

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
College of Agriculture and Life Sciences
and the
North Carolina Department of
Agriculture & Consumer Services

December 2014

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January 1, 2015

Please find attached to this letter a report entitled *The North Carolina Food Processing and Manufacturing Initiative: An Economic Feasibility Study* in response to Section 13.1 of 2014 NC Legislation:

PLANT SCIENCES RESEARCH AND INNOVATION INITIATIVE – SECTION 13.1

- (a) *The funds appropriated by this act to the Department of Agriculture and Consumer Services for the Plant Sciences Research initiative shall be used by the Commissioner to develop jointly with the College of Agriculture and Life Sciences at North Carolina State University and other stakeholders a formal proposal and economic needs assessment for establishment of a public/private partnership between the University, other academic institutions, private companies in the agribusiness and bioscience sectors, the Department, and other State regulatory agencies for the following amounts and purposes: (i) the sum of three hundred fifty thousand dollars (\$350,000) for a partnership to be known as the "Plant Sciences Research and Innovation Initiative" and (ii) the sum of two hundred fifty thousand dollars (\$250,000) for a partnership to be known as the "Food Processing Initiative."*
- (b) *The Department and North Carolina State University shall jointly submit a copy of the proposal and report on the results of the economic needs assessment to the Chairs of the House of Representatives Appropriations Subcommittee on Natural and Economic Resources, the Chairs of the Senate Appropriations Committee on Natural and Economic Resources, the Agriculture and Forestry Awareness Study Commission, and the Fiscal Research Division by January 1, 2015.*

This report specifically addresses the economic feasibility study for section 13.1, part (a) (ii) related to "Food Processing/Manufacturing" and was completed in partnership with the NC Department of Agriculture and Consumer Services and the College of Agriculture and Life Sciences at North Carolina State University. The economic analysis, evaluations and recommendations provided in this report have been provided after extensive external stakeholder input and food/agricultural data for North Carolina, and beyond.

It is our hope that this report provides meaningful information for North Carolina to grow its number one industry – Agriculture – to even higher levels. Questions and suggestions related to this report can be directed to either one of us or to the project lead: Dr. Christopher R. Daubert, Department Head of Food, Bioprocessing, and Nutrition Sciences, NC State University College of Agriculture and Life Sciences at cdaubert@ncsu.edu or 919-515-2951

Sincerely,

Steven W. Troxler, Commissioner
North Carolina Department of Agriculture
and Consumer Services

Richard H. Linton, Ph.D., Dean
NC State University
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Abstract

North Carolina has a rich history processing its biomass resources into value-added products. However, over the last two decades, three of North Carolina's traditional industrial strengths – textiles, furniture, and tobacco – have experienced significant economic decline, calling into question North Carolina's long-standing dominance in value-added biomass processing and manufacturing.

The decline in the textile, furniture, and tobacco manufacturing industries has led to underutilization of capacity throughout the State of North Carolina, particularly within the rural regions. This decline then begs the question as to whether or not it is feasible to transition this underutilized capacity to strengthen and grow another industrial sector – namely the value-added food manufacturing sector.

The answer to this question is, unequivocally, yes. By fully leveraging the existing value-added biomass processing and manufacturing capacity of the state along with North Carolina's key innovation drivers, the economic decline can be reversed. This result can be achieved by developing programs and initiatives that leverage North Carolina's unique opportunities and help it to overcome the market barriers and hurdles that are currently impeding the industry's development.

As will be illustrated through this report's analysis, it is clear that North Carolina has a unique opportunity to leverage its agricultural resources, industrial capacity, and research innovation assets to catalyze the economic growth of an important value-added industry. It is proposed that a Food Processing and Manufacturing Initiative be developed that will serve to catalyze industrial development throughout the state of North Carolina; It should focus on four primary objectives:

- Capture added value from North Carolina's agricultural commodities through the development of innovative food products and processing technologies
- Foster the growth of food manufacturing entrepreneurial endeavors
- Proactively target site selection attraction opportunities within the food manufacturing supply chain
- Provide regulatory training and outreach to the food processing/manufacturing sector.

