybeans in North Carolina results in potential benefit to soybean agriculture via NC State research and Extension work of between \$79.8 million and \$111.8 million in enhanced yield value for 2017.

With more than 80 individual crops grown in North Carolina, it is impractical to evaluate the impact that N.C. Cooperative Extension is having on each one. Extension is actively working across most crops in terms of helping farmers select high yielding crop varieties suited to individual North Carolina growing environments, working to help prevent damage from plant pathogens, pests and weeds, helping producers deploy their agricultural chemicals more efficiently and cost-effectively, advising on soil health, and guiding optimized agricultural practices to assure successful crops. Plus, Extension is working across a broad range of activities in livestock agriculture, the green industry, and forest industries. Were the impact of results of NC State research and Extension work in soybean yield enhancement to be experienced at a similar scale of impact across North Carolina's total agriculture sector, at the low end of the soybean yield enhancement range (12.5 percent), the large-scale contribution being made by Extension to North Carolina's agricultural economy can be generally estimated. If we allocate 50 percent of the yield enhancement to NC State research and 50 percent to N.C. Cooperative Extension's hands-on education, advisory, and testing activity, thereby using 6.25 percent yield increase as an estimated measure for the value of Extension-related yield increases, the impact is very large in

¹ Including: local food systems; profitable and sustainable animal production systems; profitable and sustainable plant production systems, safety and security of food and farm systems, urban and consumer agriculture.

² Including: community development; family financial management skills; healthy eating, physical activity and chronic disease reduction; leadership development; natural resources conservation and environmental sustainability; parenting and caregiver skills; school to career (for youth and adults); volunteer readiness.

scale. TEconomy used input/output analysis to model the effects of a 6.25 percent potential output increase allocable to Extension work across agriculture and forest output in the state, finding estimated impacts to be as follows:

- **\$1,526.9 million increase in total North Carolina economic output, comprising direct, indirect, and induced impact components.**
- **\$662.5 million increase in value-added within the state economy.**
- **10,469 jobs created and supported.**
- **\$489.4 million annually in additional labor income for North Carolinians.**

Extension's total annual operating budget was \$98.8 million (in 2018), and the estimated economic impact benefits generated for the state of \$1,526.9 million in agriculture alone eclipses this expense by approximately 15.5 times.

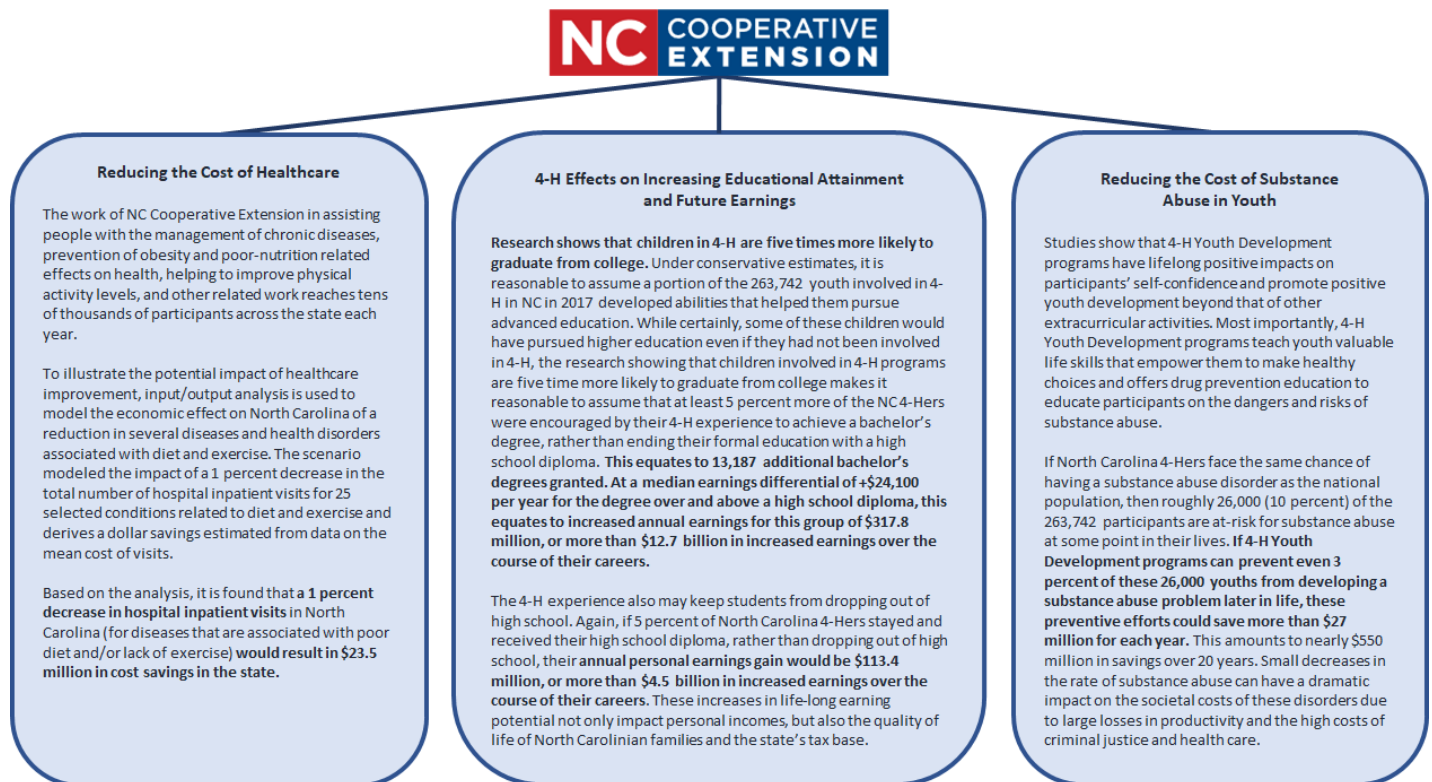
Such large impacts are to be expected given the extent of Extensions work on an annual basis in support of North Carolina agriculture. As noted previously, Extension had 3,341,765 contacts for 2017 just in the agricultural domain. Examples of just some of the work, highlighted in this report, show \$14.4 million in farmer yield gains through Extension support in cotton trials and \$8.8 million in annual fertilizer application savings through Extension recommendations. When distributed across millions of contacts, the impacts start to accumulate significantly. It is noted that NC State's leadership in turf grass research and Extension is a key support for North Carolina's golf industry, an industry which TEconomy finds to have a \$2.4 billion impact of the state, and Extension's critically important work in support of animal agriculture in North Carolina is helping to sustain an \$18.7 billion North Carolina industry. Extension is also proactive in providing assistance to the large-scale (\$8.3 billion) livestock and poultry industry in North Carolina, generating widespread impacts there also.

While the agriculture and forestry economy in the state, and the rural jobs it supports, are immensely important (with the agriculture economy supporting 17 percent of all jobs in the state), N.C. Cooperative Extension's work (as shown previously in Figure ES-2) covers many more areas of importance to the economy and society. Extension work highlighted, herein, demonstrates activities focused on:

- Understanding, managing, sustaining, and protecting North Carolina's natural resources.
- Preparing North Carolina for optimal response in the face of natural disasters and emergencies.
- Developing strategies and actions for community and economic development.
- Providing education and activity programs to help realize the full potential of North Carolina's youth.
- Improving the health, nutrition, and physical activity levels of North Carolinians, thereby helping to promote public health.
- Helping to reduce the level of food insecurity.
- Providing critical research-based input to public decision-making processes and public policy.

To highlight just some of the types of magnitude of impacts that can occur through diverse Extension activities, Figure ES-5 highlights the impact of three specific areas: reducing hospitalizations through work to improve the health of North Carolinians through better diet and increased exercise; increasing educational attainment and its impact on future earnings through 4-H youth development programs and activities; and reducing destructive behavior in youth. **Together, just these three examples in support of youth, families, and enhanced health of North Carolinians are projected to exceed \$365 million in impact annually.**

Figure ES-5: Case Studies in N.C. Cooperative Extension Impact – Examples of Healthcare and Youth Programs



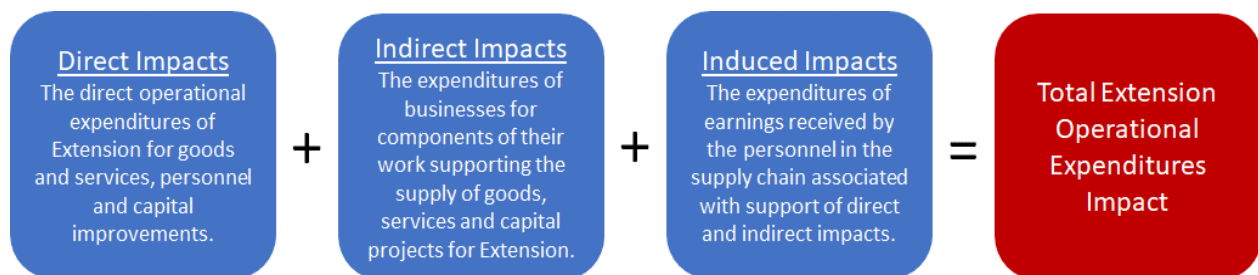
Source: TEconomy Partners, LLC

The Economic Impact of N.C. Cooperative Extension Operational Expenditures

In addition to the mission-based functional impacts of Extension, it is also the case that there are additional economic impacts generated via the operational expenditures of Extension in the state. While Extension does not exist to simply generate economic stimulus through its expenditures, given its total operating expenditures of \$98.8 million³ and 954 FTE employees, the stimulus effect is not insignificant.

To measure the impact of Extension expenditures, input/output analysis is used. The analysis calculates the direct, indirect, and induced impacts as shown in Figure ES-6.

Figure ES-6: Components of the Impact of N.C. Cooperative Extension Operational Expenditures.



Source: TEconomy Partners, LLC

³ Total N.C. Cooperative Extension funding of \$98.8 million is comprised of the following elements. \$43.9 million in State of NC funding; \$19.2 million in NC county funding; \$15.2 million in Federal funding through the USDA, and \$20.5 million in grants, contracts, fees and other self-generated resources.

The results of the input/output analysis of N.C. Cooperative Extension operational expenditures are shown in Table ES-1, indicating that the expenditures generated a total output impact of \$204.5 million in the North Carolina economy, and supported 1,701 jobs with labor income totaling \$106.8 million.

Table ES-1: Economic Impact of N.C. Cooperative Extension Expenditures, FY 2018 (\$M)

Impact Type	Employment (FTE)	Labor Income	Value Added	Output	State/Local Tax Revenue	Federal Tax Revenue
Direct Effect	953.8	\$74.68	\$78.56	\$98.83	\$4.26	\$19.03
Indirect Effect	200.6	\$9.12	\$17.85	\$31.46	\$1.26	\$2.27
Induced Effect	546.4	\$23.02	\$42.73	\$74.19	\$3.81	\$5.68
Total Impacts	1,700.8	\$106.82	\$139.14	\$204.48	\$9.33	\$26.98
<i>Multiplier</i>	<i>1.78</i>	<i>1.43</i>	<i>1.77</i>	<i>2.07</i>		

Source: TEconomy's calculations and analysis using IMPLAN I/O model for the State of North Carolina

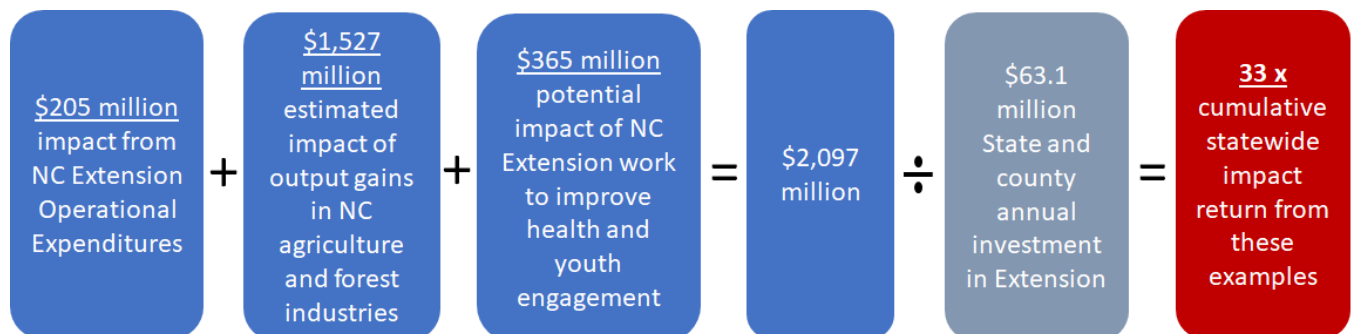
Note: Details may not add to totals due to rounding.

Conclusions

N.C. Cooperative Extension is an intensely relevant and important institution supporting the ongoing success and development of multiple components of North Carolina's economy and society. Working statewide, the impacts of NC Extension are of benefit to every North Carolina county, touching organizations and individuals in both rural and urban settings. Extension helps people cut through the complexity of modern life and commerce to receive the reliable research-based information and educational resources they need to make important decisions and solve life challenges. In an increasingly competitive global economy, Extension is a crucial resource for North Carolina's ongoing competitiveness.

While it is clearly very difficult to put a final dollar value on each and every program and activity undertaken by N.C. Cooperative Extension, the case studies and expenditure economic impact modeling highlighted herein demonstrate that the State of North Carolina and individual county investments in Extension services receive a high return on their investment in terms of growth of the economy and public expenditure savings. Figure ES-7 illustrates this, showing the combined impacts from several Extension programs as well as the operational expenditures for Extension coming from state and county sources. The effect of these program areas is that **N.C. Cooperative Extension generates an estimated 33:1 economic impact return for the overall state economy in return for State and County investments.**

Figure ES-7: Examples of Extensive Benefits from Investment in N.C. Cooperative Extension



Source: TEconomy Partners, LLC

These benefits from investment by the State of North Carolina and individual counties occur via direct and indirect 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 Extension efforts makes possible, and the expenditures made by Extension. Positive functional impact benefits are experienced at every level from the full North Carolina economy down to individual family incomes and are experienced statewide across both rural and urban environments.

The work of Extension covers thousands of activities each year, reaching an extremely wide-ranging audience. Into the future, the core role of N.C. Cooperative Extension as an engine of knowledge, know-how, and best practices transfer, combined with its ability to relay research needs from the field to the universities' research enterprise, will remain exceptionally relevant to securing a successful, healthy, and productive North Carolina.

I: Introduction

A. Knowledge as a Driver of Economic and Societal Progress

Complexity is a defining characteristic of modern economic and societal life. 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 each contribute to a seemingly overwhelmingly complex economic and societal environment.

Negotiating this complex modern reality requires not only information but, more importantly, the knowledge and skills that allow us to access, process and make sense of the information we receive. In addition, the free-wheeling universe of information, much of which emanates from unvetted, unmoderated sources or sources of questionable provenance, requires discernment regarding what to trust and what to discard. Whether in the world of work or private life, we each draw upon our education and knowledge to make decisions that affect the success and wellbeing of ourselves and others. We must also, increasingly, rely on trusted arbiters of information validity to make decisions rooted in fact not fiction. **In today's society and economy, having access to trusted, validated sources of reliable information and know-how is critically important and of high value. Equally, possessing the educational training and skills to understand information and turn it into actionable knowledge is also critical.**

Information Expansion in Today's Society

Navigating the modern world of information is hugely challenging. Consider some of the following statistics:

As of October 19th, 2018, there were 1.92 billion websites on the Web, expanding at a pace exceeding two new websites per second.

Google is used to perform over 3.3 billion searches each day, or over 38,000 searches per second.

Nature News reported, in 2014, that global scientific knowledge doubles every nine years.

Scopus, a leading indexer of published academic research contains 1.4 billion cited references, covers 22,800 unique serial titles, and has profiles on 16 million authors. *Web of Science*, another leading bibliographic system, contains over 35.7 million indexed academic publications.

B. Universities as Knowledge Engines

While not exclusively the domain of universities, the production of new knowledge rooted in rigorous, and typically peer-reviewed, research inquiry is fundamental to advancing human capacity. America's research universities are at the forefront of this activity. The USA's world-class universities play two centrally important roles in advancing knowledge and national progress—research and education. **Academic research** drives discovery and innovation across scientific, social, economic, and cultural domains and provides research-based answers to questions, and solutions to challenges, facing the nation, individual states, society and businesses. The second core university role, that of **higher education** provides individuals with the subject matter expertise, knowledge, learning and problem-solving skills required for success in the world of work and daily life. University education imparts the knowledge and skills required for successful realization of personal potential in today's complex global society and economy.

Universities represent the most powerful and widespread knowledge production engines for the U.S., making possible advancements across an extremely broad range of disciplines in physical sciences, life sciences, social sciences, arts, humanities, and professional fields. This academic knowledge engine works to assure our nation

is able to address a full spectrum of needs and opportunities across social, political, cultural, technological, and economic domains of human activity.

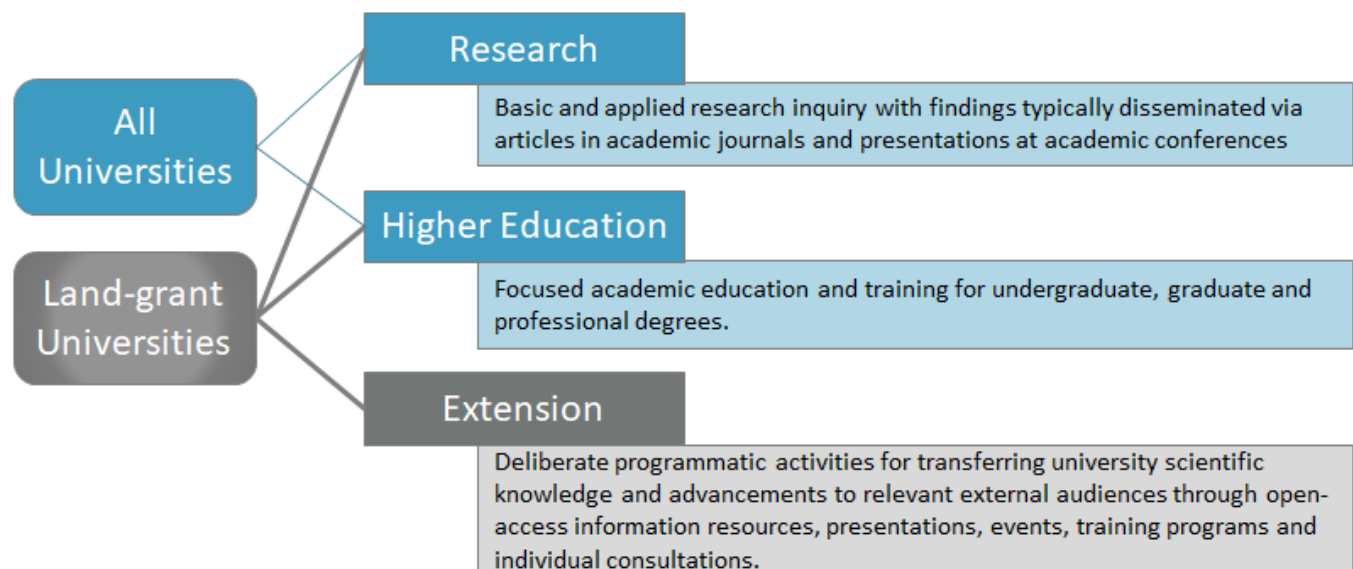
All universities in the United States engage in the two core missions of higher education and research. With over 3,000 four-year degree granting institutions in the nation, the U.S. benefits from a rich landscape of higher education institutions.

C. Land-Grant Universities Add a Third Mission

A two stringed guitar can play a broad variety of notes, assembled into a complex library of tunes. But imagine how much more can be produced with the addition of a third string. So much more, in terms of musical diversity and harmonic output, can be achieved through the addition of a third string. So it is with a special subset of universities that add a third mission called “**Extension**” to their existing two-part missions of research and formal higher education. The provision of Extension as a third functional activity allows these special universities to add further diversity and far reaching impacts to their work. These universities are America’s **Land-grant universities**.

Land-grant universities perform higher education and undertake research similar to their research university peers across the nation, but they add a deliberate organized function that works to proactively carry, or “extend”, university knowledge, recommendations, practice advancements and technological innovations to audiences outside of the academic environment. Extension, at U.S. Land-grant universities, is a dedicated organization and delivery system that has the pragmatic, purposefully designed mission to assure that research-based knowledge is not confined to academic circles but is also deliberately and professionally provided to individuals and organizations across the economy and society who can put knowledge to work. Extension provides outreach and education to individuals and organizations who will benefit from advanced information and knowledge that will enable them to solve problems, adapt to changes and new opportunities, make informed decisions, and carry innovations forward into practice. This third mission is shown on Figure 1:

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



Source: TEconomy Partners, LLC

D. The Mission of Extension

Cooperative Extension represents a visionary system (see sidebar), purpose-designed by Act of Congress to bring research-based, Land-grant developed innovations, advancements and education to a diverse range of populations.

As noted by the USDA:

“Extension provides non-formal education and learning activities to people throughout the country — to farmers and other residents of rural communities as well as to people living in urban areas. It emphasizes taking knowledge gained through research and education and bringing it directly to the people to create positive changes.”⁴

“The hallmarks of the extension program — openness, accessibility, and service — illuminate how cooperative extension brings evidence-based science and modern technologies to farmers, consumers, and families. Through extension, land-grant institutions reach out to offer their resources to address public needs. By educating farmers on business operations and on modern agricultural science and technologies, extension contributes to the success of countless farms, ranches, and rural business. Further, these services improve the lives of consumers and families through nutrition education, food safety training, and youth leadership development.”⁵

A VISIONARY SYSTEM FOR AMERICAN PROGRESS

Land-grant universities have their historic roots in the Morrill Land-Grant Act of 1862, which provided grants of land to the states that could then be sold to finance and support institutions to teach agriculture, mechanics and military tactics, without forgoing classical studies.

These institutions particularly focused on providing a practical education suited to the demands of the expanding American economy. The original Morrill Act gave rise to, and supported, a series of colleges and universities that have grown to become many of this nation’s most prestigious and research-intensive institutions. The subsequent Hatch Act of 1887 further built upon the Morrill Act’s foundation by authorizing federal grant funds to each state for the establishment of an agricultural experiment station connected to each state’s land-grant institution. These experiment stations were then funded by ongoing federal funds leveraged with state matching dollars.

The Smith-Lever Act of 1914 created a Cooperative Extension Service associated with each land-grant institution. The “Cooperative” part of the Extension Service name references the unique partnership between the federal (USDA), state (land-grant colleges), and local (county) entities that enables the pragmatic and crucially important work of translating and disseminating the latest know-how, information, and innovations that result from the research of the land-grant colleges and their experiment stations.

It is a testament to Representative Justin Smith Morrill of Vermont (for whom the Morrill Act is named), and each successive administration and congress, that this integrated system of land-grant universities, Experiment Station Systems, and Cooperative Extension Services, providing R&D-based solutions and pragmatic knowledge transfer, has grown and thrived for more than 150 years.

Simon Tripp, et al., 2017. “National Evaluation of Capacity Programs.” TEconomy Partners LLC for the National Institute of Food and Agriculture.

⁴ <https://nifa.usda.gov/extension>

⁵ Ibid

NC State and NC A&T have been North Carolina's providers of Cooperative Extension services for more than 100 years. North Carolina Cooperative Extension is a strategic partnership comprising NC State Extension, The Cooperative Extension Program at N.C. A&T State University, the U.S. Department of Agriculture's National Institute of Food and Agriculture (USDA-NIFA), and 101 local governments statewide. N.C. Cooperative Extension partners with communities to deliver education and technology that enrich the lives, land and economy of North Carolina.⁶

Taken together the programs of the two universities (NC State Extension and NC A&T Cooperative Extension) combine to comprise "North Carolina Cooperative Extension."⁷ The term "Cooperative" is commonly included in describing Extension to highlight the fact that Extension is cooperatively operated to serve the American people as a partnership between Land-grant universities, state governments and county governments, and the federal government through the United States Department of Agriculture (USDA). Extension county centers, throughout the state of North Carolina, house N.C. Cooperative Extension faculty and staff who are available to 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. Extension is supported by federal, state, and local (primarily county-level) funding. The USDA's National Institute of Food and Agriculture (NIFA) is the federal partner, providing annual Congressionally appropriated formula-based funding (also known as "capacity funding") that is further leveraged by matching state and county funding supports. Extension operations may also receive funds through performing contractual work, receiving special grants, and through charging moderate fees for some programs and materials.

As the descriptions of Extension above suggest, Extension has a diverse and far reaching mission. While perhaps best known for work in support of American farming and associated rural development, Extension's work and influence is felt considerably more broadly. Extension has evolved to embrace an expansive mission, seeking to advance not only improvements in specific sectors of the economy but also provide knowledge to empower societal, family, and individual capacity to thrive in the economy and socio-cultural fabric of the United States.

The diversity of the N.C. Cooperative Extension mission is highlighted within the key thematic mission areas called out by the participating universities. NC State notes, for example, that Extension is performing work that is:

- Feeding our future
- Improving our health
- Enriching our youth, and
- Strengthening our communities.

As shown in this report, TEconomy segments the work of Extension into functional impacts across seven principal domains of focus:

1. **Primary Agricultural and Forest Production** – comprising Extension work focused on enhancing and sustaining North Carolina's commercial agriculture (row crops, horticultural crops, animal agriculture, etc.) and forestry production.

⁶ <https://intranet.ces.ncsu.edu/brand/n-c-cooperative-extension-brand/>

⁷ Throughout this report TEconomy uses the terms Extension or N.C. Cooperative Extension to refer to the combined system of extension in North Carolina provided by NC State and NC A&T. When calling out areas of impact specific to an individual institution specific reference is made to NC State Extension or NC A&T Cooperative Extension.

