





PENNSYLVANIA AGRICULTURE

A LOOK AT THE ECONOMIC IMPACT AND FUTURE TRENDS

MAY 2018

TEAM PENNSYLVANIA

pennsylvania
DEPARTMENT OF AGRICULTURE

A REPORT BY

ECONSULT SOLUTIONS
economics | policy | strategy

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Agriculture has played an important role in our culture and our economy since the earliest days of our commonwealth. At one point over half our residents lived on farms, but today, fewer than two percent of our state's population are engaged in production agriculture. Those two percent are incredibly productive thanks to hard work, science and innovation, and increasingly advanced technology.

Indeed, Pennsylvania in many respects is a national leader in food and agriculture, and it is in the commonwealth's interests to ensure the industry remains a vibrant part of the state's economy. It is with this goal in mind that we began a process over a year ago to take a fresh look at how we can best build on our collective strengths and plan for a strong future for Pennsylvania agriculture.

The following report is the result of a public-private partnership that has brought together agricultural business leaders from throughout the commonwealth. Following the collaborative philosophy of Team Pennsylvania, we believe Pennsylvania can maximize its world-class resources by injecting private sector thought and vision into the valuable public-sector work of the Pennsylvania Department of Agriculture. To launch this partnership, leaders of the state's agriculture and food industries—from crop and animal production to food and beverage manufacturers, foresters, landscapers and horticulturalists--from throughout the Commonwealth came together to form an Agricultural Advisory Board. Over the past year, members have worked to develop a shared vision and strategic priorities for Pennsylvania's agriculture sector.

As a first step, we commissioned the following in-depth analysis and study of Pennsylvania's agricultural economic impact, as well as recent trends influencing the industry's direction. The pages that follow take that information to further define recommendations that will inform our future economic development efforts.

We are excited to unveil our hard work and fully recognize that this is just the beginning. We have the data. We have sound recommendations. Now, we need your engagement.

By working together, we will advance Pennsylvania's agriculture sector and increase the commonwealth's competitiveness in regional, national and global marketplaces—ensuring this industry remains a vibrant part of our state for generations to come.

Thank you.

Sincerely,

Russell C. Redding
Secretary
Pennsylvania Department of Agriculture

Ryan C. Unger
President and CEO
Team Pennsylvania

Executive Summary



EXECUTIVE SUMMARY

The agriculture industry is a major employer and contributor to the Commonwealth's economy. Agriculture generates employment and economic activity on more than 58,000 farms and in every county in the Commonwealth. On-farm agriculture production creates opportunities for a broad agriculture support service industry, and it underpins a large food processing industry – including bakeries, confectioners, dairy and meat processors, and snack food manufacturers, among others located throughout the state. Pennsylvania's equine industry includes some of the top breeding farms nationwide and contributes to a strong racehorse industry. The state's forest products sector is grounded in hardwoods production, where Pennsylvania ranks first in export-grade hardwood. The state has a growing beverage industry and now ranks first in craft beer production, seventh in wine product, and has expanding cider industry. In addition, the state has long been a leader in fluid milk production. The state's landscapers and horticulturalists provide important services to homeowners and businesses, delivering aesthetic appeal, as well as valuable conservation and environmental benefits.

Pennsylvania's diverse and innovative agricultural industry has made the Commonwealth a national leader. In addition to leading the country in export grade hardwoods and mushroom production, Pennsylvania ranks among the top five states for poultry layers, milk from cows, Christmas trees, and the nursery, greenhouse, floriculture, and sod sectors. Between 2002 and 2012, several sectors experienced rapid growth, well above national averages, including broiler chickens, corn for grain bushels, and soybean production. Pennsylvania also leads the nation in food-processing companies, with more than 2,300 operating across the state. The strength of the food-processing sector supports Pennsylvania's leading-state status in the value of shipments of canned fruit and vegetable specialty products, chocolate and cocoa products, potato chips, and pretzels.

Shifting consumer demand for organic products has driven a rise in organic agriculture in Pennsylvania. As the organic segment of Pennsylvania agriculture has rapidly expanded, the Commonwealth has become a national leader in organic food production. Since 2008, Pennsylvania has risen from third to second nationally in organic farm sales, and from sixth to fourth in the number of organic farms.[1]



[1] USDA, "Certified Organic Survey: 2016 Summary," www.usda.mannlib.cornell.edu. Organic Trade Association, "Percentage of U.S. Households Purchasing Organic Products," www.ota.com

Defining Agriculture

The definition of agriculture used in this report was determined through conversations with the Pennsylvania Department of Agriculture (PDA) and agricultural industry leaders. The report's definition and analysis represent the first comprehensive look at the state's agriculture industry, with the landscaping, forestry and hardwoods, equine, and food manufacturing sectors included.

1. **Crop and Animal Production**: includes grain, vegetable, fruit, mushroom, nut, tobacco, custom crop harvesting, and all other crop production industries in addition to beef, poultry, dairy, egg, and all other animal production industries. All other animal production includes the production of farm, pleasure, work, and race horses. Crop production includes nursery and tree production, including Christmas tree production, and turf production. Also included are all support activities for agriculture and forestry, based on NAICS code classifications that include forestry support services as agriculture support services. Agricultural support services include farm management, machine crop harvesting, milk testing, stud and breeding services, pedigree record services, and support services for the equine industry: breeding, boarding, training, and horseshoeing. Forestry support services include forest thinning, forest pest control services, and forest management plans preparation.

2. **Food and Beverage Processing and Manufacturing:** includes all industries related to the processing of crops and animals, including pork, poultry, beef slaughtering and processing, dairy product manufacturing, fruit and vegetable preserving, oils, chocolate, cereals, and juices, and food manufacturing, such as bread, nut butter, pasta, syrup, and other snack food manufacturing in addition to coffee, tea, beer, soft drink, and wine manufacturing.

3. **Forestry**: includes all industries related to the production and processing of forest products and commercial logging, including timber tract production sawmills, veneer and plywood manufacturing, pulp and paper mills, and wood furniture and cabinet manufacturing.

4. **Landscaping**: includes the landscape and horticultural services industry, which includes businesses that provide landscape care and maintenance services and that install trees, shrubs, plants, lawns or gardens. Businesses in this industry also design plans and construct walkways, retaining walls, decks, fences, ponds and similar structures.

Study Overview

The purpose of this report is three-fold. First is to provide an updated accounting of the economic impact of the agriculture industry in the Commonwealth. The second is to inform the roadmap for the agricultural industry by identifying where it can build on its existing strengths and capitalize on new opportunities. The third purpose is to provide recommendations to help the industry adapt to the macro trends identified through this research. Together, these analyses will support the Pennsylvania Department of Agriculture (PDA), Team Pennsylvania (Team PA), and stakeholders within the industry develop a proactive, shared vision and strategic plan for Pennsylvania's agricultural sector.

Agriculture has a long history as a strong, successful industry and major contributor to Pennsylvania's economy. In order to ensure the continued strength and success of the industry, PDA partnered with Team PA and the Agricultural Advisory Board to develop a 10-year strategic plan for the industry. The goal of this process is to develop a blueprint that will bring stability and guidance to every sector of the industry.

The research process was structured to prevent the influence of predetermined biases and to build a collective vision for the future of the industry by bringing together agricultural leaders from across sectors and across the state. The process formally began with a series of seven agricultural industry listening sessions held between November 2015 and January 2016. The sessions brought together 140 industry leaders from across the state and were led by facilitators from Telos, an independent business consulting firm, to ensure industry was driving the discussions. The major themes identified and questions posed in the listening sessions form the foundation to support the development of the 10-year strategic plan for the industry. A strategic plan will help both industry and policy makers build a better future for agriculture in Pennsylvania.

As part of the broader strategic planning process, this report integrates two methodological approaches – modeling the economic impact of the state's agricultural industry and micro sub-sector analyses – to provide a greater level of detail about critical sectors. The economic model utilizes 2015 data, the most recent year for which comprehensive data is available. The sub-sector analysis was undertaken for 10 sectors chosen through consultation with Team PA and PDA. The analysis mapped the supply and value chain for each sub-sector, explored the nature and size of demand, examined competitor dynamics, and analyzed how changes in social, political, economic and technological context might change demand, competitive dynamics or supply chains. The insights from the economic impact and sector analyses were then integrated to identify common trends, note general and sector-specific business opportunities, and develop industry and policy recommendations.

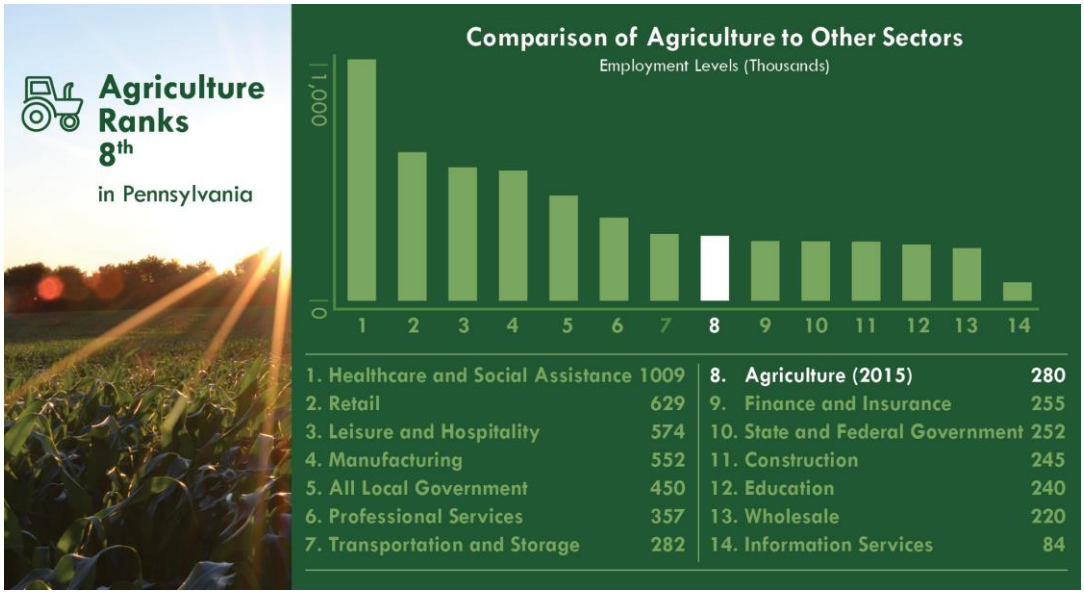
ECONOMIC IMPACT

Pennsylvania agriculture is a major driver of the state's economy. In addition to crops and livestock raised on farms, the industry includes forestry and forest products, as well as agricultural support services and agricultural product processing and food manufacturing. As with any industry, the impact of the sector goes beyond the market value of its products. In addition to the sectors that comprise the industry, direct spending in agriculture ripples out through the economy, creating indirect and induced economic impacts and supporting jobs throughout the state. Although the grocery and restaurant industries are not included in this economic impact study, they directly benefit from Pennsylvania's strong agricultural sector.

Agriculture accounts for approximately $83.8 billion in direct economic output, including $22.8 billion in value-added. It supports over 280,500 jobs with $10.9 billion in earnings. Within the industry, food processing and manufacturing is the largest sub-sector, accounting for nearly 60 percent of the economic output and 30 percent of the total direct employment. The production of crops and animals accounts for 10 percent of the total direct output ($9.2 billion), but generates 30 percent of the total direct employment.

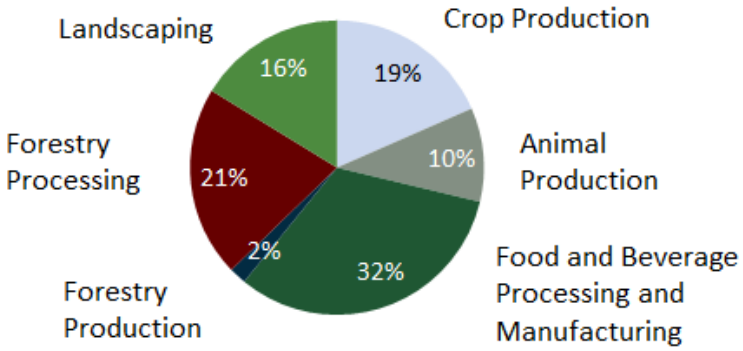
The agricultural industry generates approximately $135.7 billion in total economic impact each year and supports 579,000 jobs with $26.9 billion in earnings. For each job directly supported by Pennsylvania agriculture, another 1.06 jobs are supported across the Commonwealth. For each dollar of direct output, another $0.62 is generated in economic impact. Agriculture contributes $1 out of every $13 of gross state product and supports 1 out of every 10 jobs in Pennsylvania. In total, the state's agricultural industry generates 7 jobs per $1 million of output.

The continued importance of the agricultural industry is evident in its ranking among other industries. Agriculture currently ranks 8th in total employment in Pennsylvania.



Direct Jobs

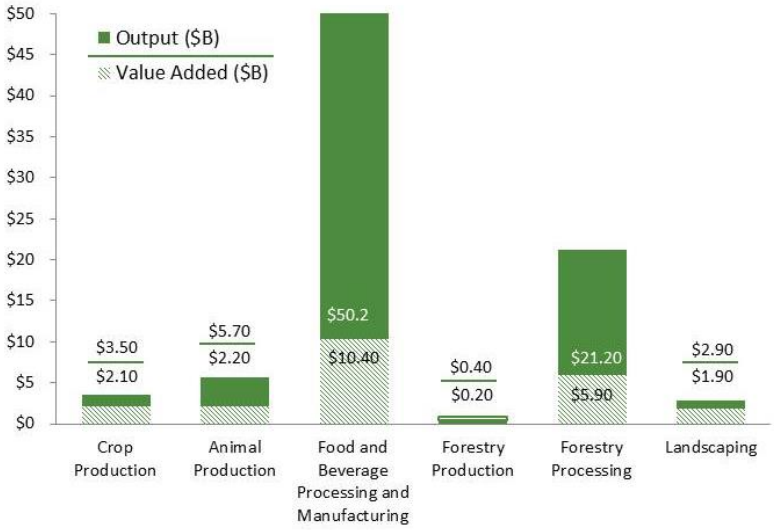
280,500
Total Direct Jobs



Direct Output

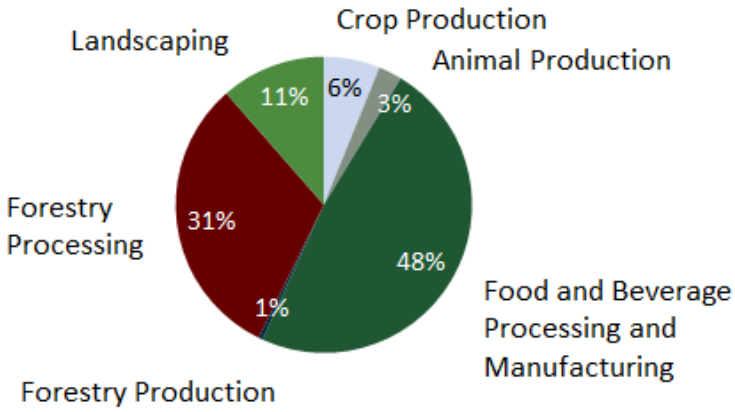
$83.8 Billion
Direct
Economic Output

$22.7 Billion
Direct
Value Added

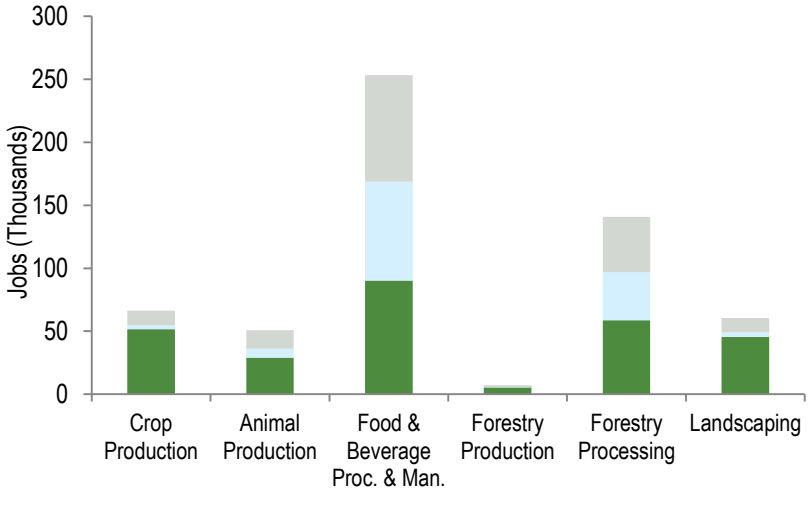


Direct Earnings

$10.9 Billion
Annual Wages &
Salaries Supported



Total Jobs



579,000

Total Direct, Indirect, and Induced Jobs

Total Output



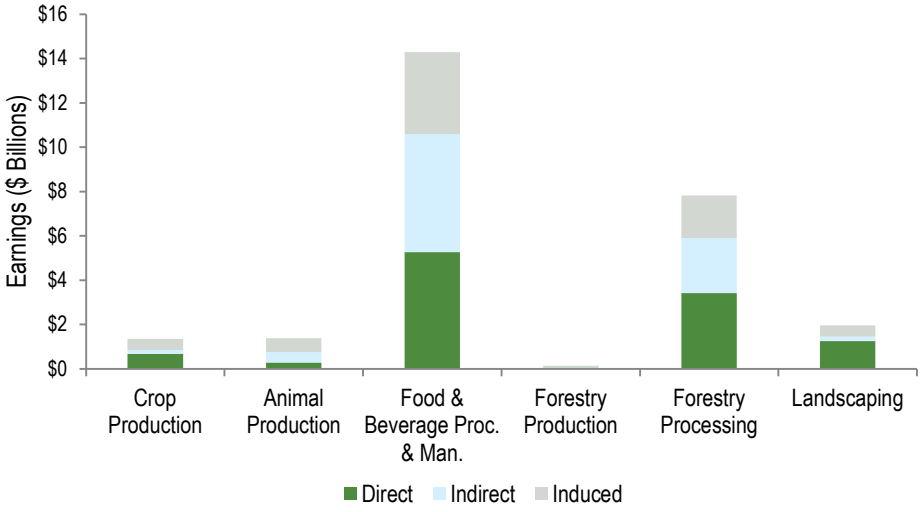
$135.7 Billion

Total Direct, Indirect, and Induced Output

$52.4 Billion

Total Direct, Indirect, and Induced Value Added

Total Earnings



$26.9 Billion

Annual Wages & Salaries Supported

SWOT Analysis

Pennsylvania's agricultural sector is competing in a constantly evolving and increasingly competitive global market. In order to understand how national and regional trends will impact Pennsylvania, it is important to first understand the strengths, weaknesses, opportunities, and threats (SWOT) facing agriculture in Pennsylvania.

Pennsylvania's agricultural industry is rooted in a number of strengths that it can build from in responding to threats and opportunities resulting from the macro-factors (Figure ES.1). The diversity and quality of crops and producers, smaller farms, a mix of conventional and natural farming practices, rich soil, a strong farming tradition and good foundation of agricultural infrastructure will enable producers and manufacturers to respond proactively.

Figure ES.1: Pennsylvania Agriculture SWOT Analysis



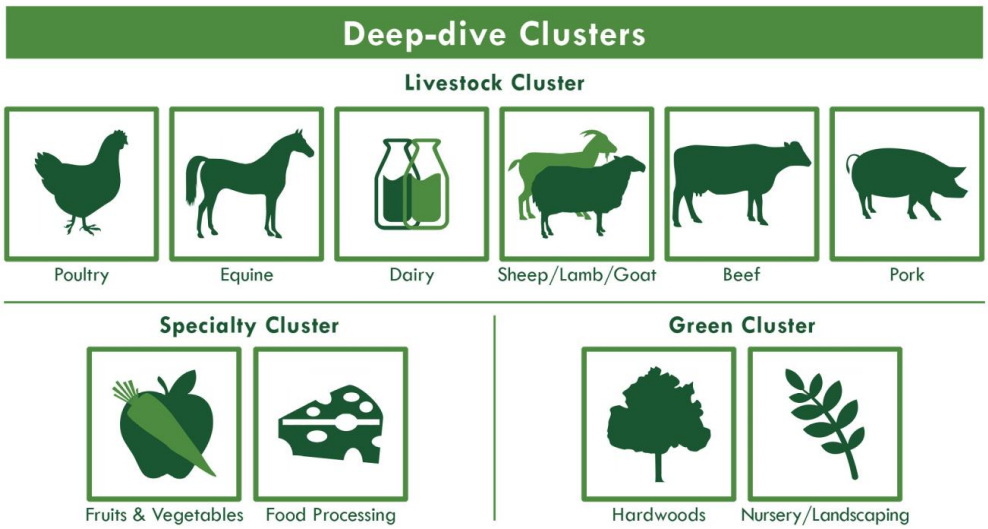
ECONOMIC CLUSTER ANALYSIS

We used cluster analysis to analyze the concentration, current employment levels, and trends over the past 10 years to evaluate each of agriculture's 35 subsectors. The cluster analysis identified agriculture subsectors that are growing and ones that are declining, the subsectors in which Pennsylvania has a competitive advantage, and those that should be the focus of economic development efforts.

Five subsectors are strong and growing: poultry and egg production; horses and other equine production; animal food manufacturing; fruit and vegetable preserving and specialty; and other food manufacturing. More than half of the agriculture subsectors represent a potential opportunity for the Commonwealth. These subsectors have low concentrations of firms, but have experienced recent job growth and, with support, could develop a competitive advantage.

Nationally, the subsectors within agriculture have been subject to divergent employment trends. In most sectors, Pennsylvania has fared better than its neighboring states and the nation, either in terms of stronger growth or less pronounced decline. Employment growth in Pennsylvania's crop and animal production and landscaping sectors has outpaced neighboring states and the nation. While the forestry sector has experienced job loss across the country, the decline has not been as severe in Pennsylvania. Food processing and manufacturing began recovering in 2010, although the growth has been slower than in neighboring states or the nation.

Within the state, employment growth in the crop and animal production sector has outpaced overall employment in Pennsylvania – increasing 22 percent compared to 11 percent across all industries. At the same time, employment growth in the food manufacturing and processing sector and forestry sector has lagged total employment growth in the Commonwealth.



DRIVERS AND TRENDS

This report builds on the major drivers identified in the agriculture industry sessions organized by PDA, Team PA, and the Pennsylvania Agricultural Advisory Board by undertaking a scan of the macro-level factors and regional trends affecting supply and demand for agricultural products. Through our review of existing research studies, analyses, data, and market reports, we identified several key trends impacting Pennsylvania agriculture.

Major Drivers Identified in Agricultural Industry Listening Sessions:

- Business Development & Environment of the Industry
- Human Capital / Workforce / Education
- Communication
- Technology & Science
- Land & Stewardship



Changing Consumer Tastes: Changing consumer tastes, particularly the growing demand for local food and transparency in food production, create both challenges and opportunities for Pennsylvania farmers and food and beverage processors and manufacturers.



Regulation and Business Environment: The business environment and regulations must be reviewed in the context of whether they are encouraging or stemming entrepreneurship and innovation in the agricultural sector.



Innovation: Technology and science are among the core drivers shaping the future of agriculture in Pennsylvania.



Trade Agreements and Exports: The changing political climate around trade has created uncertainty for the future of Pennsylvania's agricultural exports.



Workforce Shortage: The agricultural workforce shortage in Pennsylvania is driven by the aging of sector employees, uncertain guest worker conditions, and a growing skills gap. It is estimated that there will be more than 75,000 new and replacement job openings in Pennsylvania agriculture over the next decade.



Automation and Efficiency: Agriculture ranks fourth among industries with potential for automation. It is estimated that 57 percent of agricultural work in the United States can be automated.



Physical Infrastructure: Aging infrastructure is a problem nationwide, and one that restricts the production and transportation of agricultural products throughout the supply chain.



Environmental Pressures: The agricultural industry in Pennsylvania, particularly crop production, is vulnerable to environmental changes and pressures.

INDUSTRY AND POLICY RECOMMENDATIONS

The agricultural sector can best position itself to build on its strengths and capitalize on opportunities by positioning itself to address and adapt to changing consumer tastes, increased automation, workforce shortages, and uncertain trade and guest worker conditions. These recommendations are intended to guide Team PA, PDA, the Agricultural Advisory Board, and the industry's stakeholders in the development of a strategic plan, the next step in the proactive, collaborative work to best position the industry for the opportunities and challenges it will face over the next decade and beyond.

Areas of Recent PDA Focus

- Investment in farmland preservation and farm transitions
- Updates to Pennsylvania Tax Code
- Support for workforce development and apprenticeships
- Investment in Pennsylvania's physical infrastructure
- Funding for product diversification
- Expanded branding and marketing outreach





Capitalize on Branding and Marketing Opportunities

Challenge: Low visibility of the connection between the PA Preferred™ brand and consumer demand for local, natural products and transparent supply chains.

Goal: Develop the PA Preferred™ program as synonymous with local, healthy, and traceable, and expand producer enrollment in the program, targeting sectors that are well positioned to capitalize on changing consumer trends.

Strategies:

- Focus on branding PA Preferred™ as local and traceable
- Increase outreach for enrollment in the PA Preferred™ program
- Strategically market sectors that are well positioned to capitalize on demand for natural products
- Boost domestic markets and value-added manufacturing opportunities for Pennsylvania hardwoods
- Expand farm-to-school programs to build awareness of agriculture and agricultural products in Pennsylvania



Expand on Agricultural Infrastructure

Challenge: Gaps in production, processing, and manufacturing of agricultural products limit the productivity and growth of Pennsylvania agriculture.

Goal: Reduce supply and demand gaps throughout the supply chain by strategically increasing processing and manufacturing capacity, while continuing to preserve agricultural land through the Farmland Preservation Program.

Strategies:

- Maintain the strength of Pennsylvania's nation-leading Farmland Preservation Program
- Improve volume, quality, and price realization to address existing gaps in the processing and manufacturing infrastructure, including organic and extended shelf life production
- Invest in sectors with projected growth to minimize future processing bottlenecks
- Support processing automation to increase productivity and efficiency
- Increase byproduct processing capacity to reduce food waste and increase product diversification



Continue to Improve Regulatory Processes and the Business Climate

Challenge: Constraints to productivity, efficiency, and development of agriculture in Pennsylvania due to the regulatory and business environment, which can limit investments in production, processing, and manufacturing in the state.