Funding in the amount of \$500K/year for a three-year period is recommended to plan and further develop the Food Processing and Manufacturing Initiative. Due to the strong food science partnership already in place between NCDA&CS and NC State, it is proposed that the two organizations collaborate to hire a project director and establish a guiding coalition to map a strategy that will achieve the recommendations proposed in this study. Key stakeholders to be part of the coalition should include food industry leaders, the North Carolina Department of Commerce, existing food-related entrepreneurial endeavors, research innovation assets located throughout NC at a variety of higher education and research institutions, and the workforce development and community college system. The project director would be charged with overseeing the coalition to 1) develop a strategic business plan to leverage and coordinate existing activities, 2) design new programmatic efforts and operations to implement the four primary recommendations, and 3) establish a statewide food manufacturing network. As part of the strategic business planning effort, additional sources of funding would need to be identified for eventual build-out

and programmatic implementation. This initial financial investment will unite the food processing entities of North Carolina and accelerate the economic benefit and job growth potential projected by this study.

By accomplishing the recommendations outlined in this study, North Carolina has the opportunity to catalyze food processing and manufacturing industrial development throughout the state. Battelle anticipates that by implementing the North Carolina Food Processing and Manufacturing Initiative, the total economic impact of the food value chain will be an increase of nearly 38,000 jobs and an increase in associated economic output of \$10.3 billion by 2020. This economic growth will help to change the economic trajectory of North Carolina's communities, creating employment opportunities and enhancing economic sustainability.

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Executive Summary

While North Carolina has a rich history in agricultural production and forestry, its economy, unlike many other agricultural states across the nation, has been significantly concentrated in converting or transforming its biomass resources into value-added products. However, North Carolina’s long-standing dominance in value-added biomass processing and manufacturing, which includes the textile, furniture, and tobacco industries, has been in a state of decline. The decline in these value-added biomass processing and manufacturing industries has led to underutilization of capacity throughout North Carolina, particularly within the rural regions of the state.

This state of decline begs the question as to whether or not it is feasible to transition this underutilized capacity to strengthen and grow another industrial sector – namely the value-added food manufacturing sector. This sector is depicted in Figure ES-1, and it represents strengths along the entire food-related “value chain” – the holistic set of value-adding industry activities from research and development of new products and ingredients and other inputs, on through food processing and manufacturing, into packaging, and through a high-functioning distribution network onto store shelves and home cupboards.



Figure ES-1. The Food Processing and Manufacturing Value Chain.

The objective of this study is to determine whether or not a food processing and manufacturing initiative intended to catalyze the development of value-added food processing and manufacturing businesses statewide is in fact feasible based on the agricultural resources, industrial capacity, and research innovation assets present in North Carolina today.

Industrial Analysis Findings

It is important to note that while the food manufacturing industrial sector is already present throughout the state, the level of industrial concentration is not as high as one might expect based on the state's agrarian history, long-standing capacity in other value-added biomass processing industries, and access to major population centers. Key findings from the industrial analysis include:

- North Carolina's food "value chain" is large with a few key strengths. The state sector, however, has shed jobs in recent years, particularly among its largest components.
- The sector is truly statewide, with distinct regional specializations that stand out, though the recent performance among North Carolina regions varies.
- North Carolina is competing nationally and globally as a leader in animal processing and packaging, two highly specialized state subsectors; Additionally, the state is emerging in a number of other high-value food-related sectors including beverages, nuts and snacks, and animal feed.
- North Carolina has visible gaps in its food value chain that could limit the growth potential for existing and emerging companies, or for companies interested in locating in the state, namely its significant under-concentration in key wholesale and distribution areas in agricultural products and food-related warehousing and storage.
- In discussions and interviews with North Carolina food processors and other stakeholders, there is a consistent concern raised regarding a gap in the presence and availability of "intermediate" food processors.
- North Carolina's food value chain is outperforming the U.S. sector at large in the productivity of its workforce as measured by value added per worker. This signals the competitive nature of state companies within the industry and when combined with generally lower labor costs/wages makes North Carolina attractive to companies interested in locating here.
- Industry innovation in North Carolina's food sector indicates limited innovation activity in the form of patents, with some patenting in packaging and meat processing technologies.