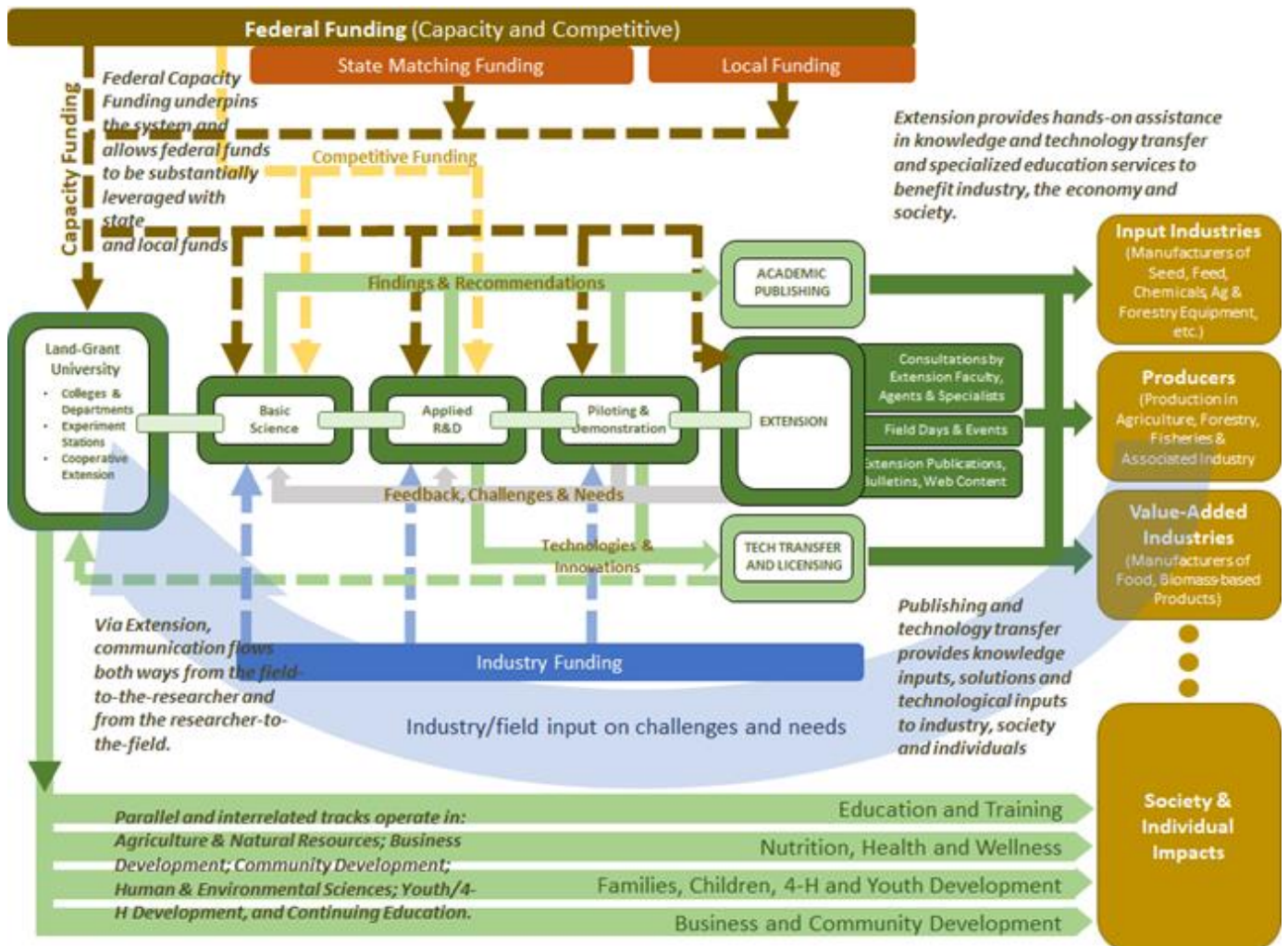
2. **Value-Added Processing of Food, Fiber and Feed** – comprising Extension’s work to build, sustain and enhance the development of North Carolina’s downstream value-added processing industries that use agricultural and forest inputs.
3. **Natural Resources and Environmental Stewardship** – comprising Extension work to help assure resiliency and sustainability in land and natural resources assets that sustain North Carolina’s economy and quality of life.
4. **Community and Economic Development** – whereby Extension works to provide knowledge and programs that assist both rural and urban communities in their ongoing development.
5. **Youth, Families and Home** – comprising Extension working to bring research-based, knowledge and programing to youth and families that enhances educational and personal development outcomes, personal productivity, employability, financial security and quality-of-life.
6. **Health and Nutrition** – where Extension works to empower individuals with the knowledge and skills to make informed decisions regarding their health, nutrition, food intake, safe food preparation and food preservation.
7. **Emergency Preparedness and Disaster Response** – comprising Extension’s work to empower individuals, agencies and key decision makers with proven solutions to build resiliency in the face of natural disasters, mitigate negative impacts and speed recovery.

E. The North Carolina Extension Delivery System

The NC Extension system is able to work across such a diversity of impact domains through a sophisticated delivery system that is empowered by a two-way flow of information/innovation and needs identification. In one direction, N.C. Cooperative Extension works to disseminate the research-based innovations and knowledge produced by campus and research station based faculty and staff to those in North Carolina who can best benefit from the information and put knowledge to work for the betterment of the North Carolina economy, society and individuals. The system is particularly effective because it also works in the reverse direction, with local Extension personnel, in the field and interacting with their local communities, to identify issues and needs that the universities’ researchers can work to find solutions for. In effect N.C. Cooperative Extension is operating as an “ecosystem” dedicated to researching solutions to needs and then transferring knowledge that will boost the North Carolina economy and assure the well-being of North Carolina communities, families and individuals. Figure 2 shows the general structure of the Extension ecosystem, illustrating the bi-directional flows of information from the field regarding needs and questions and from the universities providing answers to questions and providing new knowledge, innovations and practice recommendations.

The illustration in Figure 2 was originally developed by TEconomy for the USDA. The central chain of activity in the diagram shows the work of Extension in supporting the agricultural production system, while the arrows across the bottom of the graphic illustrate the other themes operated in parallel by Extension, covering diverse areas in: community and economic development; family and youth development, and community and individual health and well-being.

Figure 2: The N.C. Cooperative Extension Ecosystem: A Two-Way System for Enhancing Economic and Social Well-Being in North Carolina



Source: TEconomy Partners, LLC. Adapted from original figure in Simon Tripp, et al., 2017. "National Evaluation of Capacity Programs." TEconomy Partners LLC for the National Institute of Food and Agriculture.

As shown in Figure 2, Extension programmatic themes are directed toward educating a diverse range of business, government, community, and individual audiences.

F. The Functional Impacts of N.C. Cooperative Extension

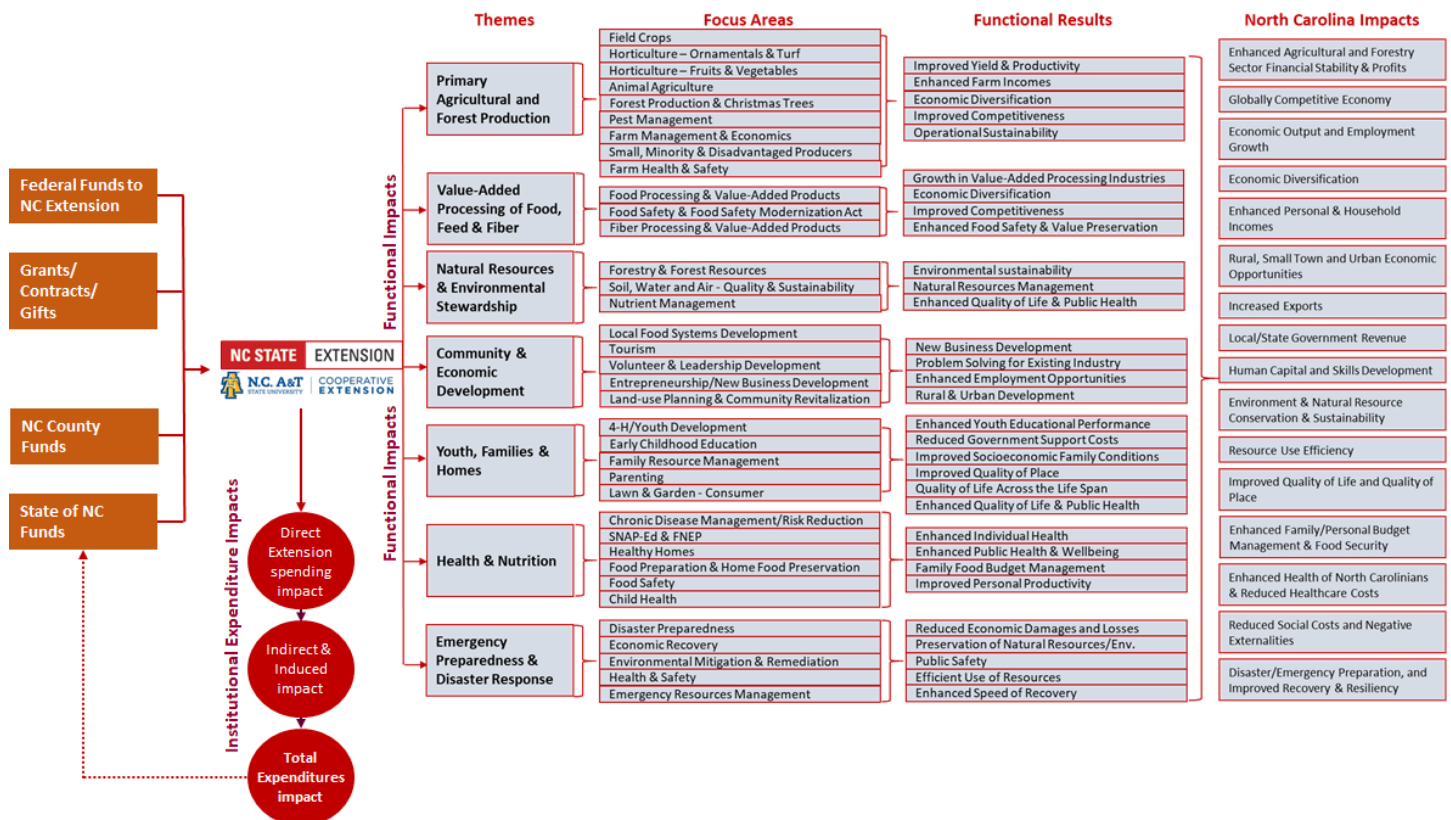
Each of the mission focus activities of NC Extension produce functional benefits and positive economic and social impacts across the state. Through examining the work of NC Extension, TEconomy developed a "Functional Impact Roadmap" as an illustrative summary and overview of the impact generation process. Figure 3 shows the results of this analysis.

From an economic perspective the impacts of NC Extension are best viewed as comprising two distinct pathways. The primary, and most important, pathway comprises the **functional impacts** (the grey boxes on Figure 3). These functional impacts are the reason for the existence of NC Extension and include the core programmatic activities operated by Extension to generate tangible advancement of North Carolina's economy,

communities, families, and individual North Carolinians. Regional economists and economic development professionals typically term these functional, mission-focused impacts “forward-linkage impacts.”

In addition to the functional impact benefits, the presence and operations of Extension also generates “economic stimulus” within the North Carolina economy and in the individual counties and communities where Extension maintains a physical footprint. This “stimulus” occurs via the direct expenditures of Extension and the expenditures of its personnel (expenditure impact). The direct and indirect economic impacts on North Carolina’s business volume (output), employment, and personal incomes generated by Extension expenditures are typically termed “backward-linkage impacts.” N.C. Cooperative Extension obviously does not exist simply to create economic stimulus through expenditures, yet this is not an insignificant impact for North Carolina—primarily because a significant portion of Extension funding comes from external (federal) funding sources that then are spent in operations across the state.

Figure 3: Functional Impact Roadmap. Principal Impacts and Functional Impact Categories Generated by North Carolina Cooperative Extension Activities



Source: TEconomy Partners, LLC.

Figure 3 lists the activities of Extension by focus area and briefly summarizes the types of functional results or benefits that this work is directed towards achieving within the state. The net result of these multifaceted programs of work are the functional impacts shown on the last column of the figure labelled “North Carolina Impacts.” These are further highlighted on Table 1 comprising 19 categories of functional impact.

Table 1: Categorization of Impacts Generated by Extension Activities and Programming

Type of Functional Impact	Description
Enhanced Agricultural and Forestry Sector Financial Stability and Profits	The universities' research and extension enterprise provides technologies, innovations and solutions to challenges that help assure North Carolina's agriculture and forestry business sectors are economically viable – able to sustain high levels of productivity, profitability and economic resiliency.
Globally Competitive Economy	Many agricultural and forest commodities are sold into global markets or are subject to competitive pressures by imported commodities. Extension works to provide producers, value-added processors and key stakeholders with the knowledge and solutions required to maintain a competitive market position in the face of global competition.
Increased Economic Output	Research at the universities may result in innovations that may result in improved or new products, services or production practices being developed that increase economic output of industry sectors. Extension carries these innovations to producers who can put the new innovation or knowledge to work. In agriculture, for example, higher yielding crops or new value-added agricultural products development may increase revenues for North Carolina producers and processors, thereby increasing state economic output.
Increased Employment	The work of Extension to disseminate new innovations and practices may result in new products or services for existing industry, generate new business start-ups, or attract new enterprises to the state. These expanded business operations generate new job demand.
Economic Growth and Diversification	The universities' research and Extension activities help bring new technologies, products, and services to market that catalyze economic growth in existing industries and foster the creation of new start-up companies, thereby improving the economic conditions of communities across the State of North Carolina. By focusing on both existing and emerging industry sectors, economies that are currently overly dependent on a few industry sectors, and therefore vulnerable to the fortunes of those industries, are able to diversify their economic base.
Enhanced Personal and Household Incomes	Extension activities increase income potential for workers and proprietors by helping people enter the workforce, improve their skills, and by helping family farms and small businesses become more profitable
Rural, Small Town and Urban Economic Activities	With a diverse focus across a value-chain spanning farm and forest production through to value-added production industries using food and biomass resources, Extension aids business sectors operating within every county in North Carolina. Furthermore, Extension's work to promote personal work readiness, youth skills and life-long learning skills is available in rural, small town, suburban and urban settings across North Carolina.
Increased Exports	North Carolina's balance of trade benefits via Extension activities that promote high productivity primary agriculture and forest production and promote the further processing of agricultural and forest output into high-value intermediate and finished products to meet global market demands.
Local and State Government Revenue	By helping to enhance economic output, business profitability and employment within North Carolina, Extension helps to support an expanded tax base in terms of business taxes, wage and earnings taxes, real property taxes and other associated governmental revenue streams.
Preparing Youth for Career and College Readiness	Extension 4-H Youth Development programs work with children and youth to promote engagement in education and the development of the knowledge and life skills that enable career readiness and participation in higher education and life-long learning.
Human Capital and Skills Development	Perhaps the most important asset that a state can have is a skilled and productive workforce. Extension works with adult learners to promote knowledge and skills development and enable participation in life-long learning. Extension's work with agricultural producers is directly aimed at expanding the agriculture and forestry sectors' knowledge and skills base. Continuing education programs help to upskill labor, increase job responsibilities and job satisfaction, and enhance retention.

Environmental & Natural Resource Conservation & Sustainability	The key fixed assets of North Carolina are its land and natural resources. Protecting and passing on these assets to the next generation of North Carolinians is a tangible public good. Extension works to help preserve natural resources, better manage water and soil resources, and provide solutions to resource use challenges across the state.
Resource Use Efficiency	Soils, forests and water are finite resources that need to be monitored and managed to assure their ongoing availability to meet economic demands and provide ecosystem services. Extension provides practitioners and other key stakeholders with state-of-the-art knowledge in the management of these critical resources across North Carolina. County-level Extension professionals, with specific knowledge of their local resources and constraints are able to customize Extension services to best reflect local conditions.
Enhanced Quality-of-Life and Quality-of-Place	Taken together, the activities and programs of NC Extension in improving and sustaining the economy, rural and urban communities, educational opportunities, and the environment combine to provide an enhanced quality-of-place and quality-of-life in North Carolina. This has economic benefits in terms of helping to attract and retain talent and commercial enterprise in North Carolina and helps sustain the attractiveness of the state for North Carolina's important tourism industry.
Enhanced Family and Personal Budget Management and Food Security	Extension provides individuals and families with the knowledge and skills that empower them to make smart and informed choices in terms of managing their finances, their household budgets and food resources. For low and moderate income individuals and families, having the skills to understand and manage financial and food resources makes a tangible difference in their economic and food security.
Enhanced Health of North Carolinians and Reduced Healthcare Costs	Extension programs in food preparation, nutrition, chronic disease management, personal fitness, healthy living, child care, stress and budget management, etc., help North Carolinians live healthier lives. Extension programs in food safety, monitoring for zoonotic diseases, etc., help support enhanced public health. Through Extension programs that enhance health outcomes in the state, Extension is an important tool for reducing healthcare costs and associated needs for government assistance.
Reduced Social Costs and Negative Externalities	Social problems, criminal behavior, health problems, environmental damage, livestock disease outbreaks, etc., all carry negative costs to society, government, and the economy. Extension programs help to prevent or mitigate these negative impacts.
Improved Community Management and Development	The management of local government operations, the governance of municipal organizations, and the management of community development take professional skills—skills that can be harder to find in small towns, rural communities, and inner-city neighborhoods. Extension programming helps enhance the skills of those engaged in the management of communities.
Efficient Response to Emergencies and Natural Disasters	Natural disasters (such as hurricanes, floods and wild fires) can and do inflict widespread environmental damage, economic losses, and human life consequences in North Carolina. Extension plays an important role in providing reliable, research-based knowledge and solutions that help communities and individuals prepare for disasters, reduce and mitigate damage to persons and property, and more rapidly recover from events that do occur.

Source: TEconomy Partners, LLC.

G. Evaluating the Economic and Functional Impacts of NC Extension

Figure 3 shows the multifaceted functional impacts that are associated with Extension. It is the case, however, that these benefits are not always as well understood by the public and key decision makers. N.C. Cooperative Extension has generally focused on carrying Extension solutions to the field and responding to needs of North Carolina's communities. It has not, historically, focused on trumpeting its achievements or building appreciation for the wide-ranging role it plays within North Carolina. In today's economy, however, where fiscal resources are constrained, and governments seek to understand what they are receiving in return for financial support of externally performed programmatic activities, it behooves Extension to summarize and explain its work to key stakeholders and interested parties.

Recognizing a need to communicate the value, modern relevance, importance and impact of N.C. Cooperative Extension, North Carolina State University (NC State) retained the services of impact analysis experts at TEconomy Partners LLC (TEconomy). TEconomy's scope-of-work encompasses assessment of both the backward-linkage (expenditure) impacts and forward-linkage (functional) impacts depicted in Figure 3. The analysis covers the full N.C. Cooperative Extension system, comprising operations of Extension at both North Carolina State University and North Carolina A&T. Where data are available, TEconomy uses quantitative techniques (such as regional input/output analysis) to illustrate impacts. In other cases, the research uses case studies or narrative description to show the range of impacts generated and to provide examples. Throughout the report, reference is made to the broad classifications of impacts that Extension generates, with examples of programmatic activity used to illustrate these.

Through study of these and other impacts, the analysis reported herein seeks to provide the following:

- Measures of the quantitative impact of Extension operations and activities on key economic metrics such as North Carolina business volume, personal incomes, and employment.
- An understanding of the broad range of functional social and community benefits afforded by Extension's activities in the state.
- Specific illustrations of the range of positive functional impacts generated in the state because of Extension's activities as they relate to: Agriculture, Food and Fiber; Natural Resources and Environmental Stewardship; Community and Economic Development; Youth, Families and Homes; Health and Nutrition; and Emergency Preparedness and Disaster Response.

As noted above, TEconomy uses both quantitative and qualitative approaches in evaluating Extension's broad range of impacts. On a quantitative basis, TEconomy reports the results of economic impact calculations using input/output analysis techniques. Qualitative research techniques are used to provide illustrative examples of the types of functional impacts generated by Extension. A series of detailed one-on-one interviews were conducted with Extension leadership, program area directors, and field extension personnel to gather insight regarding programs and impacts.

It is clear that via a broad variety of functional activities, N.C. Cooperative Extension has generated a substantial track record in contributing to North Carolina's and North Carolinians' economic and social well-being. Equally clear is that, as knowledge and innovation continue to be the foremost drivers of modern economic progress, it is extremely likely that Extension activities will be highly relevant for the foreseeable future. Strengthening the economy, communities, and families of North Carolina through research-based educational programming (activities at the core of Extension's mission) is key to the long-term competitive sustainability of North Carolina's generally robust standard of living. The degree to which N.C. Cooperative Extension's work contributes to progress in North Carolina, today and into the future, is the subject of this report.

II: The Impact of North Carolina Cooperative Extension Expenditures

A. Measuring Economic Impacts

The main impact of N.C. Cooperative Extension is created and obtained through the activities that Extension faculty and staff are engaged in throughout the State of North Carolina (functional impacts). These activities improve the opportunities and quality of life for thousands of North Carolinians in both rural and urban settings and improve economic performance through the transfer of knowledge, technologies, and practices (and they are covered in subsequent chapters). From a traditional economic perspective, it should also be noted, however, that Extension also has an “economic impact” on the state through the direct operational expenditures of Extension at NC State and NC A&T and, ultimately, the expenditures of Extension faculty, 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 spend a portion of this income with other businesses and individuals within the subject economy. This spending is termed the multiplier effect (incorporating both indirect and induced economic impacts).

The standard analytical technique for the quantification of expenditure impacts is Input/Output (I/O) analysis. I/O analysis, the technique deployed for impact measurement herein, uses a matrix representation of an economy that quantifies the impact of spending by one sector of the economy on all other sectors, consumers, and government. TEconomy uses software and data systems developed by IMPLAN for application of I/O analysis. The IMPLAN models are the most widely used models in the nation and are based on a series of federal datasets, including data from the U.S. Bureau of Economic Analysis (BEA) and the U.S. Bureau of Labor Statistics.⁸ The I/O methodology allows TEconomy to calculate the expenditure impacts of N.C. Cooperative Extension across multiple measures, including the following:

- **Economic 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” in a standard economic impact study.
- **Employment** includes both direct employment at Extension (including mission-specific contractors) and the jobs within the economy supported by Extension expenditures (indirect employment).
- **Labor Income** is the total amount of income received by labor in the economy because of the presence and operations of Extension via Extension payrolls and contractor payments.

Methodology

Impact analysis makes use of an I/O model to represent the interrelationships among economic sectors. I/O data show the flow of commodities to industries from producers and institutional consumers for any given region. The data also show consumption activities by workers, owners of capital, and imports from outside the region. These trade flows built into the model permit estimation of the impacts of one sector on other sectors. These impacts consist of three types: **direct effects** (the specific impact of the firm and/or sector(s) in question), **indirect effects** (the impact on suppliers to the focus industry or firm), and **induced effects** (the additional

⁸ This analysis uses the 2016 State of North Carolina model from IMPLAN as the 2016 models are the most currently available at the time of the study. Output, labor income, and tax revenue figures and impacts are adjusted and reported in 2018 current dollars.

economic impact of the spending of these suppliers and employees in the overall economy). The summation of these three effects are considered the **total impacts**.

Modeling Approach

Each IMPLAN model uses detailed region- and sector-specific information to estimate outcomes and gauge potential impacts. The model incorporates details of 536 individual industry and economic sectors that cover the entire state economy. With this level of sector detail, TEconomy can more precisely model the operations of N.C. Cooperative Extension by aggregating the operational characteristics and production functions of the various aspects of Extension operations, encompassing agricultural extension; youth, community, and leadership development; business and workforce development (across various sectors including agricultural production, forestry and wood products production, and tourism); and consumer, health, and nutrition support.

This economic-impact assessment provides a results table that presents the **direct-effect** values driving the model (based upon the employment and operational data provided by NC State and NC A&T), additional estimated **indirect** and **induced effects** capturing the **ripple effect** of the impacts of Extension employment and expenditures on the state economy, and the **total impacts**. An impact **multiplier** is also provided for the four model components (**employment**, **labor income**, **value added**, and **output**)—for each job or dollar of direct effect, the multiplier number will equal the total (*including the direct effect*) number of jobs or dollars created in the state economy. Thus, for example, an employment multiplier of 1.5 would indicate that, for every 1 direct job, an additional 0.5 indirect and induced job is created in the state’s economy. Finally, the IMPLAN model provides an estimate of state/local and federal tax revenues generated by Extension operations, controlled for issues related to public and nonprofit status.

B. N.C. Cooperative Extension’s Employment and Expenditures

Three data metrics are used to drive the economic interactions within the models: **employment** (more conservatively, but more precisely captured as full-time equivalent [FTE] employment, due to, for example, extension staff having part-time research or faculty appointments within other university departments); **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 Extension as **total expenditures** as they are a truer measure of total direct output than revenues.

Data were obtained from Extension at both NC State and NC A&T regarding employment and FTE equivalents and detailed operational expenditures. Additionally, data were captured to reflect the county-level resources involved in operating the County Extension Center’s infrastructure (including both additional staffing and expenditures not captured by direct Extension financial reporting), and, finally, to provide an estimate of the “in-kind” contribution the universities make to Extension in the form of operating space.

The FTE employment data used within the impact model is provided in Table 2, which shows 953.8 FTE employees for the Extension operations, with 90 percent of these Extension workers employed directly by NC State and 10 percent by NC A&T.

Table 2: N.C. Cooperative Extension FTE Employment, Fiscal Year (FY) 2018

N.C. Cooperative Extension		Total FTE Employment
NC State University Employees		855.0
NC A&T State University Employees		98.8
Total FTEs		953.8

Source: NC State CALS and CNR and NC A&T.

The operational expenditures data (output) used within the impact model reached nearly \$99 million for FY 2018. N.C. Cooperative Extension (including funding from the State of North Carolina) provided \$43.9 million to support extension activities across the state (Table 3). As part of the national Land-grant based Cooperative Extension program, Extension also received approximately \$15.2 million in annual funding from NIFA via the Smith-Lever Act Capacity Grant. County-based resources used for locally-based support and operating costs reached \$19.2 million. Competitive grants, specific contracts, program fees and other sources of self-generated resources provided an additional \$20.5 million toward the statewide extension mission.

Table 3: N.C. Cooperative Extension Operational Funding Sources, FY 2018 Annual Operations

Operational Funding Source	Funds (\$M)
State of North Carolina/NC State CALS & CNR/NC A&T	\$43.9
USDA NIFA Cooperative Extension	\$15.2
Additional County-Based Resources	\$19.2
Grants, Contracts, Fees and Other Self-Generated Resources	\$20.5
Total Operational Funds	\$98.8

Source: NC State CALS and CNR and NC A&T.

C. Economic Impact of N.C. Cooperative Extension Expenditures

Impacts are estimated from the FY 2018 employment and operational expenditures of Extension's combined statewide operations (incorporating both NC State and NC A&T) and are broken-out individually for Extension at the two universities.

The FTE employment of 953.8 within the Extension system supports an additional 747.0 jobs (including 200.6 indirect jobs with suppliers) in the North Carolina economy, for a total employment impact of 1,700.8 jobs and an employment multiplier of 1.78.

Table 4: Economic Impact of N.C. Cooperative Extension Expenditures, FY 2018 (\$M)

Impact Type	Employment (FTE)	Labor Income	Value Added	Output	State/Local Tax Revenue	Federal Tax Revenue
Direct Effect	953.8	\$74.68	\$78.56	\$98.83	\$4.26	\$19.03
Indirect Effect	200.6	\$9.12	\$17.85	\$31.46	\$1.26	\$2.27
Induced Effect	546.4	\$23.02	\$42.73	\$74.19	\$3.81	\$5.68
Total Impacts	1,700.8	\$106.82	\$139.14	\$204.48	\$9.33	\$26.98
<i>Multiplier</i>	<i>1.78</i>	<i>1.43</i>	<i>1.77</i>	<i>2.07</i>		

Source: TEconomy's calculations and analysis using IMPLAN I/O model for the State of North Carolina

Note: Details may not add to totals due to rounding.

Extension jobs, those that are funded by the universities as well as at the local level, average more than \$78,000 per year in total compensation (e.g., wages and benefits). In addition, jobs generated by suppliers as well as induced jobs average more than \$43,000 in total compensation per year.

The direct operational expenditures of \$98.8 million generate an additional \$31.5 million indirect economic activity (e.g., purchases from suppliers within the State), and an additional \$74.2 million in induced economic activity as both Extension workers and supplier workers spend their incomes throughout the State. These

combined expenditures lead to an estimated total expenditure impact of \$204.5 million within the North Carolina economy.⁹

As a program driven by the work of its Extension faculty and supporting staff, the direct-effect value-added metric only slightly exceeds the value of the total labor income of these workers (labor income is a component of the value-added metric). However, as Extension purchases ripple through the North Carolina economy, the increasing effects of suppliers (both to Extension activities but also to the connected workforce) cause the total value added to reach more than \$139.1 million on an annual basis.