Goal: Develop streamlined state permitting and regulatory processes for the agricultural industry and reconsider policies that deter agricultural investments in Pennsylvania.

Strategies:

- Establish an industry-government working group to review regulatory and business statutes impacting the agriculture industry, and provide recommendations to improve existing policies
- Establish a point of contact within PDA to help producers and processors navigate local, state, and federal regulations



Broaden Workforce Development And Education Opportunities

Challenge: A workforce shortage due to the aging of agricultural workers, changing guest worker regulations, and a shift in the skills needed to support an increasingly automated industry may hinder the productivity and long-term growth of Pennsylvania agriculture.

Goals: Reduce the current and projected workforce shortages through education and training that will meet the changing needs of the agriculture industry in Pennsylvania.

Strategies:

- Support apprenticeship and work-based learning programs to close the skills gap for an increasingly technology-driven sector
- Explore the potential of an ex-offender to work program to help alleviate workforce shortage issues
- Expand and support programs connecting veterans and minorities to agriculture
- Support loan forgiveness programs for large animal veterinarians and other high-shortage careers
- Increase agricultural education in STEM-related courses to prepare the state's workforce for increased automation
- Diversify business of farming education to address changing consumer tastes and evolving business models



Make Additional Investments in Infrastructure Systems

Challenge: The agricultural industry needs greater investments in the physical infrastructure that facilitates movement of products throughout supply chains.

Goal: Invest in Pennsylvania's transportation, broadband, and distribution infrastructure to ensure that the state's producers and processors can meet consumer demands through wholesale, retail, and direct-to-consumer channels.

Strategies:

- Invest in transportation infrastructure to strengthen movements in supply chains
- Support programs to ensure the expansion and adoption of broadband internet access in rural areas
- Work with producers and processors to ensure they have the infrastructure needed to access alternative distribution systems



Diversify Products to Strengthen Markets and Build Resiliency

Challenge: The degree to which Pennsylvania agriculture is concentrated in a small number of products leaves the industry vulnerable to the effects of changing consumer demands.

Goal: Intra- and inter-farm, processor, and manufacturer diversification that strengthens the resiliency of Pennsylvania agriculture against market changes.

Strategy:

- Encourage and support producers, processers, and manufacturers in product diversification
- Fund research and development to support product diversification

While the Pennsylvania food and agriculture sector benefits from its strong roots and culture of innovation, it needs a strategic plan to remain competitive in the current domestic and global environment. States with strong food and agriculture sectors stand to benefit significantly if they can more readily adapt to and capitalize on this new era in agriculture. This will require a shared vision and roadmap. This report contributes to PDA and Team PA's ongoing work to facilitate development of a shared vision and roadmap for Pennsylvania's agricultural industry.



Section 1: Introduction

Agriculture has a long rich history in Pennsylvania and has been a driving force of the state's economy for centuries. The first crop cultivation in what is currently Pennsylvania was done by indigenous peoples. The Lenape people of the Delaware Valley region planted corn while the Monongahela people of what is now the Upper Ohio Valley region in western Pennsylvania grew corn, beans and squash. Following the establishment of the colony of Pennsylvania, waves of settlers further cultivated farmland across the state. During the 18th century, over half of all Pennsylvanians lived on farms.[2]

While the number of Pennsylvanians farming has decreased, the importance of agriculture to the Commonwealth's economy has not. Pennsylvania's diverse food and agriculture sector accounts for a significant portion of the state's economy, with a $135.7 billion annual economic impact. Agriculture generates employment and economic activity on more than 58,000 farms and in every county in the Commonwealth. The on-farm agriculture production, largely concentrated in rural counties and those becoming more suburban and urban, underpins a large food processing industry and agriculture support services located throughout the state, including bakeries, confectioners, dairy and meat processors, and snack food manufacturers, among others. Pennsylvania's equine industry includes some of the top breeding farms nationwide and supports a strong racehorse industry. The state's forest products sector is grounded in hardwoods production, where Pennsylvania ranks first in export grade hardwood. The state has a growing beverage industry, and the state's landscapers and horticulturalists provide important services to homeowners and businesses, delivering aesthetic appeal, as well as valuable conservation and environmental benefits.

Pennsylvania's agricultural sector is competing in a constantly evolving and increasingly competitive global market. As a result, the industry and its sub-sectors face a number of challenges: including shifts in consumer tastes, an uncertain trade environment that may limit future exports, falling commodity prices, the adoption of automation and technology, workforce shortages, and evolving environmental pressures. In order to best position itself to adapt to and capitalize on these changes, the Pennsylvania agricultural industry needs to identify how these macro-changes will impact the production, processing and manufacturing, forestry, and landscaping sectors within the state.

While the Pennsylvania food and agriculture sector benefits from its strong roots and culture of innovation, it needs a strategic plan to remain competitive in the current domestic and global environment. States with strong food and agriculture sectors stand to benefit significantly if they can more readily adapt to and capitalize on this new era in agriculture. This will require a shared vision and roadmap. This document represents a first step in developing that shared vision and roadmap.

[2] Pennsylvania Historical & Museum Commission, "Agriculture in Pennsylvania," www.portal.state.pa.us/

Defining Agriculture

The size of the agriculture sector in Pennsylvania goes beyond the market value of the products sold from production on the farm. It also includes the forestry and forest products sector, as well as agricultural support services and agricultural product processing and food manufacturing. For the purposes of the analysis, we defined the agricultural sector as follows.

1. **Crop and Animal Production**: includes grain, vegetable, fruit, mushroom, nut, tobacco, custom crop harvesting, and all other crop production industries in addition to beef, poultry, dairy, egg, and all other animal production industries. All other animal production includes the production of farm, pleasure, work, and race horses. Crop production includes nursery and tree production, including Christmas tree production. Also included are all support activities for agriculture and forestry, based on NAICS code classifications that include forestry support services as agriculture support services. Agricultural support services include farm management, machine crop harvesting, milk testing, stud and breeding services, pedigree record services, and support services for the equine industry: breeding, boarding, training, and horseshoeing. Forestry support services include forest thinning, forest pest control services, and forest management plans preparation.

2. **Food and Beverage Processing and Manufacturing:** includes all industries related to the processing of crops and animals, including pork, poultry, beef slaughtering and processing, dairy product manufacturing, fruit and vegetable preserving, oils, chocolate, cereals, and juices, and food manufacturing, such as bread, nut butter, pasta, syrup, and other snack food manufacturing in addition to coffee, tea, beer, soft drink, and wine manufacturing.

3. **Forestry**: includes all industries related to the production and processing of forest products and commercial logging, including timber tract production sawmills, veneer and plywood manufacturing, pulp and paper mills, and wood furniture and cabinet manufacturing.

4. **Landscaping**: includes the landscape and horticultural services industry, which includes businesses that provide landscape care and maintenance services and that install trees, shrubs, plants, lawns or gardens. Businesses in this industry also design plans and construct walkways, retaining walls, decks, fences, ponds and similar structures.

1.1 STUDY OVERVIEW

The purpose of this report is three-fold. The first objective is to provide an updated accounting of the economic impact of agriculture in the Commonwealth. The second is to provide industry and policy recommendations to help the agriculture industry and policymakers adapt to macro global, national, and regional market trends, based on the changing business and market realities of specific agricultural sectors. The third purpose is to inform the roadmap for the agricultural industry by identifying where it can build on its existing strengths and capitalize on new opportunities. Together, these analyses will support the Pennsylvania Department of Agriculture (PDA) and Team Pennsylvania's (Team PA) work to advance the industry's economic development efforts.

In the industry listening sessions held in November 2015 through January 2016, participants identified major drivers, both positive and negative, impacting the agricultural industry in Pennsylvania. Over seven sessions, five common themes emerged around the support for developments in the industry over the next 10 years. The common themes emerged as questions that both industry and policymakers must ask of themselves in order to best position Pennsylvania agriculture for the future:

Business Development & Environment of the Industry: Is the environment of the industry positive for entering or staying in agriculture? What can be done to create a positive environment for those who work in agriculture, and between the industry, consumers, future employees, those who live near agricultural production and processing? What is Pennsylvania doing, and what should it be doing, to build a climate for business development, including entrepreneurship and innovation? What can be done to create a climate that encourages future generations to pursue careers in agriculture?

Human Capital / Workforce / Education: What can be done to address current workforce shortages and skills and education gaps to better meet the needs of the agricultural industry? What is being done to meet the human capital needs of employers in agriculture? How can Pennsylvania grow the strengths and address the weaknesses of its educational infrastructure to meet current and future needs for skilled labor in the industry?

Communication: How can the industry better communicate within itself, with consumers, and with policymakers and elected officials? Is there a disconnect between how industry members view themselves and consumers view the industry? What single message can the industry use to educate consumers on production practices and the benefits of Pennsylvania agricultural products to make the industry more competitive?

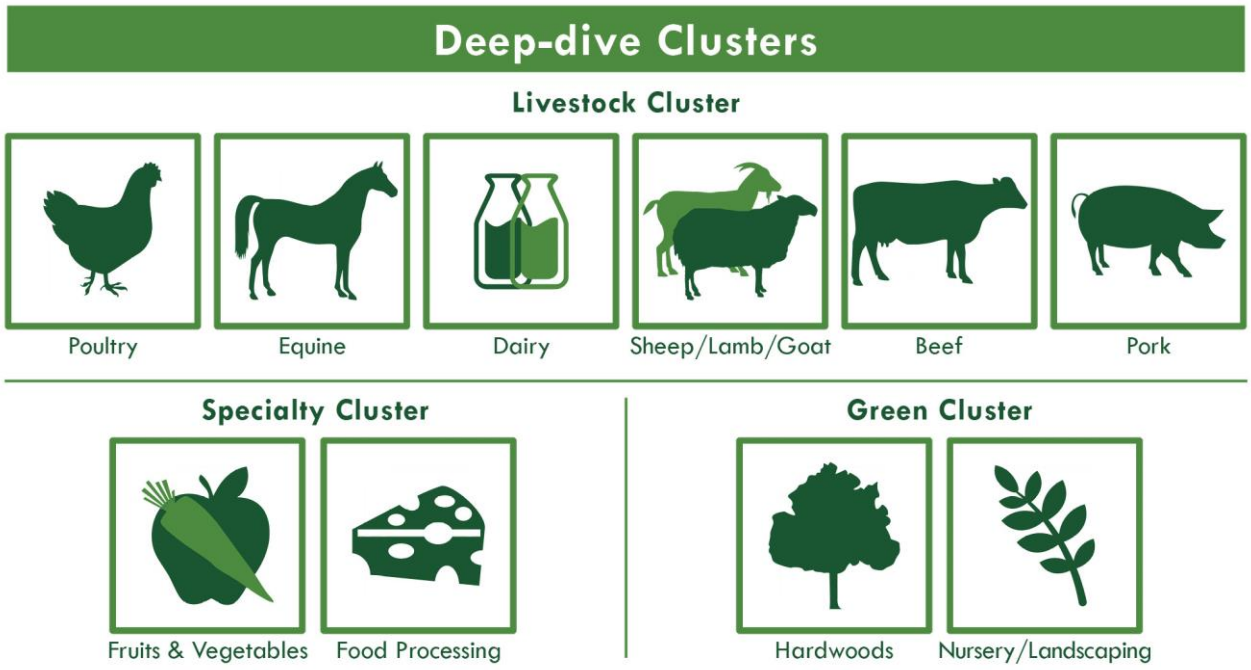
Technology & Science: How can the industry better educate consumers about the benefits of science and technology in the industry? How can industry members adopt technological and scientific innovations without negative externalities from consumer wariness around technology in food?

Land & Stewardship: How can agriculture better communicate its leadership on land stewardship, water management, and air

quality? How can the industry continue to embrace environmental responsibility and sustainability?

The major themes identified and questions posed in the industry listening sessions guided the analysis of the industry's economic impact. This report quantifies major questions that will guide the development of the strategic plan: What macro- and micro- trends are drivers of success or failure for agriculture as a whole and within specific industries, commodities, and sectors? What industries can be influenced through public policies and what industries require industry leadership? What constitutes agriculture in Pennsylvania and what are the drivers impacting all segments of the industry? What is the overall economic impact of agriculture in the state and within sectors, including crop and animal production, food processing and manufacturing, forestry, and nursery and landscaping? The analysis in this report forms the foundation to support PDA and Team PA in their work with the industry to develop a 10-year strategic plan for Pennsylvania agriculture. The strategic plan will help both industry and policy-makers build a better future for agriculture in Pennsylvania.

This report integrates two methodological approaches – modeling the economic impact of the state's agricultural industry and micro sub-sector analyses – to provide a greater level of detail about critical sectors. To analyze the economic impact of Pennsylvania agriculture, we developed a customized economic impact model using the IMPLAN input/output modeling system. This model is used to estimate a full range of economic, employment, and labor income impacts associated with the direct activity attributable to the agriculture industry in the Commonwealth of Pennsylvania. See Appendices A, B and C for more detail about the economic impact methodology, the sector definitions used, and the results.



A more granular analysis was undertaken for 10 sectors. The focal sectors were chosen through consultation with Team Pennsylvania and PDA. The selection was determined by industry priorities and the depth of existing data and reports within sectors.

Each focal sector was analyzed by a team of Temple University Fox School of Business Masters of Business Administration (MBA) students, supervised by an executive with both business and agriculture experience. The teams combined primary interview data and secondary data to map the supply and value chain for each sub-sector, explore the nature and size of demand, examine competitor dynamics, and analyze how changes in social, political, economic and technological context might change demand, competitive dynamics or supply chains. The sector insight teams traced the supply chain from producer to consumer, assessed consumer demand and industry response, evaluated historical trends and future trajectories in process and technology, and identified opportunities for growth. See Appendices D, E and F for further detail about the methodology, interviews and findings organized by theme.

The insights from the economic impact and sector analyses were then integrated to refine each analysis, identify common trends, note general and sector-specific business opportunities, and develop industry policy recommendations. Integrated with the economic impact model, these findings can be utilized to identify opportunities in each sector, to develop industry policy recommendations, and to identify areas of expected change for updating the economic impact model.

1.2 REPORT

This report contains four sections:

- Section 1 – Introduction: This section provides background on the purpose of this report, details the methodological approach used to evaluate the economic impact of Pennsylvania agriculture and expected future trends, and introduces the statewide economic impact.

- Section 2 – Agriculture in Pennsylvania: In this section, we review the current state of Pennsylvania agriculture; detail the strengths of the sector; provide context of historic economic trends; and detail the economic impact of Pennsylvania agriculture, including the methodology, the identification of different sectors within the model, and the direct, indirect, and induced impacts across crop and animal production, food and beverage processing and manufacturing, hardwoods, and landscaping. This review includes a SWOT analysis and examination of agricultural clusters in Pennsylvania.

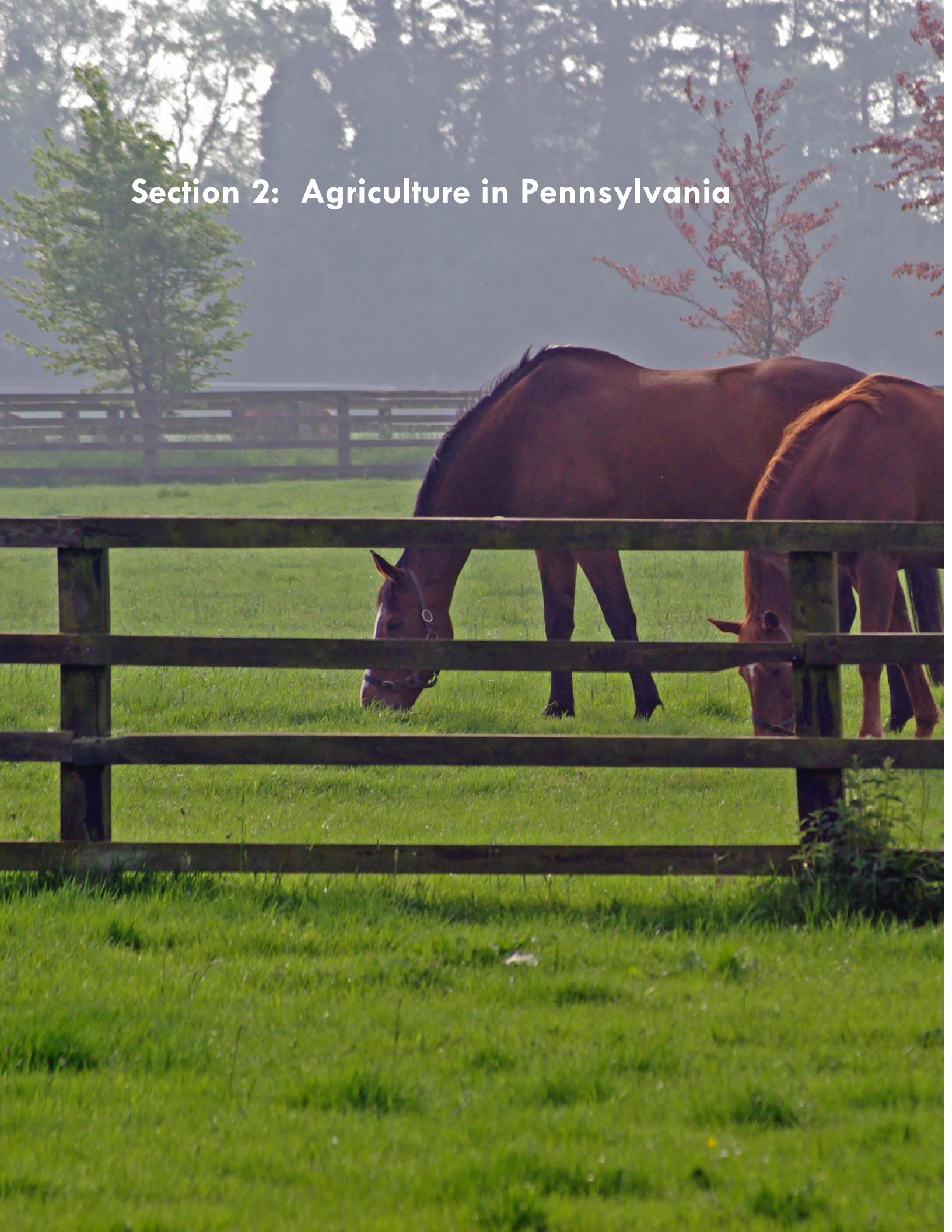
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- Section 3 – Drivers and Trends Impacting Agriculture in Pennsylvania: We detail macro trends impacting agriculture, including economic, technical, political, and environmental changes. The section details how national and regional trends have impacted the industry in the state and how changes are projected to influence Pennsylvania agriculture over the next 10 years.

- Section 4 – Industry and Policy Recommendations: Building off the economic impact analysis, identification of trends impacting Pennsylvania agriculture, and micro sub-sector analysis, we detail recommendations for industry and policymakers to capitalize on areas of growth and mitigate areas of challenge.

Together, the four sections provide the first comprehensive study of the economic impact of Pennsylvania agriculture and the trends that are expected to shape the industry over the next decade. The agricultural industry is undergoing transformational changes, and it is imperative for the sector to adapt to these changes to maintain its prominent position in Pennsylvania's economy and marketplace.

Section 2: Agriculture in Pennsylvania



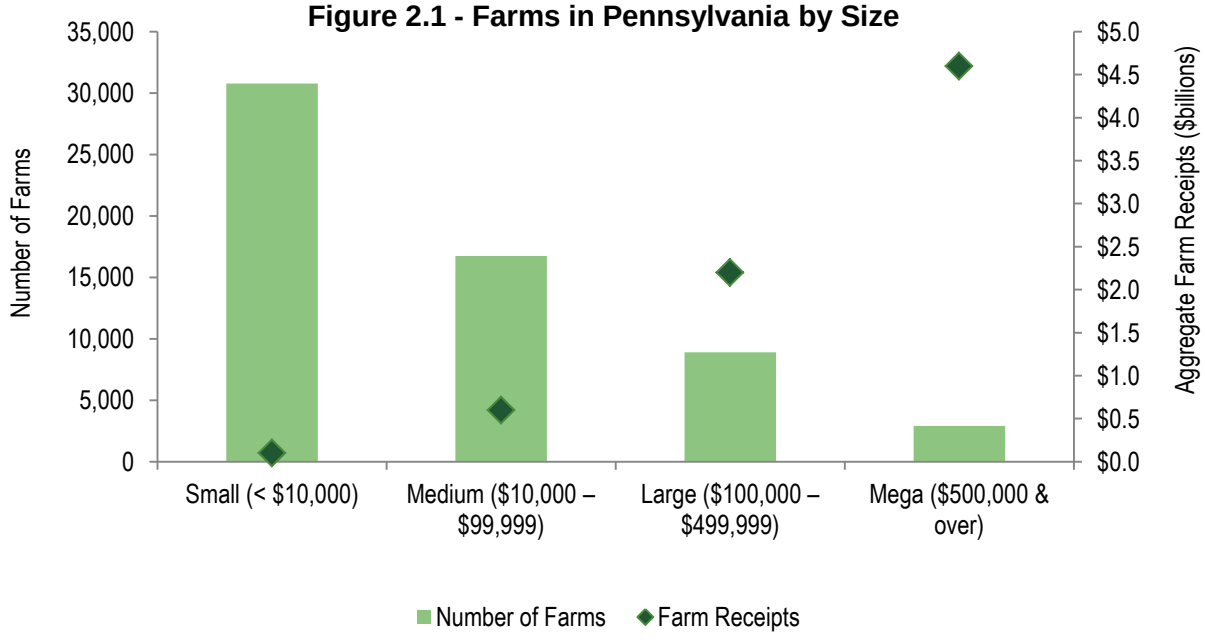
The agricultural industry plays a key role in the state's economy and workforce. Pennsylvania is an animal protein state, with strong pork, poultry, and beef production, and growing sheep, lamb, and goat production. Livestock production is also driven by the dairy, egg production, and equine sectors. The high-quality of Pennsylvania hardwoods positions the industry well for domestic and international exports. The investment of the fruit and vegetable producers in alternative distribution systems, including farmers' markets, direct-to-consumer sales, and community supported agriculture (CSAs) has enabled them to capitalize on the proximity to major urban centers throughout the East Coast.

At the time of the last USDA Census of Agriculture in 2012, there were more than 58,000 farms in Pennsylvania (see Figure 2.1).

Small farms account for over half of all farms in the Commonwealth but generate only 1 percent of farm product sales, while mega farms account for 5 percent of farms but generates 62 percent of revenue. In total, there are more than 7.7 million acres of farmland, nearly 25 percent of the total land in the state. In addition, there are more than 15.6 million acres of forested land in the state, or 53 percent of total land.

Pennsylvania agriculture is a strong, successful industry and major contributor to the state's economy. In order to build on the state's strengths and opportunities, it is essential to understand the size of the overall agricultural sector, how the sector has changed over time, and its importance in the state economy. This report represents the first comprehensive look at the state's agriculture industry, with the landscaping, forestry and hardwoods, equine, and food manufacturing sectors intentionally included for the first time.

Figure 2.1 - Farms in Pennsylvania by Size



Pennsylvania Agriculture Summary Statistics

90% *of PA Farms are owned by families or individuals*

Pennsylvania Farms

58,200
Farms in Pennsylvania

7.6 Million
Acres of Farmland

131
Average Acres/Farm

Farm Ownership

90%
Family or Individually Owned

48%
Principal Operators with Another Primary Occupation

56.1
Average Age of Principal Operator

State Farm Rankings

13th
Number of Farms

35th
Total Farmland

45th
Average Farm Size



Pennsylvania Agriculture Production Summary

1st *in production of specialty vegetable items*

Production Rankings

1st
Mushrooms
2nd California

1st
Export Grade Hardwood

4th
Poultry Layers
1st Iowa

4th
Christmas Trees
1st Oregon

5th
Milk from Cows
1st California

9th
Horses
1st Texas

Major Areas of Growth (2002-2012)

26%
Broiler Chickens
3% nationwide

85%
Farms with Chickens Producing Eggs

159%
Soybeans
8% nationwide

Food Processing & Manufacturing

2,300
Food Processing Companies

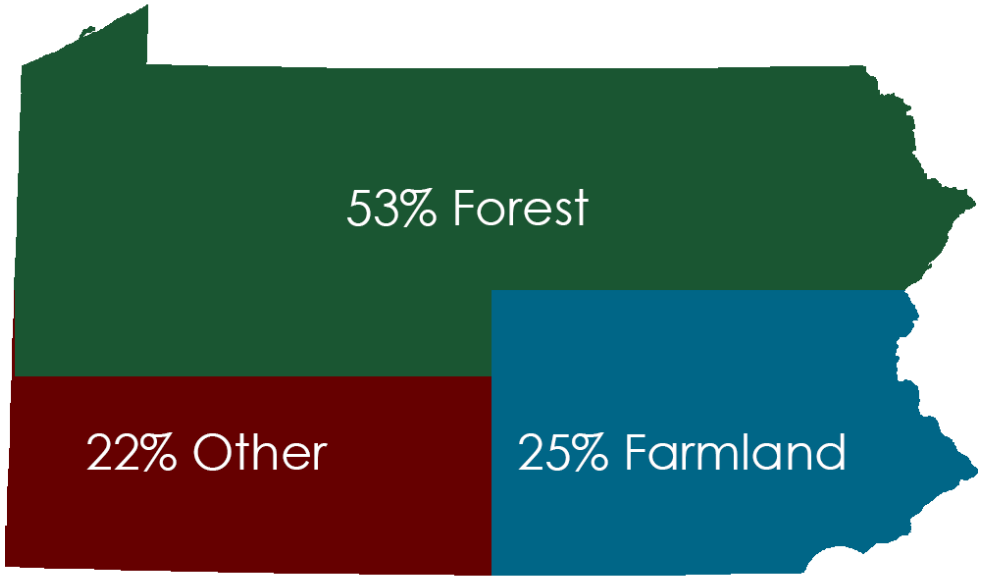
1st
Potato Chips, Pretzels

1st
Canned Fruit

1st
Chocolate & Cocoa Products

1st
Vegetable Specialty Products

FIGURE 2.2 LAND USE IN PENNSYLVANIA

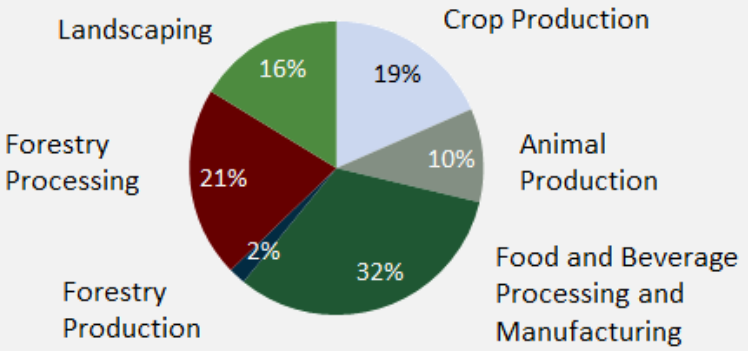


2.1 THE STATE OF PENNSYLVANIA AGRICULTURE

Agriculture directly accounts for approximately $83.8 billion in economic output and over $22.7 billion in value add, and it supports over 280,500 jobs and $10.9 billion in earnings. Within the agriculture sector, food processing and manufacturing is the largest sub-sector, accounting for nearly 60 percent of the economic output and 32 percent of the total direct employment. Production agriculture, which includes crops and animals, accounts for approximately 10 percent of the total direct output ($9.2 billion), but generates 29 percent of the total direct employment.