To advance the food manufacturing industrial sector in North Carolina, it is critical to further public-private partnerships that align innovation drivers with new product development opportunities within both large and small firms. In this way, North Carolina food processing and manufacturing firms will be better able to take advantage of growing and emerging global market opportunities.

Catalyzing the Growth of Value-Added Food Manufacturing in North Carolina

To understand factors that are hindering the value-added food manufacturing sector's development in North Carolina, it is important to analyze the specific barriers to development currently existing within the state's food-related business model/value supply chain, as well as the identification of opportunities that could catalyze growth. To this end, the Battelle TPP project team examined a series of data sources and conducted over 100 qualitative interviews in order to identify areas for development and growth.

As a result of the analysis, four drivers were identified as critical to the continued development of North Carolina's value-added food manufacturing sector and are discussed below.

Capturing added value from North Carolina’s agricultural commodities through the development of innovative food products and processes.

Worldwide agricultural commodity markets are highly competitive and price-driven. As a result, even though national agricultural productivity continues to increase, the real value of that production at “the farm gate” continues to decline. The future of agricultural and rural sustainability in North Carolina will very much depend on the ability to construct “value-added” chains of production that vertically integrate the food-related business model/value supply chain. The basic value-added concept is shown in Figure ES-2 and illustrates the substantial difference in potential income between simply growing and selling any agricultural commodity (the farmer row) and the total income that may be realized in a state that provides a vertically integrated value-added chain. In this example, by growing the berry, performing the raw agricultural processing step, further processing the berry product to obtain chemicals and compounds of nutraceutical value, and then retailing them, additional economic value is realized. An integrated value chain captures a far higher percent of the final dollar figure spent on the product for the state.

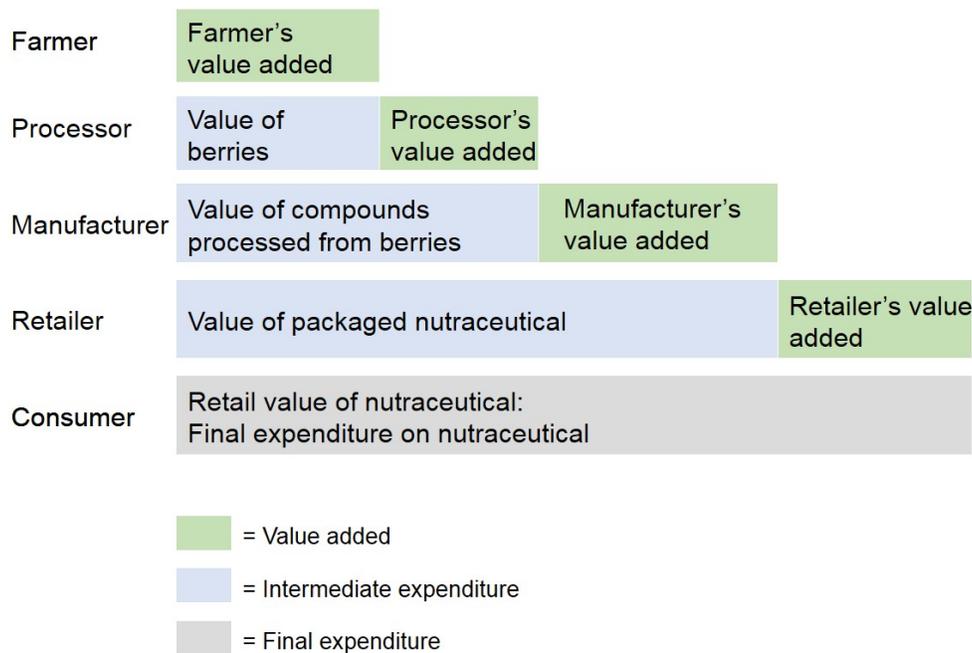


Figure ES-2. The Value-Added Concept—Berries to Nutraceuticals Illustrative Example.