As a public-sector program, the potential to generate new additional tax revenue at the local, state, and federal level is, of course, limited. That said, even though these are non-profit operations, they do generate taxes (for example through payroll and personal income taxes). In addition, the many for-profit suppliers to the system do pay taxes that are captured. Personal income-based taxes related to Extension are found to generate \$4.3 million in state/local revenue and \$19.0 million in federal tax revenue. With additional tax revenue impacts (including property and corporate taxes) generated by suppliers and through induced spending, total state/local tax revenue exceeds \$9.3 million and federal tax revenue reaches nearly \$27.0 million. Tables 5 and 6 provide the individual results for the expenditure impacts generated by NC State and NC A&T respectively.

Table 5: Economic Impact of North Carolina State University Extension (CALs and CNR) Expenditures, FY 2018 (\$M)

Impact Type	Employment (FTE)	Labor Income	Value Added	Output	State/Local Tax Revenue	Federal Tax Revenue
Direct Effect	855.0	\$68.07	\$71.57	\$89.19	\$3.88	\$17.34
Indirect Effect	146.4	\$8.20	\$16.09	\$28.34	\$1.14	\$2.04
Induced Effect	454.8	\$20.96	\$38.90	\$67.53	\$3.47	\$5.17
Total Impacts	1,456.2	\$97.23	\$126.55	\$185.06	\$8.49	\$24.56
<i>Multiplier</i>	<i>1.70</i>	<i>1.43</i>	<i>1.77</i>	<i>2.07</i>		

Source: TEconomy's calculations and analysis using IMPLAN I/O model for the State of North Carolina

Note: Details may not add to totals due to rounding.

Table 6: Economic Impact of North Carolina A&T Extension Expenditures, FY 2018 (\$M)

Impact Type	Employment (FTE)	Labor Income	Value Added	Output	State/Local Tax Revenue	Federal Tax Revenue
Direct Effect	98.8	\$6.61	\$6.99	\$9.64	\$0.38	\$1.68
Indirect Effect	19.8	\$0.91	\$1.77	\$3.12	\$0.12	\$0.23
Induced Effect	49.1	\$2.07	\$3.84	\$6.66	\$0.34	\$0.51
Total Impacts	167.7	\$9.59	\$12.59	\$19.42	\$0.84	\$2.42
<i>Multiplier</i>	<i>1.70</i>	<i>1.45</i>	<i>1.80</i>	<i>2.01</i>		

Source: TEconomy's calculations and analysis using IMPLAN I/O model for the State of North Carolina

Note: Details may not add to totals due to rounding.

⁹ The IMPLAN model, using industry-level employment and economic information, estimates economic leakages outside of North Carolina that are not included in the total impacts value (e.g., out-of-state purchases, import purchases).

III: The Functional Impacts of North Carolina Cooperative Extension

A. Introduction

Education, knowledge and skills have always been important, but today, in what is frequently termed the “information age”, the economic and societal returns to knowledge absolutely underpin national and state performance and individual wellbeing. Because knowledge is of central importance to all in society, research must be viewed as equally important because it is research that serves to increase the stock of human knowledge upon which economic, social, and technological progress depends.

Currently, and into the foreseeable future, the importance of information, knowledge and the application of knowledge to advance the economy and society is hard to overstate.

To succeed, to successfully compete in a knowledge economy, the United States and individual states, such as North Carolina, depend on access to knowledge, and having a literate populace able to turn knowledge into informed-actions that benefit themselves and their employers. Whether in daily life, in commerce, or in public service, our success is increasingly the result of having access to reliable and timely information.

A great irony of our time is that, just as the need for knowledge and information is very much at the forefront as the driver of competitiveness and success, Web-enabled technology and social networks have empowered the spread of misinformation and disinformation that confounds our ability to make informed and rational decisions. Access to computational and communications devices, such as tablets and smartphones, provide us with unprecedented access to “information” but often this information is unvetted and unmoderated or published by sources of questionable provenance. Information is not synonymous with knowledge. True knowledge comes from accessing and understanding reliable, often objective research-based, information ideally from a source that is trusted and validated.

While many in society are coming to terms with a pressing need for reliable arbiters and sources of actionable knowledge, there are certain groups that have long-benefited from having access to a purpose-designed organization serving that precise role. **For more than a century the U.S. (including North Carolina) has benefited from having a trusted, research-driven, reliable knowledge resource – one that is specifically dedicated to meeting the needs of agriculture and natural resource industry practitioners, rural and urban communities, families and individuals. That organization is Cooperative Extension operated through the 1862 and 1890 Land-grant university system.**

Extension delivers knowledge, know-how and skills development through direct personal interactions, training of intermediaries (training the trainer), group workshops and events, field days and demonstrations, and via the publication (online and in print) of a diverse range of research-based bulletins, advisories and practice recommendations. Having access to the powerful research and knowledge resources of NC State and NC A&T, Extension agents who are geographically distributed to serve every county in North Carolina, are available to meet the needs of North Carolinians where they are. These local Extension agents are able to access the full resources of their university and interact with subject matter experts (including Extension Specialists) who are able to directly address specific questions and technical needs of Extension clients and perform original research where needed to provide solutions to challenges.

Through the operation of the N.C. Cooperative Extension system, everyone in North Carolina has access to an organization with a well-established track record of service in providing best-practice, research-driven knowledge, training and expertise.

While the U.S. has an economy and a general standard-of-living that we are justifiably proud of, it is also the case that this is a nation where tens of millions of residents face significant problems and daily challenges. A report for Family and Consumer Sciences Extension in the North Central Region of the United States noted that:

Over 45 million Americans presently live in poverty, and U.S. life expectancy is just 42nd among all nations. Almost 79 million Americans are obese, and more than 117 million residents have one or more chronic health conditions. Over 87 million in the nation are worried about having enough money each month to pay their regular monthly bills, and 17.6 million U.S. households are food insecure. We have the highest incarceration rate of any nation, and, if presented with this report, more than 32 million adult Americans would be unable to read it because they are illiterate.¹⁰

North Carolina shares these national challenges, and Extension plays an important role in reaching out to many of the most vulnerable and socioeconomically disadvantaged populations in the state to provide knowledge and practical skills development that can affect positive change. Extension sustains programs in diverse areas – such as 4-H youth development, supplemental nutrition education (SNAP-Ed), nutrition and healthy living, and food preparation, safety, and preservation – which directly address fundamental human challenges and needs across the state.

Extension is similarly working to promote environmental and natural resource stewardship in North Carolina – assuring resources are used in a sustainable manner and available for use and enjoyment by future generations of North Carolinians. Extension also has proactive programs designed to prepare North Carolina to deal with natural disasters and emergencies, mitigate damages, and use resources effectively to achieve recovery – something very current in the minds of North Carolinians in the wake of 2018’s hurricanes and extreme weather events.

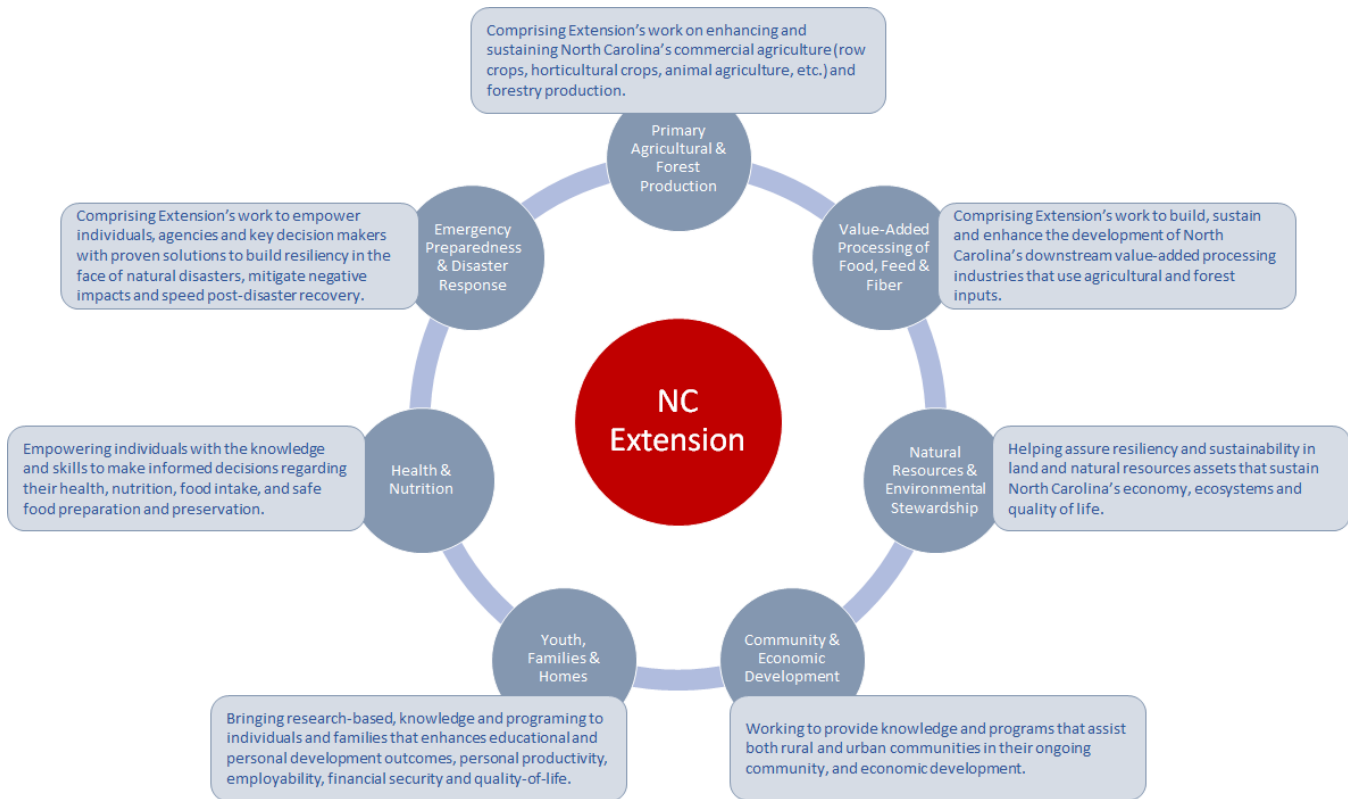
Extension provides non-formal education and learning activities to people throughout the country — to farmers and other residents of rural communities as well as to people living in urban areas. It emphasizes taking knowledge gained through research and education and bringing it directly to the people to create positive changes.

National Institute for Food and Agriculture (NIFA).
<https://nifa.usda.gov/extension>

In effect, N.C. Cooperative Extension is specially designed to work across a broad variety of pressing challenges and needs in the state and is focused on providing information and knowledge that delivers tangible benefits to individuals, families, communities, agriculture and forest producers, and value-added industries. TEconomy finds that in pursuit of these mission activities, Extension is organized around the delivery of a diverse set of services that may be categorized under seven primary functional impact program areas, or “themes”. Figure 4 summarizes these seven themes at a high level, while Figure 5 provides an overview of the types of functional impacts being generated across North Carolina through specific activities under the themes.

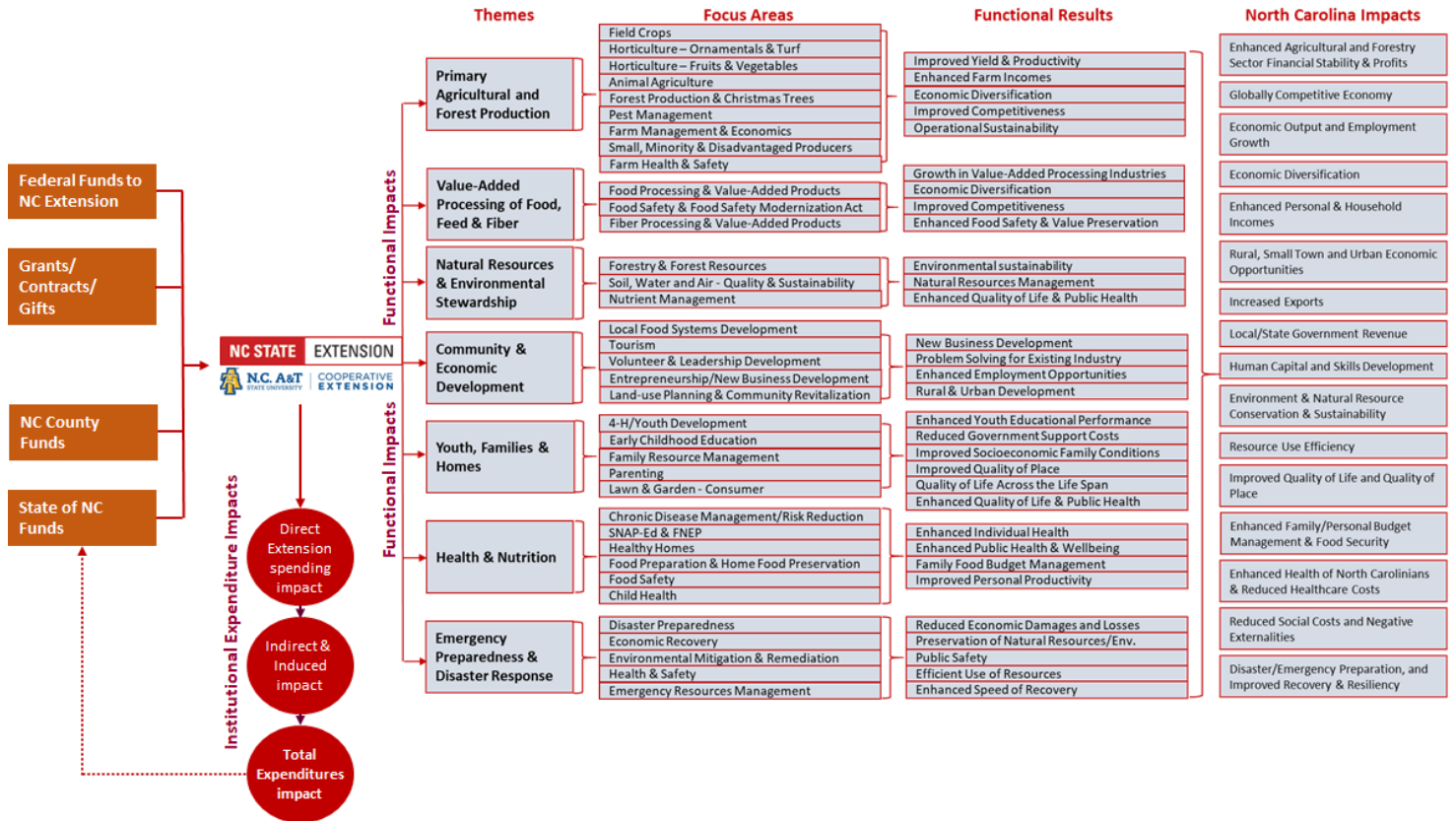
¹⁰ Battelle Technology Partnership Practice. 2015. “*Analysis of the Value of Family & Consumer Sciences Extension in the North Central Region.*” Battelle Memorial Institute. Produced for Directors of Cooperative Extension in the North Central Region.

Figure 4: N.C. Cooperative Extension Primary Program Themes



Source: TEconomy Partners, LLC.

Figure 5: N.C. Cooperative Extension Program Themes, Functional Activities and Impacts Generated in North Carolina



Source: TEconomy Partners, LLC.

Services and programs under these N.C. Cooperative Extension themes reach into every North Carolina county and every community. They are made available by Extension to North Carolinians young and old, in rural and urban environments, and at home and in the workplace. These services are the subject of this chapter, which is organized around each of the six program areas.

For each program area, TEconomy provides a definition of the program area, outlines the tangible needs being addressed in North Carolina, and provides specific examples and case studies of Extension in action and the positive impacts being generated.

B. Agriculture, Food and Fiber: Functional Impacts

1. Description

North Carolina State University's College of Agriculture and Life Sciences (CALS) is among the premier academic programs in agricultural sciences research—ranked by QS Rankings among the Top 25 universities in the World for “agriculture and forestry”¹¹, and among the top 50 programs in the world for agricultural sciences by U.S. News.¹² In addition to CALS this excellence is supported by the NC State College of Natural Resources (CNR).

Research at NC State is driven by traditional academic curiosity and, particularly, by the direct mission of CALS to: **“improve the lives, economies and communities of North Carolinians through programs and partnerships focused on agriculture, food and nutrition, and 4-H youth development.”**¹³ These needs and research questions are identified through the regular contact that occurs between faculty, staff, researchers, producers, commodity groups, industry, and other key stakeholders across North Carolina. The same process holds true for Extension operations at NC A&T.

As noted in Chapter I, Figure 2, there is a two-way flow that occurs with practitioners in the field and Extension personnel identifying needs and opportunities and relaying these to the researchers at NC State and NC A&T for investigation and innovation—and in terms of the universities' faculty and scientists making novel discoveries and practice innovations that can be applied within North Carolina agriculture, natural resource industries, and other key audiences.

2. The Need

North Carolina agriculture and natural resource industries represent a major component of the state economy. Analysis by Michael L. Walden, the William Neal Reynolds Distinguished Professor and Extension Economist at NC State, shows that:

*Agriculture and agribusiness — food, fiber and forestry — account for one-sixth of the state's income and employees. Almost 17 percent, or over \$87 billion of the \$522 billion gross state product is contributed by food, fiber and forestry industries. These industries account for 730,000 of the state's 4.3 million employees.*¹⁴

Sustaining productivity and output increases in agriculture is a constant challenge given the unique characteristics of the industry and its operational environment. North Carolina ranks 16th in the nation in the number of farms in operation, with the latest (2017) National Agriculture Statistics Service data recording 47,800 farm operations in the state.¹⁵ The sector thus comprises thousands of small and midsize businesses that must operate in a uniquely variable and challenging production environment. For agriculture and natural resource sectors to remain competitive, North Carolina's producers must be equipped with the knowledge, skills, tools, and inputs required to produce quality products at competitive prices and anticipate changing market

¹¹ QS World University Rankings by Subject 2016 - Agriculture & Forestry. Online ranking system at:

<https://www.topuniversities.com/university-rankings/university-subject-rankings/2016/agriculture-forestry>

¹² U.S. News and World Report. Best Global Universities: Online ranking system at: <https://www.usnews.com/education/best-global-universities>

¹³ NC State Extension. 2017 Annual Report. “Our Mission”.

¹⁴ Michael L. Walden. 2018. “Agriculture and Agribusiness: North Carolina's Number One Industry.” Accessed online at:

<https://cals.ncsu.edu/agricultural-and-resource-economics/wp-content/uploads/sites/12/2018/05/agribusiness2018brochure.pdf>

¹⁵ USDA National Agricultural Statistics Service. *North Carolina 2017 Agricultural Profile*. Accessed online at:

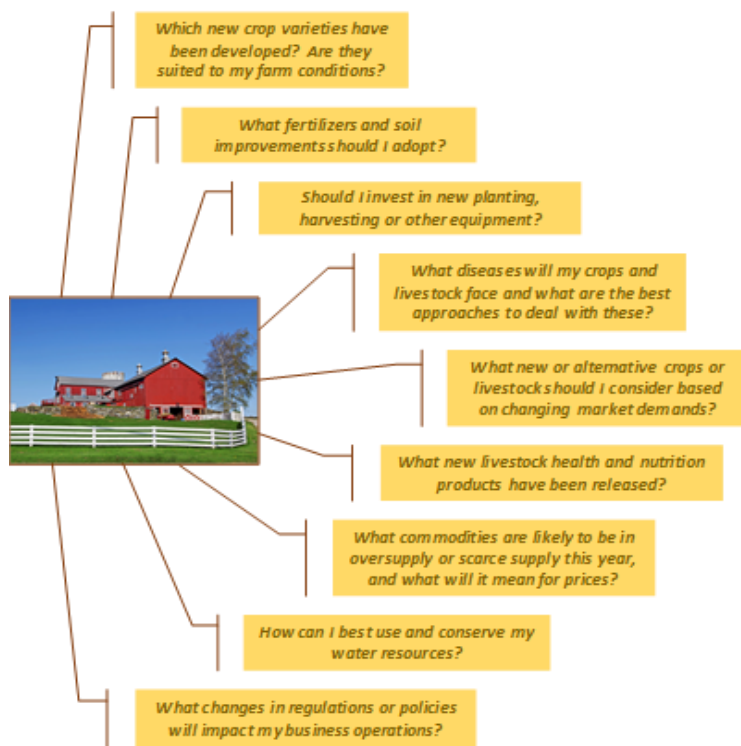
https://www.nass.usda.gov/Quick_Stats/Ag_Overview/stateOverview.php?state=NORTH%20CAROLINA

preferences. The industry, perhaps more than any other industry, requires specialized local research and development (R&D) to remain competitive. In a 2013 report by Battelle, the following is noted:

Unlike producers of the typical manufactured product, agricultural producers have to work within a dynamic production environment that contains great geographic variety and year-to-year variability, uncertainties, and risks. It is also unique in being a production industry driven by the output of over 2 million individual producers (there being 2,181,000 farms in the U.S.)¹⁶, so unlike other production sectors (such as automobile manufacturing, aerospace, information technology, chemicals, etc.) the industry does not comprise a few large entities with substantial R&D budgets, but rather comprises millions of smaller entities that have to rely on R&D, information and advice produced by external parties. It is a very unique industry.¹⁷

To be successful in this dynamic production environment, a producer needs to make informed decisions across a broad range of variables. Indeed, farmers face an almost overwhelming series of decisions each year that may make or break their bottom line (such as those illustrated in Figure 6). No other category of business faces such a variable and risky series of decisions that must be made and repeated year after year.

Figure 6: Annual Decision Making in a Complex Environment



Source: TEconomy Partners, LLC.

Having access to reliable decision support information and advice is crucial to making informed decisions. Extension serves as an indispensable advisor on these and other critically important decisions that North Carolina farmers and associated industry professionals must tackle each year. Present in every North Carolina county, Extension professionals are key access points for the information needs of agricultural and natural resource producers, and they are backed up by the full research and knowledge resources of NC State and NC A&T.

The challenge for N.C. Cooperative Extension in supporting the needs of the agriculture and forestry industry is all the more complex and challenging in North Carolina because the state has the third most diverse agricultural economy in the United States. The state has diverse animal agriculture with production, for example, of: poultry (broilers, layer and turkeys);

hogs; beef cattle; dairy cattle; goats; sheep and lambs, and an expanding aquaculture industry. Crops demonstrate even more diversity, with over 80 different commercial crop varieties grown. Compared to many

¹⁶ *Farms, Land in Farms, and Livestock Operations 2011 Summary*: Released February 2012, by the National Agricultural Statistics Service (NASS), U.S. Department of Agriculture.

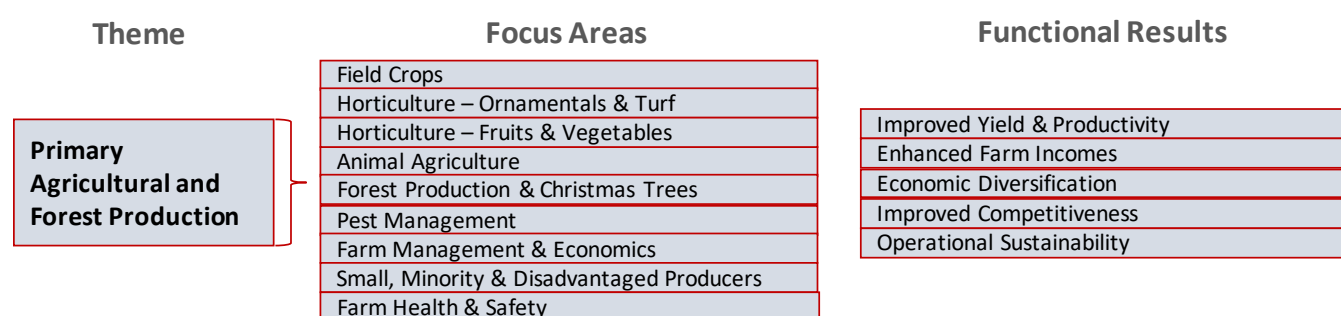
¹⁷ *Impact & Innovation: Agbioscience in the Southern United States: The Importance of the Southern Region's Land-grant Extension Service and Experiment Station System*. February 2013. Prepared by Battelle Technology Partnership Practice and BioDimensions.

states where just two or three crops dominate, Extension has to address an extraordinary diversity of agricultural commodities – each requiring specialized knowledge of best performing varieties and cultivars, soil and plant nutrient requirements, pest and disease management practices, farming equipment and agronomy procedures.

3. Themes, Impacts, and Mechanisms of Extension Impact Generation in Agriculture, Food and Fiber

In support of agricultural and forestry industries, NC State and NC A&T work together across a diverse range of themes—and these, in turn, engender a variety of positive functional benefits (impacts) for North Carolina and North Carolinians (Figure 7).

Figure 7: N.C. Cooperative Extension Functional Impact Themes in Agriculture, Food and Fiber



In addition to using the research capabilities of NC State and NC A&T to perform focused research on North Carolina needs, Extension also develops educational programs and materials based on conducting needs assessments—identifying themes, issues, emerging practices, and technologies that will benefit the growth and resiliency of North Carolina agriculture and natural resources and then developing custom curricula and materials based on best practices. These best practices may be derived not only from research at the respective universities, but may be sourced from other peer Land-grant universities, the USDA’s Agricultural Research Service (ARS), the academic literature, or other reliable resources as identified and evaluated by Extension professionals.

Extension at NC State is also unusual, versus other extension services in states across the nation, in having set-up a specialized three-tier system to meet the highly diverse agricultural production profile of the state and its various production regions. NC State Extension has agents in each county, and Extension Specialists as other extension services do, but has also added a series of Area Specialized Agents able to serve as an efficient bridge between county-level generalists and provide regionally-focused specialized knowledge.

Ultimately, the work of Extension in support of the agriculture and natural resource sectors of the North Carolina economy produces a series of desired functional benefits:

- Improved yield and quality of crop, livestock and poultry produced, thereby increasing economic output and return-on-investment for producers.
- Introduction of new commodity varieties with premium performance or enhanced responsiveness to emerging market demands.
- Enhanced farm sustainability and financial resiliency.
- Optimized use of scarce resources and inputs to reduce the environmental footprint of agricultural industries across the state.

Representing the basic industries sustaining rural and small-town North Carolina, the work of Extension in building and sustaining resilient agricultural and natural resource sectors is fundamental to the fabric of life and economic performance across the entire geography of the state.

4. Functional Impact Examples for Extension in Agriculture, Food and Fiber

Discussing every program and activity undertaken by N.C. Cooperative Extension in the area of Agriculture, Food and Fiber would lead to an excessively long and complex report¹⁸. Rather than attempting to produce a laundry list of activities, TEconomy in this (and other functional impact discussions) draws upon program examples to illustrate the types and range of functional impacts generated by Extension programming. In the case of Extension work in this theme area, the following examples are illustrative of the high-impact work taking place.

a. Examples of Programs in Field Crops and Horticulture

Program Area: Agriculture, Food and Fiber

Example 1: Extension-led on-farm cotton variety trials

Cotton is an important crop in North Carolina, grown on more than 365,000 acres of farmland in the state (2017). Growers face a key decision in terms of which cotton variety, among many on the market, they should select for their farm conditions. NC State Extension has been playing a critically important recent role in helping farmers select the optimal cotton varieties through operating the NC On-Farm Cotton Variety Evaluation Program. Operating from 2015 through 2017 the evaluation program conducted 17 trials using NC farmer's fields distributed across representative North Carolina cotton-growing areas. With full participation by all major seed companies, the trials focused on evaluating performance for 10 varieties anticipated to be best-suited to field conditions, soil types and environmental conditions.