Direct Jobs

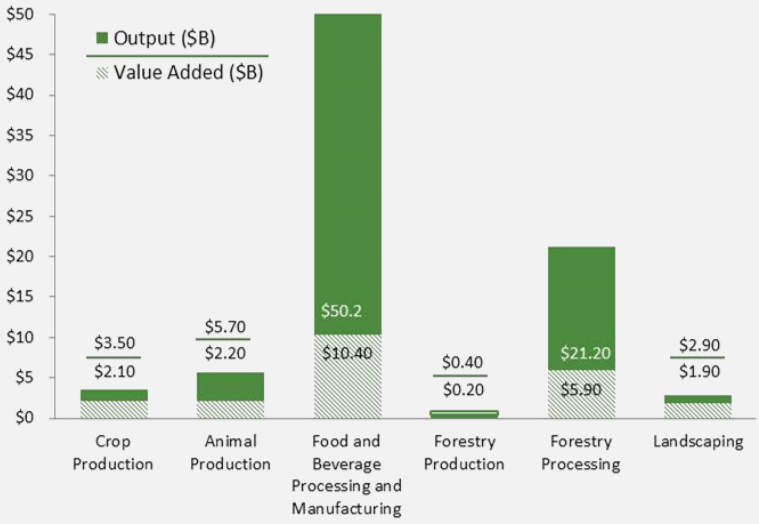
280,500
Total Direct Jobs



Direct Jobs

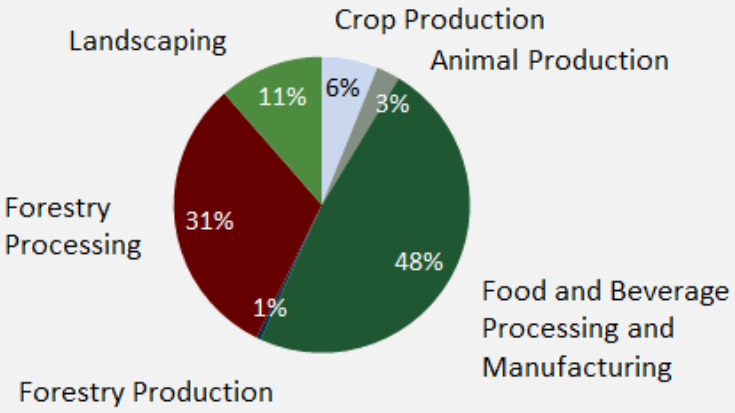
$83.8 Billion
Direct Economic Output

$22.7 Billion
Direct Value Added



Direct Jobs

$10.9 Billion
Annual Wages & Salaries Supported



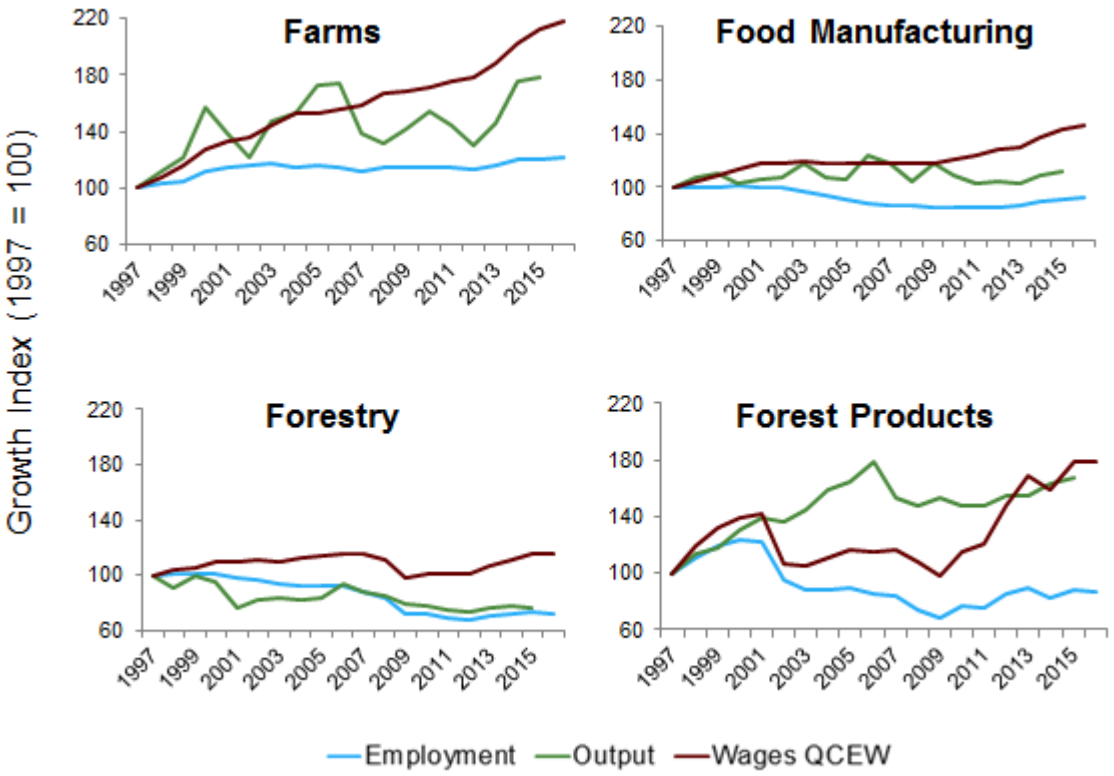
While the direct impact provides a snapshot of agriculture in Pennsylvania, it is important to understand the general historical trends. There are numerous ways in which to measure the size of the agricultural economy. A few examples include employment, wages and salaries, and output. Output and wages and salaries tend to be highly sensitive to commodity prices (e.g. the price of milk) and growing conditions (such as drought), which can make these measures fairly unstable and subject to wide swings. Employment tends to be somewhat insulated from these external factors.

The trends in each of the sectors are analyzed using a simple growth index, which allows us to compare trends across the different industries directly. Changes in the index from one year to the next can be interpreted as a percent change in the index. This allows us to determine if the industry is trending upward or downward and how that growth varies across metrics and industries.

Several trends are evident from the data:

- Wages and salaries have increased in each of the sectors, ranging from 15 percent in the forest product manufacturing sector to more than doubling in the production agriculture sector.
- Output growth in the agriculture production sector has nearly doubled in size since 1997. However, there is significant year-to-year variability in the sector.
- Employment in the agriculture production sector has not increased at the same rate as output – employment increased by 22 percent, while output increased 78 percent. This is likely due to increases in economies of scale due to the consolidation of small and medium farms into larger farms and the increased use of labor-saving technologies.
- The growth in employment of the agriculture production sector dispels the perception that agriculture is a shrinking industry. However, while employment is growing, it is becoming less labor-intensive – requiring less labor to produce a unit of output.
- Output in the food manufacturing sector has been relatively flat since 1997, increasing only 11 percent. Over the same time period, employment decreased, falling to 92 percent of the 1997 employment levels. This is likely due to increased economies of scale.
- Output in the forestry sector increased by 67 percent, while employment fell by 13 percent.
- Both output and employment decreased in the forest product manufacturing sector. Output decreased by 24 percent, while employment decreased by 28 percent.

FIGURE 2.3 – GROWTH INDEX, 1997 - 2017[3]



Source: BLS QCEW (2017)

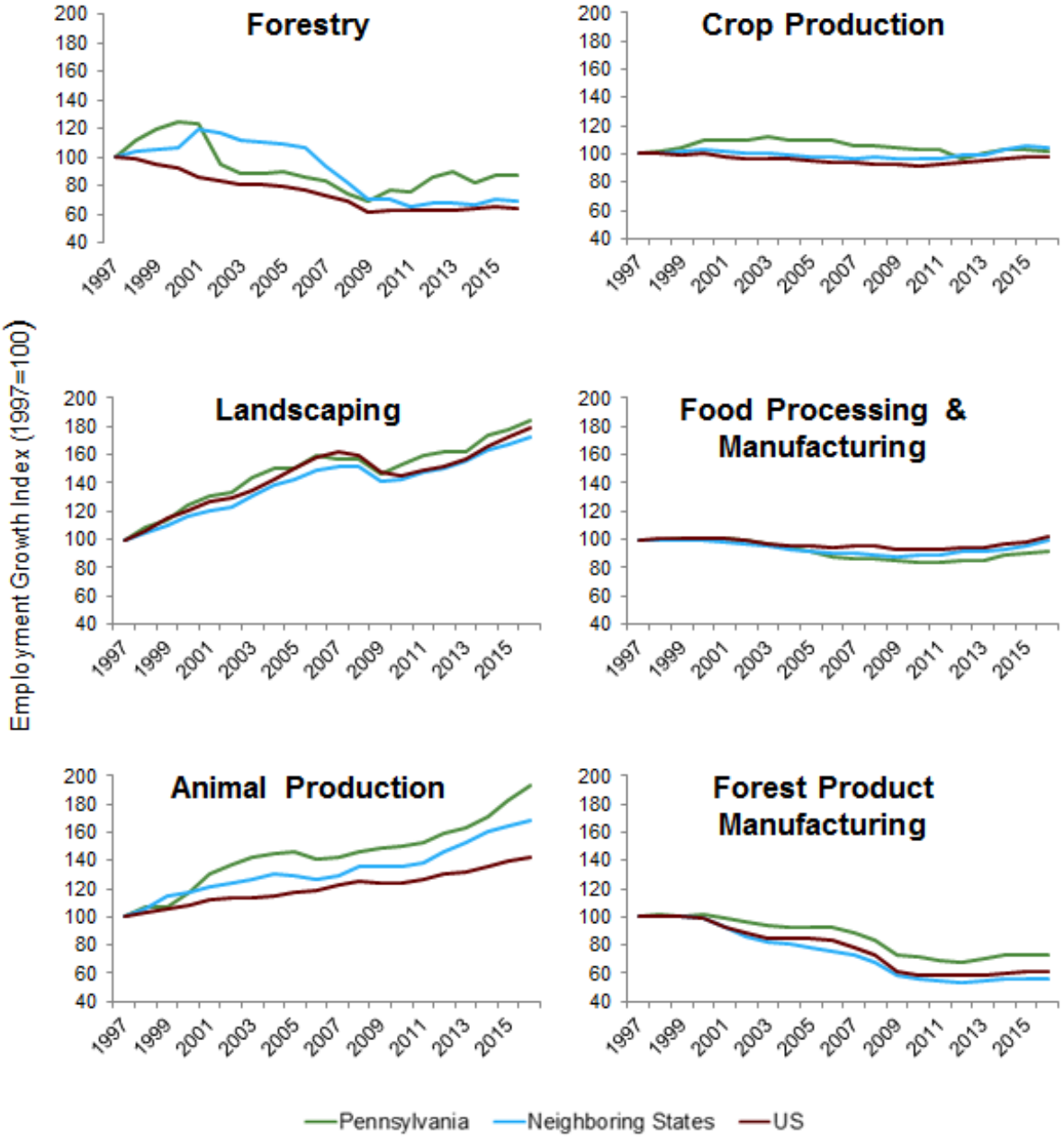
[3] Due to data availability limits, we are only able to examine the economic growth in the production agriculture (crop and animal), food manufacturing, forestry and forest product manufacturing sector. We are unable to look at the impacts of the crop and animal production sectors separately or the landscaping sector.

Given the importance of job creation, we focus on the change in employment over the 1997 to 2016 time period. Given the granularity of the available employment data, we are able to expand the analysis to look at crop and animal production separately and also include landscaping. We compare the employment growth of the sectors in the Commonwealth to the growth nationally, as well as in the surrounding states[4].

Between 1997 and 2012, employment growth in the crop production sector was flat across each of the geographies – increasing by 2 percent in Pennsylvania and 4 percent in the neighboring states, while slightly declining nationally. Over the same time period, employment growth in the animal production sector in the Commonwealth nearly doubled – increasing by 92 percent since 1997. The Commonwealth outpaced the growth in neighboring states, as well as nationally. It is not clear if the significant growth in the crop and animal production sector that occurred since 2012 is a short-term phenomenon or the beginning of a longer term trend.

[4] The surrounding states include: Delaware, Maryland, New Jersey, New York, Ohio, and West Virginia.

FIGURE 2.4 – EMPLOYMENT GROWTH INDEX, 1997 - 2017



Source: BLS QCEW (2017)

Since 1997, employment in the forestry sector has been declining in the Commonwealth, neighboring states, and nationally. However the decline in Pennsylvania has not been as severe as the decline in the sector nationally and in the neighboring states. In Pennsylvania, forestry employment was equal to 87 percent of 1997 employment levels, while national employment was equivalent to 69 percent of the 1997 levels. In the neighboring states, employment in the sector was 63 percent of the 1997 levels. Since 2009, employment in the forestry sector in the Commonwealth increased while it remained flat in the neighboring states as well as nationally. It is unclear if this trend will continue.

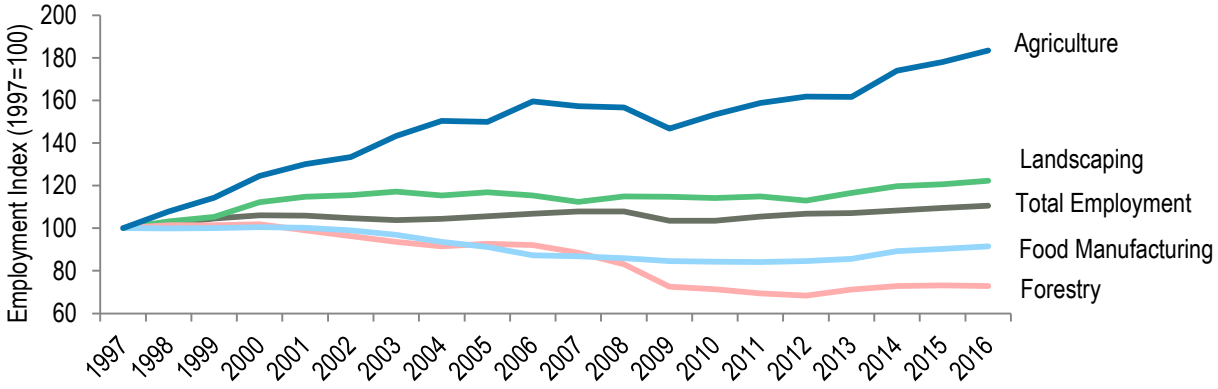
The forest products manufacturing sector has exhibited similar trends to the forestry sector; however the decline in employment has been more severe. Employment in the Commonwealth is equal to 73 percent of the 1997 level, while in the neighboring states it is equal to 57 percent of the 1997 levels and 61 percent nationally.

Across each of the geographies, employment in the food manufacturing and processing sector steadily declined over the 1997 to 2010 period, at which time the sector began to recover. By 2016, the sector in neighboring states, as well as nationally, had returned to 1997 employment levels, while in Pennsylvania employment in the sector in 2016 was equal to 92 percent of the 1997 employment levels.

Except for a slight decline due to the Great Recession, employment in the landscaping sector has been steadily increasing across each of the geographies. The largest increase has been in Pennsylvania, where employment has increased by 83 percent from the 1997 level.

Figure 2.5 compares the employment growth of the agricultural sectors to the employment growth of the Commonwealth. Since 1997, growth in the crop and animal production sector has outpaced total employment growth in the Commonwealth. Total employment in the Commonwealth has increased by 11 percent since 1997, while employment in the crop and animal production sector increased by 22 percent over the same time period. Employment growth in the food manufacturing and processing sector and forestry sector lagged total employment growth in the Commonwealth.

FIGURE 2.5: PENNSYLVANIA EMPLOYMENT GROWTH INDEX



Source: BLS QCEW (2017)

2.2 THE SPILLOVER IMPACTS OF AGRICULTURE IN PENNSYLVANIA

Looking at the direct impacts of agriculture does not tell the full story of what agriculture means to the Commonwealth's economy. There are inter-industry linkages between the agricultural sectors and other sectors of the economy that generate spillover impacts. These impacts, combined with the direct impacts, provide the complete picture of the agricultural sectors' contribution to the state's economy.

There are two types of spillover impacts.

- First, some proportion of the amount of the expenditure that goes to the purchase of goods and services gets circulated back into an economy when those goods and services are purchased from local vendors, defined as any vendors in Pennsylvania. This represents what is called the ***"indirect effect."***[5]

- Second, some amount of the proportion of that expenditure that goes to labor income gets circulated back into an economy when agricultural employees spend some of their earnings on various goods and services. This represents what is called the ***"induced effect."***

For example, a dairy farm contributes directly to the local economy by selling farm products (milk), employing individuals, and paying wages and salaries. The farm generates spillover impacts by spending money in the local economy. The farmer buys feed from feed suppliers or other farmers, fertilizer and seed, veterinary services, trucking services to haul the milk, equipment, electric and other utilities, insurance, professional services, such as accountants and lawyers and financial services, and farm equipment maintenance and repair. Some of these purchases are from other businesses in the agriculture sector, such as feed, fertilizer and seed, the impact from these purchases are captured in the direct impacts of the other agriculture sectors. The purchases from businesses outside of the agriculture sector, such as trucking services, utilities, and professional

[5] Wholesale distributions of agricultural products, which can be counted in some definitions of agriculture, are captured in the total economic impact of the industry as an indirect impact.

Agriculture contributes $1 out of every $13 of gross state product.

Every dollar of direct output generates $0.62 in additional economic activity.

Agriculture supports 1 out of every 10 jobs in Pennsylvania.

Agriculture generates 7 jobs per $1 million of output.

Agriculture is the 3rd largest sector in terms of employment.

services, generate additional economic impacts outside of the agricultural sector. These impacts are captured in the indirect impacts.

The salaries paid to employees working on the farm, as well as to the farmer themselves, generate additional economic impacts. They spend their wages in the local economy at grocery stores and other retail outlets, on rent and housing, and restaurants and entertainment. These impacts are the induced impacts.

We used standard input-output modeling techniques to estimate the full range of economic, employment, and labor income impacts associated with the direct activity attributable to the agriculture industry. The role of input-output models is to determine the linkages across industries in order to model the magnitude and composition of the spillover impacts.

To model the impacts generated by the agriculture industry, we developed a customized economic impact model using the IMPLAN input/output modeling system. IMPLAN represents an industry standard approach to assess the economic and job creation impacts of economic development projects, the creation of new businesses, and public policy changes.[6][7]

The total economic impact is the sum of the direct, indirect, and induced impacts. We quantified the economic importance of the agricultural sector using the following measures:

- Output
- Employment
- Wages and salaries
- Value added

The total output of the agriculture sector is $135.7 billion, including $84 billion in direct

[6] IMPLAN is one of several popular choices for regional input-output modeling. Each system has its own nuances in establishing proper location coefficients. IMPLAN uses a location quotient to determine its regional purchase coefficient (RPC). This represents the proportion of demand for a good that is filled locally; this assessment helps determine the multiplier for the localized region. Additionally, IMPLAN also accounts for inter-institutional transfers (e.g. firms to households, households to the government) through its Social Account Matrix (SAM) multipliers. IMPLAN takes the multipliers and divides them into 440 industry categories in accordance to the North American Industrial Classification System (NAICS) codes.

[7] Different data and input-output modeling sources can produce different numbers by sector, based on differences in sector definition and year of analysis. We have done our best to reconcile different definitions of agriculture, and through discussions with industry experts, have arrived at an inclusive definition of agriculture and the sectors included in our analysis.

impacts, $28 billion in indirect, and $24 billion in induced. The total impacts of agriculture in the Commonwealth is greater than the gross state product of 18 states, including Delaware, West Virginia, Maine, New Mexico, Mississippi, and Arkansas. Every dollar of direct output of the sector generates $0.62 in additional economic activity throughout the Commonwealth. The total output of the sector is equal to $10,700 per capita.

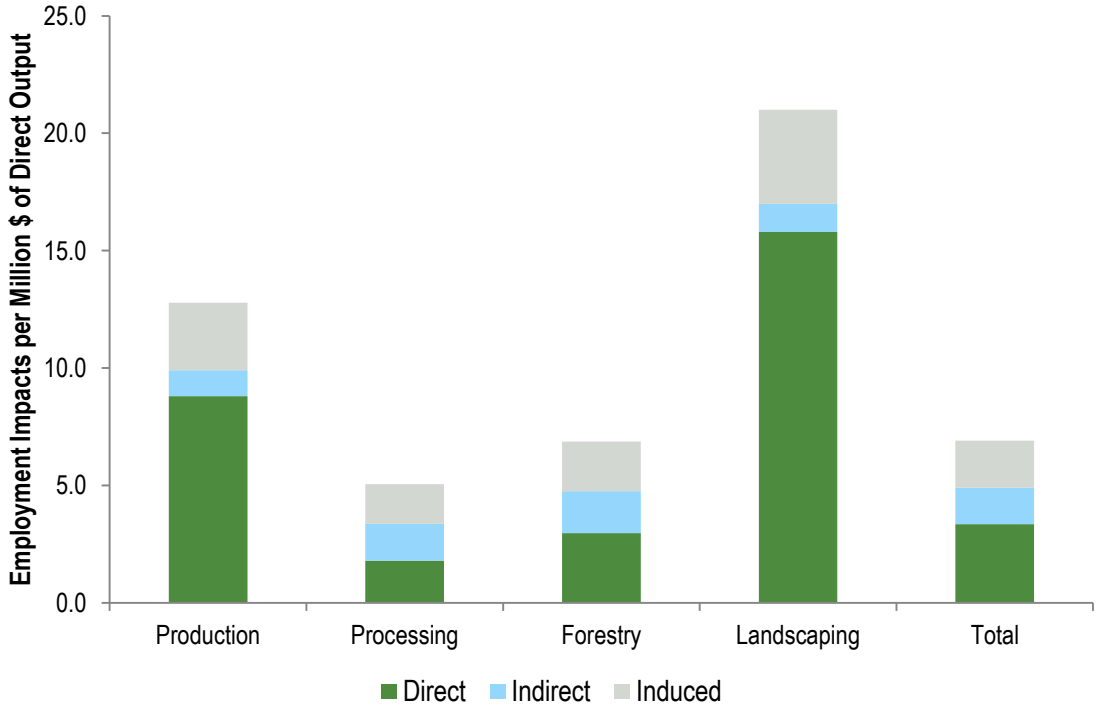
The agriculture sector is a major employer in the Commonwealth, supporting over 579,000 jobs, making it the third largest sector trailing only healthcare and retail trade. On average, the sector supports seven jobs per million dollars of direct output. Every direct job supports 1.06 additional jobs.

The agricultural production sector is more labor-intensive than the food manufacturing and processing sector. The employment impacts range from five total jobs per million dollars of direct output for the food processing sector to 21 total jobs per million of revenue in the landscaping sectors.

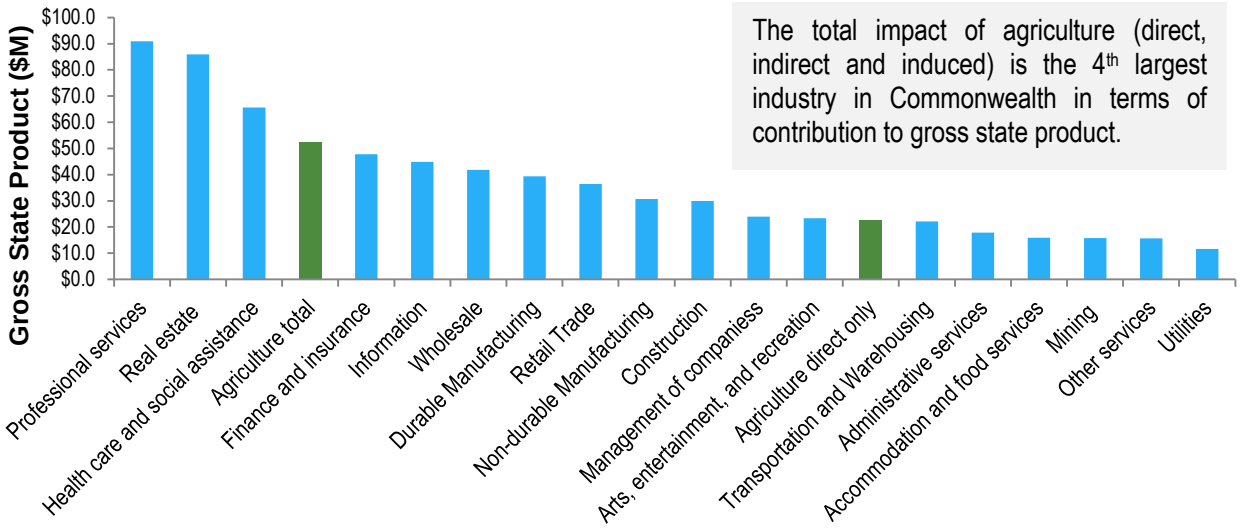
The total value add supported by the agricultural sector is $52.4 billion, including $22.7 billion in direct impacts, $15.4 billion in indirect, and $14.3 billion in induced impacts. Every dollar of direct output generates $0.62 in total value added impacts. In terms of value add, the total impact of the agricultural sector is the fourth largest sector in the Commonwealth, trailing only the professional services, real estate, and healthcare sectors

Value add is essentially the sum of the wages and salaries earned by all workers, income received from self-employed individuals and payments to businesses and individuals in the form of interest, rents, royalties, dividends, profits, and indirect business taxes. The majority of value add ultimately shows as money for residents, which they can then spend in the economy. The total value added is equal to $4,125 per resident.