Innovation in commodity processing and food manufacturing involves new product invention, development, product quality improvements, efficiency improvements, and food safety. Based on the innovation drivers found within North Carolina – food product innovation, packaging technologies, flavors, extraction and sensory technologies, food safety technologies, and functional foods – coupled with the commodities found within North Carolina and how they are currently being utilized as value-added products, North Carolina is uniquely positioned to add value to its agricultural commodities thereby driving economic growth.

Fostering the growth of food manufacturing entrepreneurial endeavors.

Entrepreneurial activity is closely tied to a state's or region's level of economic growth. However, catalyzing entrepreneurial activity is a challenge for many states. It is often stated that entrepreneurship is a "contact sport," and the barriers and obstacles to being able to scale a firm is significant, particularly for food processing and manufacturing firms. The three areas that entrepreneurs indicate are their greatest obstacles are talent, capital, and sales. Within North Carolina, a number of initiatives to support food-related entrepreneurial endeavors exist, including:

- NC State's Entrepreneurial Initiative for Food (ei4F) program, which works with small business owners and prospective entrepreneurs to manufacture and process quality food products safely.
- North Carolina's Department of Agriculture and Consumer Services (NCDA&CS), which provides North Carolina food-related entrepreneurial endeavors both agribusiness development services and initiatives such as "Goodness Grows in North Carolina," "Got to Be NC" campaign, the NC Specialty Foods Association, and the state's farmers markets.
- A number of regional shared-use commercial kitchens and/or food incubators, such as the Blue Ridge Food Ventures and the Piedmont Food and Agricultural Processing Center, in addition to several private sector co-packers who will conduct smaller batch runs for entrepreneurs.
- While not food processing/manufacturing specific, North Carolina also has developed more generalized entrepreneurial/small business development programs to aid in the growth of small businesses, including:
 - N.C. Community College System's small business centers;
 - NC State's Industrial Extension Service (IES) that focuses on assistance to manufacturers in production process, cost improvements, and diversification;
 - Small Business and Technology Development Centers (SBTDC) that focuses on the full range of business sectors with respect to strategy, budgeting, marketing, operational processes, and related issues; and,
 - Military Business Assistance Center (MBAC) that focuses on companies interested in military contracting.

However, even with these resources, interviews with entrepreneurs suggest that it can be difficult to access entrepreneurial support services tailored to the unique food processing and manufacturing industry sector. And even when the various programs are accessed, they are often disconnected from one another, making it difficult and confusing to the entrepreneur who is seeking assistance. The bottom line is that finding different and unique ways to support entrepreneurs and the growth of entrepreneurial food processing and manufacturing companies is an important component in North Carolina's efforts to develop the industrial base.

Proactively targeting site selection attraction opportunities within the food manufacturing supply chain.

The increased number of mergers and acquisitions that have occurred in the food processing and manufacturing industry in the recent past is creating a doubled-edged sword environment for economic development organizations. The first edge of the sword has been a trend for several years for food processors to regionalize production rather than have a centralized facility. This developed as a result of steadily increasing transportation costs and quality concerns. Therefore, food processors are moving closer to population centers and toward the points of consumption. This will only be accelerated by the consolidation of brands under a single corporate entity. The other edge of that sword is the

consolidations, and possible subsequent job losses, due to these acquisition and improvements in food processing technology.

The business environment makes efforts to attract industries complicated for some states. While the site selection determinants for the food processing/manufacturing industry are driven by concerns regarding food safety, cost control, and access to a qualified labor pool, there are additional factors that didn't exist in the food processing industry 20 years ago, such as skyrocketing fuel costs, concerns among consumers over dietary health and food safety, adequate water availability in many locations, ever-growing and restrictive environmental regulations, energy costs, and sustainability, which are now factoring in predominately in site selection determinations. The issue is that very few economic developers understand the complexity of the industry's business model.

North Carolina is in the unique position, due to both the environmental situation facing California as well as the consolidation of the food processing/manufacturing industry around the nation, to proactively leverage its unique biomass value-added production capabilities, including access to agricultural commodities, water, a trained workforce, and proximity to large population centers, to proactively pursue attraction opportunities. North Carolina's state government has proven through the years its ability to target key clusters in the pursuit of economic growth and diversification of its economy. This focus now needs to be applied to the attraction of key components of the food-related, value-added supply chain.