The knowledge gained, and production optimization achieved, through the NC On-Farm Cotton Variety Evaluation Program has achieved some remarkable results. Dr. Guy Collins, the developer and Extension leader of the program, notes that "this program illustrated that improper variety selection could cost producers an average of \$120 to \$156 per acre in 2015, and \$74 to \$173 per acre in 2016, which is greater than most other single agronomic inputs a grower could make." When taking into account North Carolina's hundreds of thousands of cotton production acres, these variety selection benefits demonstrate very large economic impacts. For the 2015 production year, for example, the trial results show that were the best performing variety from each seed company in the trials to be selected, the potential impact for the state's producers, across 380,000 total production acres for that year, would range between \$45.6 million and \$59.3 million. Extension also examined achieved impacts, tracking the growth of the recommended top performing varieties by North Carolina producers. **The results are impressive, showing yield-gain based impacts totaling almost \$14.4 million in 2016 and over \$11.9 million in 2017.** By identifying the top performing varieties and distributing the findings to cotton growers across the state, this Extension program has generated significant economic benefits for the producers and the state, and a resource for ongoing selection of high-performing varieties into the future.

Key Impacts:

- Enhanced agricultural sector financial stability and profits
- Globally competitive economy
- Increased economic output
- Increased exports
- Resource use efficiency

¹⁸ NC Extension reports work across approximately 13,000 programs in 2017. Source: NC State Extension document "Extension Grows North Carolina."

Example 2: Official Variety Testing

The “Official Variety Testing” (OVT) program operated by NC State Extension is a critical independent resource for farmers. The OVT program focuses on conducting intensive trials focused across four key crop areas comprising corn, soybean, grain sorghum and small grains (wheat, malting barley and oats). **In a typical year NC State will manage upwards of 17,000 test plots around the state, with between 60 and 70 individual crop trials taking place.** Seed companies submit their seed to the OVT program, and the wide geographic coverage managed by NC State allows testing to occur across a representative variety of agronomic environments. A long-standing program, Extension used to provide a “Green Book” of printed tables of trial results that were distributed to each Extension field office. This has now transitioned into an online system, providing ready access to data for all producers. As a crucial source of non-biased data for producers, Extension is continuing to work to enhance the usability of data for farmers, and current work is focusing on development of a high-resolution relational database that will advance North Carolina decision making towards a precision-agriculture model. The OVT program at NC State enjoys a robust participation rate among seed companies, with Ryan Heininger at NC State noting that the program has the participation of all wheat companies, all soybean seed companies and all but one supplier of corn.

Key Impacts:

- Enhanced agricultural sector financial stability and profits
- Globally competitive economy
- Increased economic output
- Increased exports
- Resource use efficiency

Example 3: Introducing new crops and varieties for North Carolina production

Case 1: Sweet Potato Production and Processing. One of the more recent success stories for North Carolina agriculture has been the development of a vertically integrated production system comprising on-farm production of sweet potatoes and the development of processing companies producing value-added products using sweet potato inputs. The expansion of sweet potato production is a success story for North Carolina agriculture that very much has roots in multidisciplinary work at NC State. The NC State developed variety “Covington” comprises 90 percent of the sweet potatoes grown in North Carolina, and demand for the crop has been further enhanced by food science R&D and proactive Extension work with farmers and processors. NC State also sustains the necessary tissue culture and micro-propagation team needed to provide vegetative propagation stock to meet industry needs. In 2017, the National Agricultural Statistics Service of the USDA reports that sweet potatoes were harvested from 89,500 acres in North Carolina, with a production value totaling \$346.5 million (a value that is exceeded only by tobacco and soybean production in North Carolina). With a production value of \$3,872 per acre for sweet potatoes, the crop is approaching the high level of value realized from tobacco production (\$4,414 per acre). Updating a March 2016 input/output analysis study (which used 2014 data) by TEconomy to 2017 data, examining the economic impact of NC State Research and Extension work across several crops finds that **the total economic output associated with the production of NC State-related sweet potato agriculture is \$549.3 million (for 2017), and this production contributes \$211.3 million in labor income for North Carolina workers and over 4,100 jobs in the state.**¹⁹ Similar updated 2017 estimates have been derived for NC State Research and Extension impacts on tobacco, peanut and blueberry production. **The analysis finds, that working together as an integrated system, the research and Extension enterprise at NC State, generate an annual positive impact for North Carolina through the four crops of \$1.59 billion in 2017, supporting 13,075 jobs with wages totaling almost \$561 million.** Moreover, the impacts being generated are highly dispersed across North Carolina with 97 of the state’s 100

¹⁹ TEconomy Partners, LLC. 2016. “Estimates of North Carolina State University Plant Science and Associated Extension Activities on Crop Production in North Carolina and Individual Counties.”

counties engaged in the production of one or more of the four crops analyzed. Sweet potato has proven to be a particularly good crop to reinforce the incomes of North Carolina tobacco farmers since it requires harvesting labor at a different time versus tobacco, makes efficient use of harvesting crews, and is a good fit in required crop rotation.

Case 2: Extension supporting the development of a new industrial hemp industry for North Carolina. Industrial hemp is a cannabis plant containing a low concentration of the chemical THC (which is the regulated chemical in marijuana). Rather than being grown for THC, industrial hemp is grown for use in a wide range of products, including fibers and textiles, paper, construction and insulation materials, cosmetic products, animal feed, food, and beverages. The National Conference of State Legislatures notes that “the plant is estimated to be used in more than 25,000 products spanning nine markets: agriculture, textiles, recycling, automotive, furniture, food/nutrition/beverages, paper, construction materials and personal care.”²⁰ Valuable components of the industrial hemp plant are primarily expressed in the flowers, seeds and stalk. The 2014 federal Farm Bill paved the way for limited introduction of industrial hemp cultivation, to be regulated by individual states. North Carolina is among many states to approve participation in industrial hemp research and associated piloting programs. N.C. Gen. Stat. § 106-568.50 to 106-568.54 and § 90-87(16) (2016) created an agricultural hemp pilot program overseen by the North Carolina Industrial Hemp Commission within the North Carolina Department of Agriculture and specifies that the commission must collaborate with North Carolina State University and North Carolina A&T State University. NC State has stepped forward with its “NC State University Hemp Program”, comprising research and Extension faculty. Extension’s programing has been generating significant demand, with potential producers needing access to the latest information on regulations, varieties, seed access issues, agronomy practices, and market development. **NC State Extension as of October 2018 has: held 17 information sessions with between 50 and 250 attendees at each event; conducted 6 field days with between 200 and 500 attendees; provided industrial hemp training to 200 NC State employees and conducted 22 industry presentations.** NC State has is also operating industrial hemp demonstration plots with six varieties in trial across several research stations. **The result of Extension’s work has been a quite rapid growth in industrial hemp experimental production, with the crop now grown on upwards of 5,500 acres in the state by 375 licensees.** Interest has also been highly distributed across the state, with licensed growers now present in in each region of North Carolina. NC State has also provided educational programing on industrial hemp to law enforcement agencies in the state, working to assure law enforcement understands this new crop. While the full potential of an industrial hemp value-chain is far from being realized, with the allowed activity still only at a pilot scale, the promise of this emerging industry is very much recognized in the substantial number and diversity of “Registered Processors” reported by the NC Industrial Hemp Program. **As of November 2018 the state has 200 Registered Processors,** and significant diversity can be seen in their areas of focus, ranging across applications in biotechnology and biopharmaceuticals, cosmetics and botanicals, health and nutrition supplements, fibers, livestock feed and food ingredients.

Key Impacts:

- Enhanced agricultural sector financial stability and profits
- Globally competitive economy
- Increased economic output
- Increased employment
- Economic diversification
- Rural, small town and urban economic activities
- Increased exports
- Local and state government revenue.

²⁰ National Conference of State Legislatures. “State Industrial Hemp Statutes: 8/8/2018”. Accessed online at: <http://www.ncsl.org/research/agriculture-and-rural-development/state-industrial-hemp-statutes.aspx>

Example 4: Supporting North Carolina's High-Value Tobacco Farming Sector

Tobacco continues to be an important crop for North Carolina farmers, produced in any given year within 30 to 40 of North Carolina's counties. The crop carries a high value for producers, harvested from 163,900 acres in 2017 with a production value of \$723.6 million. To put this high-value in perspective it exceeds the \$638.8 million in the production value for NC produced soybean despite using less than 10 percent of soybean's total acreage which covered 1.69 million acres in 2017.²¹ North Carolina's tobacco represents both an important export crop for the state (with circa 70 percent of the leaf harvest exported, much of it internationally), and an important supplier to the state's cigarette manufacturing industry such as RJ Reynolds in Winston Salem. While North Carolina has a rich history in the production of tobacco it is not without its challenges as a crop. Tobacco is susceptible to many diseases and insect pests, and Extension plays an intensive role in providing education, consultations and support to producers to combat these threats – sustaining Extension Specialists for tobacco plant pathology and for entomology. NC State has also worked to develop improved tobacco varieties that are resistance to two prevalent diseases – black shank (a fungal disease) and Granville wilt (bacterial). Farmers turn to their local Extension agent when they first suspect a pest or disease issue, and if the Extension agent is unable to diagnose, or needs a second opinion, they are backed-up by the NC State Extension Specialists and the NC State resources in diagnostic lab testing. Extension has also provided long-term support to the tobacco farming industry in terms of agronomy and associated production techniques, providing recommendations not just in pest-control, but in soil management, mechanization, organic production systems, and curing.

Analysis of 2017 data by TEconomy for NC State finds that the total economic impact associated with the production of NC State-related tobacco (with 65 percent of the 2017 crop being NC State developed varieties) is substantial, accounting for a total state economic output of **\$951 million, \$347.8 million in labor income for North Carolina workers, and over 7,100 jobs in the state.**

Key Impacts:

- Enhanced agricultural sector financial stability and profits
- Globally competitive economy
- Increased economic output
- Rural, small town and urban economic activities
- Increased exports
- Local and state government revenue.

Example 5: Turf

From home lawns to sports fields, from highway medians to golf courses, turfgrass is an important part of the American landscape. Turf variety development, seed and sod production, lawncare and the supplies, equipment and labor required to sustain healthy turf also represent a large-scale industry. With significant variability in application (use), climate, environmental conditions, pests, etc. the selection of an optimal turfgrass variety and care regimen are important decisions. In North Carolina, NC State Extension is a central resource for research-based information and support services for commercial, public and home turf – and with two million acres of turfgrass grown in the state, demand for Extension knowledge and information is high. Servicing the needs of homeowners, commercial enterprise and public land managers is particularly complex in North Carolina because the state is located astride a transition zone between cool and warm-season grasses.

²¹ It should be noted that soybean production is an important and integral component of the feed chain supplying North Carolina's large-scale poultry and livestock industries.

One of the key services provided by NC State is a series of annual variety trials performed to compare performance. With between 600 and 800 varieties of turfgrass to select from, the trial work performed by Extension is a critical resource for provision of independent, research-based information on comparative variety performance and recommendations for variety selection based on environmental and application considerations. Extension is also active in irrigation management research and recommendations and in evaluation of technologies for lawn care (for example testing 48 mowers over 12 months for cut quality). With hundreds of thousands of “customers” across homeowners, municipalities, golf course managers, schools and colleges with their sports fields, etc. reliable information for turf management is in very high demand. Extension meets this demand through on-the-ground capabilities of county Extension Agents, the support of turfgrass Extension specialists at NC State, holding workshops and events, field days (the turf field day in Raleigh, with 800 typical attendees, is the highest attended of Extension field day events), and via having comprehensive set of published informational resources (accessible online). Areas of information covered in detail include specific information by primary grass species, together with resources for the diagnosis and management of disease, pest damage, weeds, and abiotic stressors.

Quantifying the economic impact of turfgrass and related extension support within North Carolina is exceptionally difficult given the wide range of applications and constant flow of information. That said, just looking at one sector of the North Carolina economy that is very much dependent on performance of turfgrass helps to put impacts in perspective – the golf industry. A 2017 report, prepared by TEconomy for Golf 20/20, outlined detailed analysis of the impact of the golf industry in North Carolina and showed the impact generated to be over \$2.36 billion in direct economic impact within North Carolina. The study showed golf generating a total economic impact (including direct, indirect and induced impacts quantified via input/output analysis) to be over \$3.7 billion annually and supporting 36,688 jobs with over \$1.1 billion in North Carolina wages and benefits. The NC golf industry was also found to be generating \$434.6 million in federal, state and local taxes. When interviewed for this project, Rod Gurganus and Grady Miller of NC State Extension noted that turf management represents upwards of 50 percent of golf course operational labor expenses. Work by NC Extension to support optimal grass selection, develop efficient and sustainable management practices, and provide solutions to disease, pest and weed challenges are clearly providing important resources and support for those across the state working to sustain healthy turf.

Key Impacts:

- Increased economic output
- Local and state government revenue
- Human capital and skills development
- Environmental and natural resource conservation and sustainability
- Resource use efficiency
- Enhanced quality-of-life and quality-of-place.

Example 6: Supporting North Carolina’s Christmas Tree Industry

North Carolina is ranked as the number two state in the nation in terms of the number of Christmas trees harvested and their cash receipts. The North Carolina Christmas Tree Association (NCCTA) reports that North Carolina has over 1,300 growers producing trees for the Christmas market on an estimated 40,000 acres. In 2012 (the most recent year for a full Agriculture Census) North Carolina produced almost 4.3 million cut Christmas trees. The industry is particularly important in the western counties of the state, with primary production concentrated in the counties of Alleghany, Ashe, Avery, Buncombe, Haywood, Henderson, Jackson, Macon, Madison, Mitchell, Swain, Transylvania, Watauga and Yancey.

NC Extension is proactive in working with Christmas tree producers to assure the health of the industry. Work includes advice in terms of production practices, pest control, and weed control for example – and Extension reports that **education for growers relating to weed management generated \$1.8 million in value from improved quality of trees**. Extension also engages in special projects to help solve specific industry needs. One example has

seen Extension field faculty working with NC Department of Agriculture technicians to conduct a series of experiments and research programs focused on keeping cut trees in a fresh market state longer through forced-air cooling of the trees when they are palletized. Being able to preserve harvested trees in a healthy, marketable state for as long-as possible helps to prevent losses and boost market value and economic returns. Another example of a special project undertaken by Extension for this industry focused on sustaining the ability to market trees into Florida when NC experienced the elongate hemlock scale (EHS) insect pest. With Florida not being infested by the pest, North Carolina producers were at risk of having their cut trees shut-out of the Florida \$50 million Florida market, but Extension county educational meetings, demonstrations and one-on-one consultations with growers generated control measures that reduced the challenge by 98 percent -- thereby keeping the market open and avoiding the loss of a large scale annual market.

Key Impacts:

- Enhanced agricultural sector financial stability and profits
- Globally competitive economy
- Increased economic output
- Increased exports
- Local and state government revenue
- Human capital and skills development
- Environmental and natural resource conservation and sustainability
- Resource use efficiency

Example 7: Optimizing soil nutrients and reducing fertilizer run-off impacts

The “Green Revolution” that created large scale increases in agricultural output both domestically and globally primarily resulted from two research-based themes: 1) the specialized breeding and development of higher yielding crop varieties, and 2) the parallel development of advanced agricultural chemicals, including fertilizers. Most Americans probably forget, and younger generations may not know, the dire predictions in the 1960’s and 1970’s of large scale famine and starvation projected to result from population growth outpacing food production. These predictions went largely unrealized because of the work of agricultural researchers whose hybrid crop introductions, ag chemical and agronomic technique improvements launched unprecedented gains in yields. Developing countries saw wheat yields, for example, double in just a few years, and later similar gains were achieved in rice. The introduction of these technologies saved millions of lives and slowed the degradation of native environments that were being slashed and burned to press marginal lands into production.

Today, advanced seed, fertilizers, and other agricultural chemicals place the U.S. at the forefront of agricultural productivity. These inputs (seed, pesticides, fertilizers) are, however, expensive and comprise a major component of farm budgets. There is great economic value to be realized from optimizing application rates of inputs to avoid application of more than is needed, and there are likewise environmental benefits to be achieved through avoiding waste and avoiding run-off of excess chemicals. This latter factor of avoiding fertilizer and nutrient run-off is especially important, with watersheds negatively impacted by excess nutrients in waters and, in a coastal state like North Carolina, concerns over the impact to fragile marine ecosystems that may occur through algal blooms and oxygen depletion effects. Extension has a proactive program focused on providing farmers with information and training on best practices in nutrient management and fertilizer application. Programs are seeing high demand, with, for example, 2017 programming by Extension on optimum fertilizer management provided to 1,655 attendees at N.C. Cooperative Extension meetings and field days. The economic impact of this work can be significant, adding-up quickly give the cost of agricultural chemicals. Dr. Carl Crozier, based at the Vernon G. James Research and Extension Center (located in North Carolina’s ecologically sensitive Tidewater region), notes that programming efforts can result in circa 5 pounds per acre reduction in nitrogen application, resulting in more than \$1 million in savings to Tidewater regional farmers producing corn, wheat, cotton and potatoes across 400,000

acres of production cropland. **Extrapolating the Tidewater results for these four crops to all North Carolina production totaling 1.83 million acres (comprising 890,000 production acres of corn, 375,000 acres of cotton, 459,000 acres of wheat and 16,000 acres of potatoes and 90,000 acres of sweet potatoes in 2017) results in projections based on Extension recommendations of circa \$4.6 million statewide. Similar results in soybean fertilizer use efficiency, were they to occur, would add another 1.7 million acres to the total, bringing the estimated savings up to \$8.8 million.** These cost saving estimates undercount total beneficial impacts because the reduction in negative environmental externalities associated with excess run-off of nutrients being averted is not quantified.

The above emphasizes one particular area of focus at NC State, but Extension's work in soil health and nutrients is considerably more extensive. Extension works across the state providing research-based information and consultations regarding key issues such as: improving soil permeability; cationic exchange capacity, soil structure, soil retention, weed and soil pest management, and no-till agronomic techniques. With a wide-variety of soil types and associated agronomic conditions across the state, Extension is a valuable resource for helping producers evaluate their field conditions and select the right methods for soil improvement and suitable crop selection.

Key Impacts:

- Enhanced agricultural and forestry sector financial stability and profits
- Environmental and natural resource conservation and sustainability
- Resource use efficiency

Example 8: Preventing Losses – Extension work to fight plant diseases, pests and weeds.

Operating largely in open field environments, agricultural and horticultural production is negatively impacted annually by a host of biotic factors that can reduce yield, reduce crop value (through damage to crop quality), and potentially destroy entire crops. Plant diseases (caused by fungi, bacteria and viral pathogens) and insect pests, both together and individually, can have devastating effects on producer profitability. North Carolina's diverse climate and soil conditions, and the diversity of crops grown, means that North Carolina agriculture is particularly prone to a wide variety of disease and pest challenges. In recent years the challenge has been exacerbated by warmer temperatures extending the range of southern pests and diseases northward to impact North Carolina. Extension is very much on the front-lines in working with producers to combat diseases, pests and weeds and provide research-based scientific information to inform the fight. Extension agents in the field are available to diagnose issues brought to them by producers and are backed-up by regional specialists and Extension specialists with expertise in plant pathogens, entomology, weed science, integrated pest management, and associated disciplinary skills. Working as a valuable resource for extension agents, producers and other key stakeholders is the Plant Diseases and Insect Clinic at NC State in Raleigh. The Clinic has three permanent staff members (two plant pathologists and an entomologist) covering a full range of plant diagnostics and pest control protocol work for everything from field crops to homeowner ornamentals. The Clinic personnel diagnose the causative agent in plant damage and make recommendations for actions to take to prevent further loss, mitigate damage, and control the pathogen, pest or disease to prevent further spread. While most of the diseases and insects identified have been seen and experienced within NC agriculture and horticulture previously, the Clinic also serves a role in the identification of high risk, rare issues and exotic invaders. An example of this occurring in North Carolina was a case of Sudden Oak Death. This disease is naturally occurring in California but entered North Carolina via a western nursery shipping plants across country. A nursery in North Carolina started to notice something unusual and called in Extension to diagnose the issue who worked with the Plant Diseases and Insect Clinic to perform a diagnostic screening, identifying the *Phytophthora ramorum* pathogen, and engaging USDA APHIS and the State to put in place controls that stopped the contagion from spreading. Such events are difficult to put a value on because they prevent negative impacts from occurring – but the potential financial risk to the nursery and green industry in North Carolina would be significant in this case were the disease not identified and controlled quickly.

Extension entomologists are seeing the challenges of their work increasing as climate change impacts the range and reproduction patterns of insect pests. A key concern is that longer periods of hotter weather are leading to an increase in the generations of insects of concern to agriculture over the course of the year. In addition, the geographic range of pests is expanding northward and westward in the State, bringing more farms into the range of previously rare or unseen insect pests. The threat is significant. In North Carolina's grape and wine production value-chain, for example, production is threatened by Pierce's disease caused by the bacterium *Xylella fastidiosa*, which is spread by xylem feeding leafhoppers known as sharpshooters. The disease destroys grapevines. North Carolina's fruit industry is also threatened by the spotted wing drosophila (*Drosophila suzukii*) which infests fruit early during the ripening stage rendering the fruit unsellable. With North Carolina's robust industry in blackberries, strawberries, blueberries, etc. the potential impact of the spread of the fly could be devastating. Extension is in the field with producers making recommendations for preventative and repeated pesticide applications to combat the threat. Other concerns for fruit in North Carolina are being generated by the spread of the brown marmorated stink bug, primarily in Western NC, which damages fruit, vegetable, and ornamental crops. With Extension producers across the state know that they have a reliable organization that can diagnose the cause of impacts they observe from pests and provide science-based recommendations to combat the threat and prevent extensive losses.

Key Impacts:

- Enhanced agricultural sector financial stability and profits
- Globally competitive economy
- Increased economic output

b. Examples of Programs in Animal Agriculture

Animal agriculture represents a high-value industry for North Carolina, producer revenues from livestock, poultry and their products (dairy, eggs, etc.) being approximately double the amount for crops in the state according to USDA data.²² With such high livestock and poultry sales, North Carolina not surprisingly ranks high among all U.S. states in terms of production – ranked 2nd in hogs and pigs, 2nd in turkeys, 4th in broilers and other meat chickens, 8th in layers, and 8th in pullets for flock replacement. Animal agriculture also contributes to a large proportion of the row crop agriculture in the state, since corn and soybean (in particular) are grown as inputs to animal feed, as are hay and associated forage crops.

Analysis performed for the United Soybean Board²³, for 2015, found that in North Carolina animal agriculture contributed:

- \$18.7 billion in economic output
- 91,130 jobs
- \$4.2 billion in earnings
- \$1.1 billion in income taxes paid at local, state, and federal levels
- \$142.4 million in the form of property taxes

In addition, the study noted that from 2005-2015 animal agriculture in North Carolina increased economic output by over \$3.3 billion and boosted North Carolinians household earnings by \$711.5 million.

Extension provides a range of services in support of the animal agriculture industry in the state, with programs directed at assisting with animal waste management, animal nutrition, livestock and poultry health, worker

²² The USDA Census of Agriculture State Profile for North Carolina (last performed 2012) lists total value of all agricultural products sold at \$12.59 billion, of which \$4.3 billion comprised crops and \$8.3 billion comprised livestock, poultry and associated products.

²³ Decision Innovation Solutions, LLC. 2016. "Economic Analysis of Animal Agriculture 2005-2015: North Carolina." Produced for the United Soybean Board. Published September 2016.

health and safety, and training for necessary operator certifications. Some examples of Extension in action, supporting animal agriculture in the state, are provided below:

Example 9: Poultry and Hog Waste Management Education

As a leading state in animal agriculture North Carolina contains, at any given time, a large population of food animals. As of January 2018, NC had an inventory of 0.8 million cattle and calves and 9 million hogs. On the poultry side, the state produced over 830 million chickens and 32 million turkeys. Supporting this intensive animal agriculture sector takes a lot of feed – which is converted into energy for the growth and sustenance of the animal with the non-digestible components and waste products from metabolism excreted as waste. The bottom line effect (no pun intended) is that animal agriculture generates significant waste (manure and litter). The U.S. Poultry and Egg Association reports that during the typical 47-day grow-out period, a broiler chicken will generate approximately two pounds of litter.²⁴ With North Carolina producing 830 million chickens, chicken waste alone in North Carolina would therefore be circa 1.66 billion pounds (830,000 tons). As large animals, cattle produce substantial waste with a Holstein dairy cow, for example, producing approximately 115 pounds of manure per day (21 tons per year) and a heifer averaging circa 7 tons per year.²⁵ With 45,000 head of dairy cows in North Carolina that equates to 945,000 tons of manure, and the 370,000 beef inventory cows (January 2018) would have the potential to produce 2.59 million tons of manure. Pigs produce about 11 pounds of manure per day and are typically raised to around 6 months old before slaughter, equating to circa 2,000 pounds of manure produced per pig. With an inventory of 9 million hogs as of December 2017, North Carolina could expect to see 18 million pounds or hog waste (turning over two times annually) for 36 million pounds total in a year (18,000 tons annually). Adding up these four species (chickens, dairy cattle, beef cattle, and hogs) sums to approximately 4.38 million tons of manure/litter waste produced annually.

Livestock waste will contain nitrogen, potassium, phosphorus and other nutrients – rendering the “waste” suitable for application as fertilizer to farm fields – and this is how it is commonly used in North Carolina. However, since the manure may also contain excreted antibiotics, heavy metals, and other non-desirable elements, it must also be used with care. Care must also be taken not to apply too much manure to fields, which can result in excess nutrient run-off (associated with negative environmental impacts). **For these, and other reasons, such as odor control, intensive animal agriculture operations need training to assure personnel are able to handle waste products appropriately. Poultry operations need to be certified in their waste management practices and Extension is the provider of education for achieving the required certifications and for ongoing continuing education for certification maintenance.** Hog operations fall under different guidelines and regulations, but Extension is similarly engaged in education regarding their waste products. **Extension agents and specialists also work with farmers to assess soil fertility needs and provide education and advisory services in regard to optimal application of animal waste-based fertilizer.** N.C. Cooperative Extension is thus providing key resources to the animal agriculture industry that enable it to operate (via achieving certification) and avoid negative environmental impacts. Similarly Extension value is being realized through guidance provided to producers on the appropriate use of this valuable source of soil nutrients.

Key Impacts:

- Human capital and skills development
- Environmental and natural resource conservation and sustainability
- Resource use efficiency
- Enhanced quality-of-life and quality-of-place.

²⁴ Poultry Industry Frequently Asked Questions Provided by the U.S. Poultry & Egg Association. Accessed online at: <https://www.uspoultry.org/faq/docs/industryFAQ.pdf>

²⁵ Source: David B. Fischer. “Energy Aspects of Manure Management.” Accessed online at: <http://livestocktrail.illinois.edu/dairynet/paperDisplay.cfm?ContentID=274>

Example 10: Animal Husbandry and Livestock Management

Extension has the breadth and depth of capabilities across its county, regional and Extension specialists to provide a broad range of education, training, diagnosis and advisory services to North Carolina animal agriculture producers. The list of areas covered by Extension's research-based education programs and materials is extensive, covering key areas including:

- **Animal health** – covering use of vaccination and antibiotics in animal health, prevention and management of parasites and pests (such as ticks, lice, flies, parasitic worms, etc.), identification of toxic weeds and plants in grazing systems, etc.
- **Animal nutrition** – covering nutrition optimization and management, feeding and weaning recommendations for young animals, forage in livestock systems, stocking rates, feed storage, etc.
- **Animal reproduction** – with advice regarding breeding practices, estrous cycles, nutrition impacts on brood/offspring health, etc.