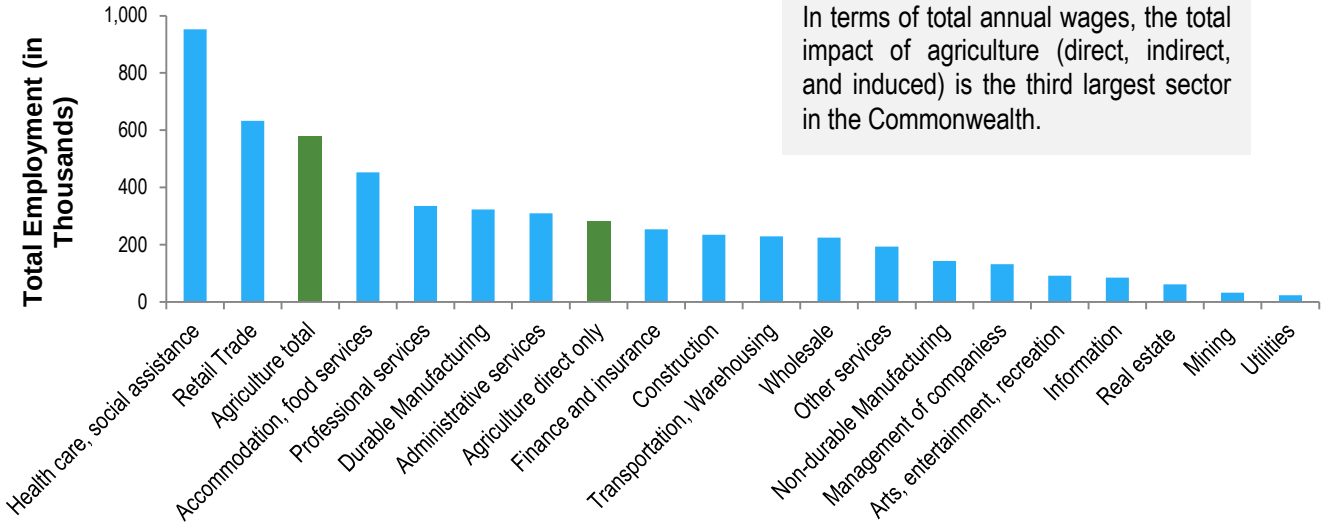
FIGURE 2.6 – DIRECT, INDIRECT, AND INDUCED EMPLOYMENT SUPPORTED BY $1 MILLION OF DIRECT OUTPUT



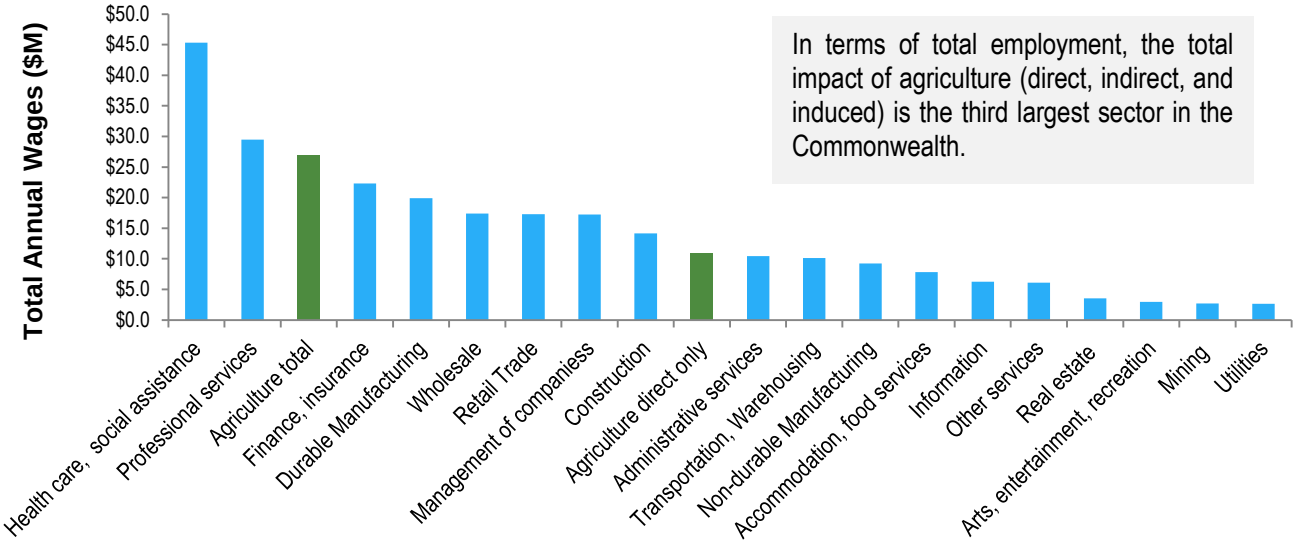
Source: IMPLAN (2015)



The total impact of agriculture (direct, indirect and induced) is the 4th largest industry in Commonwealth in terms of contribution to gross state product.

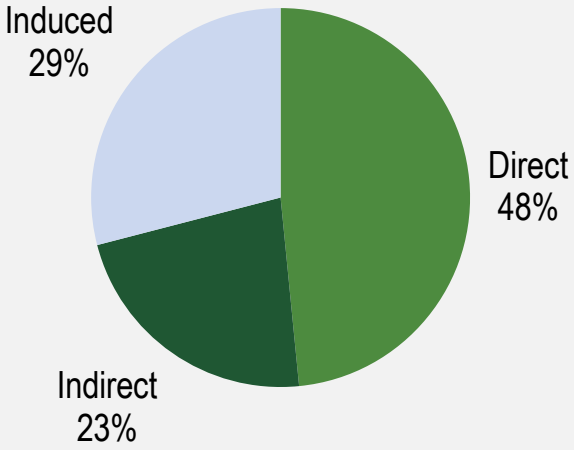


In terms of total annual wages, the total impact of agriculture (direct, indirect, and induced) is the third largest sector in the Commonwealth.



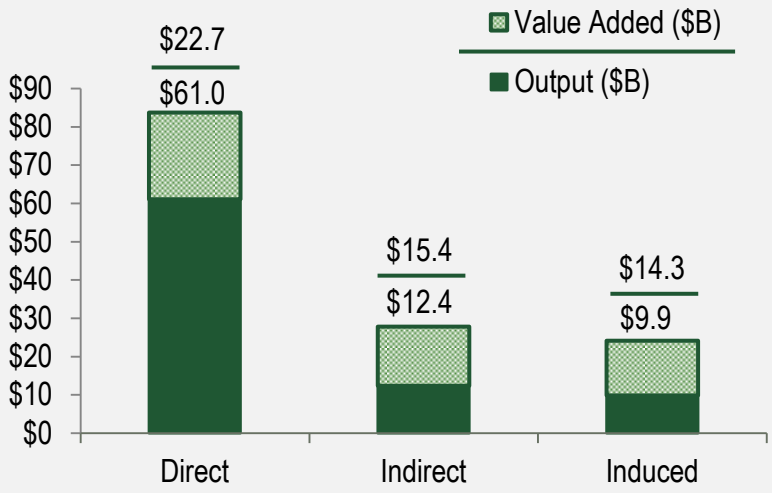
In terms of total employment, the total impact of agriculture (direct, indirect, and induced) is the third largest sector in the Commonwealth.

Total Jobs



579,000
Total Direct, Indirect, and Induced Jobs

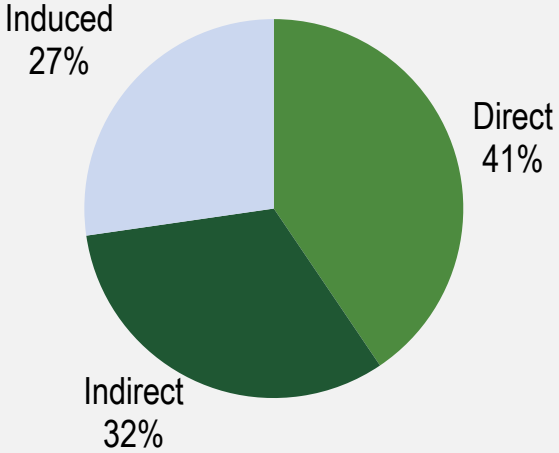
Total Output



$135.7 Billion
Total Direct, Indirect, and Induced Output

$52.4 Billion
Total Direct, Indirect, and Induced Value Added

Total Earnings



$26.9 Billion
Annual Wages & Salaries Supported

Industry Spotlight: The Equine Sector and Horse Racing in Pennsylvania

The equine sector is the second largest animal agricultural industry in Pennsylvania. The sector supports more than 20,000 jobs across the state.[*] A 2017 study by Delaware Valley University found that the equine industry has a $670 million economic impact on the 10-county Southeastern Pennsylvania region. The region's equine industry generates more than $58 million in tax revenues for the Commonwealth. The sector also has experienced significant growth in recent years. There are currently more than 50,000 equines in the 10-county region, an increase of 9.3 percent over the past 5 years. Further, the 10-county region represented just 36 percent of Pennsylvania's equine population and 32 percent of equine farms, indicating that the impact of the equine industry state-wide is significantly greater.

The equine sector is the foundation of the horseracing industry, another major economic driver in the state. Pennsylvania's equine sector supports horseracing through the production and care of racehorses. In a 2013 study, ESI found that Pennsylvania's horseracing industry, underpinned by the state's equine sector, is also a major driver for the Commonwealth's economy. Horseracing in Pennsylvania has an annual economic impact $850 million and supports 14,000 jobs.[+] In addition to the production, care, and transportation of thoroughbreds and standardbreds, racetrack operations support more than 1,300 employees statewide, with total annual earnings of $38.8 million. Pennsylvania racetracks have an aggregate 1,000 racing days per year, drawing over 1 million spectators annually. Racetrack visitors spend an estimated $35 million in ancillary spending annually.

The Pennsylvania Standardbred Breeders Development Fund, Pennsylvania Breeders Fund Award Program, and Pennsylvania Sire Stakes Program help strengthen the equine industry in the Commonwealth. Act 71 of 2004 provided funding for breeders, stallion owners, and owners of Pennsylvania-bred horses who produce top-level horses racing in the state. The program encourages the breeding and racing of horses in Pennsylvania and builds on the long, successful history of the equine sector and horse racing in the state.[A]

* Penn State Extension, *Economic Impact Study of the Pennsylvania Equine Industry*, 2003.
& John M. Urbanchuck, et al. *Impact of the Equine Industry on the Economy of Southeastern Pennsylvania*, Delaware Valley University, 2017.
[+] Econsult Solutions, *The Economic Impact of the Horse Racing Industry in the Commonwealth of Pennsylvania*, 2013.
[A] PDA, "PA Standardbred Breeders Development Fund," and "Pennsylvania Breeders Fund," www.agriculture.pa.gov

Industry Spotlight: Farm Equipment Manufacturing

Pennsylvania has a long history with farm equipment manufacturing. Early in the nineteenth century Joseph and Robert Smith of Berks County invented a practical cast iron plow and a thresher that cleaned and threshed grain in a single operation (patented by Andrew Ralston in 1842) was produced in the factory of Robert McClure in Washington County.

Today, Pennsylvania is home to global-leaders in the farm equipment manufacturing sector, including New Holland Agriculture, a global exporter of agricultural machinery including tractors, combine harvesters, and seeding equipment. Founded in 1895 in New Holland, Pennsylvania, New Holland Agriculture has grown into a global leader in the industry. Its facilities in Pennsylvania include the largest hay tools production facility in the world, and it has been at the forefront of farm equipment innovation, including the development of a renewable, hydrogen-powered tractor. In addition, New Holland has developed an autonomous tractor which can help reduce fatalities from tractor roll-overs, the leading cause of death from farm accidents in Pennsylvania.

In addition to New Holland, Pennsylvania is also home to other farm equipment manufacturers. This includes EBY Trailers, a third-generation family run business that manufactures horse, livestock, flatbed, utility and bulk commodity trailers, used to facilitate transportation throughout the agricultural supply chain. EBY is headquartered and has a large manufacturing facility in Blue Ball, Pennsylvania.

The farm equipment manufacturing sector – including the manufacturing of planting machines, feed processing equipment, tractors and attachments, and milking machines – has a direct economic output of more than $760 million per year in Pennsylvania, employing more than 1,300 residents with $83.4 million in employee compensation. The equipment purchased in-state is captured in the indirect impacts of the agricultural industry's economic impact, and its strong exports bring money into the state, generating additional economic impact to Pennsylvania.

2.3 PA AGRICULTURE'S STRENGTHS, WEAKNESSES, OPPORTUNITIES, AND THREATS

The macro-level factors need to be viewed through the lens of the Strengths, Weaknesses, Opportunities, and Threats (SWOT) facing agriculture in Pennsylvania. The components of SWOT are defined as follows:

- **Strengths**: characteristics of Pennsylvania agriculture that give it an advantage over others.
- **Weaknesses:** characteristics of Pennsylvania agriculture that place it at a disadvantage relative to others.
- **Opportunities**: elements in the environment that Pennsylvania agriculture could exploit to its advantage.
- **Threats:** elements in the environment that could cause trouble for Pennsylvania agriculture.

In general, Strengths and Weaknesses are internal, while the Opportunities and Threats are external. The Strengths and Weaknesses can change over time but not without some work. The Opportunities and Threats are out there in the market, happening whether you like it or not and generally cannot be changed.

The SWOT analysis can help PDA, Team PA, the Agriculture Advisory Board, and industry leaders assess the changing environment surrounding agriculture in Pennsylvania and respond proactively to the macro-level factors.

Pennsylvania's agricultural industry is rooted in a number of strengths that it can build from in responding to threats and opportunities resulting from the macro-factors (Figure 2.7). The diversity and quality of crops and producers, smaller farms, a mix of conventional and natural farming practices, rich soil, a strong farming tradition and a good foundation of agricultural infrastructure will help enable producers and manufacturers to respond proactively.

FIGURE 2.7 – PENNSYLVANIA AGRICULTURE SWOT ANALYSIS



2.4 AGRICULTURAL CLUSTER ANALYSIS

Economic cluster analysis can help identify which sub-sectors within agriculture are growing, which are declining, which sub-sectors Pennsylvania has a competitive advantage in, and which sub-sectors should be the focus of economic development efforts. There are two quantitative methods that are typically used to identify potential clusters: location quotient analysis and shift-share analysis.

A location quotient (LQ) is an indicator of industry concentration within a region, expressed as the ratio of the proportion of the industry locally within the total local economy to the proportion of the industry nationally within the total national economy. It can help reveal what makes a particular region "unique" in comparison to the national average. Therefore, an LQ greater than one indicates that the industry is a bigger piece of the local economy than it is of the national economy, with the implication being that the industry is producing more goods and services than are being consumed locally, and must therefore be exporting them outside of the region. Conversely, an LQ less than one indicates that the industry is a smaller piece of the local economy than it is of the national economy, and therefore the region must be importing those goods and services from outside.

The location quotient for on-farm activity is significantly below one, which indicates that the agricultural sector in the Commonwealth is underperforming. However, the LQ has increased from 0.39 to 0.47, which suggests that the on-farm sector has the potential to increase in importance. The same holds for the landscaping sector. The LQ in the forestry sector is greater than one and has been steadily increasing, which suggests that the Commonwealth has a competitive advantage in this sector over other regions that is increasing and it may have further growth potential. The LQ of the food manufacturing and processing sector, while still above one, has decreased slightly over time. The decline of the LQ of the sector, combined with the large size of the sector, could be endangering the Commonwealth's economy.

The LQ analysis is augmented by two additional pieces of information: the size of industry in terms of the current number of jobs, and percent change in employment over a given time period. A high-LQ industry with a small number of jobs may be an export-oriented industry, but is not vital to the region's economy, while a large, high-LQ industry with declining LQ over time is endangering the regional economy.

To better understand what is driving the impacts in the farm production and food processing and manufacturing sectors, we used detailed employment data to calculate the LQs at the detailed sector levels for 19 sub-sectors (3 and 4 digit NAICS) in the farm production sector and 16 sub-sectors in the food processing and wood product manufacturing sectors.

In Figures 2.9 and 2.10 the X-axis (horizontal axis) indicates the percentage change in employment from 2000-2016, the Y-axis (vertical axis) represents how concentrated the industry is in the region relative to the US (the location quotient) in 2016, and the size of the bubble indicates the number of employees in the respective industries in 2016. Figure 2.9 and Table 2.1 present the

results for the agricultural production sub-sectors and Figure 2.10 and Table 2.2 presents the results for the sub-sectors that comprise the food processing and wood product manufacturing sector.

The LQ analysis allows for the classification of sub-sectors into one of four mutually exclusive categories, each corresponding to specific quadrants in Figures 2.9 and 2.10.

FIGURE 2.8 – LQ CLASSIFICATIONS CATEGORY DEFINITIONS

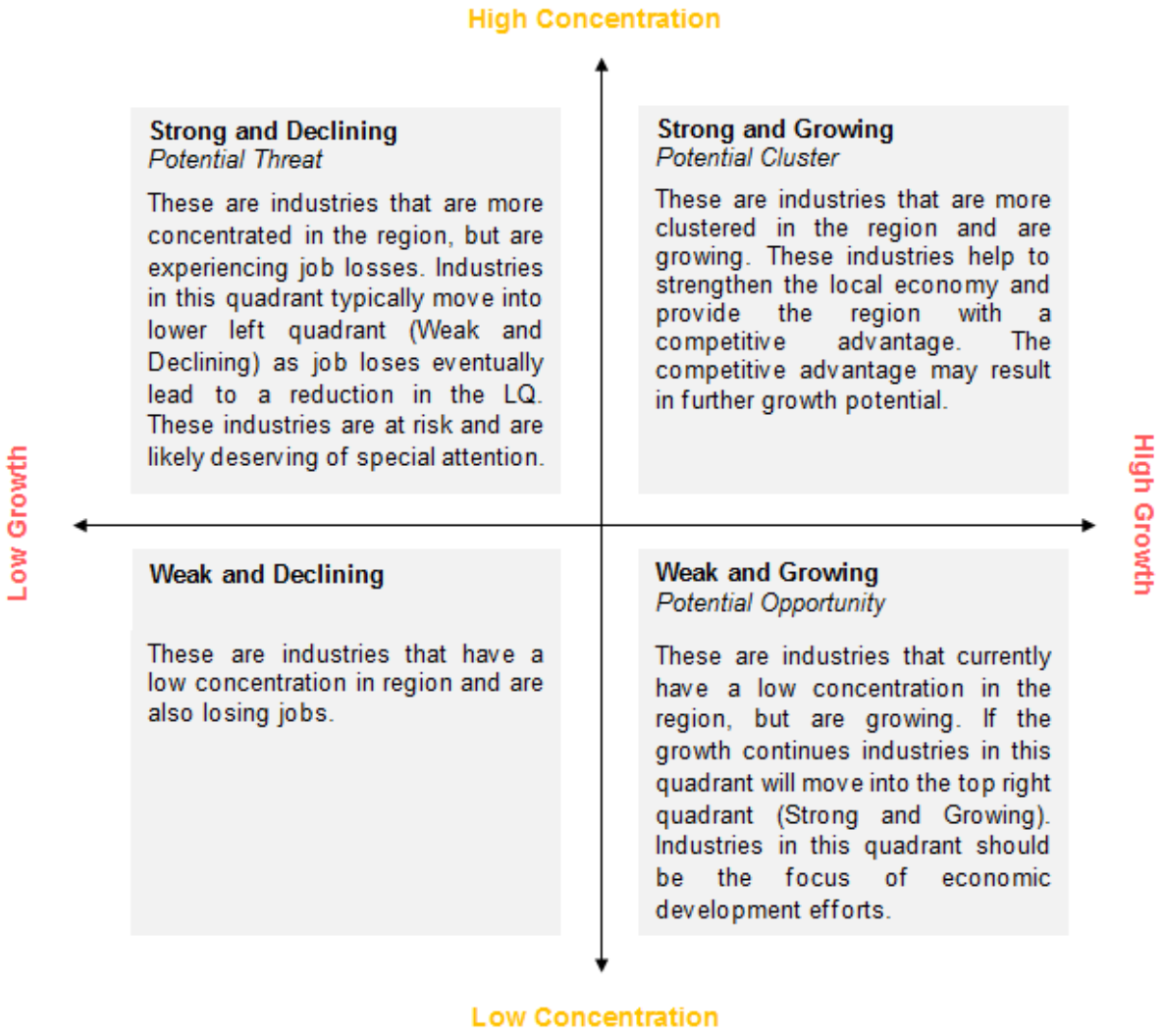
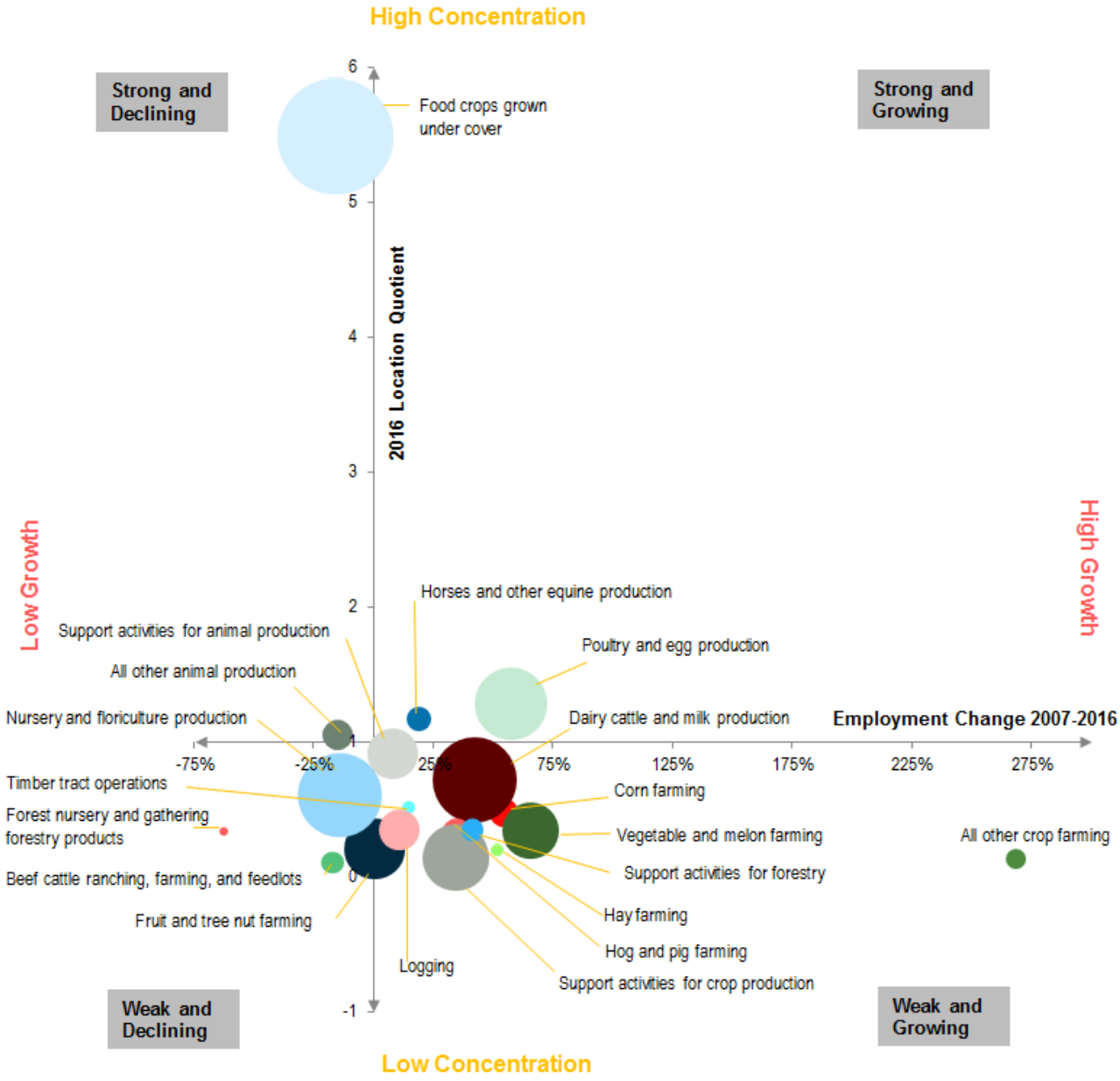


FIGURE 2.9 – FARM PRODUCTION CLUSTER ANALYSIS



Source: BLS QCEW (2017)

TABLE 2.1 – POTENTIAL FARM PRODUCTION CLUSTER ANALYSIS

	LQ 2016	Change in Employment 2007-2016	2016 Employment
Strong and Growing (Potential Cluster)			
Poultry and egg production	1.28	58%	2,314
Horses and other equine production	1.17	19%	289
Strong and Declining (Potential Threat)			
Food crops grown under cover	5.49	-16%	6,012
All other animal production	1.05	-15%	387
Weak and Growing (Potential Opportunity)			
Corn farming	0.47	54%	355
Vegetable and melon farming	0.34	66%	1,404
Fruit and tree nut farming	0.21	1%	1,662
Hay farming	0.20	52%	82
All other crop farming	0.13	269%	177
Dairy cattle and milk production	0.72	42%	3,142
Hog and pig farming	0.32	35%	431
Timber tract operations	0.51	15%	70
Logging	0.34	11%	744
Support activities for crop production	0.14	34%	1,935
Support activities for animal production	0.91	8%	1,133
Support activities for forestry	0.34	41%	219
Weak and Declining			
Nursery and floriculture production	0.60	-14%	3,139
Beef cattle ranching, farming, and feedlots	0.10	-17%	221
Forest nursery and gathering forest products	0.34	-63%	30