Providing regulatory training and outreach to the food processing/manufacturing sector.

In 2011, the Food Safety Modernization Act (FSMA) was signed into law and heralded as the most significant reform to U.S. food safety standards in over 70 years. In interviews with small- and medium-size food processors and manufacturers, significant concern was expressed regarding their ability to understand and then comply with the vast regulations of the industry. The implementation of FSMA is only continuing to put a strain on the time, resources, and knowledge required to ensure that a company remains compliant with both the federal and state regulations. In particular, due to the roll-out nature of FSMA, companies, as well as inspectors, are finding it difficult to stay abreast of changes that are being implemented.

North Carolina, led by the efforts of NC State, is already well-regarded for its regulatory training and outreach to both industry as well as state and federal inspectors, and therefore is in a unique position to create a competitive advantage for its industrial base by providing regulatory training and outreach to the food processing and manufacturing sector, thereby proactively helping to improve the business climate.

A Call to action

In answer to the question that was posed at the outset of this endeavor – is it feasible to foster the economic development of a value-added food manufacturing industrial sector in the state of North Carolina – the answer is, unequivocally, yes. By fully leveraging the existing agricultural resources and industrial capacity of the state, found particularly in the rural regions, along with North Carolina's key research innovation drivers, the recent economic decline experienced by the industry sector can be reversed by developing programs and initiatives that leverage North Carolina's unique opportunities and help it to overcome the market barriers and hurdles that are currently impeding the industry's development.

It is proposed that a Food Processing and Manufacturing Initiative be developed that will serve to catalyze industrial development throughout the state of North Carolina and be composed of four primary initiatives:

- **Capturing added value from North Carolina’s agricultural commodities through the development of a Food Product & Process Innovation Center** that would serve as a statewide resource to increase the breadth, depth, and expertise in product and process development. It is envisioned that the Food Product & Process Innovation Center would be comprised of food labs, GMP pilot plant facilities, intermediary food processing facilities, and demonstration facilities built around the specialized knowledge and expertise in North Carolina’s five innovation drivers: food product and process innovation, packaging, functional foods, flavors, extracts and sensory technologies, and food security. In addition to working with a range of companies encompassing every stage in the business life cycle, the Food Product & Process Innovation Center would also be charged with working with the various state commodity groups to ascertain which commodities would be best served by developing a value-added research and application program. It is envisioned that the Food Product & Process Innovation Center would be located on NC State’s Centennial Campus, serving from a central location the needs of the food processing and manufacturing industry across the state.
- **Fostering the growth of food processing and manufacturing entrepreneurial endeavors through the development of a Value-Added Food Entrepreneurship Network**, a seamless entrepreneurial services delivery system that provides all of the services required by an entrepreneur to ideate, develop, create, and scale their food processing and/or food manufacturing business. To this end, it is envisioned that three nodes would be developed initially, one in each region of the state. All three nodes would provide a full range of business assistance and market development expertise. The three nodes would also develop intermediary processing capability that could be utilized by start-up companies from throughout their region and tailored to the specific agricultural commodities with the greatest demand for further processing/manufacturing. In addition, start-up companies would also be able to gain access to more technical expertise located at the Food Product & Process Innovation Center. Based on the existing analysis, it is recommended that Blue Ridge Ventures, located in Asheville, would be a strong partner as the Mountain Region’s value-added food entrepreneurship node, and if selected, would also bring intermediary processing capacity to the network. It is further recommended that the Piedmont Region’s value-added food entrepreneurship node be co-located at the Food Product & Process Innovation Center in order to leverage the research, innovation assets, pilot plants, and intermediary processing capacity that will be developed at that facility. Finally, it is recommended that a value-added food entrepreneurship node be located within the Coastal Plains region, possibly leveraging the efforts of Ayden to develop a food manufacturing entrepreneurship center.
- **A proactive industrial recruitment campaign**, leveraging North Carolina’s unique biomass value-added production capabilities, including access to agricultural commodities, water, a trained workforce, and proximity to large population centers, to pursue food manufacturing attraction opportunities. The North Carolina Department of Commerce, in close partnership with the NCDA&CS, should either develop or recruit staff with food processing/manufacturing business model expertise and then proactively target potential candidates for relocation marketing efforts. In addition, the state’s economic development toolkit will need to be examined to ensure that the current offerings are relevant to this industry sector and are on par with other states’ incentive programs.
- **Providing regulatory training and outreach to the food processing and manufacturing sector.** North Carolina, led by the efforts of NC State, is already well regarded for its regulatory training and outreach to both industry as well as state and federal inspectors. North Carolina has the opportunity to further set itself apart from other states by proactively developing additional in-depth training, education, and outreach efforts relevant to the food processing and manufacturing sector and relevant inspectors, particularly as it relates to the ongoing roll-out of