Extension agents and specialists provide services to the full spectrum of producers in North Carolina, ranging from backyard producers, through small farms, midsize and large enterprises.

Key Impacts:

- Enhanced agricultural sector financial stability and profits
- Globally competitive economy
- Increased economic output
- Increased exports
- Local and state government revenue
- Human capital and skills development
- Environmental and natural resource conservation and sustainability.

c. Farm Health and Safety**Example 11: Farm Health and Safety**

According to the National Institute for Occupational Safety and Health (NIOSH): "Agriculture ranks among the most hazardous industries. Farmers are at very high risk for fatal and nonfatal injuries; and farming is one of the few industries in which family members (who often share the work and live on the premises) are also at risk for fatal and nonfatal injuries."²⁶ The North Carolina Agromedicine Institute is a collaboration between East Carolina University, NC State and NC A&T. The Institute's mission is to "promote the health and safety of farmers, fishermen, foresters, their workers and their families through research, prevention/intervention, and education/outreach."²⁷ NC State, through Extension, provides the outreach activities that carry the Institute's health and safety research findings, recommendations, best practices and associated information to producers.

Among the initiatives of the Institute has been adaptation and implementation of the AgriSafe-NC program to meet the needs of producers. The program provides: "health screenings for general wellness and specific occupational health conditions; an educational program that targets occupational health and wellness information tailored to specific operations; assistance in the selection, fit, and use of personal protective equipment to prevent occupational illness or injuries; and support services to assist individuals and their families with issues such as

²⁶ NIOSH. Workplace Safety & Health Topics. "Agricultural Safety." Accessed online at: <https://www.cdc.gov/niosh/topics/aginjury/default.html>

²⁷ NC Agromedicine Institute. "Mission." Accessed online at: <http://www.ncagromedicine.org/index.php>

insurance coverage, caring for aging family members and stress associated with agricultural operations.”²⁸ The Institute also operates the Certified Safe Farm program which provides training and informational resources that include an on-site safety review together with coverage of safe equipment use and practice, chemical safety and storage, safe livestock handling procedures, etc. Importantly, the implementation of recommendations and a successful review of the producers’ safety practices leads to formal certification as a Safe Farm with the likelihood of liability insurance premium reductions for the producer. Currently over 300 farms have been so certified, and with one farmer noting that they saved over \$10,000 on insurance the potential upside benefits for producers are significant. Other programs operated through the Institute, and ported to the field by Extension include: the “First on Scene” program (teaching individuals, from farm workers to EMS and firefighting personnel, who are first on scene at a farm incident how to respond safely); “Fit to Farm” which supports farm worker fitness and health; the Grain Safety / Grain Rescue Program (which covers safe grain handling and rescue procedures for grain bins and other associated environments), and the North Carolina “AgrAbility” Program, supported by USDA funding, which provides farmers who have disabilities with the education and assistance they need to remain active in production agriculture.

Key Impacts:

- Human capital and skills development
- Enhanced health and safety of producers and the agriculture, forestry and fisheries workforce
- Reduced negative social costs and externalities.

d. Agricultural Workforce Preparedness and Education

While the work of Extension in providing advice, best practice information and hand-on support for agriculture is quite well recognized, less well understood is the highly important work undertaken by Extension in providing formal training for technical credentials and certifications needed by many workers to participate in the job opportunities provide by the sector. Education and raining performed by NC Cooperative Extension covers a broad range of required and mandated certifications for North Carolina workers, including in:²⁹

- **Crop Advisor:** The Certified Crop Adviser (CCA) program of the American Society of Agronomy is the benchmarks of professionalism. The program is open to anyone who provides crop management recommendations to clients (e.g. farmers, growers, farm managers/operators). The purpose of the program is to provide base standards for certification for these individuals.
- **ISA Arborist:** ISA Certified Arborist is a program of the International Society of Arboriculture. ISA credentials help consumers identify qualified, knowledgeable tree care professionals. To earn an ISA Certified Arborist credential, individuals must be trained and knowledgeable in all aspects of arboriculture.
- **Pesticide Applicators:** Certification is required for farmers (private applicators) wishing to apply restricted use pesticides to an agricultural commodity. Licensing is required for commercial applicators applying any type of pesticide for compensation, public operators working for a state or local government who apply pesticides in their course of work, dealers selling restricted use pesticides, or pest control consultants making recommendations for pesticide treatment of pest problems.
- **Worker Protection Standard (WPS) Trainers:** The Worker Protection Standard (WPS), an Environmental Protection Agency regulation, was incorporated into the North Carolina Pesticide Law of 1971 in 1993 by

²⁸ About AgriSafe-NC. Accessed online at: <http://www.ncagromedicine.org/program.php#agrisafe>

²⁹ NC Plant Sciences Initiative: Outcome Metrics and Baseline Data. November 15, 2018. FY2018 Report. Prepared for the Golden LEAF Foundation. Project #FY2016-120/Plant Sciences Initiative-Phase 3

the North Carolina Pesticide Board. It is a regulation designed to protect persons who use or come in contact with pesticide treated surfaces while in the production of agricultural plants or commodities on farms, in forests, nurseries, and greenhouses. Designated Trainers are the only individuals in the state who can issue EPA WPS verification cards to workers.

- **Licensed Landscape Contractors:** The Landscape Contractors Law, Chapter 89D, is a statute which regulates landscape contracting in North Carolina; thereby safeguarding life, health, and property and maintaining a high professional standard for the landscape industry. The law states, in part, that “no person shall engage in the practice of landscape construction or contracting, use the designation “landscape contractor,” or advertise using any title or description that implies licensure as a landscape contractor unless the person is licensed as a landscape contractor by the North Carolina Landscape Contractors’ Licensing Board.”
- **Certified Plant Professional:** The North Carolina Certified Plant Professional certification seeks to recognize proficiency in the green industry’s workforce, upgrade the status of industry professionals and provide the public with a means of identifying qualified green industry professionals.
- **Landscape Industry Certified:** Landscape Industry Certified is the international distinction awarded by the National Association of Landscape Professionals (NALP) that represents individuals in the landscape industry who are Qualified, Confident, Recognized.
- **GAP (Good Agricultural Practices):** Good Agricultural Practices (GAP) and Good Handling Practices (GHP) are voluntary audits that verify that fruits and vegetables are produced, packed, handled, and stored as safely as possible to minimize risks of microbial food safety hazards.
- **Certified Turfgrass Professional:** The North Carolina Certified Turfgrass Professional (NCCTP) program is a comprehensive program developed to enhance the technical competency of turfgrass professionals while elevating professional image, that of the business and of the turfgrass management industry. Administered by the Turfgrass Council of North Carolina, the NCCTP designation confirms expertise in turfgrass management to prospective customers and peers.
- **Animal wasteland applicators:** The North Carolina General Assembly passed legislation in 1995 and 1996 requiring certification of operators of animal waste management systems. When properly operated and managed, land application allows safe disposal of animal wastes and beneficial use of the nutrients and water by crops. Sound animal waste management practices reduce risks to human health and the environment, while ensuring that farmers and producers gain the maximum fertilizer value from the byproducts of their animal operations.
- **Licensed Irrigation Contractor:** Licensure law in North Carolina states that no person shall engage in the practice of irrigation construction or contracting, use the designation ‘irrigation contractor’, or advertise using any title or description that implies licensure as an irrigation contractor unless the person is licensed as an irrigation contractor. All irrigation construction or contracting performed by an individual, partnership, association, corporation, firm, or other group shall be under the direct supervision of an individual licensed by the NC Irrigation Contractors’ Licensing Board.

The demand for Extension’s services across these programs is intense. In 2017, across the programs bulleted above, 29,268 individuals received certification training provided through NC Cooperative Extension. In 2016 there were 29,268 persons certified, while in 2015 the number was 26,161.

As the above examples show, those working in the highly competitive commercial agriculture sector have a highly experienced and responsive organization to turn to in N.C. Cooperative Extension, providing advice, analysis, and access to the latest research and innovations. It should be noted that commercial agriculture is not the only beneficiary of this Extension expertise. Noncommercial land owners and home gardeners are also served. Extension provides services for North Carolinians in growing fruits and vegetables for their families and

in landscaping to beautify their homes and communities. Programs are provided across the state, leveraging NC State and NC A&T expertise in horticulture and associated disciplines to cover subjects including vegetables and fruits, flowers and houseplants, trees and shrubs, landscape management and design, and ground cover and lawn grasses. Extension also serves the noncommercial sectors by providing diagnostic resources for plant health and advice and guidance in the prevention and treatment of pests, weeds, and diseases.

5. The Functional Economic Impact of N.C. Cooperative Extension in Agriculture, Food and Fiber: Example of Impact Associated with Each One-Percent Increase in Production in North Carolina.

As seen above, Extension is sustaining and enhancing agriculture and agriculture-related economic activity in North Carolina and enhancing the non-commercial landscape across the state. Via Extension, individuals working in agriculture and related industries have access to research, education, and training. 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. The long-standing work of Extension in the agriculture and natural resource sectors, and the dedicated resources of Extension, and the NC State and NC A&T research enterprises, applied to improving and growing the agriculture and agribusiness sectors of the state economy, mean that Extension's work has an annual impact on state economic performance.

To identify a potential scale of this impact, TEconomy analyzed the effect that every one-percent increase in total agricultural production would have on the State of North Carolina. Given the wide-range of programs provided by Extension to the agriculture sector in North Carolina, it is highly likely that Extension's services generate considerably more than a one-percent gain in agricultural output in the state on an annual basis—however, the use of a conservative one-percent estimate serves as a baseline for considering the significant impacts of improving agricultural sector performance within the North Carolina economy. The impact of a one-percent agricultural production increase in the state is shown below:

N.C. Cooperative Extension reports that in the most recent year Extension had 1.9 million contacts with North Carolinians, 691,580 face-to-face contacts, and 225,219 producers adopted Extension best management practices.

The Economic Impact of a One-Percent Increase in Agricultural Output in North Carolina

Use of the IMPLAN North Carolina input/output models enables TEconomy to quantify the total effect on North Carolina's economic output, employment, and other variables of an increase in agricultural output (dollar value). The analysis performed by TEconomy details the impact of a 1 percent increase in output for the agricultural sector overall, and sub-sectors comprising the livestock, crop, and forestry production.

In terms of total agricultural production, a 1 percent increase would generate the following impacts:

- **\$244.3 million increase in total NC economic output, comprising direct, indirect and induced impact components.**
- **\$106.0 million increase in value-added within the NC economy.**
- **1,675 jobs created and supported.**
- **\$78.3 million annually in additional labor income for North Carolinians.**

Examining the **livestock and poultry production** industry subsector (which, as shown in examples herein, has been the subject of intensive Extension programmatic activity), shows the potential impact of a 1 percent increase in this subsector. The impact of a 1 percent increase in the livestock and poultry industry would be:

- \$143.1 million increase in NC economic output.
- \$54.0 million in value added within the NC economy.
- 723 jobs created and supported.
- \$39.3 million in additional labor income.

For **crop production**, the impact of a 1 percent increase in direct production output would be:

- \$85.2 million increase in NC economic output.
- \$42.2 million in value added within the NC economy.
- 754 jobs created and supported.
- \$31.4 million in additional labor income.

For **forestry production**, the impact of a 1 percent increase in direct production output would be:

- \$14.7 million increase in NC economic output.
- \$8.8 million in value added within the NC economy.
- 160 jobs created and supported.
- \$7.2 million in additional labor income.

It also should be noted that expanding the agricultural sector could benefit every county in the state. Agriculture and associated processing industries are distributed across the whole of North 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.

Note: total agricultural production in the model also includes a small amount of fishing-hunting production.

What is the Potential Impact Percent Gain Through NC Cooperative Extension’s Work in Support of the Agricultural Economy?

The above numbers project the impacts of a one-percent gain in agricultural output in North Carolina. The reality is that research suggests that the impact of Extension is higher than this, although triangulating a precise figure is not possible. As noted in the Executive Summary, in 2014 analysis, performed by TEconomy, it was concluded that the combined effect of research and Extension activity by NC State in support of soybean agriculture would have conservatively generated between a 12.5 percent to 17.5 percent benefit in terms of improved yield. These yield benefits were generated through multiple activities in variety development, variety testing, production practice recommendations, pest and disease prevention and diagnostics, soil nutrient studies and recommendations, and multiple other recommendations, practice advancements and business supports. Extrapolating those impacts to more recent 2017 production of soybeans in North Carolina results in potential benefit to soybean agriculture via NC State research and Extension work of between \$79.8 million and \$111.8 million in enhanced yield value for 2017.

With more than 80 individual crops grown in North Carolina it is impractical to evaluate the impact that N.C. Cooperative Extension is having in each one. Extension is, however, active in work across most crops in terms of helping farmers select high yielding crop varieties suited to individual North Carolina growing environments, working to help prevent damage from plant pathogens, pests and weeds, helping producers deploy their agricultural chemicals more efficiently and cost-effectively, advising on soil health, and guiding optimized agricultural practices to assure successful crops, to name just some areas of Extension support. Extension is similarly focused on work to enhance the states large-scale livestock industry as well as forest industries.

Were the impact of results of NC State research and Extension work in soybean yield enhancement to be similar in scale of impact across North Carolina’s total agriculture sector, at the low end of the soybean yield enhancement range (12.5%), the large-scale contribution being made by Extension to North Carolina’s agricultural economy can be generally projected. If we allocate 50% of the yield enhancement to NC State research and 50% to N.C. Cooperative Extension hands-on education, advisory and testing activity, thereby using 6.25% yield increase as an estimated measure for the value of Extension-related yield increases, the impact is

very large in scale. Expanding the 1 percent increase in agricultural output metric to embrace a potential 6.25% output enhancement effect for Extension results in impacts as follows:

- **~\$1,526.9 million increase in total North Carolina economic output, comprising direct, indirect and induced impact components.**
- **~\$662.5 million increase in value-added within the state economy.**
- **~10,469 jobs created and supported.**
- **~\$489.4 million annually in additional labor income for North Carolinians.**

For 2017, Extension reports having connected made 6.89 million direct and indirect contacts in the State of North Carolina via 13,000+ programs. In the agricultural production sector, Extension reports that it accomplished 681,580 face-to-face contacts and that “225,219 producers adopted best management practices.”³⁰ The USDA’s National Agricultural Statistics Service (NASS) data for 2017 show North Carolina having 47,800 farm operations. As these data indicate, Extension is intensive in its coverage and interactions with agricultural producers in the state. With 225,219 producers adopting best management practices that is equivalent to an average of **4.7 personnel for every farm** in North Carolina using best practice recommendations from Extension. Having such reach and influence across the North Carolina farming establishment, with widespread adoption of Extension best practices, certainly suggests that a 6.25 percent positive impact on agricultural production is reasonable approximation.

C. Value-Added Processing of Food, Feed and Fiber

1. Description

While Extension performs considerable work in support of the primary production of food, feed and fiber (on farms and in North Carolina forests), it does not stop there. Extension also is proactive in support of downstream value-added agricultural processing, food processing, wood processing and other value-added industries that use the output of North Carolina’s farms and forests as inputs to production. North Carolina has a long-history of vertical integration of industries from “farm and forest to factory”. Examples of this integration include supply chains in:

- Tobacco farming and cigarette and finished tobacco products manufacturing.
- Cotton farming and downstream industries in cotton textiles manufacturing and the production of garments and other textile-based products.
- Forest production and value-added processing into furniture.
- Poultry, hog and other livestock farm production and finishing operations, continuing into livestock processing and the production of value-added food products.
- On farm production of grains, oilseeds and horticultural products and their downstream processing into value added food and feed products.

While global economic and competitive forces have changed the fortunes of several of these supply chains (with substantial declines experienced in North Carolina’s textile, furniture and, to a lesser extent, tobacco industries), there is still considerable innovation taking place in value-added industries. A notable example is discussed

³⁰ NC State Extension. “Extension Grows North Carolina.” Accessed online at: https://www.ces.ncsu.edu/wp-content/uploads/2018/03/Extension-is-Everywhere_Impact-Sheet-2018.pdf?pwd=no

herein, comprising the development of sweet potato farming and a downstream processing industry value-chain in the state.

In support of industry, NC State researchers work to provide innovations, that Extension then relays to producers and processors to enhance and develop new products and associated supply chains. Extension specialists work to solve issues and resolve needs of value-added processors, and are a key interface carrying the needs and questions of processing industries back to research teams at NC State and NC A&T to develop solutions.

2. The Need:

While several of North Carolina's agricultural and forest production integrated value-added industries have experienced substantial decline (due largely to global forces beyond the control of the state, producers or the industries), the fact remains that the overall agriculture, agribusiness and associated value-added industries continue to represent a highly significant component of the North Carolina economy. **A relatively recent analysis by NC State found that food, fiber and forestry production and associated industries had a value of \$78 billion, or nearly one-fifth of the state's GDP in 2012. The integrated supply chain was found to be responsible for 640,000 jobs in the state (out of a total of 4 million jobs).³¹ Given that the sale of primary agricultural commodities totaled \$12.6 billion in 2012 in North Carolina³², it is clear that with total industry value-chain activity of \$78 billion, there is considerable value-added processing and associated industry activity ongoing in the state.**

One of the key advantages for North Carolina in developing agribusiness, forest business and associated value-added processing industries is the dispersed geographic characteristic of these industries. With primary production of food, feed and fiber products distributed across the entire state, and present in every county to some degree, the value-chain represents a key generator of job opportunities for the entire state. This is an especially important industry sector for rural North Carolina's economic and community development.

As specialized industries, typically subject to regulatory oversight (such as food safety regulations, labelling regulations, etc.) these are not industries that are easy to establish and manage. In the case of food products, for example, value-added processors must understand commodity markets, negotiate contracts for the supply of key (and seasonal) production inputs, invest in specialized processing, production and packaging equipment, train and maintain a workforce skilled in food safety and associated production practices, and manage the complex logistics of getting product (often perishable product) to market. Manufacturers must navigate a highly competitive market to get retail shelf-space, market their products, build awareness, and sustain market share. Often products produced by the industry have comparatively slim margins, and the professional management of operations for maximum efficiency is critical for success and sustainable business operations.

While large multinational food companies have the capital and human resources required to successfully negotiate this challenging business environment, it is much more difficult for smaller producers and new market entrants. Food, feed and fiber value-added product entrepreneurs and small business operators often require help to understand and navigate the supply-chain, production process, regulatory and market challenges associated with the sector. N.C. Cooperative Extension is an important resource providing this assistance, particularly for smaller producers.

³¹ North Carolina State University. College of Agriculture and Life Sciences. "Agriculture and Agribusiness: North Carolina's Number One Industry." Fact Sheet, 2014.

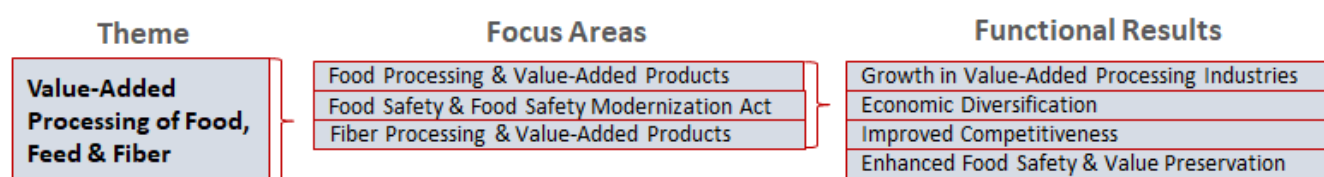
³² USDA National Agricultural Statistics Service (NASS). Census State Profile for North Carolina 2012.

3. Themes, Impacts and Mechanisms of Extension Impact Generation in Value-Added Processing

Figure 8 shows the primary activities of Extension and pathways to impacts associated with the food, feed and fiber value-added industries in North Carolina. Extension is proactive in working with entrepreneurs and existing businesses in a broad-variety of areas. Examples include advice in the post-harvest handling and storage of farm products to preserve their quality as they enter the supply chain, methods of transport to processing facilities, processing technologies and techniques, food safety procedures and regulatory management, packaging and finished product distribution.

Ultimately, N.C. Cooperative Extension's work is geared towards assuring value-added industries have the knowledge they need to build and sustain competitive business operations in the state (Figure 8).

Figure 8: N.C. Cooperative Extension Functional Impact Themes in Value-Added Processing



It should be noted that NC State has been proactive in planning for a significantly enhanced presence in the development and support of value-added industry in North Carolina. In December of 2014, NC State and the North Carolina Department of Agriculture and Consumer Services, under the direction and financial support of the North Carolina legislature, worked with Battelle's Technology Partnership Practice (now TEconomy) to develop an in-depth feasibility study for a "North Carolina Food Processing and Manufacturing Initiative". The study concluded that:

*By fully leveraging the existing value-added biomass processing and manufacturing capacity for the state along with North Carolina's key innovation drivers, the economic decline [seen in biomass-based industries such as tobacco, textiles and furniture] can be reversed.... The opportunity comes through growing another industrial sector – namely the value-added food manufacturing sector. This result can be achieved by developing programs and initiatives that leverage North Carolina's unique opportunities and help it overcome the market barriers and hurdles that are currently impeding the industry's development.*³³

Extension, as the primary mechanism for CALS engagement with industry across the state is an integral component of the now developing North Carolina Food Processing and Manufacturing Initiative. Extension's engagement includes continuation of existing long-standing work with value-added industries, together with new activities that will develop under the Initiative.

Examples of current and recent Extension work in supporting value-added industries are highlighted below.

4. Functional Impact Examples for N.C. Cooperative Extension in Value-Added Processing

In the case of Extension work in value-added processing, several examples are illustrative of the high impact work taking place:

³³ Battelle Technology Partnership Practice. 2014. "The North Carolina Food Processing and Manufacturing Initiative: An Economic Feasibility Study." Prepared for the State of North Carolina by the partnership of NC State University CALS and the North Carolina Department of Agriculture and Consumer Services. December 2014.

Program Area: Value-Added Processing of Food, Feed and Fiber

Example 1: Developing the sweet potato processing value-chain in North Carolina

NC State's development of the leading sweet potato variety, well suited to North Carolina production conditions, has led to the development of such a reliable supply of sweet potatoes that value-added processing industries have now developed in North Carolina. Several significant firms are now producing value-added sweet potato food products, including firms such as:

- Carolina Innovative Food Ingredients, Inc. in Nashville, NC.
- JR Simplot Company in Winterville, NC.
- Moody Dunbar, Inc. in Dunn, NC.
- Trinity Frozen Foods in Pembroke, NC.
- Wada farms Marketing Group, LLC. in Raleigh, NC.
- Wayne E. Bailey Produce Company, Inc. in Chadbourne, NC.

The North Carolina Sweet Potato Commission's latest NC Marketing Report noted that, in addition to fresh market sweet potatoes, state food processing industries are producing canned sweet potatoes, sweet potato baby food, chips and frozen products (such as sweet [potato] fries).³⁴

The sweet potato example is a textbook case of the value of Land-grant university research and extension working together to advance the development and improvement of new crops, support farmers with the knowledge required to successfully produce the crop, and then working to support the development of value-added processing industries. **From relatively modest beginning, the North Carolina sweet potato industry has grown to become a greater than \$300 million crop for the state, and part of a value-chain creating impacts in excess of \$490 million.**

Similar effects have been achieved in peanut. NC State has conducted breeding, cultivar development, and release of foundation seed to provide peanut farmers with high performance peanut varieties suited to North Carolina growing conditions. Furthermore, a peanut processing industry has been encouraged, with Extension assistance, to develop in the state, producing a variety of products ranging from edible nuts through to peanut butter. In 2017 peanuts were harvested from 117,000 acres in North Carolina with a production value of \$113.2 million. Particularly notable is that all of the commercial peanuts grown in North Carolina are NC State developed varieties. In the previously cited analysis by TEconomy for NC State the overall economic impact of the peanut industry in North Carolina, using NC State varieties, was calculated. Updating the analysis to 2017 data, it is found that **the peanut industry and associated value chain generated a total economic output in North Carolina of \$222.4 million (based on 2017 data) and supported 2,994 jobs in the state with a payroll of \$75.2 million.**

Key Impacts:

- Enhanced agricultural financial stability and profits
- Globally competitive economy
- Increased economic output
- Increased employment
- Economic diversification
- Enhanced personal and household incomes
- Rural, small town and urban economic activities
- Increased exports
- Local and state government revenue.

³⁴ North Carolina Sweet Potato Commission. "Sweet Potato Speak." Issue 02, June 2018. <https://ncsweetpotatoes.com/wp-content/uploads/2018/06/JUN-2018-Newsletter-Final.pdf>

Example 2: Helping value-added industries access the specialized inputs they need for ongoing growth and success

Several new and potentially fast-growing value-added processing industries for North Carolina can see their development enhanced through an ability to source high-quality, specialized inputs produced locally, within North Carolina. Several examples illustrate how N.C. Cooperative Extension is coordinating with researchers at NC State, to advance the production of necessary food and fiber ingredients for industry:

- **Beer Ingredients.** North Carolina has experienced rapid growth in its beer brewing industry. Especially focused on craft brewery production, the industry is characterized by many small and moderate sized brewery operations. The North Carolina Brewers Guild notes that the industry comprises 200+ breweries and brew pubs in the state with an annual economic impact exceeding \$1.2 billion and 10,000 associated jobs. Of note is the sourcing of local North Carolina ingredients for specialty brews, with several state produced commodities finding application, including sweet potatoes, sorghum, blueberries, blackberries, barley, wheat and rye. NC State researchers and Extension specialists have recently been working with the industry and farmers to identify optimal hop cultivars for production in North Carolina, develop optimized production practice recommendations, and assess optimal locations for successful in-state production.
- **Industrial Hemp** provides a pathway to growth of a new North Carolina commodity well-suited to local growing conditions and to the development of specialized plant phytochemical extract industries (for health product applications) and for use as industrial biomass inputs for fiber industries. Extension is actively engaged in the development of this industry opportunity, with work in testing plant varieties for optimized characteristics needed by the industry, development of agronomy practice recommendations, and assistance with market studies and other analysis needed by potential growers and processors.
- **Natural Low-Calorie Sweeteners.** The food and beverage industries have significant demand for low-calorie sweeteners that come from natural sources. Stevia represents a significant potential source for such sweeteners, and Extension is active in research and outreach services (similar to those in industrial hemp) focused on increasing the production and utilization of North Carolina-grown stevia as a new industry opportunity.

Key Impacts:

- Increased economic output
- Increased employment
- Economic diversification
- Increased exports
- Local and state government revenue.

Example 3: Food Safety and the Food Safety Modernization Act

According to data from the Centers for Disease Control and Prevention (CDC) approximately 48 million people in the U.S. (1 in 6) get sick, 128,000 are hospitalized, and 3,000 die each year from foodborne diseases. In response to the issue Congress enacted the Food Safety Modernization Act (FSMA) to further the prevention of foodborne illness. In part the FSMA is a response to the increasing globalization of the food supply system, but it also aims to enhance procedures within domestic food production. N.C. Cooperative Extension has long been engaged in activities focused on food safety across the production supply chain – from farm production all the way through to final safe food preparation in home, institutional and commercial kitchens. North Carolina has a very safe food system (and Extension has contributed to that safety), but FSMA recognizes the reality of global supply chains and foreign produced food entering our system, and that even domestic procedures can be improved to reduce the public health burden associated with foodborne illnesses.