Source: BLS QCEW (2017)

Source: BLS QCEW (2017)

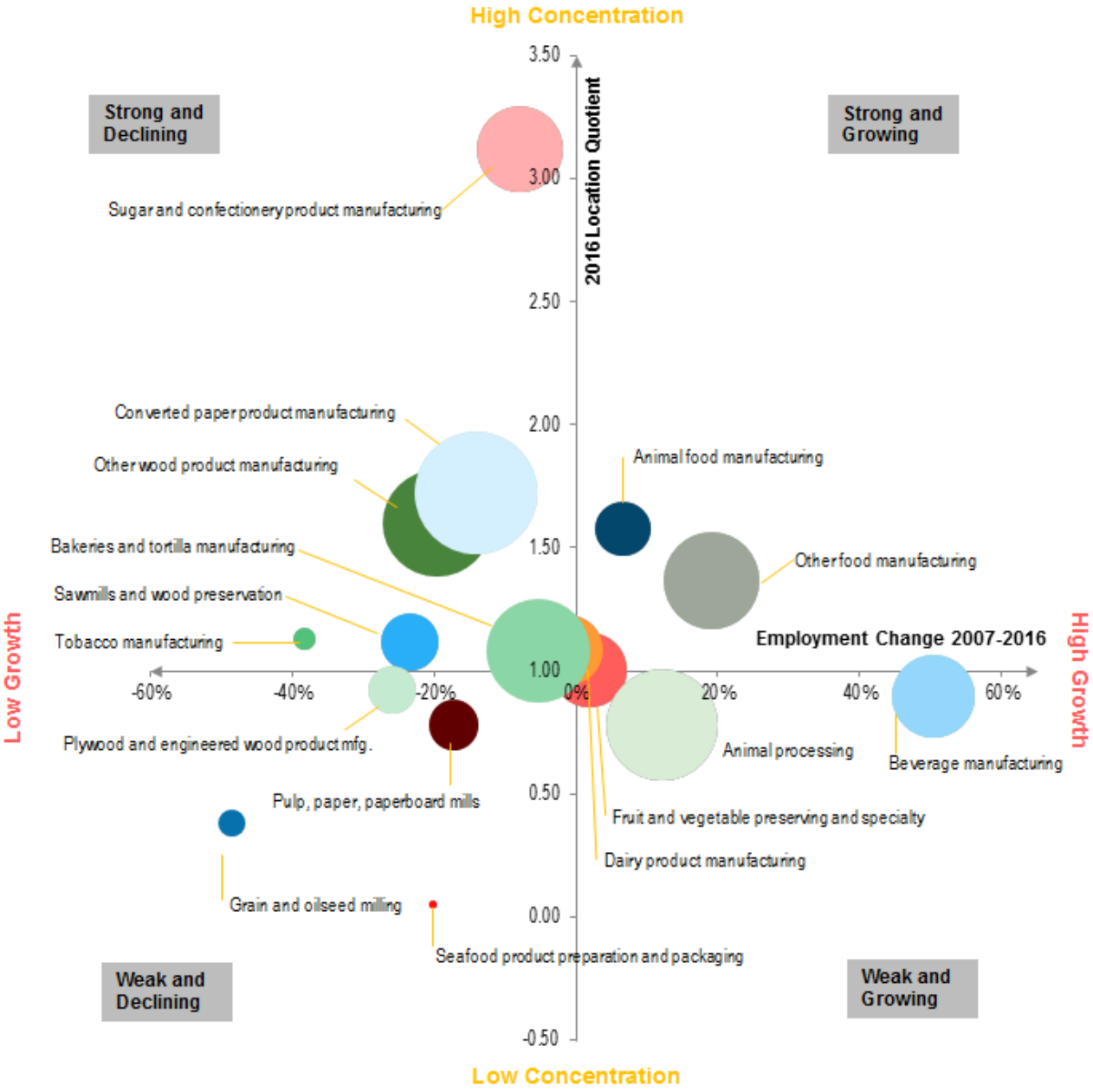
There are two sectors that fall into the strong and growing sector – poultry and egg production and horses and other equine production. Neither of these is surprising – there have been recent significant investments in the poultry sub-sector in Pennsylvania and as illustrated in the box above, the equine sector is very important to the Commonwealth. Two sectors are under threat – food crops grown under cover and all other animal production. These sub-sectors are under threat because, while the Commonwealth currently has a LQ above one for these sectors, they have experienced job losses and if the job loss continues, it will erode the Commonwealth's competitive advantage.

There are 12 sub-sectors that fall into the weak and growing quadrant and are thus candidates for potential cluster development. Given the large number of sub-sectors that fall into this category, PDA and Team PA will likely be unable to focus effectively on all of these sectors. Sectors that represent the best opportunities for PDA and Team PA to support growth include dairy cattle and milk production, support activities for animal production, and vegetable farming.

Within the food processing and wood products manufacturing sector, Pennsylvania has a competitive advantage in the animal food manufacturing, other food manufacturing, and to a lesser extent the fruit and vegetable preserving sub-sectors. There are number of sub-sectors that represent potential threats due to the fact that the Commonwealth currently has a competitive advantage (LQ greater than one), but the advantage is potentially being eroded due to job losses. This includes several wood product manufacturing sectors such as sawmills, other wood product manufacturing, and converted paper product manufacturing.

Two sub-sectors represent potential opportunities for the Commonwealth – animal processing and beverage manufacturing. Within the animal processing sub-sector, the Commonwealth has a competitive advantage in the meat processed from carcasses sector (LQ of 1.22), however the poultry processing sub-sector has a LQ of only 0.47. This suggests that a beef processing sector is able to meet local demand, but significant portion of the poultry raised within the Commonwealth needs to leave the Commonwealth to be processed. When coupled with the competitive advantage enjoyed by the poultry and egg production sector (LQ of 1.28), this suggests that there is significant opportunity for the poultry processing sector to expand. The potential of the beverage manufacturing sector is mainly being driven by the significant recent growth in the number of micro-breweries within the state. Given the fact that the Commonwealth's climate is favorable for growing hops, farmers may be able capitalize on the growth of the micro-brewing sector by diversifying into growing hops to support Pennsylvania breweries and to export to other states.

FIGURE 2.10 – FOOD PROCESSING AND WOOD PRODUCT MANUFACTURING CLUSTER ANALYSIS



Source: BLS QCEW (2017)

TABLE 2.2 – POTENTIAL FOOD PROCESSING AND WOOD PRODUCT MANUFACTURING CLUSTER ANALYSIS

	LQ 2016	Change in Employment 2007-2016	2016 Employment
Strong and Growing (Potential Cluster)			
Animal food manufacturing	1.58	7%	3,869
Fruit and vegetable preserving and specialty	1.01	2%	7,222
Other food manufacturing	1.37	19%	11,914
Strong and Declining (Potential Threat)			
Sugar and confectionery product manufacturing	3.12	-8%	9,619
Dairy product manufacturing	1.08	-1%	6,380
Bakeries and tortilla manufacturing	1.08	-5%	13,866
Tobacco manufacturing	1.13	-38%	606
Sawmills and wood preservation	1.11	-23%	4,269
Other wood product manufacturing	1.60	-20%	14,963
Converted paper product manufacturing	1.73	-14%	19,535
Weak and Growing (Potential Opportunity)			
Animal processing	0.78	12%	16,203
Beverage manufacturing	0.90	50%	8,834
Weak and Declining			
Grain and oilseed milling	0.38	-48%	957
Seafood product preparation and packaging	0.05	-20%	83
Plywood and engineered wood product mfg.	0.92	-26%	2,959
Pulp, paper, and paperboard mills	0.78	-17%	3,269

Source: BLS QCEW (2017)

Shift Share is another standard regional analysis method that attempts to determine how much of regional job growth can be attributed to national trends and how much may be due to unique regional factors. It shows the industries in which the region is outcompeting or under-competing the nation. While LQs focus on the total number of jobs in an industry, shift-share focuses on job growth over a specific period.

Shift Share is typically used to identify industries for investment. This can help high-performing regional industries either continue to outperform national trends or catch up to national trends.

Shift Share disaggregates regional job growth into three components: (1) national growth effect, (2) industrial mix effect, and (3) regional competitive effect.

1). **National Growth Effect**: the change in employment associated with the overall health of the national economy.

2). **Industrial Mix Effect**: the change in employment associated with the health of the industry nationally.

3). **Regional Competitive Effect**: the change in employment associated with the health of the industry locally.

The three components can move in different directions, but their sum is equal to the total change in jobs observed in the region's economy. The most important indicator is the regional shift; a positive value indicates that the local industry is outperforming the national industry, which can be true even if there is a net decrease of jobs. A negative value indicates that the local industry is lagging the national industry, which can be true even when there is a net-increase in employment.

Table 2.3 summarizes the Shift Share analysis for the farm production sub-sectors and Table 2.4 for the food processing and manufacturing sectors.

The Commonwealth appears to have a large competitive advantage in vegetable farming, dairy cattle and milk production, poultry and egg production, logging and various support activities. In the poultry and egg production sector, the job growth would have been minimal (approximately 110 jobs) if it were not for the regional competitive effect, which was responsible for adding nearly 740 jobs in the sector. The food grown under cover and fruit and tree nut farming have experienced large negative regional effects. This suggests that those industries in the Commonwealth are underperforming the national industry. The regional effect in the food crops grown under cover was so negative that it wiped out the job increases that were attributed to general economic growth and growth in the sector nationally. The regional effect was a loss of nearly 2,900 jobs.

Similar to what we found with the LQ analysis, the Commonwealth has a competitive advantage in the fruit and vegetable processing and animal slaughtering and processing sector. In the animal processing sector the regional competitive effect was so large (2,030 jobs) that it was able to offset a large decrease due to changes in the industry naturally. The same holds for many of wood product manufacturing sectors, where large regional competitive effects were able to offset large potential job losses due to changes in the industry nationally.

TABLE 2.3 – FARM PRODUCTION SHIFT SHARE ANALYSIS

	2007	National Growth Effect	Industrial Mix Effect	Regional Competitive Effect	Total Shift	2016
Corn farming	230	13	97	14	125	355
Vegetable and melon farming	848	48	-13	520	556	1,404
Fruit and tree nut farming	1,651	94	125	-208	11	1,662
Food crops grown under cover	7,140	407	1,337	-2,872	-1,128	6,012
Nursery and floriculture production	3,657	208	-932	206	-518	3,139
Hay farming	54	3	12	13	28	82
All other crop farming	48	3	1	125	129	177
Beef cattle ranching, farming, and feedlots	267	15	16	-77	-46	221
Dairy cattle and milk production	2,206	126	460	350	936	3,142
Hog and pig farming	320	18	46	47	111	431
Poultry and egg production	1,468	84	25	738	846	2,314
Horses and other equine production	243	14	-56	88	46	289
All other animal production	455	26	-37	-57	-68	387
Timber tract operations	61	3	-10	16	9	70
Forest nursery and gathering forest products	80	5	-15	-39	-50	30
Logging	672	38	-130	164	72	744
Support activities for crop production	1,441	82	136	276	494	1,935
Support activities for animal production	1,051	60	0	22	82	1,133
Support activities for forestry	155	9	-14	69	64	219

Source: BLS QCEW (2017)

TABLE 2.4 – FOOD PROCESSING AND WOOD PRODUCT MANUFACTURING SHIFT SHARE ANALYSIS

	2007	National Growth Effect	Industrial Mix Effect	Regional Competitive Effect	Total Shift	2016
Animal food manufacturing	3,629	207	386	-353	240	3,869
Grain and oilseed milling	1,858	106	-142	-865	-901	957
Sugar and confectionery product manufacturing	10,444	595	-664	-756	-825	9,619
Fruit and vegetable preserving and specialty	7,094	404	-622	346	128	7,222
Dairy product manufacturing	6,454	368	135	-577	-74	6,380
Animal slaughtering and processing	14,447	823	-1,099	2,032	1,756	16,203
Seafood product preparation and packaging	104	6	-14	-13	-21	83
Bakeries and tortilla manufacturing	14,645	834	504	-2,117	-779	13,866
Other food manufacturing	10,004	570	2,225	-885	1,910	11,914
Beverage manufacturing	5,875	335	1,663	962	2,959	8,834
Tobacco manufacturing	981	56	-464	33	-375	606
Sawmills and wood preservation	5,577	318	-1,304	-321	-1,308	4,269
Plywood and engineered wood product mfg.	3,989	227	-1,397	139	-1,030	2,959
Other wood product manufacturing	18,610	1,060	-5,630	923	-3,647	14,963
Pulp, paper, and paperboard mills	3,951	225	-1,178	271	-682	3,269
Converted paper product manufacturing	22,755	1,296	-5,143	627	-3,220	19,535

Source: BLS QCEW (2017)

Section 3: Drivers and Trends Impacting Agriculture in Pennsylvania



Agriculture is a major industry in Pennsylvania because of more than 200 years of innovation and hard work. The industry has the opportunity to maintain its strength within the state's economy and build on its leadership, but this will take smart policy, public and private investment, and attention to how the world and industry are changing.

Like any industry, the agricultural sector in the United States is undergoing major changes, including shifts in consumer tastes, the adoption of automation and technology, workforce shortages, and evolving environmental pressures. To help Pennsylvania agriculture build on its strengths and enable producers and processors to best position themselves to adapt to and capitalize on these changes, the Pennsylvania agricultural industry needs to understand how these macro-changes will impact the production, processing and manufacturing, forestry, and landscaping sectors within the state.

In order to identify how national and regional trends will impact Pennsylvania, we began with the major drivers identified in the agriculture industry sessions organized by PDA, Team PA, and the Pennsylvania Agricultural Advisory Board in mind. We built on the identified drivers by undertaking a scan of the macro-level factors and regional trends affecting supply and demand for agricultural products. Through our review of existing research studies, analyses, data, and market reports, we identified several key trends impacting Pennsylvania agriculture: regulation and the business environment; automation and efficiency; technology and innovation; trade agreements and exports; decreasing commodity prices; workforce shortages due to changes in immigration policy and the aging of the existing workforce; changing consumer tastes including an increased demand for local and organic food; the aging of Pennsylvania infrastructure; pollinator decline; and the relationship between farm size and profitability in a state dominated by small farms. The importance of these factors was reinforced by the findings of the micro sub-sector teams.

Major Drivers Identified in Agricultural Industry Listening Sessions:

- Business Development & Environment of the Industry
- Human Capital / Workforce / Education
- Communication
- Technology & Science
- Land & Stewardship



3.1 THE MACRO FACTORS

CHANGING CONSUMER TASTES

Demand for Healthy and Local Products

Changing consumer tastes, particularly the growing demand for local food and transparency in food production, create both challenges and opportunities for Pennsylvania farmers and food and beverage processors and manufacturers.[8] This is coupled with an increasing demand for "healthy" and "natural" foods.[9] In addition, due to consumers' shift in preferred products and growing attention to the transparency of food chains – how food is grown, how it is processed, and how it is brought to market – traditional food distribution systems are being challenged through newly-expanded food distribution channels. These include products coming direct from the producer, consumer-supported agriculture, and farmers' markets.[10]

The highest demand for healthy foods is in vegetables, dairy, and animal proteins – including beef, pork, chicken, lamb, and goats – but this also corresponds with changes in demand for snack foods.[11] Changing consumer demands are felt across the agricultural industry, but expressed in

[8] Hartman, L. (2016, September 08). Developing Foods for Millennials. Retrieved August 14, 2017, from http://www.foodprocessing.com/

[9] Nancy Gagliardi, "Consumers Want Healthy Foods--And Will Pay More For Them," *Forbes*, 2015. https://www.forbes.com

10 Agricultural Education in Pennsylvania, Report of the PA Agriculture Education Advisory Committee

[11] B Neese, How the Pennsylvania Snack Food Industry Found Success, Alvernia University, June 9, 2015. https://online.alvernia.edu/

different, sector-specific ways. The movement towards native plants, those that occur naturally in a region and are matched to its growing requirements, has begun to push into the mainstream. Native plants thrive in their region's growing environment and therefore require less supplemental watering and chemical pest treatments, which assists in maintaining healthy soil and water supplies. Several municipalities in Pennsylvania have enacted native plant ordinances to provide for the use of native plants in development. [12] The Hershey Company recently acquired Amplify Snack Brands to build up its "better-for-you" snacks portfolio.[13]

"Healthy" and "natural" can be defined in a number of often sector-specific ways – grass-fed, anti-biotic free, and/or humane. This demand can be met by expanding and shifting the product mixes produced, processed, and manufactured in the state, and by branding Pennsylvania agriculture as natural, authentic, and transparent. The term "local" also adds significant value to agricultural products, providing opportunities for conventional farmers to capitalize on consumer trends through marketing strategies. The close proximity of Pennsylvania agriculture to major urban and suburban centers along the Northeast corridor means that all sectors have the ability to capitalize on "local" access to 35 percent of the national population. Sector-specific impacts and recommendations are detailed in Section 4.

Organic Demand

A second major trend in consumer tastes is the growing demand for organic products. Over the past decade, organic sales more than doubled nation-wide, with $47 billion in organic sales in 2016. [14] Pennsylvania has been a growing leader in this sector.

Growth in Organics

In 2016, 78 percent of Pennsylvania households and 82 percent of households nationwide purchased organic products. Household demand has been driving growth at the farm level. Between 2012 and 2016, the number of certified organic farms in Pennsylvania grew by 18 percent and the total value of organic agricultural products sold more than doubled, with the 2016 organic sales value topping $659 million.

Despite rapid growth at the farm level, there has not been a commensurate increase in processing capacity. Growth in organic processing and manufacturing can help Pennsylvania agriculture increase its share of the increase in organic demand, and prevent the leakage of organic production to processing facilities out of state.

12 Audubon Pennsylvania, " Municipalities," 2017. http://pa.audubon.org

13 Fortune, "Consumers' Obsession with Snacking is Reshaping the Food Industry," www.fortune.com

14 Organic Trade Association, "Robust Organic Sector Stays on Upward Climb, Posts New Records in U.S. Sales," www.ota.com

As noted, since 2008 Pennsylvania rose from third to second nationwide in organic farm sales and now ranks fourth in the number of organic farms, up from sixth. Pennsylvania is also home to industry-leaders in organic processing. For example, Bell & Evans, located in Lebanon County, has been able to capitalize on the growing demand for organic poultry and transparency in animal-welfare. The newest Bell & Evans facility is the world's first organic, humane, animal-welfare chicken hatchery and will help meet the demand for organic broilers, which grew by 115 percent from 2008 to 2014.[15]

PDA has been working with producers who want to transition to organic farming. The Organic Transition Assistance Program, created in 2015, provides funding for farmers to transition to organic production or processing. The Department also hires experts to guide producers and processors through the transition process to minimize bottlenecks that may impact profit margins. PDA also provides support for farmers who have already transitioned to organic to support the productivity and profitability of their organic operations.[16] PDA co-sponsors the annual Growing Pennsylvania Organic Farms Conference, which gives organic farmers the opportunity to learn from international experts in organic and sustainable agriculture. The conference provides direct interactions between organic farmers and leaders in innovative and successful organic techniques, while also strengthening Pennsylvania's ability to meet consumer demands for high quality organic products.[17]

REGULATION AND BUSINESS ENVIRONMENT

The agricultural industry listening sessions identified of the industry's regulatory and business environment as a major factor in Pennsylvania agriculture. The industry must ask itself and ask policymakers whether the state's business environment supports firms and individuals who want to enter or stay in agriculture. Analysis of the business environment and regulations must also be examined in the context of whether they are encouraging or stemming entrepreneurship and innovation. Agriculture is a core part of Pennsylvania's economy because of its long history of leadership and innovation. In order to maintain its current strength, it is important to analyze whether the business and regulatory environment supports continued innovation and investments.

Agriculture in Pennsylvania has a number of strengths that should allow it to capitalize on the new global era in agriculture. It is located in the middle of Boston-Washington corridor, which contains nearly 50 million residents. The Port of Philadelphia provides a gateway for Pennsylvania agricultural and forestry products to the burgeoning global middle class. It is also home to some of the most productive farmland in the world. Pennsylvania's historic leadership in the use of science and technology in agriculture has been supported by its world-class agricultural research institutions at Penn State University, Delaware Valley University,

[15] USDA, "Census of Agriculture," www.agcensus.udsda.gov
[16] PDA, "Funding, Experts Available to Help Farmers Transition to Organic Production," www.agriculture.pa.gov
[17] PDA "Growing Pennsylvania's Organic Farms Conference to Deep-Dive Into Proven Organic Production Techniques," www.agriculture.pa.gov

and the University of Pennsylvania School of Veterinary Medicine.

To unlock the state's full potential, however, the state needs to continue to strive for a more positive business climate. Pennsylvania has recently made significant strides in this area, providing a foundation for further changes to create optimal conditions for agribusiness investments in Pennsylvania. Under the Wolf Administration, the Department of Environmental Protection has undertaken an agency-wide effort to shift its work of issuing permits from being solely a paper-based process to online applications as part of a broader effort to modernize its regulatory permitting functions.

Additionally, tax structures have been updated to provide more appropriate tax conditions for agriculture. The 2016 tax code bill, Act 84 of 2016, included a realty transfer tax exemption for operations with an agriculture conservation easement. This change prevents farms on the backlog for conservation easements and those awaiting final confirmation of easement agreements from being subjected to realty transfer taxes.[18] The subsequent Act 175 made the realty transfer tax exemption retroactive, further benefiting farm owners.[19]

Other recent changes to the tax code include SB 356, which amended the Local Tax Enabling Act to streamline local income tax reporting and subsequently the financial reporting of agricultural operations.[20] The family farm inheritance act also was expanded to include all business structures and trusts that are solely within one family.[21] The 2016 tax code bill made timbering operations eligible for sales and use tax exemption, extending a tax benefit for other sectors of the agricultural industry to the hardwoods sector.[22]

Act 89 of 2016 amended the Clean and Green Preferential Tax Assessment Program, requiring counties to "lock in" land value assessments and prohibiting further changes to assessments short of a county-wide reassessment. This change was created to provide farmers with greater tax predictability. Updated, locked-in assessment values also increased the incentive for farmers in counties where assessed values had not been updated and use values exceeded count assessed values, to protect farmland and forest lands through the Farmland Preservation

Technology Investment

Venture capital investment in agriculture technology has grown steadily since 2012, reaching $4.6 billion domestically and $25 billion globally in 2015. Although investments in 2016 dipped to $3.2 billion, reflecting broader pullback across global venture markets, investment levels are well ahead of the $2.4 billion invested in 2014 and the $0.4 to $0.5 billion invested per year from 2010 to 2012. In addition, the number of deals closed increased between 2015 and 2016, with an uptick of 10 percent compared to the global venture capital market where the number of deals declined by 24 percent during the same time period.*

[18] Pennsylvania Department of Revenue, "2016 State Tax Summary: Act 84 of 2016," www.revenue.pa.gov.
[19] Pennsylvania General Assembly," 2016 Act 185," www.legis.state.pa.us
[20] Pennsylvania General Assembly, "Bill Information: Regular Session 2015-2016, Senate Bill 356," www.legis.state.pa.us
[21] Pennsylvania General Assembly, "Bill Information: Regular Session 2015-2016, Senate Bill 580," www.legis.state.pa.us
[22] Pennsylvania Department of Revenue, "2016 State Tax Summary: Act 84 of 2016," www.revenue.pa.gov.

Program.[23] Together, these changes have ensured that Pennsylvania's tax code better meets the unique needs of the agricultural sector.

The commonwealth has also made significant investments in economic development projects related to agriculture. Over the past three years, Pennsylvania has invested more than $50 million in grants, low-interest loans, and tax credits to agricultural and agribusiness enterprises, helping new farmers start their operations, helping existing farms expand, and helping producers install best management conservation practices to protect vital natural resources among many other projects.

While examining the fiscal and budgetary issues for other aspects of the agricultural industry is beyond the scope of this project, further progress in this area would benefit all industries in Pennsylvania, not just the food and agriculture sector. Efforts to make Pennsylvania's overall business tax and regulatory structure more efficient would generate significant benefits for the food and agriculture sector.

INNOVATION

As noted, Pennsylvania agriculture is grounded in the strength of its innovations and has the opportunity to develop further by capitalizing on technological trends. Innovation in agriculture occurs both with technology and aside from it, and Pennsylvania has the opportunity to draw on the best technology and non-technology related innovations. The listening sessions identified technology and science as one of the core drivers shaping the future of agriculture in Pennsylvania. Industry leaders questioned how the agricultural industry can adopt technology and science to improve efficiency and production, while translating the benefits of this scientific innovation to consumers who may be wary of technology in their food. Research into mega trends in agriculture builds on this area identified as a major driver of Pennsylvania agriculture currently and over the next 10 years.

Pennsylvania is a leader in conservation innovation. It is the only state with a State Conservation Commission (SCC), which is alternately chaired by the Secretaries of Agriculture and Environmental Protection. The 14-member commission recognizes that a strong agricultural future is dependent on being good stewards of the state's natural resources. It works to protect natural

Technology and Broadband

The ability of farms to adopt agriculture innovations is impacted by the limited availability of broadband internet in rural areas. The FCC estimates that only 65 percent of rural areas nationwide have access to broadband internet services, compared to 97 percent access rate of urban areas. In addition, **only 62 percent of Pennsylvania farms have computers with internet access**. Of the 62 percent with internet access, less than two-thirds have broadband internet access. Without internet access and reliance on dial-up-only service, farms are limited in their ability to adopt advances that improve farm productivity, efficiency, and marketing, including e-commerce and blockchain technologies. The New Deal Rural Broadband Act and the Broadband Connections for Rural Opportunities Program Act, both introduced to Congress in 2017, aim to provide grant funding to expand broadband internet access in rural areas. Investment in broadband internet access would open up the technological advances in agriculture to a broader range of farms.