FSMA. By helping to ensure that the small and medium size food processors and manufacturers in the state, as well as those that are tasked with undertaking the inspections, have access to the knowledge required in an educational format that is tailored to their specific situation, North Carolina has the opportunity to create a competitive advantage for its industrial base by proactively helping to improve the business climate.

Funding in the amount of \$500K/year for a three-year period is recommended to plan and further develop the Food Processing and Manufacturing Initiative. Due to the strong food science partnership already in place with NCDA&CS and NC State, it is proposed that the two organizations collaborate to hire a project director and establish a guiding coalition to map a strategy that will achieve the recommendations proposed in this study. Key stakeholders to be part of the coalition should include food industry leaders, the North Carolina Department of Commerce, existing food-related entrepreneurial endeavors, research innovation assets located throughout North Carolina at a variety of higher education and research institutions, and the workforce development and community college system. The project director would be charged with overseeing the coalition to 1) develop a strategic business plan to leverage and coordinate existing activities, 2) design new programmatic efforts and operations to implement the four primary recommendations, and 3) establish a statewide food manufacturing network. As part of the strategic business planning effort, additional sources of funding would need to be identified for eventual build-out and programmatic implementation. This initial financial investment will unite the food processing entities of North Carolina and accelerate the economic benefit and job growth potential projected by this study.

The value of catalyzing the growth of the food processing and manufacturing industrial sector is that it will spur growth and competitive advantage within the state. Economic gains that are predicted if a robust, proactive action plan for fostering the food-related value chain is implemented include:

- Rising productivity of companies in the value chain, creating a competitive advantage for the state
- Accelerated pace of innovation resulting in new products and processes
- More frequent start-up of new, high-growth-potential businesses
- Stronger supplier networks, increasing the economic multiplier impact of the value-chain for the state
- Larger pools of specialized workers and education and training programs geared to the particular industrial needs, introducing significant cost savings for firms and increasing the breadth and depth of employment opportunities for workers in the supply chain.

By implementing the initiatives outlined in this study, North Carolina has the opportunity to catalyze food processing and manufacturing industrial development across the state. Battelle anticipates that if the recommendations prescribed in this report are implemented, by the year 2020 the annual economic impact of North Carolina's food manufacturing industry could be:

- **\$80.2 billion in total North Carolina economic output (business volume)**, comprising \$47.6 billion in direct economic output and \$32.6 billion in indirect and induced output.
- **290,553 jobs in North Carolina**, comprising 103,768 direct jobs and an additional 186,785 jobs generated in the North Carolina economy via the employment multiplier effect.
- Direct and indirect employment generating **personal**

Projected Impact

Battelle anticipates that the total direct and indirect impact of the food value chain, with the prescribed steps of this study implemented, will be an increase of nearly 38,000 jobs and an increase in associated economic output of \$10.3 billion by 2020.

income for North Carolina residents amounting to \$15.4 billion annually. This is divided between direct income at \$6.2 billion and indirect and induced income at \$9.2 billion.

In summary, as illustrated in Table ES-1, the benefits of developing a robust food value chain within North Carolina are significant.