FSMA is quite complex, comprising seven individual rules that cover different aspects of food safety. Currey Nobles, an Extension Area Specialized Agent for Food Safety, has summarized the seven rule categories:

- **Preventive Controls for Human Food:** Requires that food facilities have safety plans that set forth how they will identify and control food safety hazards.
- **Preventive Controls for Food for Animals:** Establishes Current Good Manufacturing Practices (CGMP) and preventive controls for food for animals.
- **Standards for Produce Safety:** Establishes science-based standards for growing, harvesting, packing and holding produce on domestic and foreign farms.
- **Foreign Supplier Verification Programs (FSVP)** for Importers of Food for Humans and Animals: Importers will be required to verify that food imported into the United States has been produced in a manner that provides the same level of public health protection as that required of U.S. food producers.
- **Mitigation Strategies to Protect Food Against Intentional Adulteration:** Requires domestic and foreign facilities to address vulnerable processes in their operations to prevent acts intended to cause large-scale public harm.
- **Sanitary Transport of Human and Animal Food:** Requires those who transport food to use sanitary practices to ensure the safety of food.
- **Accredited Third-Party Certification:** Establishes a program for the accreditation of third-party auditors to conduct food safety audits and issue certifications of foreign facilities producing food for humans or animals.

The large scale legislated rule changes under FSMA, effectively impacting the entire food production and supply chain, has created substantial demand for information on rule requirements, best practices in effectively addressing the requirements, how to adapt current practices, compliance issues, etc. N.C. Cooperative Extension has been highly responsive to the need, responding with reliable education, information and hands-on guidance.

Furthermore, NC State Extension is hiring eight area specialized agents, five of whom are focused on dealing directly with FSMA needs and the remaining three focused on reinforcing consumer food safety. At a time when funding is tight for Extension, the commitment by N.C. Cooperative Extension of resources to meet the changes wrought by the FSMA have been particularly robust – demonstrating Extension’s commitment to responding to the needs of the agriculture, agricultural processing, food processing, distribution and the food retail and meal preparation supply chain.

Extension also works with agricultural producers in provision of **Good Agricultural Practice (GAP)** training and supporting information to sustain FDA GAP certification. This important program helps to assure fruits and vegetables are produced, packed, handled and stored according to regulatory requirements. In 2017 Extension trained 1,427 growers in GAP requirements through county center programs across the state.

Key Impacts:

- Human capital and skills development
- Enhanced health of North Carolina and reduced healthcare costs
- Reduced negative social costs and externalities.

Example 4: Mountain Horticultural Crops Center – Sorting and Packing Demonstration Facility

Growing a crop is only one part of a multi-step process required to get from “seed to fork”, and the value of a crop can be significantly influenced by how it is handled during harvesting, transportation, sorting and packing. Mishandling can cause quality issues in terms of bruising and other defects, reducing the value of the damaged produce. At the Mountain Horticultural Crops Center, NC State has invested in an instrumented sorting line (unique to the East Coast of the U.S.) which allows quantitative high-throughput data to be gathered on various external and internal characteristic of product coming down the line. This is an invaluable tool for research analysis of North

Carolina produced fruit quality, but it is also a valuable demonstration resource for Extension working with producers and packers to demonstrate modern technologies and the impact of handling practices on quality and market price. The system is now up-to-speed and Extension will be inviting producers to the facility for the first educational programs. This represents an example of how Extension can take the risk to experiment with new technologies and assess their “fitness to purpose” and optimal utilization in North Carolina production systems, without commercial producers having to take a leap-of-faith as early adopters. N.C. Cooperative Extension is recognized as an independent, objective and trusted provider of evaluation data and research-based information and recommended practices – and this very much includes an important role as an evaluator and demonstrator of new technology for North Carolina’s agricultural sector.

Key Impacts:

- Enhanced agricultural sector financial stability and profits
- Globally competitive economy
- Increased economic output.

Example 5: Entrepreneur Initiatives for Food (EI4F)

NC State’s Entrepreneurial Initiative for Food (EI4F) program works with small business owners and prospective entrepreneurs to manufacture and process quality food products safely. The program helps ensure individuals and firms transform agriculture commodities into safe, nutritious and value-added food and beverage products. The mission of EI4F is to help small food business owners and prospective entrepreneurs make informed decisions leading to greater economic development and job creation.

EI4F provides a variety of services to start-up companies, including product testing, product classification, nutritional labeling, label review, and consultation and training, including the Acidified Foods Manufacturing School. This school is intended for operators or operating supervisors involved in production of thermally-processed acidified foods and will qualify commercial operators of plants producing acidified foods to meet the requirements of the specific GMP for acidified foods. EI4F also serves as the process authority for the State of North Carolina.

Since the beginning of the effort, the EI4F has worked with thousands of clients across the State of North Carolina. In 2016 alone, the EI4F program:

- Analyzed 877 food products to provide processing recommendations (based on pH and water activity)
- Generated 539 nutritional labels and ingredient statements for food products
- Trained over 77 individuals in the Acidified Foods Manufacturing School.

Key Impacts:

- Enhanced agricultural sector financial stability and profits
- Increased economic output
- Economic diversification
- Safer food supply and reduction of food related illnesses
- Enhanced personal and household incomes.

D. Natural Resources and Environmental Stewardship: Functional Impacts

1. Description

Human activities shape the American landscape. Both economic and social activities impact the landscape through natural resource consumption, construction of infrastructure and buildings, waste outputs, and agricultural and forest land use. Our use and shaping of the landscape impacts ecosystems and natural biodiversity, natural resource availability, resource quality, landscape aesthetics, water flows, and other environmental characteristics. With intensive agricultural and industrial activity, and a population of 10.3 million people, North Carolina's landscape, natural resource base, and ecology are impacted every day and not always in ways readily apparent to the eye.

2. The Need:

Ultimately, the most important fixed assets that North Carolina has are embodied in its land. The land, and inherent natural resources, hold intense value as the home to present day North Carolinians and are held in trust for generations to come. Sustaining a viable North Carolina mandates understanding of the effects of human activity on the state and the development of protocols, regulations and recommendations designed to protect and conserve resources and assure their ongoing sustainability.

Without consideration being paid to environmental impacts and natural resource sustainability there is little doubt that human activity has the potential to seriously degrade land, resources and overall "livability". Pollution, flooding, wildlife depletion, loss of ecosystem services, negative impacts on health and quality of life are each threats associated with unrestrained human activities. However, these threats can be managed, and past-harms can be mitigated or remediated, if we have the knowledge, training and willingness to perform the appropriate actions.

3. Themes, Impacts and Mechanisms of N.C. Cooperative Extension Impact Generation in Natural Resources and Environmental Stewardship

Land-grant universities, including NC State have long been engaged in understanding human-landscape interactions and the impact we have on natural systems. N.C. Cooperative Extension represents 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 knowledge to sustain resources and be good stewards of North Carolina's natural resources, biodiversity, landscape assets, and the important ecosystem services they provide. Figure 9 depicts some of the key areas of activity undertaken by Extension under the theme of Natural Resources and Environmental Stewardship.

Healthy ecosystems provide us with fertile soil, clean water, timber, and food. They reduce the spread of diseases. They protect against flooding. Worldwide, they regulate atmospheric concentrations of oxygen and carbon dioxide. They moderate climate. Without these and other ecosystem services, we'd all perish.

David C. Holzman. "Accounting for Nature's Benefits: The Dollar Value of Ecosystem Services." *Environmental Health Perspectives*. 2012 Apr; 120(4).

Figure 9: N.C. Cooperative Extension Functional Impact Themes in Natural Resources and Environmental Stewardship



4. Functional Impact Examples for Extension in Natural Resources and Environmental Stewardship

In the case of N.C. Cooperative Extension's work in Natural Resources and Environmental Stewardship, some examples below are illustrative of the high impact work taking place:

Program Area: Natural Resources and Environmental Stewardship

Example 1: Soil Fertility and Watershed Management

Human activities have significant effects on global fresh water quality, and such is the case in North Carolina as well. Run-off from urban areas, nutrient flows from agriculture, contamination from flooding events, and other factors, present ongoing challenges for North Carolina watersheds and their ecosystems. Extension is active with a range of programs focused on conserving, managing and protecting the quality of North Carolina water resources. One example has seen Extension develop a computer program, that has been in operation since 2000 by the State Division of Soil and Water Conservation, which enables users to calculate water impacts and reductions in nitrogen flows based on adoption of Extension recommended farm management and conservation practices. It is anticipated that the program has been instrumental in helping farmers avoid expensive mitigation techniques that would be required in the event of excess run-off of chemicals and nutrients from their fields. In effect voluntary conservation practices, helped by modeling achieved through the program, has effectively met the reduction goals in multiple North Carolina watersheds. **The likely impact has been many millions of dollars in mitigation expenditures prevented.**

Key Impacts:

- Enhanced agricultural sector financial stability and profits
- Environmental and natural resource conservation and sustainability
- Resource use efficiency
- Enhanced quality-of-life and quality-of-place
- Reduced negative social costs and externalities.

Example 2: Pesticide Safety Education

This important example of Extension's work is actually relevant across several key Extension themes – providing support for important activity in biomass production, for environmental stewardship, and for human health and safety. Pesticides are an important tool in sustaining strong agricultural production yields and preserving the green industry and its associated benefits for the state. North Carolina's diverse environments support an equally diverse variety of plant pathogens, fungi, insect pests, weeds, and other challenges to maintaining plant health. Extension provides deep expertise in diagnosing pests that are having an impact on crops, turf and ornamentals and providing information and consultations pertaining to solutions to identified pest issues. Every Extension agent in the field in North Carolina is called upon to address pest related issues.

Combatting pests, especially at a commercial level, will often require appropriate application of pesticides. Pesticides are typically chemical compounds specifically formulated to target a specific pest or provide a broad

spectrum of control. Nearly all comprise a complex mix of active and inert ingredients, with the pesticide designed for efficacy via specific recommendations for application technique, dose, timing, storage and disposal. Federal regulations require labeling of the product which specifies their allowable use. Pesticides are an effective tool for controlling pests but, with over \$1 billion pounds of pesticides used in the United States each year³⁵, there is significant risk in terms of their misuse or mishandling having the potential to harm the environment and human health. Acute exposure to certain pesticides may result in poisoning leading to serious health issues for those exposed, and long-term exposures may have chronic health impacts and create increased risk for developing cancers. Because of these risks, particularly for those in farming or the commercial application of pesticides (those with the potential to be exposed at scale), professional training in safe handling, use and application procedures is crucial – and often mandated under law in terms of requiring initial training leading to certification as an applicator and ongoing continuing education to sustain certification status. In North Carolina the NC Department of Agriculture and Consumer Services is the state lead agency, through its Structural Pests and Pesticides Division, in regulating the sale and use of pesticides and for certification management. **Extension’s role is as the education arm of the certification process – with NC State Extension providing education and training (for agricultural producers and commercial applicators) within the state.** Extension provides workshops, “Pesticide Schools” and continuing education and recertification courses that are mandated for applicators who must receive education credits to sustain their licenses. With 16,000 private applicators (typically farmers) and 18,000 commercial applicators, this education role for Extension requires dedication of significant resources. **In recent years, NC State Extension has been providing training for upwards of 10,000 applicators per year (covering new licenses and recertification/continuing education training).** Training programs are conducted in combination with tradeshow and events and through training programs offered at each County Extension service center. The NC State “Pesticide School” is a two-day workshop that prepares applicators for their applicator exam which occurs at the close of the two-days. Sustaining the pesticide education program is a key mission for Extension, serving an essential role in the state, and it is particularly challenging in North Carolina given the highly diverse range of crops produced, diversity of pests involved, and the wide variety of regulated pesticides available to cover this diverse production environment. Pesticides also represent a significant part of farm budgets, and thus training in their efficient use provides benefits for producers not just in terms of reducing environmental or health impacts, but also in sustaining the bottom line of producer operations.

At a national average wage level of \$36,815 for certified pesticide applicators³⁶, the training of 10,000 applicators per year in North Carolina is helping to support the generation of over \$368 million in wages for North Carolinians.

Key Impacts:

- Enhanced agricultural and forestry sector financial stability and profits
- Increased employment
- Environmental and natural resource conservation and sustainability
- Resource use efficiency
- Enhanced health of North Carolinians and reduced healthcare costs
- Reduced negative social costs and externalities.

³⁵ Michael C.R. Alavanja. 2009. “Pesticides Use and Exposure Extensive Worldwide.” Rev Environ Health. 2009 Oct–Dec; 24(4)

³⁶ ZipRecruiter.com statistics at: <https://www.ziprecruiter.com/Salaries/Certified-Pesticide-Applicator-Salary>

Example 3: Wildfire Prevention

North Carolina has 18.1 million acres of timberland. This timberland supports large-scale commercial activity across a wide-ranging forestry and forest products sector in the state – **comprising a sector that generates \$32.7 billion in industry output and supports circa 150,000 jobs.**³⁷ NC State Extension is active in providing assistance to this industry across a range of dimensions (with work in economics, pest management, forest products development etc.). An area of work that is very much in people’s minds, given California’s ongoing fires, is Extension work in fire management and wildfire prevention. **Over the past 10 years, North Carolina has averaged 3,342 forest fires per year, with an average of over 15,900 acres burned per annum (which at an average value of circa \$1,855 per acre³⁸ for the timber equates to \$29.5 million in lost value per year).** Wildfires are started by lightning as a natural occurrence, but the leading cause of wildfires in North Carolina is either accidental ignition by humans, or deliberate arson.

N.C. Cooperative Extension is working to limit the frequency and extent of wildfires through various initiatives. A key program is focused on joint work with other agencies under a “Prescribed Fire Initiative”. Prescribed fires are planned fires (sometimes referred to as “controlled burns”), fires that are pre-planned and carefully managed to achieve environmental management objectives. A leading purpose of prescribed fire is to reduce the fuel load of forests (including “surface fuels” such as grass, logs, woody debris and brush, and “ladder fuels” such as shrubs, small trees and snags). The prescribed burning of the surface and ladder fuels, carefully managed and undertaken in favorable conditions, removes fuel loads and reduces future potential of catastrophic wildfires developing. The Prescribed Fire Initiative has seen good uptake and since the project began in 2013, Extension reports that prescribed fire in longleaf pine ecosystems has increased from 1.1 to 1.6 million acres per year. NC Extension has also produced an online web app that advises on best smoke management practices for prescribed fires, and in 2016 more than 1,700 people accessed the application. Extension has also developed a train-the-trainer wildland fire program with a focus on preventing fires in the more wildfire-prone western region of the state. In the past year 32 county Extension Agents and Master Gardeners participated in the training and now have the ability to train others in their service area.

Key Impacts:

- Enhanced agricultural and forestry sector financial stability and profits
- Environmental and natural resource conservation and sustainability
- Reduced negative social costs and externalities

³⁷ NC State Extension. “*Economic Contribution of the Forest Sector in North Carolina, 2016.*”

³⁸ Nathan Thomas. 2018. “*How Much Money is an Acre of Timber Worth?*” Forest2Market.com. \$1855 value is for natural southern pine forests clearcut.

E. Community and Economic Development: Functional Impacts

1. Description

N.C. Cooperative Extension delivers programs that improve the vitality of the state's communities and the expansion of economic opportunities; promote social cohesion; improve efficiency of local government; and grow a cooperative spirit that engages people as participants and contributors. The three key elements of programmatic efforts are focused on:

- **Building Economically Viable Communities** – Extension is exploring avenues to help communities build and expand on their unique assets. Included are efforts to invest in the development of local food systems, promote agritourism, strengthen entrepreneurship, promote business growth and expansion, and build on the competitive strengths of regions.
- **Renewing Civic Engagement** – Extension seeks to revive and expand the civic activeness of local people, institutions, and organizations recognizing that this is a critical prerequisite for gaining traction and support for the tough choices that communities must make today. Extension is pursuing proven and innovative science-based strategies to expand the diversity of people and organizations having an active role in tackling the challenges that are affecting the well-being of communities.
- **Enhancing Community Decision-Making and Governance** – Extension provides sound data and analysis to help guide local decision-making. Communities are grappling with a host of perplexing issues today, be it the quality of public education, school consolidation, urban/rural linkages, health care access, adult/child poverty, outmigration of youth/young adults, or race relations. These issues are complicated with no clear consensus on how best to address these difficult matters. Given that Extension is highly respected for its objectivity and neutrality, it makes sense that Extension could be an important mediator in helping communities embrace dialogue, deliberation, and action on these issues.

2. The Need:

Put simply, most of rural America faces a make or break period in the coming years. The challenges are immediate for the rural communities scattered throughout the nation's countryside, including 40 percent of North Carolinians, or approximately 4 million people, who live in one of North Carolina's rural counties (counties with a population density of 250 people per square mile or less).³⁹

Rural America has always faced unique challenges, but the challenges ahead are different, in part because the rural economy has moved far beyond agriculture. Furthermore, significant variances in economic performance now makes it unlikely single economic factors will create large economic shifts. Against the backdrop of these rural changes, **five issues are shaping the rural economic outlook: overcoming the digital divide, catalyzing entrepreneurship, leveraging new agricultural practices, improving human capital, and sustaining the rural environment.**

These challenges impact not only agricultural producers and processors, but all aspects of rural life in North Carolina. These are the challenges of modern economic and community development in rural regions, and Extension plays an extremely important role in helping North Carolina's communities understand and adjust to the positive and negative ramifications of these forces for their economic, community, and social development.

³⁹ <https://www.northcarolinahealthnews.org/2018/01/22/n-c-rural-health-numbers/>

3. Themes, Impacts and Mechanisms of N.C. Cooperative Extension Impact Generation in Community and Economic Development

The work of Extension through the efforts of NC State and NC A&T focuses on addressing critical issues related to social and economic sustainability for the communities of North Carolina. In fact, Extension was originally formed under a mandate to diffuse knowledge and to develop a more informed and educated population of agricultural practitioners and community residents to help improve the overall quality of life and economic sustainability of rural regions across the state.

Today, N.C. Cooperative Extension continues to operate under that mandate, providing a broad variety of initiatives and programs across all 100 counties of North Carolina. Figure 10 serves to illustrate the breadth of the key community and economic development initiatives and the variety of positive functional benefits (impacts) that result for North Carolina and North Carolinians (Figure 10).

Figure 10: N.C. Cooperative Extension Functional Impact Themes in Community and Economic Development



4. Functional Impact Examples for NC Extension in Community and Economic Development

In the case of Extension work in Community and Economic Development, several examples are illustrative of the high impact work taking place:

Program Area: Community and Economic Development
Example 1: Local Foods Program
<p>In 2012, Local Foods was named as N.C. Cooperative Extension's first "flagship program." Recognizing that small farms can have a challenging time sustaining profitability if only supplying into large, price constrained commodity markets, Extension works actively with small farm producers to examine alternative crop opportunities, niche market opportunities (such as farmers markets, local food opportunities, etc.), and to help with advice regarding value-added food production and other entrepreneurial endeavors on the farm. Efforts include looking for opportunities for adding value to farm commodities in diverse ways, including for example: organic and specialty markets, direct marketing of products, community supported agriculture, and agritourism.</p> <p>Local food systems generally refer to the geographic context in which food is produced, marketed, and consumed and all other intermediary supply chain steps taking food from farm to table. Additionally, localized food systems are place-specific and seek to embed the production, distribution, and consumption of foods in community relationships. Farms, from large to small and from conventional to certified organic, are finding opportunities to engage in local foods market opportunities across the supply chain in the state.</p> <p>The Local Food Program is comprised of approximately 80 faculty working within inter-disciplinary teams to strengthen North Carolina's Local Food systems. In addition, each county Cooperative Extension office has a designated Local Food Coordinator to extend this knowledge across the entire state.</p> <p>The Local Foods Program is focused on a variety of issues, including:</p>

- Local Food System Supply Chain
 - Local Food Production
 - Distribution & Aggregation
 - Processing
 - Markets & Purchasing
 - Preparation & Consumption
 - Resource & Waste Recovery
- Nutrition & Health
 - Food and Nutrition Programs
 - Cooking Local Food
 - Food Safety
- Youth, Families & Community
 - Community Gardens
 - Farm to School
 - Farm to Childcare
 - School Gardens
 - Youth Food System Leadership
- Strong Communities
 - Local Food Access & Food Security
 - Local Government, Planning, & Agriculture Policy
 - Food Justice
 - Local Food & Economic Development
 - Partnerships & Collaboration

In addition, a Local Food web portal has been developed to provide local food systems resources and timely information to all citizens and businesses across the state. The goal of the website is to provide information and link to resources from Extension as well as from other North Carolina organizations and state partners working on local food programming. It is a dynamic portal and is intended to include new resources as they are developed over time.

Key Impacts:

- Enhanced agricultural financial stability and sustainability
- Economic diversification
- Enhanced personal and household incomes
- Enhanced nutrition and health of North Carolinians
- Improved quality of life and quality of place

Example 2: Stronger Economies Together (SET) program

The Stronger Economies Together (SET) program has been developed by the USDA Rural Development program. SET operates with land-grant universities in each state, and in North Carolina, NC State Extension leads the work. The aim of the program is to significantly enhance rural economic development through professionally developed strategic plans at a regional (multi-county) level – bringing together resources to achieve projects at a significant and effective scale. The SET program provides:

- Step-by-step coaching to guide the design and implementation of a practical and viable regional economic development plan.
- In-depth data tailored to the region, describing its current and emerging clusters, comparative economic advantages, and detailed demographic and socio-economic information.

- Tools to uncover local assets and resources that can advance the region's economic strategies
- Technical assistance from Extension educators, USDA staff, the Regional Rural Development Centers, and the Purdue Center for Regional Development to guide the initial stages of implementation of regional goals and strategies.

Extension at NC State has facilitated the SET planning process in five regions in North Carolina, who through their strategic planning efforts have leveraged an additional \$10.5 million of investments into their communities for strategic initiatives, including the development of a food hub to aggregate produce from small farms across the region in the Sandhills Region and a Food Commercialization Center in the Eastern Triangle Region.

Key Impacts:

- New business development
- Enhancement of economic viability of existing industry
- Increased employment opportunities

Example 3: Community Voices

Community Voices, a program led by NC A&T, is a leadership development program that trains participants to identify and resolve community issues. The target audience are those that have not been historically active in public decision-making processes, and who may have experienced social, economic, and educational limitations.

One example of Community Voices in practice is in New Bern where Community Voices training was part of an effort to revitalize one of the region's most economically depressed areas—Greater Five Points, which encompasses Craven Terrace, a public housing community. Most of its households are headed by women, and its median income is \$8,000 less than the rest of the city. The community is challenged with limited transportation, high crime rates, poor educational attainment levels, and high rates of chronic health problems.

In an effort to improve the community, the U.S. Department of Housing and Urban Development provided grant funding for revitalization efforts, but this required a shared vision be developed for the community. Community Voices training was used to develop that community cohesiveness. As a result of the leadership development program, a community garden and food pantry has been developed that serves the community, a 4-H program has been established, the community has seen an increase in participation in the city's Boys and Girls Club, and the first Girl Scout troop was launched in the public housing community.

Key Impacts:

- Increased community engagement
- Improved quality of place
- Reduced social costs and negative externalities

Example 4: NC AgVentures

Through a grant from the NC Tobacco Trust Fund Commission, NC State Extension developed the NC AgVentures Program, which provides grants to North Carolina farmers to pursue innovative projects with the goal of increasing farm profits. The primary goal is to strengthen agriculturally dependent families and communities by providing support and funding directly to North Carolina farm operators who have innovative plans to diversify, expand, or implement new entrepreneurial plans in their operations or communities. Innovative efforts that have been funded include efforts to use resources in a new way, experimenting with an unusual solution to resolve an old problem,

re-purposing old tools and equipment, or adapting new technology to reduce labor or expand production to enhance the farm operation.

Between 2014 and 2016, the NC AgVentures Program

- Created 104 new jobs
- Sustained another 458 jobs
- Taught new skills to 196 farm workers
- Sustained over 34,000 acres of farm land, and
- Produced more than \$600,000 in farm crops or value-added products.

Based on this level of activity, the NC AgVentures Program generated \$1.26 million in total State economic output during this time period (an estimated output multiplier of 2.10).

Key Impacts:

- New business development
- Enhancement of economic viability of existing industry
- Increased employment opportunities

F. Youth, Families and Homes: Functional Impacts

1. Description

N.C. Cooperative Extension improves the lives of children, youth, and families as a whole, including improving their home environment. Extension works to understand youth and family development challenges, and to develop educational content and programming designed to assist individuals, families, and communities to engage in productive personal and social behavior.

Within this functional impact theme, Extension’s major area of focus is youth development delivered through 4-H programs. 4-H provides education and development programs through experiential learning models where young people learn by doing. As noted by the national 4-H organization:

Kids complete hands-on projects in areas like health, science, agriculture and citizenship, in a positive environment where they receive guidance from adult mentors and are encouraged to take on proactive leadership roles. Kids experience 4-H in every county and parish in the country—through in-school and after-school programs, school and community clubs and 4-H camps.⁴⁰

4-H programs seek to instill integrity, service, leadership, a sense of duty, and personal growth in the youth it serves. It is through these efforts that 4-H programs can be seen to build a basis for positive personal and societal economic impacts. Specific life skills development activities are built into 4-H projects, activities, and events with the goal of helping youth become contributing, productive, self-directed members of society.

It is important to note that Extension differs from social service organizations in that it targets prevention education before significant problems arise or just as difficulties emerge, whereas “social service organizations

⁴⁰ National 4-H Council Website. “What is 4-H.” <https://4-h.org/about/what-is-4-h/>

typically provide intervention services to those who have been clearly identified as having that need. Preventing problems before they happen, through education, is more effective and more economical than intervention or remediation after unhealthy behaviors have become entrenched.”⁴¹

2. The Need:

A report for the directors of Cooperative Extension services in the North Central Region of the U.S. noted that:

*While the United States provides its people with many opportunities and represents the largest and most diverse economy among nations, there is no hiding the fact that it is also a country where tens of millions of residents face significant problems and challenges. Over 45 million Americans presently live in poverty, and U.S. life expectancy is just 42nd among all nations... Over 87 million in the nation are worried about having enough money each month to pay their regular monthly bills, and 17.6 million U.S. households are food insecure. We have the highest incarceration rate of any nation, and, if presented with this report, more than 32 million adult Americans would be unable to read it because they are illiterate.*⁴²

These and similar issues are felt acutely in North Carolina, where persistent poverty, illiteracy, and other socio-economic challenges continue to affect large numbers of North Carolinians. The need for solutions to these human challenges is significant, since:

- One in five North Carolinians live in poverty. One in four North Carolina children live in poverty, and more than one in ten live in extreme poverty.⁴³
- The state has the 11th highest poverty rate in the nation⁴⁴
- A new report from the federal Centers for Disease Control (CDC) shows that deaths from drug overdoses in North Carolina in 2017 soared at the second-highest rate in the nation. The CDC expects to attribute 2,515 deaths in North Carolina last year to overdoses, a 22.5 percent increase from the previous year.⁴⁵
- More than 1,000,000 (approximately 22 percent) adult citizens experience reading and writing difficulties that seriously affect their daily lives and that of their families.⁴⁶
- Approximately 12 percent of the state's population are adults without a high school credential.⁴⁷

3. Themes, Impacts and Mechanisms of NC Extension Impact Generation in Homes, Families and Youth

In support of improving the quality of life and creating opportunities for the youth and families of North Carolina, Extension works across several areas of focus—and these, in turn, engender a variety of positive functional benefits (impacts) for North Carolina and North Carolinians (Figure 11).