[23] PA Code, "Chapter 137b. Preferential Assessment of Farmland and Forest Land under the Clean and Green Act," www.pacode.com

resources through conservation of soil water and related resources, and administers several conservation programs statewide and works in collaboration with county conservation districts. With the support of the USDA Natural Resources Conservation Service, the SCC helps farmers adopt Best Management Practices to reduce water quality impacts.[24]

It is anticipated that future changes in supply chain agriculture technology will be driven by major investments in e-commerce, crop biotechnology, and farm management software, including agriculture data capturing, decision support software, and big data analytics. [25] These changes can support farmers in addressing other macro trends. More efficient farm management and resource efficiency can create financial buffers against decreasing profit margins, detailed below. Traceability can be used to capitalize on increased consumer demand for transparency in food supply and product differentiation. Blockchain technology, a comprehensive ledger of all transactions in a supply chain, promises to improve the transparency of agriculture value chains, enabling consumers to trace the origin of their food products.

The strength of Pennsylvania's Plain Sect famers has also driven major innovations outside of technological advancements. Use of no-till farming and cover crops, including by Plain Sect farmers are major innovations in soil health. Between 2002 and 2014, no-till adoption increased from 20 percent of acres planted to more than 60 percent. Together with cover crops, no-till farming improves soil health by reducing runoff, building soil organic matter, retaining nutrients, fixing atmospheric nitrogen, and providing weed control. Cover crops can also be used for livestock feed, providing further economic benefit to farmers. Reduced erosion through no-till and cover crops has also made Pennsylvania a leader in addressing the environmental impacts of crop production. The innovations shaping Pennsylvania agriculture come from within and outside of changing technologies.

TRADE AGREEMENTS AND EXPORTS

The changing political climate around trade has created uncertainty for the future of Pennsylvania's agricultural exports. An estimated 18,100 jobs in Pennsylvania are supported by agricultural exports. The state's agricultural exports are valued at $2.4 billion annually. [26] Renegotiations of the North American Free Trade Agreement (NAFTA), and the United States' potential exit from the agreement, coupled with the United States' withdrawal from the Trans-Pacific Partnership (TPP), threaten both the foundation and potential growth of agricultural exports.

Nationwide, China, Canada, and Mexico rank as the top three markets for U.S. agricultural exports. Since NAFTA was signed in 1994, the export of national agricultural and food products to Canada and Mexico increased from $8.9 billion in 1993 to more than $38 billion in 2017. Thirty-seven percent of Pennsylvania's agricultural

[24] PDA, "State Conservation Commission," www.agriculture.pa.gov
[25] Rob Leclerc, "The Next Phase for Agriculture Technology" *Forbes,* 2016. https://www.forbes.com
Shurti Singh, "Agricultural Tech Investment Rises to Record $25 Billion" *Bloomberg,* 2016. https://www.bloomberg.com/

[26] Office of the United States Trade Representative, "Pennsylvania Trade Facts," 2014. www.ustr.gov/

exports go to Canada and Mexico.[27] In 2016, Pennsylvania exported $1.4 billion of agricultural goods to Canada and $205 million to Mexico. In total, Pennsylvania's agricultural exports account for 3.4 percent of the NAFTA total of agricultural goods.[28] Several commodities in Pennsylvania are particularly vulnerable to NAFTA changes, due to the high percentage of those exports that go Canada and Mexico. They include livestock with 86 percent of exports to NAFTA, 86 percent of fruits and vegetables, 60 percent of poultry, 48 percent of beef, 43 percent of pork, and 24 percent of dairy exports.[29]

The United States' withdrawal from the TPP represents an estimated $101.5 million in lost net exports and $177.4 million in lost cash receipts for Pennsylvania. It was also estimated that TPP would have added 760 new jobs to the state from increased agricultural exports. Sectors where Canada and Mexico make up a significant portion of exports are particularly vulnerable to NAFTA renegotiations. Pennsylvania is the top state for hardwood lumber and wood products exports, but China, Canada, and Mexico account for 75 percent of its lumber exports. [30] Across all sectors, trade uncertainty at the federal level is creating uncertainty about the future of Pennsylvania's agricultural exports.

WORKFORCE SHORTAGE

The agricultural workforce shortage in Pennsylvania is driven by three trends: the aging of employees in the sector, uncertain guest worker conditions that decrease the number of both documented and undocumented guest workers, and a skills gap among potential agricultural workers, with concern that the state's pool of skilled workers is insufficient to meet the agricultural industry's current and future needs. The high average age of farmers in the United States is well documented. From 2007 to 2012, the average age of farm principal operators increased from 57.1 years to 58.3 years, more than 17 years older than the average American worker. [31] Pennsylvania falls slightly below the national average, with an average principal operator age of 56.1.[32] However, the Pennsylvania agricultural workforce is impacted by aging throughout the supply chain. The hired workforce is aging, with an average age of 39 and a decrease in the share of workers 20-34 years of age from more than 50 percent in 2000 to less than 40 percent today.[33] The aging of agricultural support workers, including large-animal vets and butchers, further impacts the industry and future workforce shortages.

The changing immigration environment has the greatest impact on crop and animal production, including fruit and tree nut farms; dairy, cattle, and milk production;

[27] Farm and Dairy, "Pa. Farm Bureau Talks NAFTA and Tax Reform," www.farmanddairy.com
[28] United States Department of Agriculture Foreign Agricultural Service, "NAFTA Totals and PA Percentage."
[29] Farm Bureau, "NAFTA by Commodity and by State,"www.fb.org
[30] Interview with Wayne Bender, Bureau Director, Hardwoods Development Council, PDA, October 17, 2017.

31 Farm Credit Council, "Different Ways to Look at the Aging of U.S. Farmers," 2012. http://www.fccouncil.com/
32 USDA National Agriculture Statistics Service "2016 State Agriculture Overview Pennsylvania," 2016. https://www.nass.usda.gov/
33 Philip Martin, "Hired U.S. and California Farm Workers are Aging and Settling Comparisons From 1990, 2000, and 2016," *University California, Davis*, 2017. https://wrdc.usu.edu/files-ou/

greenhouse, nursery, and floriculture; vegetable, mushroom, and melon farming; and other crop production, which rely heavily on hired workers. In 2012, there were more than 65,000 hired workers in Pennsylvania agriculture, collectively earning an estimated $671 million on nearly 15,000 farms across the state. It is estimated that 73 percent of hired workers are non-citizens, and 47 percent are unauthorized.[34]

Farms rely on the H-2A Visa for Temporary Agricultural Workers due to a shortage of qualified domestic workers and the H-2B Visa for Temporary Non-Agricultural Workers, which alleviates workforce shortages in the supply chain, including processing and packaging, and green industries, including landscaping businesses. Political uncertainty about the future of guest worker programs and increased Immigration and Customs Enforcement (ICE) raids to deport undocumented workers threaten the stability of agriculture in Pennsylvania, the ability of farmers to produce and harvest crops, and the ease with which products get through the supply chain to consumers.[35]

PDA projects that there will be 75,042 new and replacement jobs in the agriculture and food industry and its supply and distribution chains over the next 10 years. That represents 22 percent of the total workforce. The most in-demand jobs over the next decade are: landscaping and grounds keeping workers; farmworkers and laborers; crop, nursery, and greenhouse; farmers, ranchers, and other agricultural managers; veterinary technologists and technicians; and farm, ranch, and aquaculture animal workers. In addition, there will be a strong demand for truck drivers, sales representatives, maintenance and repair workers, food batch makers, and team assemblers, amongst many other traditional, support services, and supply chain positions. [36] Together, the aging of the domestic agricultural workforce and potential limitations on temporary foreign workers pose significant challenges to the productivity of Pennsylvania agriculture.

Agriculture futurists have predicted that farm managers and food manufacturers will increasingly rely on automation and robots to fill workforce shortages, including where there are not enough workers available to fill vacancies and for agricultural technology advances that cannot be done by humans. However, the capital costs of automation create barriers for farms, particularly small and medium sized operations, in adopting technological advancements, leaving them vulnerable to ongoing workforce shortages. Therefore, there is a continued need for the agricultural industry to address workforce shortages by addressing the human capital needs of production and processing firms.

In the agricultural industry listening sessions, human capital was identified as one of industry's major drivers. In particular, industry leaders expressed concern over the skills and education gap between the state's current pool of skilled labor and the needs of an increasingly automated and technological industry. PDA has implemented programs that seek to address this skills gap, including the Jobs that Pay Apprenticeship Program for STEM Jobs in Agriculture, micro-credentials, the Desk Guide for Careers in

34 PDA, Facts on the Role of Foreign-Born Workers and Hired Farmworker Labor Force

35 Interview with Scott Sheely, Special Assistant for Workforce Development, PDA, October 10, 2017.

36 PDA, Fast Facts on Agricultural Food Careers in Pennsylvania

the Agriculture and Food Processing Industry, and encouraging the growth of work-based training programs in agriculture. Through the continued development of skills-based programs and matching potential employees with agricultural careers, PDA can support the industry in meeting its human capital needs through the educational and training needed to develop a stronger pool of skilled labor.

The strength of the FFA and 4-H programs in Pennsylvania can be leveraged to educate current students about the opportunities in the agriculture sector that go beyond traditional roles and grow the agricultural skills of the next generation of leaders. More than 12,000 young Pennsylvanians are involved in FFA and nearly 100,000 Pennsylvania residents between the ages of 5 and 18 are enrolled in 4-H activities.[37]

AUTOMATION AND EFFICIENCY

As noted, industry leaders identified science and technology as a major driver of Pennsylvania agriculture. This includes technological changes driving increased automation and efficiency within the industry. Agriculture ranks fourth as the industry for potential automation. It is estimated that 57 percent agricultural work nationwide can be automated.[38] The sectors of crop and animal production, and food and beverage processing and manufacturing are all highly susceptible to automation because much of the activity within these sectors is both physical and predictable. Work that is both physical and predictable suggests the potential for automation.[39]

Large-scale farms in the United States have been leaders in automation, working to increase efficiency and get ahead of workforce shortages due to the aging of the agricultural workforce and the uncertain immigration environment detailed below.[40] Automated processes already exist for cow-milking, apple and other produce picking, and truck driving.[41] However, because the automation adoption is highly correlated with farm size – with large and mega farms having a higher automation potential – automation may continue to widen the productivity gap between large/mega and small/medium farms.[42]

In addition to driving productivity and efficiency gaps, automation will increasingly shape workforce needs within the agricultural sector. The automation of farm and processing work will create a growing demand for technological and scientific jobs within the sector. Agriculture job opportunities with STEM backgrounds are expected to grow. These include plant scientists, food scientists, precision agricultural specialists, sustainable biomaterials specialists, and water resources

[37] PDA, "Fast Facts on Agriculture and Food Careers in Pennsylvania."
[38] James Manyika, Michael Chui, Mehdi Miremadi, Jacques Bughin, Katy George, Paul Willmott, Martin Dewhurst, "A Future That Works: Automation, Employment, And Productivity," *Mckinsey Global Institute*, 2017. https://www.mckinsey.com
[39] James Manyika, Michael Chui, Mehdi Miremadi, Jacques Bughin, Katy George, Paul Willmott, Martin Dewhurst, "A Future That Works: Automation, Employment, And Productivity," *Mckinsey Global Institute*, 2017. https://www.mckinsey.com/
[40] Emily Breslin and John Hartnett, "With Farm Labor Getting Scarcer, Big U.S. Farms Are Preparing To Turn To Robots" *Forbes*, 2017. https://www.forbes.com/
[41] Olivia Schaber, "Robots take over traditional farming practices, but not jobs, in the 'Silicon Valley of agriculture'" *Silicon Valley Business* Journal, 2017. https://www.bizjournals.com/
[42] James Manyika, Michael Chui, Mehdi Miremadi, Jacques Bughin, Katy George, Paul Willmott, Martin Dewhurst, "A Future That Works: Automation, Employment, And Productivity," *Mckinsey Global Institute*, 2017. https://www.mckinsey.com/

scientists and engineers.[43] To best meet the demands of the agriculture sector, programs will need to address workforce shortages in areas including landscaping and grounds keeping workers, farmworkers and laborers, and agricultural managers – and STEM-based careers that support the increased automation of the industry.[44]

PHYSICAL INFRASTRUCTURE

Aging infrastructure is a problem nationwide, and one that restricts the production and transportation of agricultural products throughout the supply chain. Transportation infrastructure, including roads and bridges, rail, airports, and waterways and ports, enables agricultural products to move from production to processing through to wholesale and retail distribution, both domestically and internationally. Pennsylvania has recently made investments to improve the state's roads and bridges, and doubled the container capacity of the Port of Philadelphia while supporting its improved efficiency and potential for future growth. Building on these investments, Pennsylvania can further reduce the negative impact that aging infrastructure can have on the movement of agricultural goods.

Pennsylvania has worked to mitigate the impact of infrastructure on supply chain efficiency and costs incurred to producers. Act 34 of 2016 allows the state's Department of Transportation (PennDOT) to issue special-travel permits to milk-hauling trucks weighing more than 80,000 pounds, allowing them to travel on Pennsylvania's interstate highways. This improves the efficiency of milk shipments, and was developed in response to milk haulers taking longer routes due to weight restrictions placed on aging bridges.[45] The state's aging infrastructure can create inefficiencies throughout supply chains, and incurs costs to producers at a time of decreasing profit margins.

Recent investments in the state's roads and bridges help mitigate the number of operations and supply chains that face inefficiencies due to infrastructure. The bipartisan Act 89 of 2013 transportation funding plan provided the funding to address the state's backlog of transportation infrastructure needs. Since the funding plan was enacted, PennDOT has completed more than 2,300 projects worth $5 billion and has an additional 707 infrastructure project worth $5.3 billion underway. In the past two years, PennDOT has improved nearly 6,300 miles of two-lane roads, resurfaced 2,100 roadway miles, and fixed more than 1,000 bridges that had been structurally deficient. Since 2008, the number of structurally deficient bridges has been nearly halved, from 6,000 to fewer than 3,300.[46] These major investments are ensuring that Pennsylvania's agricultural products will continue to be able to reach markets throughout the state and region, and connect to national transportation infrastructure.

In 2016, Pennsylvania enacted a $300 million comprehensive Capital Investment

[43] USDA National Institute of Food and Agriculture, "One of the best fields for new college graduates? Agriculture," 2015. https://nifa.usda.gov/

[44] Pennsylvania Department of Agriculture, "Fast Facts on Agriculture and Food Careers in Pennsylvania," 2015. http://www.agriculture.pa.gov/

[45] Pennsylvania Department of Transportation, "Governor Wolf Signs Law Eliminating Competitive Disadvantage For Pa Dairy Producers," 2016. http://www.penndot.gov/

[46] PennDOT, "Penn DOT Accomplishments." Office of the Governor, "Governor Wolf Outlines Plan to Invest Additional $2.1 Billion for Highways and Bridges Through New Road MaP Program," www.governor.pa.gov

Broadband Programs:

- Pennsylvania Broadband Initiative: Broadband Investment Incentive Program: Launched in 2018, Pennsylvania's Broadband Investment Incentive offers $35 million of financial incentives to internet service providers bidding to provide download speeds of 100 Mbps in the Connect American Fund II Auction (CAF-II). This will help bidders in Pennsylvania become more competitive to win federal support through CAF-II, which has $1.98 billion in subsidies to provide broadband and services in rural areas.
- Learn more: www.governor.pa.gov/broadband

- USDA – Rural Development: Rural Broadband Access and Loan Guarantee Program: The Broadband Program furnishes loans and loan guarantees to non-profit and for-profit organizations – including corporations, LLCs, state and local governments, and cooperatives – for the construction, improvement, or acquisition costs associated to provide broadband lending speed in eligible areas.
  Learn more: www.rd.usda.cgov

- Pennsylvania Department of Community and Economic Development (DCED) Broadband Funding: Pennsylvania does not have any financial assistance programs that are allocated exclusively for broadband, but DCED administers several broadband-eligible programs.
  Learn more: www.dced.pa.gov

Program at the Port of Philadelphia. The investments will double the container capacity of the Port, enabling agricultural producers and processors to increase exports transported through the Port of Philadelphia. Changes in structure and operation, including new electric post-Panamax container cranes, the reorganization and relocation of warehouse facilities, the construction of new warehouse facilities, and matching the depth of the terminal's berth to the new 45-foot depth of the Delaware River's main channel will all improve the efficiency of the Port. Together, these changes will help producers and processors increase the export of agricultural products through the Port of Philadelphia.[47]

As noted, broadband internet access is another component of infrastructure that impacts the supply chain, limiting the ability of producers and processors to adopt technologies that increase productivity and save operational costs. In addition, broadband technology enables producers to better meet changing consumer demands, including the use of blockchain to increase supply chain transparency and connect to consumers through alternative distribution systems, including direct-to-consumer sales.

ENVIRONMENTAL PRESSURES

Pennsylvania's agricultural leaders recognize the importance of their environmental leadership in sustaining the future of the industry. In the agricultural industry listening sessions, participants identified land stewardship as one of the major drivers of the sector. It is important to account for current and potential environmental pressures that impact the industry in order to build on existing

[47] Office of the Governor, "Governor Wolf Touts Port of Philadelphia Investment to Create Thousands of Middle Class Jobs," www.governor.pa.gov

Pollinator Loss and Protection

Preliminary results of the Bee Informed Partnership's annual loss survey found that that Pennsylvania's bee colonies reported a 51.7 percent in total annual loss in colonies, ranked 12th in Top Colony Loss of all states. Historically, Pennsylvania's bee colonies report a significant increase in total loss each year, often being one of the top 10 states to have a major decline in bee colonies.

Pennsylvania beekeepers have been addressing bee shortages by importing honeybees from the south, which are not well suited to Pennsylvania's climate. PDA is working in cooperation with the Center for Pollinator Research at Penn State on improving the state of pollinator populations in the state through the Pennsylvania Pollinator Projection Plan. The collaborative five-part Pennsylvania Pollinator Protection Plan (P4) serves as a living document to provide current information on the health and status of pollinator populations in the state, as well as provide state-specific best practice recommendations for forage and habitat, pesticide use, and beekeepers, and details on programs throughout the state to support the diverse group of stakeholders involved in pollinator protection.

accomplishments in the area, create collaborative environmental policy that establishes trust between the industry and consumers, and address the use and protection of the state's natural resources.

The agricultural industry in Pennsylvania, particularly crop production, is vulnerable to environmental pressures. Crop production, forestry, landscaping, and other sectors are vulnerable to pollinator decline, invasive species, and changing weather patterns that leave the agricultural industry vulnerable to crop and nutrient losses from droughts, warm winters and cold springs, and extreme rainfall.[48] Together, these threats will impact agricultural productivity and supporting sectors.

Honeybee population is in steep decline, and Pennsylvania ranks as one of the worst hit in the country, with significant bee colony loss. Bees pollinate 75 percent of the states' major crops, and the continued decline of honeybee population could lead to higher food prices, or require farmers to put more land into crop production, as poor pollination leads to yields loss and a reduction in production per acre.[49]

Pollinator decline is a major challenge facing the agriculture industry, but the resources PDA and Penn State are dedicating to research and programming are aimed to slow this decline and mitigate its impact on Pennsylvania agriculture. The Pennsylvania Pollinator Protection Plan provides best practices for agricultural landscapes, including Integrated Pest and Pollinator Management (IPPM).[50]

Crop production and the forestry sector are also vulnerable to invasive and exotic species, including the Spotted Lanternfly,, which was first discovered in Berks County in 2014. This relatively new pest to North America highlights the threat of invasive and exotic species to Pennsylvania agriculture, and how PDA and agricultural researchers work to stem the growth of invasive species. In response to the Spotted Lanternfly, PDA

[48] USDA, "USDA Regional Climate Hubs: Managing Your Risk in a Changing Climate," and "Northeast Climate Hub," www.climatehubs.oce.usda.gov

[49] David Templeton, "Honeybee population in free fall; Pennsylvania among worst hit in nation," Pittsburgh Gazette, May 16, 2015, http://www.post-gazette.com/

[50] Penn State: Center for Pollinator Research, *The Pennsylvania Pollinator Projection Plan*, 2017.

has established quarantines and regulated the movement of product and vehicles. In 2016, PDA received $1.6 million from the USDA for research on Spotted Lanternfly eradication. [51] Penn State's College of Agricultural Sciences and Penn State Extension are at the forefront of education and research to stop the insect's spread and limits the damage it causes to crops. This work helps to address the species' threat to Pennsylvania's hop, grape, tree-fruit, and nursery industries.[52]

A large portion of Pennsylvania's farmland lies within the Chesapeake Bay watershed. Agriculture is the single largest source of nutrient and sediment pollution entering the Bay. According to 2015 estimates from the Bay Program, agriculture contributes 42 percent of the nitrogen, 55 percent of the phosphorous and 60 percent of the sediment entering the Bay.[53] The Chesapeake Bay Program is working with farmers across the watershed to use best management practices to help reduce nutrient runoff into Pennsylvania streams and rivers and ultimately the Bay.

In 2016, Pennsylvania implemented a comprehensive strategy to improve water quality in the Chesapeake Watershed and the state more broadly. The Clean Water Restoration Plan is a joint effort of PDA, DEP, and the Department of Conservation and Natural Resources (DCNR). By integrating technical and financial assistance for farmers, increased data collection, expanded program coordination and capacity, technology, and when-required increased enforcement and compliance measures, the Plan balances agricultural and environmental needs while protecting water quality in the watershed.[54] It is through the collaborative partnerships that Pennsylvania can continue to strengthen its agricultural sector while preserving natural resources for the future of farming and broader environmental health.

Pennsylvania farmers' can apply for Resource Enhancement and Protection (REAP) program tax credits to implement best management practices or purchase on-farm conservation equipment to add conservation credits and improve water quality.[55] Through its tax credit programs,

REAP Program Tax Credits

The REAP program was created in 2007 on a bi-partisan basis to provide tax credits to farmers in support of adopting conservation practices. The program provides up to $150,000 in tax credits per agricultural operation to fund 50 to 75 percent of a conservation project investment.

In the first 10 years of the program, the tax credit has been used to support more than 4,800 conservation projects, keeping nearly 700,000 tons of sediment on fields and nearly 12 million pounds of nitrogen and 800,000 pounds of phosphorus out of Pennsylvania waterways.

[51] Pennsylvania Pressroom, "PA Awarded $2.8 Million from USDA to Promote Specialty Crops, Protect Against Plant Pests, Diseases," www,media.pa.gov.
[52] Chuck Gill "Penn State researchers take aim at invasive, 'pernicious' spotted lanternfly" *Penn State News* 2017. http://news.psu.edu/story/
Pennsylvania Department of Agriculture, "Spotted Lanternfly" 2017 http://www.agriculture.pa.gov/
[53] Chesapeake Bay Program. "Agriculture," www.chesapeakebay.net

[54] Pennsylvania Pressroom, "Pennsylvania Unveils Comprehensive Strategy to Improve Water Quality in state and Chesapeake Bay Watershed," www.media.pa.gov.
[55] Pennsylvania Pressroom, "Tax Credits Available to Help Farmers Add Conservation Practices, Improve Water Quality," www.media.pa.gov

PDA is helping farmers reduce the industry's environmental impact.

Changes to on-farm practices must also account for the changing climate and weather patterns that are expected to impact Pennsylvania agriculture. Producers will need to adapt to continued warming trends, more frequent and intense heat waves, and increased precipitation, particularly in the winter and spring.[56] Research from Penn State and the Pennsylvania Department of Environmental Protection has identified several adaptive strategies including mitigating heat stress in dairy herds, planting different grain and fruit crop varieties or crops, and preparing for more aggressive pest, disease, and invasive species outbreaks.[57] The USDA's Northeast Climate Hub is connecting agricultural stakeholders to climate-related resources and addressing gaps in related information by building network collaborations across 12 states from West Virginia to Maine. The Northeast Climate Hub provides technical support for land managers, regional assessments for climate change adaptation planning, and outreach and education to help land managers adapt to climate-related risks while increasing the long-term sustainability of land under agricultural production.[58]

[56] Pennsylvania State University, Pennsylvania Department of Agriculture, "Pennsylvania Climate Impact Assessment Report Topics in Focus: Agriculture," 2016. www.iee.psu.edu/
[57] Pennsylvania State University, Pennsylvania Department of Agriculture, "Pennsylvania Climate Impact Assessment Report Topics in Focus: Agriculture," 2016
[58] USDA, "USDA Regional Climate Hubs: Managing Your Risk in a Changing Climate," and "Northeast Climate Hub," www.climatehubs.oce.usda.gov



Section 4: Industry and Policy Recommendations

Our economic impact analysis demonstrates that agriculture is a core part of Pennsylvania's economy. The industry supports more than 579,000 jobs in the Commonwealth, with an annual economic impact of $135.7 billion. However, as detailed in Chapter 3, the agricultural sector can best position itself to build on its strengths and capitalize on opportunities by positioning itself to address and adapt to changing consumer tastes, increased automation, workforce shortages, and uncertain trade and guest worker conditions.

This section details recommendations for the agricultural industry and for the government to support industry changes. These recommendations are intended to guide various sectors of the agriculture industry in the development of a strategic plan, the next step in the proactive, collaborative work to best position the industry for the opportunities and challenges it will face over the next decade and beyond. They build on the major drivers identified in the industry listening sessions. The recommendations are organized into six major areas.

In recent years, Pennsylvania has implemented key policy changes that provide opportunities and support across these seven areas. These accomplishments are identified to provide context for the challenges, goals, and strategies within each area. The recommendations are a mix of pragmatic and aspirational strategies, identifying changes that industry and policymakers can implement, and goals that both can strive towards in the development of a 10-year strategic plan that is tailored toward the needs of each particular industry in Pennsylvania's agriculture sector. The strategies for achieving each area's goals are detailed, providing recommendations for how the Pennsylvania agricultural industry can best capitalize on its strengths and opportunities in the future.



CAPITALIZE ON BRANDING AND MARKETING OPPORTUNITIES

Challenge: Low visibility of the connection between the PA Preferred™ brand and consumer demand for local, natural products and transparent supply chains.

Goal: Develop the PA Preferred™ program as synonymous with local, healthy, and traceable, and expand producer enrollment in the program, targeting sectors that are well positioned to capitalize on changing consumer trends.