Table ES-1. Benefits of a Robust Food Value Chain in North Carolina

Expansion of Economic Output and Economic Growth	Employment and Personal Income
<p>Substantial economic activity is generated throughout the food value chain. Companies supplying inputs to manufacturing generate significant revenues, as do the direct agricultural commodity and livestock sectors and all the business sectors that provide inputs to agricultural production. The direct expenditures of each value-chain element in turn generate indirect output as suppliers also receive revenues and make expenditures in North Carolina.</p>	<p>Each component of the food value chain provides jobs and income for North Carolina employees and business owners. The wages and benefits generated by this value chain provide support for families in every county in North Carolina. Via the multiplier effect, the spending of income in North Carolina via the food value chain employees generates income for a broad range of other businesses and individuals in the state.</p>
Local and State Government Revenues	Economic Diversification
<p>Business taxes paid up and down the food value chain, together with personal income and property taxes paid by those employed directly or indirectly via the value chain, provide significant sources of revenue for state and local governments in North Carolina. Again, the broad geographic spread of the food value chain across North Carolina assures that all North Carolina counties, and the vast majority of individual municipalities and school districts, receive revenues directly and indirectly generated by the food value chain.</p>	<p>The food value chain, with its varied inputs and outputs, creates a broad spread of economic activity across the state. The sector provides a secure economic base for the state – one unlikely to sustain a significant impact from one structural shift. Furthermore, modern agricultural science and the biosciences are generating new products and innovations that will create new business opportunities for North Carolina, expanding the base of business and further diversifying the state’s economy.</p>
Enhanced State and Community Sustainability	Reduced Social Costs
<p>The long-term growth and sustainability of North Carolina is, in part, secured by the impacts described above. The food value chain forms part of an integrated economic system that supports business revenues, business growth, personal wages and benefits, government revenues, health, and social welfare. This activity is woven into the overall fabric of state, county, and community economies contributing support for overall economic and social sustainability.</p>	<p>Without the food value chain, North Carolina would experience substantial economic dislocation and associated social costs. The geographic diversity of the sector provides family economic support across the state, into North Carolina’s major cities and its smallest rural communities. Without the economic activity generated by the sector, North Carolina would experience substantial costs in social support programs, unemployment compensation, and human-capital retraining expenses.</p>

List of Acronyms and Abbreviations

ARS	USDA Agricultural Research Service
AUFSI	Auburn University Food Systems Institute
BLS	U.S. Bureau of Labor Statistics
C2ER	Council for Community and Economic Research
CAGR	cumulative annual growth rate
CALS	College of Agriculture & Life Sciences
CAPPS	Center for Advanced Processing and Packaging Studies
CAS	College of Agricultural Sciences
CASIC	Center for Advanced Science, Innovation and Commerce
CMAST	Center of Marine Sciences and Technology
CNR	Michigan State University College of Agriculture and Natural Resources
EDA	U.S. Economic Development Administration
Ei4F	Entrepreneurial Initiative for Food
FBNS	Food, Bioprocessing, & Nutrition Sciences
FDA	U.S. Food and Drug Administration
FPC	Food Processing Center
FSMA	Food Safety Modernization Act
GREEN	Generating Research and Extension to meet Economic and Environmental Needs
I/O	input/output
IANR	Institute of Agriculture and Natural Resources
IES	Industrial Extension Service
MBAC	Military Business Assistance Center
MEP	Manufacturing Extension Partnership
MSU	Michigan State University
MSUE	Michigan State University Extension
M-TAC	Manufacturing Technology Acceleration Center
NAICS	North American Industry Classification System
NC LEAD	North Carolina Department of Commerce's Labor and Economic Analysis Division
NC State	NC State University
NC	North Carolina
NCDA&CS	N.C. Department of Agriculture and Consumer Services
NIC	Nebraska Innovation Campus
NIST	National Institute of Standards and Technology
NSF	National Science Foundation

Acronyms and Abbreviations

OSU	Oregon State University
QCEW	Quarterly Census of Employment & Wages
SBA	U.S. Small Business Administration
SBIR	Small Business Innovative Research
SBTDC	Small Business and Technology Development Center
SDFRC	Southeast Dairy Foods Research Center
SOP	standard operating procedure
PHHI	Plants for Human Health Institute
TPP	Technology Partnership Practice
UNDESA	United Nations Department of Economic and Social Affairs
USDA	U.S. Department of Agriculture
WHO	World Health Organization