⁴¹ Anne Kemerer and Simon Tripp, 2015. “*Analysis of the Value of Family & Consumer Sciences Extension in the North Central Region.*” Battelle Technology Partnership Practice. November 2015.

⁴² Battelle Memorial Institute, Technology Partnership Practice. 2015. “*Analysis of the Value of Family & Consumer Sciences Extension in the North Central Region.*” http://www.nccca.org/app/download/7241418760/Battelle_FCS_Executive_Summary_11-2015.pdf

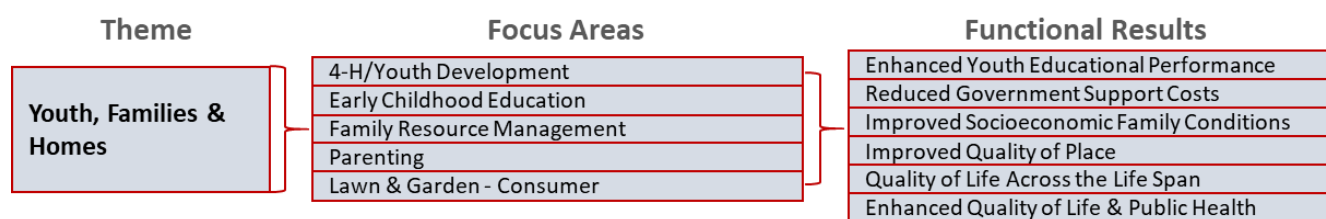
⁴³ <https://www.publicschoolsfirstnc.org/resources/fact-sheets/the-facts-on-child-poverty/>

⁴⁴ United States Census Bureau. *Income and Poverty in the United States: 2017.* <https://www.census.gov/content/dam/Census/library/publications/2018/demo/p60-263.pdf>

⁴⁵ <https://www.cdc.gov/nchs/nvss/vsrr/drug-overdose-data.htm>

⁴⁶ https://proliteracy.org/Portals/0/pdf/ProLiteracy_member-central-media-resources_adult-literacy-facts-letter.pdf?ver=2016-03-08-155040-310

⁴⁷ Ibid.

Figure 11: N.C. Cooperative Extension Functional Impact Themes in Homes Families and Youth

N.C. Cooperative Extension works to understand the key social and behavioral factors that impact quality of life and quality of place, and to give children, youth, and adults the skills that contribute to positive lifestyle choices across their lifespan. It also works to identify the community and societal factors that facilitate or inhibit positive or negative lifestyle choices, and address these through programs targeted at behavior influencers.

Ultimately, the work of Extension in support of youth, families and homes produces a series of desired functional benefits:

- Enhanced youth educational performance and skills attainment, thereby improving career opportunities and ultimately individual earning potential
- Improved socioeconomic family conditions through improved management of family financials, thereby enhancing personal and household incomes and decreasing food insecurity.
- Improved quality of place.
- Reduced government support costs for substance abuse programs and detention centers.

Working across all 100 North Carolina counties, N.C. Cooperative Extension's programmatic efforts to advance the health and nutrition of North Carolinians is influencing key social and behavioral factors resulting in improved quality of life and reduced healthcare costs for citizens across the state.

4. Functional Impact Examples for N.C. Cooperative Extension in Homes, Families and Youth

In the case of Extension work in Youth, Families and Homes, several examples are illustrative of the high impact work taking place:

Program Area: Youth, Families and Homes

Example 1: North Carolina 4-H Program

4-H is North Carolina's largest youth organization, bringing positive youth development programming to thousands of young people each year. Through the work of NC State and NC A&T agents and trained volunteers, Extension served more than 263,000 youth in 2017 through 4-H clubs, school enrichment programs, camps, 4-H robotics and other 4-H programs supported by more than 21,000 volunteers.

4-H is found to be a highly effective and beneficial program. The National 4-H Impact Assessment Project identified the following beneficial impacts for youth engaged in 4-H programs:⁴⁸

- The opportunity to value and practice service for others
- An opportunity for self-determination
- A positive relationship with a caring adult

⁴⁸ Prepared and Engaged Youth Serving American Communities: National 4-H Impact Assessment Project, <http://www.national4-hheadquarters.gov/about/impact/impact1.pdf>.

- A physically and emotionally safe environment
- An inclusive environment
- Engagement in learning
- Opportunity for mastery
- An opportunity to see oneself as an active participant in the future.

National research studies have provided convincing evidence over the years that participation in 4-H Youth Development programs engenders positive self-esteem, personal responsibility, and an engagement with and responsibility toward community. Richard M. and Jacqueline V. Lerner at Tufts University lead a team which has conducted the preeminent research on the youth development impacts of 4-H Youth Development programs nationwide. The *4-H Study of Positive Youth Development* (PYD) is a longitudinal study repeated annually from 2002 to 2010 which surveyed more than 7,000 adolescents across 42 states in grades 5-12. Findings from the 2013 study, which examined youth development across all eight waves, suggest that:

- **4-H youth are five times more likely to graduate from college;**
- **4-H youth are four times more likely to make contributions to their communities than youth participating in other out-of-school activities;**
- **4-H youth are three times as likely to make healthier choices and be physically active; and,**
- **4-H youth are twice as likely to participate in science programs/activities outside of the school day and as a result are more likely to pursue a career in science, engineering, or computers.**

Furthermore, participants who achieve such positive outcomes through 4-H Youth Development programs are, of course, less likely to succumb to external peer pressures and the low self-esteem issues that so often lead to antisocial and self-destructive behavior. Therefore, the role that 4-H Youth Development programs play in both encouraging community service and discouraging risk behaviors through its programming and activities, positively impact the economy of North Carolina over the long-term.

Key Impacts:

- Enhanced educational performance—4-Hers are five times more likely to graduate college (see case study that follows this section)
- Improved quality of place—4-Hers are four times more likely to contribute to their community
- Increased economic growth and prosperity—4-Hers are twice as likely to pursue a career in science, engineering or computers thereby supporting the talent needs of advanced industries in a state

Example 2: NC State's Juntos Program

NC State's Juntos Program works with schools and communities to help Latino students achieve academic success and prepare for higher education. More than 600 Latino youth participated in Juntos programming, which is comprised of four components:

- Family Engagement
- Juntos 4-H Clubs
- Success Coaching and Mentoring
- Juntos Summer Academy

Of the Juntos participants:

- 100 percent of high school seniors who participated in Juntos graduated from high school on time
- 89 percent of students in the program improved their grades preparing themselves to pursue advanced education
- 95 percent of students report that Juntos helped them feel like they belonged in school
- 4 seniors received scholarships from the North Carolina Society of Hispanic Professionals.

The Juntos program model is receiving national recognition and Extension at NC State provides technical assistance to the twenty other states who are implementing the program.

Key Impacts:

- Enhanced educational performance leading to greater rate of high school graduation and the pursuit of higher education
- Improved quality of place as participants better integrate into their communities

Example 3: B.E. Safe Behavioral and Environmental Safety Program for Early Childhood Educators

Recognizing the impact that early childhood education has on enhancing children’s cognitive, social, and emotional development, NC State has developed the BE SAFE Program to provide resources for Early Childhood Educators focused on issues ranging from nurturing positive relationships to creating safe learning environments. The environmental portion of the program addresses principles of a healthy child care environment, disaster preparedness, playground safety, asthma control, safety in the classroom, and indoor air quality. The behavioral aspects of the program address mental health, diversity and inclusion, safe technology, bullying prevention, building connections with parents, and serving children with special needs. The main goal of B.E. Safe is to address environmental and behavioral federal regulations for early childcare providers while also helping to meet their requirements for CEUs for the NC Division of Child Development and Early Education.

Access to quality childcare is critical to any state’s economic growth and its citizens’ economic prosperity. Reliable access to quality childcare:

- Increases worker productivity by reducing absenteeism and improving employee retention.
- Increases earnings for parents in the workforce. Every dollar invested in formal childcare results in \$15.25 in additional income for parents. By providing quality childcare, families are able to seek employment and educational opportunities to better their own lives.⁴⁹
- Increasing our youngest citizen’s ability to learn and grow, thereby decreasing other long-term costs. For every dollar invested in quality childcare, \$16 in public savings is realized through decreased costs related to special education, grade retention, criminal justice, and welfare.⁵⁰

Early childhood education is a critical component of North Carolina’s economy. Within the state, nearly 40,000 citizens are either directly or indirectly employed as a result of the industry sector, making it possible for another nearly 67,000 parents of young children to either become or remain employed, which in turn supports over \$3.5 billion in economic activity each year.⁵¹ Extension’s work to ensure a safe behavior and physical environment for North Carolinians youngest citizens is critical to sustaining this long-term economic impact.

Key Impacts:

- Helping to provide a safe quality of place for North Carolina’s youngest citizens
- Enhancing child development to ensure that North Carolina children are ready and prepared to enter Kindergarten, thereby helping to ensure educational success.
- Increasing worker productivity.
- Increasing family incomes.

⁴⁹ “High Quality, Affordable Childcare for All: Good for Families, Communities, and the Economy.” Policy Link supported by the Marguerite Casey Foundation, 2016.

⁵⁰ Laurence J. Schweinhart, et.al. “Lifetime Effects: The High Scope/Perry Preschool Study Through Age 40.” High/Scope Press, 2005.

⁵¹ Kelly O’Donnell. “The Economic Impact of Early Care and Education in North Carolina.” Institute for Child Success, October 2015.

Example 4: NC A&T Parenting Matters Program

The Parenting Matters program was originally intended to help parents either mandated by the courts to attend training or referred by social-service agencies, but today Parenting Matters has also proven itself an effective resource for those parents who are simply self-inspired to become better parents. Strong parent-child relationships support positive child development, learning, and school successes. Through the efforts of NC A&T Extension, 155 parents and caregivers have participated in the program and gained the skills to meet their parenting challenges.

One participant noted that she learned to manage the stress associated with parenting, which has enabled her to cope with parenting challenges. The participant noted that she is so changed by what she learned in *Parenting Matters* that she and other parents in the same class formed a parent support group that continued to meet beyond the eight sessions offered in the program.

Key Impacts:

- Helping to provide a safe and supportive quality of place for North Carolina's youth
- Enhancing child development to ensure that North Carolina children are able to succeed in life.

Example 5: Financial Management Tools

People spend a great deal of time working to earn an income, but research shows most Americans paying only limited attention to managing income, family budgets and financial planning for the future. In a research paper published by the National Bureau of Economic Research it is noted that:

Increasingly, individuals are in charge of their own financial security and are confronted with ever more complex financial instruments. However, there is evidence that many individuals are not well-equipped to make sound saving decisions. This paper demonstrates widespread financial illiteracy among the U.S. population, particularly among specific demographic groups. Those with low education, women, African-Americans, and Hispanics display particularly low levels of literacy. Financial literacy impacts financial decision-making. Failure to plan for retirement, lack of participation in the stock market, and poor borrowing behavior can all be linked to ignorance of basic financial concepts.⁵²

Low levels of "financial literacy" are an issue for many North Carolinians. In recognition of this, N.C. Cooperative Extension provides programs targeting several key aspects of personal finance that have a large impact on family incomes and budgets.

Extension at NC State has developed an on-line financial management portal, called *Money Matters*, where North Carolinians can access information and tools that will help them organize their finances. Information on the portal covers such topics as:

- Basic financial instruments, such as cash flow statements and personal income statements
- Consumer credit, including credit repair and student loan relief
- Home ownership, including information on mortgages, homeowner's insurance, and the purchasing process
- Protecting assets, including insurance and estate planning
- Investing.

⁵² Annamaria Lusardi. 2008. "Financial Literacy: An Essential Tool for Informed Consumer Choice?" NBER Working Paper No. 14084. Issued in June 2008.

NC A&T has also developed *H Plan*, a financial money management system that, when accompanied with the computer software PowerPay (a computer-based financial management tool), helps participants improve their finances and establish and meet their financial goals. The financial management system includes a worksheet for users to assess their monthly income and expenses. It is called H Plan because users are asked to evaluate:

- How much are you spending?
- How well are you managing?
- How do you move ahead?

The impact of the financial money management system has been sizeable. Through 2017, nearly 2,750 people have gained basic knowledge and skills in areas such as budgeting, record keeping, and goal setting; more than 2,500 people have gained knowledge and skills managing credit reports and scores; and over 1,500 people implemented strategic actions to support family economic well-being.

Key Impacts:

- Improved financial literacy for individuals and families across North Carolina
- Enhanced family incomes through improved budgeting and financial planning
- Improved family well-being and stress reduction associated with financial challenges.

Example 6: The North Carolina Master Gardeners Program

NC State Extension operates a volunteer-focused statewide “Master Gardener” program which is a powerful example of how a “train-the-trainers” approach can leverage volunteers to create a large-scale base of expertise to serve the needs of diverse communities. Extension professionals provide training, materials and support to Master Gardeners and these individuals pass on the information they learned during their training, as volunteers who advise and educate the public on gardening, horticulture and community gardening. Master Gardeners are effectively trained by Extension to provide science-based solutions to help people solve their gardening and landscape needs and challenges. The Master Gardeners program is large and extensive in its coverage, with 4,500 active volunteers in North Carolina and NC State training 500 Master gardeners each year.

Educational content and programming are diverse, ranging from gardening for pleasure and home landscape management and improvement through to home and community horticulture to grow fruits and vegetables. Master Gardeners are also reaching out to a diversity of populations doing programs for school children through to seniors and in a range of community settings. Special programs have been developed for therapeutic applications also (at nursing homes, hospitals and rehabilitation centers). As noted by NC State, Extension provides volunteers with a 40-hour training program, and the volunteer must then pass an examination, and complete at least a 40-hour internship. To remain active in the program volunteers must log a minimum of 20 hours of volunteer time and a minimum of 12 hours of continuing education each year. **The commitment made to serving North Carolina through this program is substantial, with Extension trained Master Gardener’s providing over 216,000 hours of service in 2017.** The effective value provided is large in scale. **Were the services provided by the volunteers have to instead be performed directly by Extension professional personnel, the equivalent personnel cost of these services (inclusive of salary and benefits) would be over \$8.7 million.**⁵³ Alternatively, if calculated at the minimum wage level for state employees, the value would be equivalent to \$3.24 million.

Key Impacts:

- Human capital and skills development

⁵³ Calculation is \$68,176,786.39 in total personnel costs / 842 FTE personnel = \$80,969 average annual cost per FTE. \$80,969 / 2000 working hours in a year = \$40.48 per hour. \$40.48 per hour multiplied by 216,000 service hours = \$8.7 million.

- Environmental and natural resource conservation and sustainability
- Resource use efficiency
- Enhanced quality-of-life and quality-of-place
- Enhanced family and personal budget management and food security.

4-H Impact on Educational Attainment and Future Earnings

By working to keep youth feeling positive about themselves and their abilities and instilling a desire to learn and improve, 4-H can lead to greater personal and societal economic success. Research has proven that there are increasing personal returns from educational attainment, with greater levels of education being rewarded with higher median earnings (and benefiting society through higher taxation receipts). Furthermore, research has shown that children involved in 4-H programs are five times more likely to graduate from college.

Therefore, even under the most conservative of estimates, it is reasonable to assume a portion of the 263,742 youth involved in 4-H in North Carolina in 2017 developed the personal abilities that would lead them to pursue advanced education opportunities. While certainly, some of these children would have pursued higher education even if they had not been involved in 4-H, with research showing that children involved in 4-H programs are five times more likely to graduate from college, it is reasonable to assume that at least 5 percent more of the North Carolina 4-Hers were encouraged by their 4-H educational experience to achieve a bachelor's degree, rather than ending their formal education after receiving their high school diploma, which would equate to 13,187 additional bachelor's degrees being granted. At a median earnings differential of an additional \$24,100⁵⁴ per year for the degree over and above a high school diploma, **this equates to increased annual earnings for this group of \$317.8 million, or more than \$12.7 billion in increased earnings over the course of their careers.**

The 4-H experience also may keep students from dropping out of high school. Again, if 5 percent of North Carolina 4-Hers stayed and received their high school diploma, rather than dropping out of high school, their annual personal earnings gain would be \$113.4 million, or more than \$4.5 billion in increased earnings over the course of their careers.

These increases in life-long earning potential not only impact personal incomes, but also the quality of life of North Carolinian families and the state's tax base.

⁵⁴ Anthony P. Carnevale, Stephen J. Rose and Ban Cheah. "The College Payoff: Education, Occupation, Lifetime Earnings." The Georgetown University Center on Education and the Workforce,

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 66 million reported binge drinking in 2015. Overall, 20.8 million Americans aged 12 and older had a substance use disorder that same year.⁵⁵ The National Institute on Alcohol Abuse and Alcoholism estimates that 10 percent of U.S. adults have a substance use disorder at some point in their lives.⁵⁶ Tragically, only 11.2 percent of Americans who need treatment for substance abuse in a specialty facility actually receive it.⁵⁷

The societal cost of substance abuse is staggering. The National Institute on Drug Abuse estimates that alcohol, tobacco, and illicit drug use costs the United States \$740 billion annually.⁵⁸ Roughly 70 percent of the cost of substance abuse is due to losses in productivity, with incarceration and health care costs comprising much of the rest.⁵⁹ With an estimated 20.8 million people suffering from substance abuse every year and annual societal costs of \$740 billion, 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.⁶⁰ Because most illicit drugs use begins during the teenage years⁶¹, 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, 4-H Youth Development programs 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 4-H Youth Development programs have lifelong positive impacts on participants' self-confidence and promote positive youth development beyond that of other extracurricular activities. Most importantly, 4-H Youth Development 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 North Carolina 4-Hers face the same lifetime chances of having a substance abuse disorder as the national population, then roughly 26,000 (10 percent) of the 263,742 participants are at-risk for substance abuse at some point in their lives. **If 4-H Youth Development programs can prevent even 3 percent⁶² of these 26,000 youths from developing a substance abuse problem later in life, these preventive efforts could save more than \$27 million for each year that those 780 individuals do not have a substance abuse disorder. This amounts to nearly \$550 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.**

⁵⁵ <https://addiction.surgeongeneral.gov/system/files/report-highlights.pdf>.

⁵⁶ <https://www.nih.gov/news-events/news-releases/10-percent-us-adults-have-drug-use-disorder-some-point-their-lives>.

⁵⁷ <https://www.drugabuse.gov/publications/drugfacts/treatment-statistics>.

⁵⁸ <https://www.drugabuse.gov/related-topics/trends-statistics>.

⁵⁹ <https://dmh.mo.gov/docs/ada/burdenofsaonmissouri.pdf>.

⁶⁰ <https://www.drugabuse.gov/publications/preventing-drug-abuse-among-children-adolescents-in-brief/chapter-1-risk-factors-protective-factors/when-how-does-drug-abuse-start-progress>.

⁶¹ <https://www.drugabuse.gov/publications/drugs-brains-behavior-science-addiction/preventing-drug-abuse-best-strategy>.

⁶² RAND estimates that school-based drug prevention programs can reduce lifetime use of drugs by as much as 3 percent (https://www.rand.org/content/dam/rand/pubs/testimonies/2005/RAND_CT237.pdf)

G. Health and Nutrition: Functional Impacts

1. Description

Access to nutrition information, ability to combat chronic illness, and ensuring food security are all persistent societal problems across the nation, and Extension is working on multiple fronts to combat the problem in North Carolina by helping to ensure that people have information regarding nutritious food for an active, healthy life. First, Extension develops and delivers programming related to chronic disease prevention and management. Through programs to help reduce personal chronic disease risk, including managing diabetes through lifestyle changes and preventing heart disease and other chronic illness through making healthier lifestyle choices, N.C. Cooperative Extension empowers people with the tools they need to reduce the incidence of preventable illness and better manage the chronic conditions they already have.

Extension programming also provides families the tools to purchase and prepare food on a limited budget and improves their access to healthy foods by increasing the availability of fresh foods through local food initiatives as well as helping ensure the foods are prepared safely within the home. These programs create an infrastructure that improves access to sufficient, healthy food for all North Carolinians. Extension works to create partnerships with local producers to make these programs available and effective, and also gets involved at the policy level to help to eliminate food deserts, a barrier to healthy food access in both rural and urban communities.

In addition to encouraging healthy food and physical activity decision making, Extension is also on the frontlines in working to prevent foodborne illnesses. Each year the CDC estimates that 48 million Americans get sick, 128,000 are hospitalized, and 3,000 individuals die from foodborne illnesses.⁶³ Much of the toll on human life, together with the estimated \$152 billion in associated healthcare costs and economic losses annually, can be avoided by consumers being taught safe food handling and preparation techniques, and through the training and certification of commercial and institutional food handlers in proper food safety procedures.

2. The Need:

Over the past century, many infectious diseases have been conquered, and the majority of the U.S. population can now anticipate a long and productive life. However, as infectious disease rates have dropped, the rates of chronic diet-related diseases have risen, due in part to changes in lifestyle behaviors. A history of poor eating and physical activity patterns have a cumulative effect and have contributed to significant nutrition- and physical activity-related health challenges that now face the U.S. population. About half of all American adults—117 million individuals—have one or more preventable chronic diseases, many of which are related to poor quality eating patterns and physical inactivity. These include cardiovascular disease, high blood pressure, type 2 diabetes, some cancers, and poor bone health. More than two-thirds of adults and nearly one-third of children and youth are overweight or obese.⁶⁴

These high rates of obesity and chronic disease have persisted for more than three decades and come not only with increased health risks, but also at high cost. For example, in 2008, the medical costs associated with all chronic diseases related to obesity were estimated to be \$147 billion.⁶⁵ By 2012, the total estimated cost of just

⁶³ See: <https://www.cdc.gov/foodborneburden/estimates-overview.html>

⁶⁴ U.S. Department of Health and Human Services and U.S. Department of Agriculture. 2015–2020 Dietary Guidelines for Americans. 8th Edition. December 2015. Available at <http://health.gov/dietaryguidelines/2015/guidelines/>.

⁶⁵ <https://www.cdc.gov/obesity/adult/causes.html>

one chronic disease related to obesity—diabetes—had risen to \$245 billion. By 2017, the total costs of diagnosed diabetes had risen more than \$80 billion to reach \$327 billion, a 26 percent increase over the five-year period. After adjusting for age group and sex, average medical expenditures among people with diagnosed diabetes were about 2.3 times higher than expenditures for people without diabetes.⁶⁶

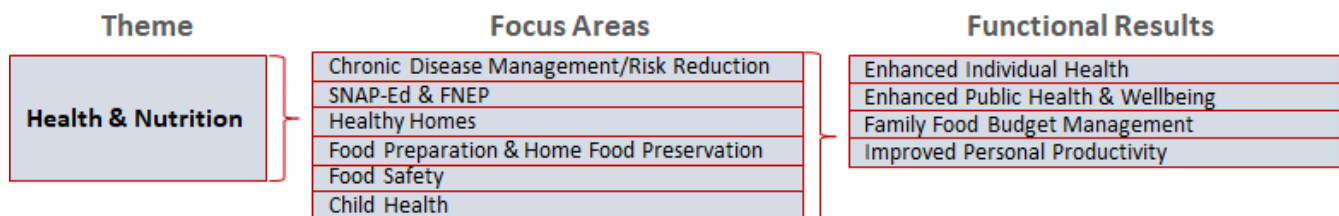
North Carolina has not fared any better than the nation in this troubling epidemic. North Carolina has the 20th highest adult obesity rate in the nation, with one-third of its adult population classified as obese, up from 20.9 percent in 2000 and from 12.3 percent in 1990.⁶⁷ This has led to devastating consequences—over 1 million North Carolinians have diabetes, 13 percent of the adult population. Total direct medical expenses for those diagnosed with diabetes in North Carolina was estimated at \$7.7 billion in 2017, and another \$2.9 billion was spent on indirect costs from loss of productivity due to diabetes.⁶⁸

Further compounding the problem of chronic disease is the rise of the number of citizens that are food insecure. Despite North Carolina having the tenth largest GDP in the nation, there are many thousands of North Carolinians who face daily challenges and unmet basic needs. U.S. Census data released in 2017 indicate that 14.7 percent of the population, or more than 1.5 million North Carolinians, live at or below the federal poverty level, including nearly 500,000 children.⁶⁹ The poverty rate for African Americans, Native Americans and Hispanic residents of North Carolina is more than double that for whites.⁷⁰ The North Carolina Justice Center reports that almost 630,000 North Carolina households don't have enough to eat, ranking North Carolina with the 8th highest rate of food insecurity in the nation.⁷¹

3. Themes, Impacts and Mechanisms of NC Extension Impact Generation in Health and Nutrition

In support of advancing the health and nutrition of all North Carolinians, NC State and NC A&T researchers and N.C. Cooperative Extension work together across several areas of focus—and these, in turn, engender a variety of positive functional benefits (impacts) for North Carolina and North Carolinians (Figure 12).

Figure 12: N.C. Cooperative Extension Functional Impact Themes in Health and Nutrition



Extension works to understand the key social and behavioral factors that impact health and nutrition, and to give children, youth, and adults the skills that lead to lifestyle choices that contribute to better health across their lifespan. It also works to identify the community and societal factors that facilitate or inhibit healthy nutrition and lifestyle choices, and address these through programs targeted at behavior influencers, through establishing infrastructure that will advance healthy living, and by working at the policy level to help bring about

⁶⁶ American Diabetes Association. "Economic Costs of Diabetes in the U.S. in 2017." March 22, 2018.

⁶⁷ Trust for America's Health and Robert Wood Johnson Foundation. *The State of Obesity 2018*. Washington, D.C.: 2018.

⁶⁸ American Diabetes Association. "Economic Costs of Diabetes in the U.S. in 2017." State Fact Sheets. See: <http://main.diabetes.org/dorg/assets/pdfs/advocacy/state-fact-sheets/NorthCarolina2018.pdf>

⁶⁹ <http://www.law.unc.edu/centers/poverty/numbers/northcarolina/>

⁷⁰ Ibid.

⁷¹ <https://www.ncjustice.org/sites/default/files/Fact%20Sheet%20-%20Hunger%20in%20the%20Tar%20Heel%20State.pdf>

broad changes to promote a healthier society. In this regard, Extension professionals work on major questions and issues such as:

- What are the underlying causes of unhealthy diet decisions?
- What tools and information do people need to help them make healthy nutrition decisions?
- How can children be encouraged to develop healthy eating and physical activity patterns that will persist across their lifespan?
- What do recipients of food assistance programs need in order for them to make wise food purchase decisions and stretch their food dollars?
- What actions should individuals take to avoid the development of preventable chronic diseases and the associated physical and cost burdens?
- How can public policy impact access to healthy food and improve food security?
- What techniques can consumers use to reduce the risk of foodborne illness?

Ultimately, the work of Extension in support of the health and nutrition of the citizens of North Carolina produces a series of desired functional benefits:

- Enhanced individual health of North Carolina citizens, thereby improving the quality of life and reducing healthcare costs for North Carolinians.
- Enhanced public health and wellbeing, thereby improving overall productivity and decreasing the costs of healthcare.
- Improved management of family food budgets, thereby enhancing personal and household incomes and decreasing food insecurity.
- Improved personal productivity, generating the opportunity to increase personal and household incomes leading to an improved quality of life.