Recent Related Accomplishments:

- **PA Preferred™ Culinary Connection**: The Pennsylvania Preferred Culinary Connection Stage provides chefs throughout Pennsylvania the opportunity to demonstrate their use of state-sourced agricultural products. The program highlights Pennsylvania's farm to table connection.[59]

- **PA Preferred™ Brews**: Launched in 2017, the PA Preferred™ Brews initiative provides branding for beers that are brewed in Pennsylvania using agricultural commodities that are grown in state. The branding positions commodity producers, breweries, pubs, and grocery stores to capitalize on local demand in the rapidly growing $5.8 billion beer brewing industry in Pennsylvania.[60]

- **Philly Farm & Food Fest**: In recent years, PDA has begun to participate in the Philly Farm & Food Fest, an annual event that connects consumers with local farmers, processors, and food and farm organizations. Participation in this event helps PDA grow consumer awareness between PA Preferred™ and demand for local products.

- **Farm to School Tour**: The 2015 'Farm to School' tour, where state officials from PDA and the Department of Education visited schools throughout Pennsylvania to help students make the connection between healthy, Pennsylvania-grown foods and academic achievement, is one example of how farm to school programs build awareness of Pennsylvania agriculture. The tour also increases agricultural dollars in-state through procurement programs for cafeterias to purchase local agricultural products for school meals and snacks.

Strategies:

- Focus on branding PA Preferred™ as local and traceable
- Increase outreach for enrollment in the PA Preferred™ Program
- Strategically market sectors that are well positioned to capitalize on demand for natural products

[59] Pennsylvania Pressroom, "PA Preferred™ Culinary Connection Calling All Chefs," www.media.pa.gov.

[60] Penn Live, "Some Craft Beer is now Officially PA Preferred Under New Initiative," www.pennlive.com

- Boost domestic markets and value-added manufacturing opportunities for Pennsylvania hardwoods
- Expand farm to school programs to build awareness of agriculture and agricultural products in Pennsylvania

As noted in the review of market trends impacting Pennsylvania agriculture, there is increased consumer demand for healthy products and products produced through local and traceable supply chains. This shift in consumer tastes creates a branding and marketing opportunity for Pennsylvania agriculture. The agricultural industry listening sessions identified the need for the industry to speak with a single message and to convey to consumers the benefits of purchasing Pennsylvania-grown products. Pennsylvania agriculture can build on the PA Preferred™ brand to better meet the growing demand for authenticity and transparency. We recommend four primary strategies for developing the Pennsylvania agriculture's branding and marketing: branding PA Preferred™ as local and traceable, increasing enrollment in the PA Preferred™ Program through targeted outreach to producers and processors, strategically marketing sectors that are well positioned to capitalize on demand for natural products, and boosting domestic markets for Pennsylvania hardwoods. Together, these strategies can raise the profile of Pennsylvania agriculture and grow regional and national markets for agricultural products produced and processed in the state.

4.1.1 Focus on Branding PA Preferred™ as Local and Traceable

Changing consumer tastes have increased demand for products that are healthy, natural, and local. In addition, there is a growing interest in where and how agricultural products are produced and processed. This consumer trend, for locally source foods from identified producers, is found across a wide range of foods, including vegetables, dairy, and animal proteins – including beef, lamb, goats, pork, and poultry – as well as snack foods. The food system creates an opportunity for Pennsylvania agriculture to focus on branding its existing PA Preferred™ Program as local, with identified farm of origin on products.[61] A strategic marketing plan for the PA Preferred™ program can boost recognition of Pennsylvania agriculture as synonymous with these trends in state and regional markets. As noted, consumer demand for local products also creates marketing opportunities for conventional farmers, in addition to those who are looking to transition to organic production.

PA Preferred™, introduced in 2004 and enacted into law in 2011, markets and advertises Pennsylvania agricultural products. The program is open to products that are entirely harvested from a Pennsylvania location, or which are grown in the Commonwealth for at least 75 percent of their production cycle. Agricultural products processed in Pennsylvania, whether in whole or in part, are also eligible. In addition to certifying products, the program connects Pennsylvania companies with suppliers,

[61] "Governor Wolf Announces New Branding Program for PA-Brewed Beers; Touts 'Jobs that Pay' Potential of Local Brewers," 2017, /www.governor.pa.gov/

distributors, retailers and restaurants, helping members grow and reach consumers. As illustrated by the recent marketing push to enroll and promote Pennsylvania breweries, the program can adopt initiatives with targeted messages.

As part of its strategic marketing plan, PA Preferred™ can continue in external and consumer-facing events to grow brand recognition. This includes farm and food festivals that target consumers who are interested in local foods and direct-to-consumer purchasing, such as the Philly Farm & Food Fest, which PDA and PA Preferred™ have been participating in for the past several years. Through strategic marketing, PA Preferred™ can build the perception that Pennsylvania agriculture is synonymous with local and traceable.

PA Preferred™ should also target marketing in alternative distribution systems, including an emphasis on Pennsylvania products meeting culinary and ethnic demand for local protein sources. Through effective branding, PA Preferred™ can also help traditional distribution systems meet consumer demands for local and traceable food. Raising consumer awareness of PA Preferred™ should be coupled with connecting regional wholesale and retail food companies with producers and processors across the state.

Pennsylvania farms are situated in close proximity to major metropolitan areas throughout the Northeast corridor. Their location makes them well positioned to claim localness in both alternative and traditional food systems. Although Pennsylvania agriculture faces challenges in price-point and efficiency due to farm size, climate conditions, transportation infrastructure, and productivity position farms throughout the state to capitalize on premium and value-added markets, focusing on regional demands for local animal proteins, dairy, produce, and native plants.

4.1.2 Increase Producer Enrollment in the PA Preferred™ Program

The Department of Agriculture can increase the effectiveness of strategically marketing the PA Preferred™ brand by increased outreach for producer and processer enrollment in the program. The recently launched PA Preferred™ Brews branding initiative demonstrates how innovative marketing can build on the existing PA Preferred™ brand, and incentivize producers and processors to enroll in the program. The program was designed to support both the brewers, and hops and wheat producers across the state. By enrolling in PA Preferred™ Brews, program members can use the PA Preferred™ logo on products that are brewed in Pennsylvania in compliance with state and federal standards, and are produced using agricultural commodities grown in the state.[62] In addition to product-branding, the program promotes PA Preferred Brews with branded tap and handles and coasters at pubs, bars, and restaurants throughout the state.[63]

Increased enrollment in the PA Preferred™ brand can be used to connect producers and consumers across a range of agricultural products. Targeted outreach to plant nurseries and landscapers can be focused

[62] "Governor Wolf Announces New Branding Program for PA-Brewed Beers; Touts 'Jobs that Pay' Potential of Local Brewers," 2017. https://www.governor.pa.gov
[63] Sue Gleiter, "Some craft beer is officially PA Preferred under new initiative" *Penn Live* 2017. www.pennlive.com/food/index.ssf

on strengthening connection between producers, wholesalers, and retailers in the landscaping sector. PA Preferred can encourage enrollment by facilitating connections between plant nurseries and landscapers that produce native plants, and state municipalities and other institutions that have native plant requirements. This facilitation should be highlighted as a member benefit when conducting target outreach. The PA Preferred™ program's efforts to increase brand recognition in alternative and traditional distribution systems, and among the general public, should also be highlighted as a member benefit when undertaking efforts to increase enrollment in the program.

4.1.3 Support Sectors Well Positioned to Capitalize on Demand for Natural Products

As noted, demand for natural and local is uneven amongst sectors. Although there is growth across all sectors, the effectiveness of strategic marketing can be improved by supporting sectors that have high consumer demand for local and traceable products. Targeting support in these areas can help close the gap between current supply and market demand. Inversely, targeted marketing can close gaps in consumer awareness of local products that already satisfy their demands.

Market trends have identified animal proteins, produce, dairy, and snack foods as leading sectors for the demand for natural, local, and traceable products. Demand for grass-fed and organic beef is projected to account for one-third of beef demand within a decade.[64] Between 2008 and 2014, demand for organic broilers grew by 115 percent.[65] Pennsylvania farms have already begun to capitalize on this trend, with 250 dairy farms adding broiler chicken operations between 2015 and 2017.[66]

Goat, lamb, and sheep are increasingly used to meet the demand for local animal proteins in the culinary and Halal communities throughout the mid-Atlantic.[67] Demand for local produce has increased with the demand for community supported agriculture (CSAs), farmers' markets, and other, direct-to-consumer distribution systems. Supporting growth in these sectors, through expanded and diversified production, can enable Pennsylvania agriculture to better meet changing consumer demands through strategic marketing and brand recognition.

4.1.4 Boost Domestic Markets for Pennsylvania Hardwoods

Pennsylvania hardwoods have strong brand recognition internationally, due to the quality of hardwoods grown in the state and the work of the Hardwoods Development Council (HDC) to boost international markets.[68] Pennsylvania is the largest producer of hardwoods in the United States,

[64] ix.VanOverbeke, H. a. (n.d.). Retail and Foodservice Marketing Trends for Beef. Retrieved from Cabpartners.com: www.cabpartners.com

[65] The Poultry Site, "USDA International Egg and Poultry: NAFTA, the First Twenty Years," 2014. www.thepoultrysite.com/reports/?id=3446

[66] Zack Hoopes, "Diversifying Dairy: Seeking solutions for Pennsylvania farms," *Cumberland Valley Business Journal*, 2017. cumberlink.com/

[67] Chris Kick, "Goat meat is in high demand," *Farm and Dairy*, 2012. www.farmanddairy.com/

[68] Sanford Smith, "From the Woods: Ten Important Hardwoods," *Pennsylvania State University*, 2017. extension.psu.edu/

with $11 billion in annual sales. More than 58 percent of land in Pennsylvania is forested, including hardwoods as 90 percent of forested lands. The quality of the state's hardwoods sector is enabled by Pennsylvania's rich soil composition, mountain elevation, and tight growth rings.[69]

The quality of Pennsylvania hardwood has created strong international recognition and demand. However, changing international market demands are impacting where hardwood processing occurs, and subsequently the value-add for hardwood products and demand for forestry support services work. A major concern is that China has increased its demand for raw saw logs. Log exports from Pennsylvania to China increased 118 percent in 2016 and 32 percent in 2017 (through October) – much of this being saw logs. The export of saw logs makes it more difficult for sawmills to supply lumber for their domestic market and other export customers, and increases the costs of the raw material. Historically, most log exports were primarily high quality veneer logs to meet the demand of the veneer industry in Europe and in Southeast Asia. Continued increased demand in China for saw logs could result in costing jobs in closed sawmills. Growing the domestic demand for Pennsylvania hardwoods would help keep more sawmill work within the state.

The expansion of the domestic Pennsylvania hardwoods market should build on the existing Pennsylvania Hardwoods: Stands for Quality brand. The logo has high brand recognition in international hardwood markets, and presents a strong foothold for the sector to grow its markets domestically through consistent branding. HDC has focused its efforts to boost domestic demand through strategic marketing to architects and designers to grow demand for hardwood in the United States, participating in more consumer-based shows to create direct-consumer demand for Pennsylvania hardwoods, and public education on the environmental benefits of hardwood products. The HDC has also focused on new hardwoods applications, including thermally modified hardwoods and cross-laminated timber, to create increased demand for hardwoods in the construction industry. The hardwood sector is a leader within Pennsylvania's agricultural community, and strategic development and marketing can support its continued strength.

4.1.5 Expand Farm to School Programs to Build Awareness of Agriculture and Agricultural Products in Pennsylvania

Farm to school programs have three main areas of focus: 1. Classroom curriculum; 2. Experiential learning; and 3. Access to healthy, local foods through cafeteria procurement. [70] Growing farm to school programs throughout the state and the emphasis placed on agricultural careers in classroom curriculum can increase interest in food-related careers. Farm to school programs introduce children to education activities related to agriculture, food, and health from an early age, while providing them with access to nutritious food. The integration of food access and education is strengthened through hands-on, experiential learning about agriculture and provides a

[69] PDA, "Hardwoods Development Council," www.agriculture.pa.gov

70 Interview with Patrick Andrews, PDA Bureau of Market Development, October 6, 2017.

foundation for advanced agricultural-related education at the secondary school level.[71] Exposure to Pennsylvania agriculture through farm to school programs, including the "Farm to School" tour, helps to create PA Preferred™ brand awareness, encourage changes in procurement programs for school cafeterias to purchase PA-grown products, and increase students' awareness of potential agricultural careers.

Currently there are more than 150 high school agricultural programs in Pennsylvania, with 16,000 agriculture students, approximately 2.9 percent of all high school students in the Commonwealth.[72] To position the Pennsylvania workforce for the increased automation of the agricultural industry, classroom curriculum on food and agriculture should be encouraged in science, technology, engineering, and math (STEM) programs. The state can build on existing programs by emphasizing the technical skills and innovation required in an increasingly automated sector. Integrating food and agricultural science into STEM-courses outside agricultural programs can expose a broader number of students to career opportunities in the industry.

71 National Farm to School Network, "About Farm to School What is farm to school, and how does it contribute to vibrant communities?" 2017. http://www.farmtoschool.org/about/
72 Pennsylvania Department of Agriculture, "Fast Facts on Agriculture and Food Careers in Pennsylvania," (2017). http://www.education.pa.gov/

EXPAND ON AGRICULTURAL INFRASTRUCTURE

Challenge: Gaps in production, processing, and manufacturing of agricultural products limits the productivity and growth of Pennsylvania agriculture.

Goal: Reduce supply/demand gaps throughout the supply chain by strategically increasing processing and manufacturing capacity, while continuing to preserve agricultural land through the Farmland Preservation Program.

Recent Related Accomplishments:

- **Farmland Preservation Program**: Since 1988, nearly 550,000 acres of Pennsylvania farmland have been preserved through $1.4 billion in state, local, and federal investments under the Farmland Preservation Program. This nation-leading program supports the state's agricultural infrastructure by protecting prime farmland from development.

- **Succession Planning for Preserved Farms**: PDA recently created a Preserved Farm Resource Center to support farmers who have preserved land under the Farmland Preservation Program to develop and implement a farm succession plan. The Center also holds workshops for preserved farm owners across Pennsylvania. This work further protects preserved land from being converted to non-agricultural use.

- **Opportunities and Funding for Farm Transition**: Beyond preserved farms, PDA's Center for Farm Transition strengthens agricultural infrastructure by connecting farmers transitioning out of the business with new farmers to keep the land in agricultural production. By partnering with Pennsylvania Farm Link, the Center holds succession/transition planning workshops and facilitates potential matches between landowners and beginning farmers. Between 2007 and 2012, the number of principal operators between 25 and 34 years of age grew by 2.2 percent – only the second increase in that age demographic over the past century.[73] A recent survey of current and aspiring farmers under 40 years of age found that access to land and student loan debt are the top two barriers to entering the industry. Funding for farm transition programs help aspiring farmers reduce both of these barriers.[74]

- **Funding to Support New and Beginning Farmers**: In addition to matching beginning farmers to landowners planning farm transitions, Pennsylvania provides tax exempt loans. Since 1998, the Next Generation Farmer Loan Program (NGFLP) assists beginning and new farmers with tax exempt loans. In 2015, NGLFP provided 18 tax-exempt loans totaling more than $7.7 million, which generated an

[73] USDA, "2012 Census Highlights: Farm Demographics," www.agcensus.usda.gov
[74] National Young Farmers Coalition, "Building a Future with Farmers II: Results and Recommendations from the 2017 National Young Farmer Survey," www.youngfarmers.org

additional $7 million in private and federal funding. The 18 new farmers that secured these loans enabled the transfer of 1,800 – 2,000 acres of land, further protecting this key agricultural resource.

- **Southwest Pennsylvania Local Food Shed**: In 2017, PDA provided a grant to expand food production and exportation in Southwestern Pennsylvania through the expansion of the Republic Food Enterprise Center. The Center serves as an agricultural hub in the southwest region of the state, and the creation of the Southwestern Pennsylvania Local Food Shed is structured to create sustainable agricultural products, create jobs in the agricultural sector, and bridge gaps between farm and table by expanding established markets and deploying technology to improve efficiency and distribution.

- **Increased Agricultural Building Code Exemptions**: Act 35 of 2017 amended the PA Construction Code to provide producers with an exemption for one structure that is used for direct, seasonal sales of agricultural commodities, structures under 1,000 sq. ft. used to process maple sap, and structures used to load, unload, or sort livestock on livestock auction facilities. These exemptions support agricultural-related physical infrastructure that facilitate production and processing.

- **Expansion into Wholesale Markets through the PA Preferred™ Program**: In 2017, the PA Preferred™ program launched a series of workshops to help farmers expand into institutional wholesale markets to expand their sales. The expansion into alternative distribution systems, including schools, universities, hospitals, and retirement homes, can create greater economic security from sales diversification.[75]

Strategies:

- Maintain the strength of Pennsylvania's nation-leading Farmland Preservation Program
- Improve volume, quality and price realization to address existing gaps in the processing and manufacturing infrastructure, including organic and extended shelf life production
- Invest in sectors with projected growth to minimize future processing bottlenecks
- Support processing automation to increase productivity and efficiency
- Increase byproduct processing capacity to reduce food waste and increase product diversification

Pennsylvania has strong agricultural production and processing/manufacturing sectors, but greater alignment between production and current processing capacity strengthens economic impact and employment. Central to increasing the current efficiency and productivity of Pennsylvania agriculture and optimizing future growth is strategic investments in the state's processing capacity and distribution systems. By targeting sectors that are currently experiencing processing shortages and areas of anticipated shortages due to changing consumer tastes, Pennsylvania can best position itself to align supply and demand throughout supply chains.

[75] http://www.media.pa.gov/pages/Agriculture_details.aspx?newsid=609

The agricultural cluster analysis above identified one such area. The LQ for the poultry processing sector is a 0.47, which means that the poultry processing industry is unable to meet current demand and a significant portion of the poultry raised within the Commonwealth needs to leave the state to be processed. When coupled with the competitive advantage enjoyed by the poultry and egg production sector (LQ of 1.28), this suggests that there is significant opportunity for the poultry processing sector to expand.

Pennsylvania's agricultural infrastructure is grounded in the strength of its Farmland Preservation Program, which supports the continued predominance of agriculture in the state's economy. In addition to preserving prime farmland, the continued success of Pennsylvania agriculture is rooted in the industry's ongoing land stewardship. Industry leaders have identified land and stewardship as a major driver of agriculture in Pennsylvania. The Farmland Preservation Program keeps prime farmland in agricultural use, while environmental responsibility and sustainability protect the foundation of Pennsylvania agriculture through leadership on water management, land use, and air quality.

4.2.1. Maintain the Strength of Pennsylvania's Nation-Leading Farmland Preservation Program

The future of Pennsylvania agriculture is rooted in the strength of its Farmland Preservation Program. The program preserves farms in historically rural counties with agricultural sectors that are increasingly desirable locations for residential development. The Agricultural Land Preservation Board protects prime farmland from development by approving conservation easement purchases. Pennsylvania is the national leader in the number of farms and acres permanently preserved for agricultural use, and the success of the program is rooted in the strong, bi-partisan support it has continued to receive since its creation.[76] Since the Farmland Preservation program was launched in 1988, Pennsylvania has preserved nearly 550,000 acres on 5,242 farms in 59 of the state's 67 counties. The $1.4 billion invested by federal, state, and local governments in the Farmland Preservation program over this time period slows the loss of prime farmland to non-agricultural use. Continued investment in this program will further strengthen the industry's place in the state economy.[77]

4.2.2. Improve Capacity to Address Existing Gaps in Processing and Manufacturing Infrastructure

Pennsylvania agricultural supply chains are impacted by supply/demand gaps due to shortages in processing and manufacturing capacity. Gaps within agricultural sectors are due to multiple factors. These include capital improvements required for processing, technological investments, growth and diversification in animal protein processing, and workforce shortages.

One example, milk processing gaps for both fluid milk and dairy solids, including cheese and yogurt production, limits income potential for dairy farmers and increases transportation costs for dairy producers,

[76] PDA, "Farmland Preservation," www.agriculture.pa.gov
[77] PDA, "Wolf Administration Adds 29 Farms Covering 2,093 Acres to PA Farmland Preservation Program," www.agriculture.pa.gov

reducing their profit margins. [78] Milk transported out of state for processing removes a segment of the revenue and employment generated by the supply chain. PDA and The Center Dairy Excellence have been collaborating with the Pennsylvania Department of Community and Economic Development (DCED) to promote investment in dairy manufacturing in the state. Building on efforts to attract national cooperatives to the state will help the dairy industry capitalize on its ability to support additional cheese processing in the state.

In addition, the growth of home delivery food services – including meal kits – has created an increased demand for extended shelf life processing. Meal delivery kits require dairy products "in the box" to be extended shelf life products. However, there is currently limited to no processing capacity for extended shelf life products. A re-investment in fluid milk processing, including extended shelf life products, would enable Pennsylvania to capture part of this growing market.

Animal protein, another major driver of Pennsylvania agriculture, faces similar challenges from limited processing capacity. The limited options for beef and poultry processors, particularly in the western half of the state, create leakages to other states and create on-farm revenue losses from producers. Further investments in processing capacity would provide marketing options, encourage greater investment, and help grow the workforce in Pennsylvania. The LQ for the poultry processing sector is a 0.47 which means that the poultry processing industry is unable to meet current demand and a significant portion of the poultry raised within the Commonwealth needs to leave the Commonwealth to be processed. When coupled with the competitive advantage enjoyed by the poultry and egg production sector (LQ of 1.28), this suggests that there is significant opportunity for the poultry processing sector to expand.

Finally, while Pennsylvania has experienced a significant increase in organic production, organic processing in the state has lagged. An expansion of food processors' capacity to produce organic foods would enable to Pennsylvania to further capitalize on organic demand. The Pennsylvania Industrial Development Authority (PIDA) can support this expansion by better advertising its low-interest financing for producers to add new lines of equipment and storage.

4.2.3 Invest in Sectors with Projected Growth to Minimize Potential Processing Bottlenecks

In addition to existing processing gaps, current and projected consumer trends can be used to identify areas for investment to prevent future processing bottlenecks. Investments in product shifts and diversification can be optimized by supporting the development of processing facilities that will capture a greater share of value chains within the state. For example, growth in sheep, lamb, and goat production to meet demand for local animal-protein will require more processing facilities. [79] Diversification of dairy processing can enable processors and manufacturers to

[78] Ad Crable, "Lancaster is the top dairy county in Pennsylvania, but most of its milk goes out of state" *Lancaster County Online*, 2015. http://lancasteronline.com/

79 Chris Kick, "Goat meat is in high demand," *Farm and Dairy*, 2012. www.farmanddairy.com/

capture the growing demand for cheese, yogurt, and other dairy-products while mitigating the impact of declining fluid milk consumption. Investment in hops processing technology can support the growth of the PA Preferred™ Brews program, enabling the industry to capitalize on consumer demand. [80] Strategically coordinating production and processing investments will best position the state's agricultural industry to minimize leakages across the value chain.

4.2.4 Support Processing Automation to Increase Productivity and Efficiency

The adoption of automation technologies and robotics are projected to increase efficiency and productivity through the agricultural value-chain. Historically there has been a lag for agricultural processing automation compared to other sectors, due to low-profit margins within the industry compared to the high capital costs of technological adaptions. [81] However, the agricultural sector has adopted automation techniques from other sectors and has experienced direct venture capital investments in recent years.[82]

Further investments are projected to address declining labor supplies from tightening guest worker regulations. [83] At recent workforce levels, automation offers opportunities for increased productivity and efficiency. Facing increased workforce shortages, there is a new sense that the adoption of technology is necessary for producers and processors to maintain current outputs.[84] Investors are expected to capitalize on the workforce shortage and growing market for agricultural automation.[85] However, small-scale processors and manufacturers will need support to adopt the technological advancements.

4.2.5 Increase Byproduct Processing Capacity to Reduce Waste and Increase Product Diversification

The efficiency and productivity of supply chains can be further increased by developing byproduct processing capacity in the state. The value-added from agricultural byproducts, or total resource use, includes the processing of byproducts and wastes from crop and animal production, and forestry and wood products into edible food items, functional ingredients, or additional forestry products. [86] Increased utilization of agricultural byproducts processing strengthens the financial viability of the industry, and can reduce overall environmental impacts from crop and animal production and processing.[87]

80 Governor Wolf Announces New Branding Program for PA-Brewed Beers; Touts 'Jobs that Pay' Potential of Local Brewers," 2017. https://www.governor.pa.gov/
81 Darwin Caldwell, Steve Davis, Rene Moreno Masey, John Gray, "Automation in Food Processing," *Springer Handbook of Automation*, 2009. link.springer.com/
82 Darwin Caldwell, Steve Davis, Rene Moreno Masey, John Gray, "Automation in Food Processing," *Springer Handbook of Automation*, 2009
83 Karen Graham, "With immigrants targeted, US farms look to automation," *Digital Journal*, 2017. www.digitaljournal.com/
84 Karen Graham, "With immigrants targeted, US farms look to automation," *Digital Journal*, 2017
85 Karen Graham, "With immigrants targeted, US farms look to automation," *Digital Journal*, 2017. www.digitaljournal.com/
86 Linda Benedict, Witoon Prinyawiwatkul, "Value-added from Agricultural and Aquacultural Byproducts and Wastes" *Louisiana State University Ag Center*, 2005. www.lsuagcenter.com/
87 Lauryn G. Chan, Joshua L. Cohen, Juliana Maria Leite Nobrega de Moura Bell, "Conversion of Agricultural Streams and Food Processing Byproducts to Value-Added Compounds using Filamentous Fungi," *Annual Review of Food Science and Technology, 2018.* www.annualreviews.org/

CONTINUE TO IMPROVE REGULATORY PROCESSES AND THE BUSINESS CLIMATE

Challenge: Constraints to productivity, efficiency, and development of agriculture in Pennsylvania due to some challenges in the regulatory and business environment, in addition to fragmented levels of government with shared responsibility, limit investments in production, processing, and manufacturing in the state.