Working across all 100 North Carolina counties and the Eastern Band of the Cherokee Indians, Extension's programmatic efforts to advance the health and nutrition of North Carolinians is influencing key social and behavioral factors resulting in improved quality of life and reduced healthcare costs for citizens across the state.

4. Functional Impact Examples for N.C. Cooperative Extension in Health and Nutrition

In the case of Extension work in Health and Nutrition several examples are illustrative of the high impact work taking place:

Program Area: Health and Nutrition

Example 1: SNAP-Ed, Steps to Health Program

The largest program through which Extension provides nutrition education is the Supplemental Nutrition Assistance Program Education (SNAP-Ed), which is funded by the federal government to help SNAP recipients make informed, healthy, food choices. SNAP-Ed, branded *Steps to Health* by NC State and *Try Healthy* by NC A&T, is a research-based nutrition education and obesity prevention program that is overseen by state agencies, and managed and delivered through implementing agencies at state and local levels. In North Carolina, Extension is a leading provider of nutrition and physical activity education for SNAP recipients and SNAP-eligible individuals.

The non-partisan Center on Budget and Policy Priorities (CBPP) notes that "SNAP is heavily focused on the poor. About 93 percent of SNAP benefits go to households with incomes below the poverty line, and 58 percent go to

households below half of the poverty line (about \$10,080 for a family of three in 2016). Families with the greatest need receive the largest benefits. These features make SNAP a powerful antipoverty tool.”⁷²

Both *Steps to Health* and *Try Healthy* educate and inspire limited resource North Carolinians to “eat smart and move more” through nutrition and food resource management education programs targeting elementary-aged children, adults, older adults, and families. It is well understood that no single intervention or program can affect the type of change in knowledge, attitudes, and behaviors needed to promote healthy lifestyle choices. Rather, Extension and its partners have developed a series of activity and action domains that address four areas of critical importance to SNAP-Ed—these include:

- Educating SNAP-Ed recipients on dietary quality and nutrition choices
- Teaching about effective shopping behavior and food resource management
- Addressing food access and food security issues
- Enhancing understanding of the need for physical activity and the avoidance of a sedentary lifestyle.

Beginning in 2007, *Steps to Health* has improved diets, nutrition-related behaviors, and physical activity levels of thousands of North Carolinians. During this time, ***Steps to Health* educators, in collaboration with N.C.**

Cooperative Extension, made 447,651 education contacts, reaching 59,517 participants within 94 of North Carolina’s 100 counties. In addition, *Try Healthy* educators served an additional 10,250 participants across 11 counties. Extension has evaluated results from pre- and post-education surveys of program participants indicate positive results being achieved. Data reported by Extension indicate that:

- 72 percent of elementary school children eat more fruits and vegetables
- 77 percent of children and youth are more active
- 49 percent of adults and older adults are more active
- 100 percent of Summer Meals site managers said Steps to Health increased participation and retention at their site, and
- 93 percent of food pantries and small retail stores made at least one change in their policies, systems, or environment.⁷³

Recently, *Steps to Health* created its first social marketing campaign in 10 counties in southeastern North Carolina. The 8-week campaign focused on the benefits of modeling healthy fruit and vegetable intake behaviors for mothers of young children through television, radio, digital media, billboards, gas pump toppers, posters, and promotional materials. Using online data tracking tools, the campaign reached a total of 902,382 low-income mothers an average of three times, for a total of 2,707,146 impressions. The social marketing campaign impacted this community. Based on telephone surveys, 70 low-income mothers remembered seeing or hearing about the campaign; 31 percent reported consuming more fruits; and 19 percent reported consuming more vegetables.

By focusing on educating participants on the value of nutrition and physical activity, both *Steps to Health* and *Try Healthy* help improve public health, thereby reducing the incidence of obesity, diabetes and other diet-related chronic health problems in North Carolina’s low-income populations, and reducing the economic burden created by health consequences arising from those diseases.

⁷² Reported in Simon Tripp, Ryan Helwig, Joseph Simkins, Martin Grueber, David Friedrich and Deborah Cummings. 2016. “SNAP-Ed FY2015: Supplemental Nutrition Assistance Program Education through the Land-Grant University System. A Retrospective Review of Land-Grant University SNAP-Ed Programs and Impacts.” Prepared by TEconomy Partners LLC for Cooperative Extension Service Directors/Administrators through the National Land-Grant University SNAP-Ed Assessment. April 2016. Available online at: <https://articles.extension.org/sites/default/files/FY2015%20SNAP%20Ed%20Report%20Final.pdf>.

⁷³ https://ncstepstohealth.ces.ncsu.edu/wp-content/uploads/2018/05/SNAP-Ed_StakeholdersRpt2017_3pager.pdf? fwd=no

Key Impacts:

- Improved use of SNAP benefits by recipients across North Carolina
- Healthier diet and physical activity behaviors among SNAP-recipients and SNAP-eligible individuals. Results in better health and ability to perform effectively at school and at work.
- Reduced costs for the state in terms of chronic healthcare costs associated with improper diet and lack of sufficient exercise. Numerous studies have been conducted on the return on investment of nutritional education programs, and they consistently show that for every \$1 invested, up to \$10 is saved in health care costs.

Example 2: Expanded Food and Nutrition Education Program (EFNEP)

The Expanded Food and Nutrition Education Program (EFNEP) is a federally funded nutrition education program that serves low-income youth and families with children to help improve their dietary intake and physical activity; increase food resource management skills; improve food safety and preparation skills; and reduce food insecurity. EFNEP serves limited-resource families with young children, school-age youth, and pregnant teens through a series of lessons offered by paraprofessionals and volunteers, many of whom are indigenous to the population. In 2017, EFNEP served 45 counties in North Carolina. Participants learned how to:

- Make wise food choices
- Increase daily physical activity
- Manage food resources
- Practice food safety

In 2017, 3,907 parents and 17,731 youth participated in EFNEP. Graduates of the program learned new skills to help them make changes to improve their overall health.

- 97 percent of program graduates improved their dietary intake
- 58 percent increased their daily physical activity
- 93 percent adopted practices that helped them better manage their food resources, and
- 77 percent improved their home food safety practices.⁷⁴

EFNEP addresses a wide variety of healthy food choices. For example, one major cause of excessive weight is drinking a lot of sweetened beverages. In an effort to address this problem, the Surry County Cooperative Extension's EFNEP partnered with the Surry County Health and Nutrition Center to deliver a series of nutrition education classes to parents of young children. One of the lessons in the series helped participants learn more about the sugar in the beverages they drink and strategies to reduce excess added sugars in theirs and their children's diets. Participants were encouraged to reduce sweetened drinks and to drink more water. One participant stated that after putting the new knowledge and skills into practice, she was able to lose 38 pounds in six months and feels that she has more energy to take care of her toddler. Additionally, when reviewing program evaluation data for all participants, 50 percent were shown to have decreased their consumption of added sugar in their diet. This behavior change will help participants and their families reduce the risk of chronic diseases associated with being overweight or obese.

⁷⁴ https://ncefnep.org/partners/reports2017/EFNEP_Report_2017.pdf

Key Impacts:

- Healthier diet and physical activity behaviors among participants. Results in better health and ability to perform effectively at school and at work.
- EFNEP families on average saved \$47 per participant per month in food costs.
- Reduced costs for the state in terms of chronic healthcare costs associated with improper diet and lack of sufficient exercise. Numerous studies have been conducted on the return on investment of nutritional education programs, and they consistently show that for every \$1 invested, up to \$10 is saved in health care costs.

Example 3: Faithful Families

Faithful Families Thriving Communities (Faithful Families), a program created and implemented by NC State Extension that has now expanded to twenty other states, works directly in communities of faith across the country to promote health for individuals, families, and local communities. The practice-tested program is open to all faith and religious traditions and engages faith communities in health education, environmental changes to support health, and community-wide health initiatives.

Faith-based organizations offer particular resources to help implement and sustain community-level changes that can have long-term impact, particularly in communities affected by health disparities or lacking access to crucial public health resources. Faithful Families promotes healthy eating and physical activity in communities of faith through a nine-lesson curriculum. Additionally, Faithful Families facilitators work with each faith community to help them adopt environmental supports for healthy eating and physical activity.

In 2017, Faithful Families led to 16 policy and environmental changes in faith communities across North Carolina. These include changes such as re-paving the parking lot to serve as a walking track, establishing policies to serve water at all events, establishing guidelines that all meals offered at the faith community must be healthy, establishing physical activity breaks for all meetings, opening up spaces for physical activity on faith community grounds for community usage (“shared use”), and establishing community gardens.

Of the participants in the program:

- 78 percent now practice better food resource management
- 93 percent improved dietary intake
- 49 percent have improved their daily level of physical activity, and
- 67 percent have improved their food safety practices.

Key Impacts:

- Leveraged community assets to enhance quality of life
- Enhanced individual health of North Carolina citizens
- Enhanced public health and wellbeing, thereby improving overall productivity and decreasing the costs of healthcare
- Improved management of family food budgets, thereby enhancing personal and household incomes and decreasing food insecurity.

Example 4: Speedway to Healthy

Created and managed by NC A&T, *Speedway to Healthy* is a 1,200-square-foot, walk-through, traveling exhibit representing the human body. This creative, educational exhibit teaches children in kindergarten through fifth (K-5)

grades how the foods they eat affect their bodies and their health. The Speedway, named to reflect the state's racing heritage, teaches children about their body through a series of pits stops focused on the brain, mouth, stomach, small intestine, heart, lungs, kidneys, bones, muscles, and skin. The custom-made exhibit was designed to help combat the alarming trends in childhood obesity in North Carolina. **Since the Speedway to Healthy program launched in 2014, more than 25,000 elementary students have toured the exhibit across 27 counties.**

Students are given a pre-test before starting the exhibit and post-test upon finishing it. The pre-test asks students to rate the number of days per week that they engage in a variety of healthy behaviors (i.e., eat vegetables, eat fruits, eat breakfast, make healthy choices, and exercise). The post-test then asks students how often they intend to engage in these healthy behaviors in the future. After going through the Speedway to Healthy exhibit, students indicated that they intended to eat vegetables more often and make healthy choices on most days. The results suggest that after children complete the Speedway to Healthy exhibit, there is an increase in their intention to engage in healthy behaviors.

Key Impacts:

- Reduced rates of childhood obesity, which in turn reduces adult obesity in the future as obese children are more likely to be obese adults
- Reduced costs of chronic illness linked to childhood obesity
- Enhanced public health and wellbeing, thereby improving overall productivity of children and improving their academic performance.

Example 5: Increasing Knowledge Related to Local Foods and its Relationship to Health and Wellness

Recognizing that the Local Foods movement has not only significant benefits to agricultural production but also significant benefits to the health and wellness of North Carolinians, NC State Extension has created programs over the last several years to increase the knowledge of citizens regarding how to prepare and cook local produce and other food ingredients safely. Programs that are focused on these efforts include the following.

Cooking Local Foods Made Simple: Cooking Local Foods Made Simple (CLFMS) is an intensive, three-part, 60-hour hands-on training series designed specifically for Family and Consumer Science Extension Agents to improve confidence and develop food preparation skills for nutrition and local foods programs. By increasing the capacity of FCS Agents to effectively teach healthy cooking skills, CLFMS allows them to better promote healthy eating and the adoption of healthy food behaviors within their communities. The CLFMS pilot series (2014–2015) trained 11 FCS Agents across North Carolina. A second cohort (2017–2018) trained 12 FCS Agents. Subsequent training series are expected to take place every other year.

Master Volunteer Food Program: While trained FCS Agents are critical, the number of agents can simply not meet the demand across the state for knowledge dissemination. As a result, the Master Volunteer Food Program was created and piloted in 2016. Mirroring the success of the Master Gardener Program, an intense series of trainings are provided to FCS volunteers in subjects related to food safety, cooking skills, food systems and local foods, diversity inclusion and equity. These Master Volunteers can then reach more citizens through cooking demonstrations, taste tests, and other training venues to help promote consumption of local foods and healthy eating habits.

Food Preservation Workshops: Workshops on canning, pickling, drying, freezing, and other preservation techniques are taught to help ensure that local produce is preserved safely to limit food-related illnesses and increase the level of individual home consumption of local foods. This is in addition to the food safety extension work that is ongoing to design, implement, and evaluate food safety strategies, messages, and media tools directed at consumers, including taking advantage of social media, with the goal of lessening foodborne illnesses.

Key Impacts:

- Enhanced human health through improved nutrition for individuals and families.
- Reduction in foodborne illnesses as cooking and preserving skills are improved.

The Functional Economic Impact of N.C. Cooperative Extension Work to Enhance the Health of North Carolinians

The work of Extension in assisting people with the management of chronic diseases, prevention of obesity and poor-nutrition related effects on health, helping to improve physical activity levels, and other related work reaches tens of thousands of participants across the state each year. Improving the health of North Carolinians has an obvious benefit for the quality of life of people across the state, but it also generates tangible savings in terms of reducing healthcare costs.

To illustrate the potential impact of healthcare improvement, TEconomy used input/output analysis to model the economic effect on North Carolina of a reduction in several diseases and health disorders associated with diet and exercise. The scenario modeled 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 [2014], 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 North Carolina (for diseases that are associated with poor diet and/or lack of exercise) would result in \$23.57 million in cost savings to the state.** This estimate results in the question of whether one-percent is high, low, or in the ballpark in terms of the potential impact of Extension health and nutrition programs targeting population and individual health benefits. Based on EFNEP and SNAP-Ed program contacts by Extension alone, a one-percent estimate for impacts is likely conservative. North Carolina has a 10.27 million population and an average household size of 2.48 (U.S. Bureau of the census data). In 2017, 3,907 parents and 17,731 youth participated in EFNEP Extension programs. For a combined total of parents and youth of 21,638. Dividing 21,638 by 10.27 million it is evident that 0.21 percent of North Carolinians are reached in the year with EFNEP programing. If it is assumed that the changed behavior of one member of the household also influences others, then use of the NC 2.48 average household size can be used to calculate the influenced population, which will be 0.52 percent of North Carolinians. As detailed herein, Extension's SNAP-Ed programing reaches many more people than EFNEP, and thus a 1 percent impact on health nutrition and health behaviors through this deep reach into the North Carolina population is likely a conservative figure.

H. Emergency Preparedness and Disaster Response: Functional Impacts

1. Description

Natural disasters are a part of life on Earth. A natural disaster may be defined as a major adverse event resulting from natural Earth system processes – with examples that may affect North Carolina including major storms and hurricanes, storm surges and watershed flooding events, geologic events (such as earthquakes, landslides, etc.), and wildfires. Biological events may also be sources of substantial threats – with infestations or disease epidemics possible via domestic or exotic insect pests and pathogens. In addition to natural disasters, there are

accidental manmade disasters that may occur (a train derails carrying toxic chemicals, a pipeline bursts, or there is a chemical plant explosion for example). And, an unfortunate modern reality is we must be prepared for deliberate acts of terror or sabotage.

Recognizing the reality of these threats, society must prepare (particularly public entities) – working to develop strategies and actions that prevent or mitigate damages, move people out of harm’s way, and promote rapid recovery in the event that disasters and emergencies do occur.

2. The Need:

The need to be prepared for disasters, and for efficient work to recover from them, is certainly very current in the minds of North Carolinians in the wake of 2018’s hurricanes and the resulting flood damage across the state. This year’s extreme weather events brought physical injuries and loss of human lives and resulted in uncounted millions in property and infrastructure damage. In rural North Carolina the storms flooded farms and resulted in the death of 3.4 million chickens and turkeys and 5,500 hogs.

With agriculture and forestry together comprising the leading industry for North Carolina, threats of disasters associated with fire, with disease or pest outbreaks, or deliberate or accidental food or farmland contamination events have the potential to substantially impact a large part of the North Carolina economy and the incomes of many thousands of North Carolinians.

3. Themes, Impacts and Mechanisms of NC Extension Impact Generation in Emergency Preparedness and Disaster Response

Extension is a key contributor to North Carolina’s preparedness in dealing with emergencies and disasters. As discussed previously in this report, Extension personnel are on the frontlines in preventing and combatting plant and livestock diseases, pests and invasive weeds. Extension is called upon to diagnose emerging threats in the North Carolina biosphere (in farms, forests, commercial, public and residential landscapes) and to provide informational resources and tangible advice to control identified problems and prevent a serious disease breakout or spread of an infestation. Extension is also a key resource for understanding how to address damage from flooding and how agricultural producers and North Carolina citizens can best recover from natural or other disasters. This was very much evident in the rapid response by N.C. Cooperative Extension to Hurricane Florence, where the Extension website was rapidly populated with best practice information regarding preparation, mitigation and recovery. Extension agents across the state were in the field, working with farmers and local communities as the hurricane unfolded to advise on property, crop and livestock protection and to assist in recovery efforts. Indeed, while national media highlighted the loss of livestock and poultry and the overflow of some waste confinement ponds on farms, the reality is that Extension recommendations, based on knowledge gained in previous sentinel events in the state, were actually extremely effective in assuring damages and losses were not far worse. Indeed, Newsweek reports that losses caused by Hurricane Florence were just one-quarter of those experienced when Hurricane Floyd hit in 1999. It is perhaps particularly telling that Extension agents were in the field during and after Hurricane Florence, helping farmers, while the agents’ own homes flooded.

Figure 13 highlights key focus areas of Extension in emergency preparedness and disaster response.

Figure 13: N.C. Cooperative Extension Functional Impact Themes in Emergency Preparedness and Disaster Response



4. Functional Impact Examples for N.C. Cooperative Extension in Emergency Preparedness and Disaster Response

The functional impacts of Extension in emergency preparedness and disaster response are well illustrated by Hurricane Florence. It serves as a case study illustrating much of Extension's work in this regard.

- Research-based solutions for prevention of future damage.** After Hurricane Floyd in 1999, NC State and other key partners and stakeholders undertook study of lessons learned for livestock operations from the effects of the storm. The result was a series of recommendations, provided through N.C. Cooperative Extension, for increasing the elevation of livestock and poultry confinement operations to mitigate flooding risk, and new recommendations for placement and construction of waste confinement ponds and associated facilities. The effectiveness is perhaps well illustrated by the fact that Hurricane Florence only caused the loss of 5,500 hogs out of the State's population of 9 million (just 0.06 percent).
- Research-based solutions to enhance recovery.** The losses and damage that did occur via Hurricane Florence were certainly significant. Extension has been providing advice to enhance recovery for those who have been negatively impacted. Examples include:
 - Providing input to livestock producers on appropriate disposal of deceased livestock.
 - Providing information to farmers whose fields were inundated regarding crop evaluation and soil analysis.
 - Assistance to homeowners with advisory materials on mold mitigation and proven methods for dealing with home flood damage.

NC State's advanced capabilities in atomic absorption and mass spec analysis are providing capabilities for detailed analysis of sites impacted by contaminated waters.

IV. Conclusion

The findings from the analysis laid out in this report clearly indicate that the programs and activities of N.C. Cooperative Extension have a robust stimulus effect the North Carolina economy. In terms of expenditure impacts alone, Extension generates \$205 million of economic output annually and supports more than 1,700 jobs for North Carolinians. However, these expenditure impacts are significantly eclipsed by the benefits that accrue to the state through the wide array of services provided through Extension's network of functional programs and initiatives.

While perhaps best known for its work to support production and associated rural development, Extension's work and influence is felt far more broadly across the state. N.C. Cooperative Extension's expansive mission to advance not only improvements in specific sectors of the economy but also to provide knowledge that enables better governance, the development of youth, improved health for North Carolinians, and a broad range of other activities are paramount to the underlying strength of North Carolina's economy and society. TEconomy terms the activities conducted by Extension and the results obtained "functional impacts". The core focus areas or "themes" under which NC Extension undertakes its work are found to be those highlighted in Figure 14.

Figure 14: Core Themes for NC Extension Programmatic Activities

NC Extension Programmatic Themes	Primary Agricultural & Forest Production	Comprising Extension's work on enhancing and sustaining North Carolina's commercial agriculture (row crops, horticultural crops, animal agriculture, etc.) and forestry production.
	Value-Added Processing of Food, Feed & Fiber	Comprising Extension's work to build, sustain and enhance the development of North Carolina's downstream value-added processing industries that use agricultural and forest inputs.
	Natural Resources & Environmental Stewardship	Helping assure resiliency and sustainability in land and natural resources assets that sustain North Carolina's economy, ecosystems and quality of life.
	Community & Economic Development	Working to provide knowledge and programs that assist both rural and urban communities in their ongoing community and economic development.
	Youth, Families & Homes	Bringing research-based, knowledge and programing to individuals and families that enhances educational and personal development outcomes, personal productivity, employability, financial security and quality-of-life.
	Health & Nutrition	Empowering individuals with the knowledge and skills to make informed decisions regarding their health, nutrition, food intake, and safe food preparation and preservation.
	Emergency Preparedness & Disaster Response	Comprising Extension's work to empower individuals, agencies and key decision makers with proven solutions to build resiliency in the face of natural disasters, mitigate negative impacts and speed post-disaster recovery.

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 every day in the lives of North Carolinians in all 100 counties in the state across both rural and urban settings.

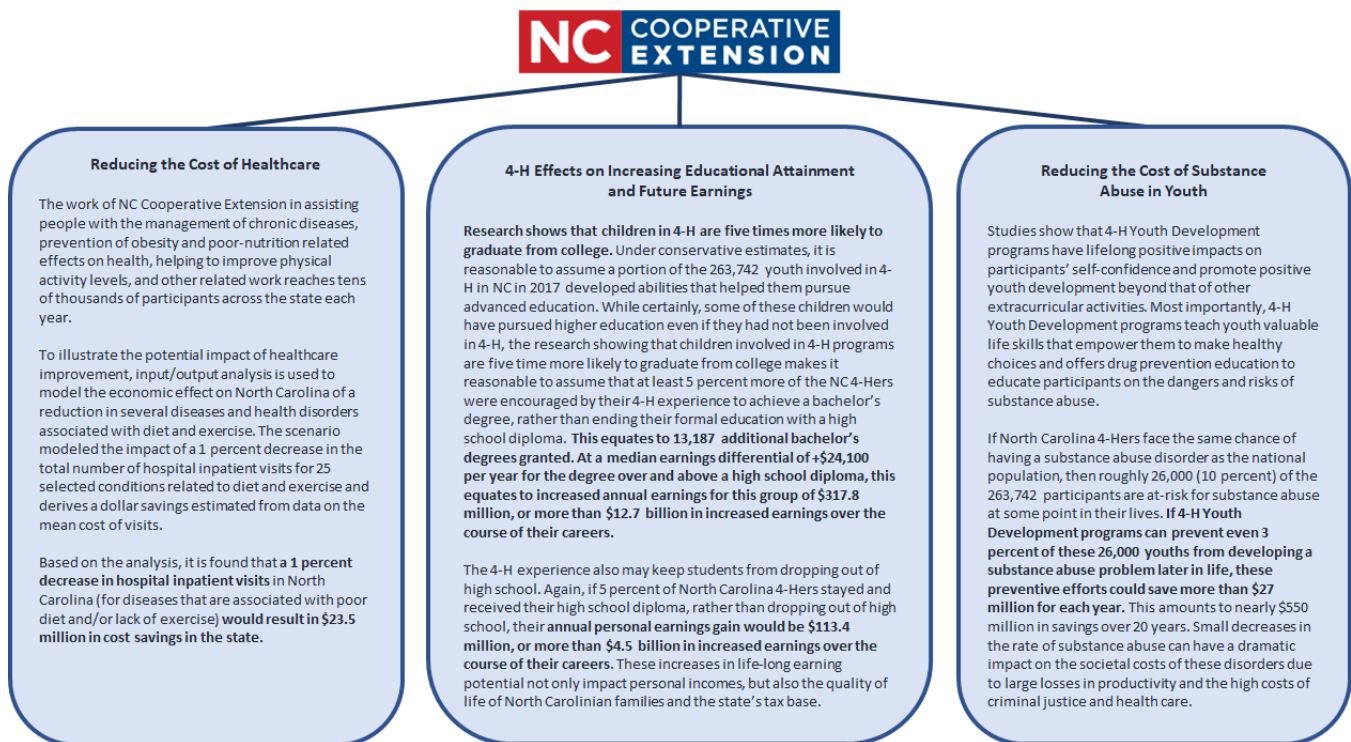
While it is impractical to determine the economic impact of every program and initiative of Extension (with many thousands of activities taking place), case studies to assess the impact of just a few of these initiatives

highlight many positive benefits for the North Carolina economy that run into the hundreds of millions of the dollars.

The impact of Extension's work in supporting enhanced agricultural and forest production in the state is estimated herein to approach \$1,526.9 million in terms of estimated increase in total North Carolina economic output, comprising direct, indirect, and induced impact components. Programs in support of youth, families, and enhanced health of North Carolinians are projected to exceed \$365 million annually (see Figure 15).

Source: TEconomy Partners, LLC

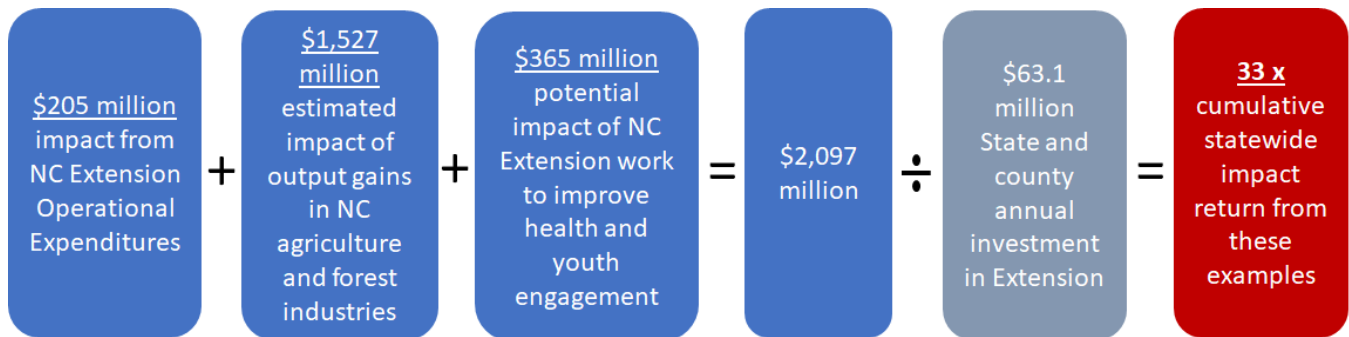
Figure 15: Case Studies in N.C. Cooperative Extension Impact – Examples of Healthcare and Youth Programs



Source: TEconomy Partners, LLC

The case studies and expenditure economic impact modeling demonstrate that the State of North Carolina and individual County investments in Extension Services see a high return in terms of economic impact across the economy return on their investment in terms of growth of the economy and public expenditure savings. Figure 16 illustrates this, showing the combined impacts from several Extension programs as well as the operational expenditures for Extension coming from state and county sources.

Figure 16: Statewide Economic Impact Return to State and County Investment Based on Selected N.C. Cooperative Extension Programs



Source: TEconomy Partners, LLC

The bottom line is that **N.C. Cooperative Extension is likely generating at least a 33:1 impact in terms of growth of the economy in return for State and County investments.** 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 Extension work makes possible. Positive functional impact benefits are experienced at every level from the full North Carolina economy down to individual family incomes and are experienced statewide across both rural and urban environments.

Into the future, the core role of Extension as an engine of knowledge, know-how, and best practice transfer, combined with its ability to relay research needs from the field to the universities' research enterprise, will remain exceptionally relevant to securing a successful, healthy, and productive North Carolina.



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