Goal: Develop streamlined state permitting and regulatory processes for the agricultural industry and reconsider policies that deter agricultural investments in Pennsylvania.

Recent Related Accomplishments:

- **Act 84 of 2016 and Act 175 of 2016**: The 2016 tax code bill included an exemption for operations with an agricultural conservation easement. Act 175 made this exemption retroactive. Together, the two changes created stronger financial incentives for farmers to enter the Farmland Preservation Program.

- **Clean and Green Tax Preferential Assessment Values Amendment**: Act 89 of 2016 amended the Clean and Green Preferential Tax Assessment Program. The changes created greater predictability for farmers and incentivized Farmland Preservation enrollment in counties that had outdated assessments.

Strategies:

- Establish an industry-government working group to review regulatory and business statutes impacting the agricultural industries at the state and local levels, and provide recommendations to improve existing policies
- Establish a point of contact within PDA to help producers and processors navigate state and federal regulations

4.4.1 Establish an Industry-Government Working Group to Review Regulatory and Business Statutes Impacting the Agricultural Industries, and Provide Recommendations to Improve Existing Policies

Pennsylvania's ability to capitalize on innovation and compete regionally, coupled with other mega trends, is limited by the state's current business and regulatory environment. The agricultural industry listening sessions identified business development and the business climate, as one of the industry's major drivers. While significant strides have been made to improve Pennsylvania's business climate – including Acts 84, 89, and 175 of 2016 – greater work on the state's tax structure, regulatory environment, and economic development assistance programs is required.

In order to understand how these issues impact both existing producers and processors, and potential investments in the state, Team PA should form an industry-government working group to review

regulatory and business statutes in the state. The creation of an industry-government working group was a key recommendation of the Agricultural Advisory Board from its meeting at the 2017 Ag Progress Days. Following its review of statutes impacting Pennsylvania agriculture, the working group should make recommendations on improvements to existing policies to increase agricultural productivity, efficiency, and investments.

4.4.2 Establish a Point of Contact Within PDA to Help Producers and Processors Navigate State and Federal Regulations

In addition to establishing a working group to recommend changes to regulations, PDA can further support industry growth by establishing a point of contact that helps producers and processors navigate local, state and federal regulations. The position could facilitate more efficient development and expansion of agricultural businesses. Coordination with the Department of Community and Economic Development (DCED) and the Department of Environmental Protection (DEP) can also help support producers and processors through the navigation of federal and particularly state regulations.

Industry Spotlight: Feed Production

Pennsylvania's long history as an animal protein state is supported by a strong animal feed manufacturing sector. Feed mills across the state produce layer, broiler, turkey, swine, dairy and beef, equine, and specialty feed products. To support high yield and high quality animal production, the sector requires scientific innovation in custom feed formulations, employing STEM positions including animal nutritionists and veterinarians. The sector also supports the transportation industry, transporting feed from feed mills to animal production facilities throughout the state and mid-Atlantic region, in addition to crop production and manufacturing. Between 2002 and 2012, soybean production in Pennsylvania grew by 159 percent. In September 2017, Perdue Agribusiness opened a $60 million soybean processing plant, which will primarily produce soybean meal for chicken feed and soybean husks for dairy cattle and swine feed. The plant opening was supported by Pennsylvania's Redevelopment Assistance Capital Program to meet processing demand, retaining more dollars from feed production in-state.

BROADEN WORKFORCE DEVELOPMENT AND EDUCATION OPPORTUNITIES

Challenge: A workforce shortage due to aging agricultural workers, changing guest worker regulations, and a shift in the skills needed to support an increasingly automated industry may hinder the productivity and long-term growth of Pennsylvania agriculture.

Goals: Reduce the current and projected workforce shortages through education and training that will meet the changing needs of the agriculture industry in Pennsylvania.

Recent Related Accomplishments:

- **Desk Guide for Careers in the Agriculture and Food Processing Industry**: PDA has developed the Desk Guide for Careers in the Agriculture and Food Processing Industry, and distributed it to educators and counselors, including career counselors in the K-12 and post-secondary education system, vocational guidance program, and veterans' programs. The Desk Guide details career clusters and occupations that will be in high demand over the next decade, and the skills, knowledge, and education needed for employment in those fields.

- **"Jobs that Pay" Apprenticeship Program for STEM Jobs in Agriculture**: In 2017, the Wolf Administration introduced a new apprenticeship program to help students develop the hands-on science, technology, engineering, and math (STEM) skills needed for agricultural equipment service technician jobs. The program also provides a pre-apprenticeship program for students enrolled in FFA agricultural education programs, building on the strength of FFA in Pennsylvania. The growth of apprenticeship and work-based learning programs will help close the skills gap in an increasingly STEM-based agricultural workforce.[88]

Strategies:

- Support apprenticeship and work-based learning programs to close the skills gap for an increasingly technology-driven sector
- Explore the potential of an ex-offender to work program to help alleviate workforce shortage issues
- Expand and support programs connecting veterans and minorities to agriculture
- Support loan forgiveness programs for large animal veterinarians and other high-shortage careers
- Increase agricultural education in STEM-related courses to prepare the state's workforce for increased automation
- Diversify business of farming education to address changing consumer tastes and evolving business models

4.5.1 Support Apprenticeship and Work-Based Learning Programs to Close Skills

[88] Central Penn Parent, "New Apprenticeship Program for STEM ' Jobs that Pay' in Agriculture," www.centralpennparent.com

GAPS CONTRIBUTING TO WORKFORCE SHORTAGES

It is anticipated that there will be more than 75,000 new and replacement job openings in Pennsylvania's agricultural sector between 2017 and 2027. Many of the occupations with the highest projected demand are skilled labor, including farm equipment mechanics and service technicians, packaging machine operators, butchers, industrial machinery mechanics, fallers, and logging equipment operators.[89] Registered apprenticeship and micro-credential programs offer opportunities for potential employees to acquire the skills needed to enter these careers through on-the-job training or high school agriculture education programs.[90] The recently created "Jobs that Pay" Apprenticeship Program for STEM jobs in agriculture will help address the shortage of skilled workers by developing and training more than 1,000 Pennsylvanians as farm and equipment mechanics and service technicians, with a focus on new and emerging technologies that will shape agricultural production, including electronics, global positioning, and information systems.[91]

In developing its Desk Guide and Fast Facts on Agriculture and Food Careers in Pennsylvania, PDA has identified Registered Apprenticeships that Pennsylvanians can pursue for employment opportunities in the agricultural sector. PDA has also been collaborating with industry partners to promote work-based learning programs, identifying existing training that could lead to micro-credentials, and identifying opportunities for new micro-credentials to close the skills gap in meeting workforce demand. One potential untapped labor supply to help close the agricultural labor gap is ex-offenders. Industry partners should work with PDA to identify potential opportunities for ex-offenders and also work with the Department of Corrections to explore the possibility. By continuing to support and expand its work connecting potential employees with apprenticeship programs, identifying new micro-credential opportunities, and supporting the educational resources underlying high school programs that provide educational training through pre-apprenticeships, PDA can help strengthen the agricultural workforce against current and projected shortages.

4.5.2 EXPLORE THE POTENTIAL OF AN EX-OFFENDER TO WORK PROGRAM TO HELP ALLEVIATE WORKFORCE SHORTAGE ISSUES

In order to alleviate workforce issues, Pennsylvania can explore the potential of agricultural re-entry programs for ex-offenders. Similar programs have been enacted, typically by non-profit organizations in Philadelphia, PA (Roots to Re-entry from the Pennsylvania Horticulture Society), Paterson, NJ (Green Corps horticultural and gardening programs), Chicago, IL (Windy City Harvest Corps), and Baltimore, MD (Volunteers of America Chesapeake in partnership with CBO Financial Inc. and Arcturus Growthstar Technologies, Inc.)

89 Pennsylvania Department of Agriculture, "Fast Facts on Agriculture and Food Careers in Pennsylvania," 2017. http://www.education.pa.gov/

90 Pennsylvania Department of Agriculture, "Fast Facts on Agriculture and Food Careers in Pennsylvania," 2017

91 http://www.centralpennparent.com/2017/new-apprenticeship-program-for-stem-jobs-that-pay-in-agriculture/

4.5.3 Expand and support programs connecting veterans and minorities to agriculture

Pennsylvania can broaden the agricultural workforce through programs targeted to groups historically under-represented in the industry, including veterans, women, and minorities.

PDA is a participating member of Homegrown by Heroes, a veteran farmer designation, and markets participating farms through PA Preferred. PA Grows connects minority and women producers to UDSA Farm Service Agency Farm Ownership Loans and Operating Loans for: Socially Disadvantaged Applicants (SDA): women, African Americans, Alaskan Natives, American Indians, Hispanics, Asians, Native Hawaiians, and Pacific Islanders. Expanded promotion of these programs can help further expand the agricultural workforce.

4.5.4 Support Loan Forgiveness Programs for Large Animal Veterinarians and Other High-Shortage Careers

In addition to apprenticeships, loan forgiveness programs can help address workforce shortages with high debt barriers. Historically, Pennsylvania's Agricultural Education Loan Forgiveness Program provided partial loan forgiveness for degrees in farm operations, the practice of large animal veterinary medicine, or teaching agricultural curriculums. [92] In other states, state agricultural veterinary loan-repayment programs require veterinarians to devote a portion of their practice to agricultural animal health and productivity, and/or livestock biosecurity or food animal disease diagnosis. Minimum portions range from 30 to 51 percent, and are structured as either loan repayments or up-front tuition grants with a commitment to practicing in-state post-graduation. [93] Although Pennsylvania's program is not currently funded, reinstating this program is an important step in addressing the workforce shortage of large animal veterinarians and other agricultural careers with high-cost educational training or licensing.

4.5.5 Diversify Business of Farming Education to Address Changing Consumer Tastes and Evolving Business Models

The Department of Agriculture Center for Farm Transitions could be expanded to accommodate changing farm business models. The Center currently provides guidance for transitions, such as entering the farming vocation or planning farm expansions, including financing for farm groups, assisting with multi-generational farming families, and management strategies for farm owners, partnering with PA Preferred™, the Center for Dairy Excellence, USDA's RMA Risk Management, PAGrows, and the Pennsylvania Farm Link. The Center also supports Agricultural Security Areas (ASA), the Pennsylvania Agricultural Conservation Easement Purchase Program, and the Clean and Green preferential tax

92 "Agriculture Education Loan Forgiveness Act - Agriculture Education Loan Forgiveness Program And Funding," 2004. http://www.legis.state.pa.us/

93 American Veterinary Medical Association, "State veterinary loan-repayment program summary," 2017. https://www.avma.org/

assessment program.[94] Expanding the transitions program to other steps in the agricultural supply chain and promoting product diversification in areas with projected growth can help strengthen the state's agricultural sector. In particular, there is growing need for education to develop marketing, technology, and financial skills.

94 Center for Farm Transitions, Pennsylvania Department of Agriculture, 2017. http://www.iplantofarm.pa.gov/

MAKE ADDITIONAL INVESTMENTS INFRASTRUCTURE SYSTEMS

Challenge: The agricultural industry needs greater investments in the physical infrastructure that facilitates movement of products throughout supply chains.

Goal: Invest in Pennsylvania's transportation, broadband, and distribution systems' infrastructure to ensure that the state's producers and processors can meet consumer demands through wholesale, retail, and direct-to-consumer channels.

Recent Related Accomplishments:

- **Act 89 and the Road Map Program**: Act 89 of 2013 designated funding to address the backlog of Pennsylvania infrastructure needs, including roads, highways, and bridges. The 2017 Road Map program allocated an additional $2.1 billion for major transportation infrastructure projects over the next decade.

- **Capital Investment Program at the Port of Philadelphia**: The recent $300 million investment to double the container capacity of the Port of Philadelphia and improve its overall efficiency will help agricultural producers and processors increase their exports.

- **Pennsylvania Agricultural Surplus (PASS) Program**: The PASS Program utilizes existing local, charitable food distributers to connect agricultural producers with non-profits to distribute food to Pennsylvanians at risk of hunger. The program demonstrates innovation in using existing distribution systems and infrastructure to connect agricultural producers, packers, and processors with non-profit partners who already distribute food to low-income Pennsylvanians in need of food assistance, including shelters, food pantries, and soup kitchens.[95]

- **DCED Programs with Broadband Deployment Eligibility**: DCED administers several economic development programs which include broadband deployment as an eligible use. These programs, along with the USDA Rural Development Community Connect Grants, can be utilized to develop the broadband capabilities required to implement new technological innovations in agriculture production and processing.[96]

- **DCED Small Business Finance Programs**: Through the First Industries Fund, DCED and the Commonwealth Financing Authority have invested millions in Pennsylvania farms and food companies at attractive interest rates. Loans have supported the purchase of land, buildings, machinery, and equipment across the agricultural sector.

- **Act 34 of 2016**: The 2016 Act enabled PennDOT to issue special-travel permits for milk-hauling trucks that weigh more

[95] PDA, "Agriculture Support Program," www.agriculture.pa.gov
[96] DCED, "Broadband Funding and Information Resources," www.dced.pa.gov

than 80,000 pounds. The permits allow the 80,000 plus pound milk-hauling trucks to ravel on interstate highways, increasing the efficiency of dairy distribution systems and increasing profit markets for the state's dairy producers.

Strategies:

- Invest in transportation infrastructure to strengthen movements in supply chains
- Support programs to ensure the expansion and adoption of broadband internet in rural areas
- Work with producers and processors to ensure they have the infrastructure needed to access alternative distribution systems

4.6.1 Invest in Transportation Infrastructure to Improve the Efficiency of Supply Chains

Pennsylvania agriculture is impacted by the state's aging transportation infrastructure. The infrastructure deficit impedes the efficiency of agricultural products moving throughout the supply chain, cutting into profit margins. Increased financing for infrastructure should include infrastructure improvements that enable agricultural products to move through production, processing and manufacturing, and through wholesale, retail, and direct-to-consumer distribution systems.

4.6.2 Support Programs to Ensure the Expansion and Adoption of Broadband Internet in Rural Areas

Pennsylvania can best position its rural communities and agricultural sector to increase productivity and efficiency, and adopt automation trends driving the industry by ensuring the expansion of broadband access across the state. As noted, broadband services enable producers and processors to adopt technologies that increase productivity, save operational costs, and better meet changing consumer demands. The adoption of blockchains and direct-to-consumer distribution open up new markets for producers and processors. Without statewide broadband access, the productivity and efficiency gap between farms that are able to adopt automation technologies and those who lack the necessary internet speeds will widen. The Commonwealth can support statewide broadband access through network investments and public-private partnerships.

4.6.3 Work With Producers and Processors to Ensure They Have the Infrastructure Needed to Access Alternative Distribution Systems

Transportation infrastructure and broadband internet both enable better accessibility to distribution systems, including co-ops, farmers' markets, community supported agriculture (CSA), and other forms of direct-to-consumer distribution. Alternative distribution has focused primarily on the produce sector, which is already heavily invested in these systems. There is now growing demand for local proteins, creating an opportunity to aggregate small-scale animal protein production and distribute it through the northeast corridor to meet the culinary demand for local products.

The state can also expand Farm to School programs by using existing infrastructure to

connect producers and procurement programs.[97] This could include food banks to move produce from small farms into schools, and the development or expansion of co-ops and cooperative distribution networks to ensure that production levels collectively meet procurement needs. [98] Working with producers and processors to identify and ensure access to alternative distribution systems can help diversify and strengthen the agricultural sector.

97 Interview with Patrick Andrews, Division Chief of Markets, Bureau of Market Development, PDA, October 6, 2017.
98Grace Communications Foundation, "Innovative Agriculture," 2017. http://www.sustainabletable.org/

DIVERSIFY PRODUCTS TO STRENGTHEN MARKETS AND BUILD RESILIENCY

Challenge: The degree that Pennsylvania agriculture is concentrated in a small number of products leaves the industry vulnerable to the effects of changing consumer demands.

Goal: Support greater intra- and inter-farm, processor, and manufacturer diversification to strengthen the resiliency of Pennsylvania agriculture against market changes.

Recent Related Accomplishments:

- **Industrial Hemp Research Act**: Act 92 of 2016 launched the Industrial Hemp Research Pilot Program. The 2014 Farm Bill gave state departments of agriculture and post-secondary institutions permission to research industrial hemp cultivation and marketing. The Pilot Program launched in 2017 with a research permit that studied the effects of planting variables including dates and seed densities, hemp variety for suitability to growing conditions in Pennsylvania, and evaluations of hemp's antibacterial properties. The Pilot Program has been renewed for 2018. By investing in industrial hemp research and other potential growth crops, PDA strengthens the potential for agricultural diversification in Pennsylvania.

- **Perdue Agribusiness:** In late September 2017, Perdue Agribusiness opened a $60 million soybean processing plant, which is capable of processing 17.5 million bushels per year. The Commonwealth supported the plant with a grant from the Redevelopment Assistance Capital Program, recognizing the need for more in-state processing capacity, which helps soybean growers get a better price for their beans rather than shipping the commodity out of state.

- **PA Preferred™ Brews**: As part of the PA Preferred™ Brews initiative, PDA is working with the Penn State Extension to support farmers growing hops. This includes identifying the different hop flavors created in the varied climate conditions across the state. The hops research will help producers and processors better capitalize on the growing demand for locally brewed beer and the marketing efforts of the PA Preferred™ Brews program.[99]

Strategies:

- Encourage and support producers, processers, and manufacturers in product diversification
- Fund research and development to support product diversification

4.7.1 Support Producers, Processers, and Manufacturer in Product Diversification

Product diversification enables producers, processors, and manufacturers to strengthen their resiliency against changing consumer tastes. The Department of Agriculture can catalyze product diversification through a mix

[99] Cheryl Cook Interview.

of research, sharing of best practices, and loans to adapt production or processing facilities.

For example, PDA can build on the research currently being undertaken at Penn State in support of the PA Preferred™ Brews program, by supporting farms in transitioning some of their acres to hops production.[100] Farms can go beyond producing the raw materials for the Pennsylvania's growing brewing industry; farmers can actively participate by developing farmhouse breweries. Several states, including Maryland, New York, Massachusetts, Virginia, and North Carolina have farmhouse brewery laws that allow farmers to start commercial brewing operations by obtaining special licenses with reduced fees. The beer can be sampled and sold onsite and at certain beer festivals and farmers markets. Maryland's law also allows up to 3,000 barrels to be self-distributed at restaurants and liquor stores within the state. There is a catch, though: a portion of the ingredients for the beer – which could include hops, wheat, barley, fruit, or other components – must be grown on the farm.[101] PDA should work with the Pennsylvania Liquor Control Board to establish a pilot farmhouse brewery program and DCED to connect farmers with low interest loans and other funding opportunities for the development of the brewery infrastructure.

Industrial hemp is a versatile agricultural plant which could one day be a valuable crop option for Pennsylvania farmers. The Commonwealth has taken some important steps toward making that a reality. In 2016, Governor Wolf signed the Industrial Hemp Research Act, or Act 92 of 2017, after which PDA launched the Industrial Hemp Pilot Research Program. Through this program, the Department of Agriculture issued research permits to institutions of higher education and to persons interested in contracting with the Department to participate in the research of industrial hemp cultivation and marketing in Pennsylvania. In 2017, 14 research permits were issued to 12 researchers, who cultivated industrial hemp in 13 different Pennsylvania counties.[102]

Goats, sheep, and lambs can be added in small herds for protein diversification. Low-interest loans would help processors and manufacturers diversify production to include value-add and healthier products. Pennsylvania's nation-leading mushroom industry has begun to investigate production diversification and expansion by growing vegetables indoors through vertical farming. [103] The expansion of product diversification highlights where PDA can build on its existing programs and strengths to best position the agricultural industry over the next 10 years.

4.7.2. Fund Research and Development to Support Product Diversification

Pennsylvania has historically been a leader in the incorporation of science and technology into agricultural production and processing. The industry's leadership has its foundation in innovation occurring both on-

100 Interview with Cheryl Cook, Deputy Secretary for Animal Health and Food Safety, October 4, 2017.
101 Fortune, "Beer: The Latest Cash Crop for Maryland Farmers," www.fortune.com

102 PDA, "Industrial Hemp," www.agriculture.pa.gov.
103 The Philadelphia Inquirer, "Chester Co.'s Powerhouse Mushroom Farms Have a New Vision to Expand: Growing Veggies Indoor," www.philly.com

farm and at the state's world-leading agricultural research institutes at Penn State University, Delaware Valley University, and the University of Pennsylvania School of Veterinary Medicine. Continued investment in agricultural research and development at these institutions, including the Penn State Extension and funding for crop research, can help more agricultural producers and processors diversify their operations.

Innovation also occurs on-farm and in processing facilities. PDA can best position itself to support this innovation and product diversification by connecting producers and processors with funding opportunities in research and development. The federal Research and Development Tax Credit can be applied to the agricultural sector, giving producers and processors more financial flexibility to institute research and development practices that can lead to better product diversification.[104]

[104] Successful Farming, "Can the Research & Development Tax Credit be Applied to Your Farm?" www.agriculture.com

4.7 CONCLUSION

The agricultural industry has been a core part of the Pennsylvania economy throughout the commonwealth's history. The industry's continued strength is rooted in the diversity of crops and producers; the state's farming tradition and agricultural infrastructure, and innovative practices. The industry stands to benefit from opportunities for growth due to its location in the Northeast Corridor, powerful consumer demand for local and healthy products, global demand for Pennsylvania hardwoods and some value-added products, and further technological adaption throughout supply chains. Despite these strengths and opportunities, the industry faces challenges from both existing weaknesses – including workforce shortages and overwhelmed processors – and potential threats, including federal trade and immigration problems and the misalignment of some agricultural trends and existing regulations.

This in-depth analysis of the economic impact of Pennsylvania agriculture and the major trends impacting the industry creates a stronger foundation for Team Pennsylvania, PDA, the Agricultural Advisory Board, and leaders in the industry to develop a shared strategic plan for the industry. This report builds off the ongoing work of this public-private partnership and identifies recommendations for both industry and policymakers to ensure the continued strength of agriculture in Pennsylvania.

Appendices



APPENDIX – A: INPUT/OUTPUT METHODOLOGY

A.1 OVERVIEW

Economic impact estimates are generated by utilizing **input-output models** to translate an initial amount of direct economic activity into the total amount of economic activity that it supports, which includes multiple waves of spillover impacts generated by spending on goods and services and by spending of labor income by employees. This section summarizes the methodologies and tools used to construct, use, and interpret the input-output models needed to estimate this project's economic impact.

A.2 INPUT-OUTPUT MODEL THEORY

In an inter-connected economy, every dollar spent generates two spillover impacts:

- First, some amount of the proportion of that expenditure that goes to the purchase of goods and services gets circulated back into an economy when those goods and services are purchased from local vendors. This represents what is called the "indirect effect," and reflects the fact that local purchases of goods and services support local vendors, who in turn require additional purchasing with their own set of vendors.

- Second, some amount of the proportion of that expenditure that goes to labor income gets circulated back into an economy when those employees spend some of their earnings on various goods and services. This represents what is called the "induced effect," and reflects the fact that some of those goods and services will be purchased from local vendors, further stimulating a local economy.

The role of input-output models is to determine the linkages across industries in order to model out the magnitude and composition of spillover impact to all industries of a dollar spent in any one industry. Thus, the total economic impact is the sum of its own direct economic footprint plus the indirect and induced effects generated by that direct footprint.

A.3 INPUT-OUTPUT MODEL MECHANICS

To model the impacts resulting from the direct expenditures, Econsult Solutions, Inc. developed a customized economic impact model using the IMPLAN input/output modeling system. IMPLAN represents an industry standard approach to assess the economic and job creation impacts of economic development projects, the creation of new businesses, and public policy changes within its surrounding area. IMPLAN has developed a social accounting matrix (SAM) that accounts for the flow of commodities through economics. From this matrix, IMPLAN also determines the regional purchase coefficient (RPC), the proportion of local supply that satisfies local demand.

These values not only establish the types of goods and services supported by an industry or institution, but also the level in which they are acquired locally. This assessment determines the multiplier basis for the local and regional models created in the IMPLAN modeling system. IMPLAN takes the multipliers and divides them into 536 industry categories in accordance to the North American Industrial Classification System (NAICS) codes.

The IMPLAN modeling system also allows for customization of its inputs which alters multiplier outputs. Where necessary, certain institutions may have different levels of demand for commodities. When this occurs, an "analysis-by-parts" (ABP) approach is taken. This allows the user to model the impacts of direct economic activity related to and institution or industry with greater accuracy. Where inputs are unknown, IMPLAN is able to estimate other inputs based on the level of employment, earnings, or output by an industry or institution.

A.4 EMPLOYMENT AND WAGES SUPPORTED

IMPLAN generates job estimates based on the term "job-years", or how many jobs will be supported each year. For instance, if a construction project takes two years, and IMPLAN estimates there are 100 employees, or more correctly "job-years" supported, over two years, that represents 50 annual jobs. Additionally, these can be a mix of a full and part-time employment. Consequently, job creation could feature more part-time jobs than full-time jobs. To account for this, IMPLAN has a multiplier to covert annual jobs to full-time equivalent jobs.

Income to direct, indirect, and induced jobs is calculated as employee compensation. This includes wage and salary, all benefits (e.g., health, retirement) and payroll taxes (both sides of social security, unemployment taxes, etc.). Therefore, IMPLAN's measure of income estimates gross pay opposed to just strictly wages.

A.5 Data Sources and Issues

The data for the economic impact analysis was drawn from two main sources. The primary source of information on agricultural output and employment is the United States Department of Agriculture – National Agricultural Statistics Service (USDA-NASS) Census of Agriculture. The most recent data comes from the Census of Agriculture conducted in 2012. The second source was data obtained from the IMPLAN input/output modeling system.

We used the total direct outputs for the selected agriculture industries (available through IMPLAN and specific to Pennsylvania) as inputs to estimate the spillover effects in industries not related to agriculture. Because many of the agriculture industry sectors overlap, impacts to one could create indirect and induced impacts within other agriculture-related industries, we zeroed-out the spillover into these industries to avoid double counting.

For example, the poultry processing industry clearly has indirect impacts in the poultry production industry through the purchase of chickens. Similarly, a mechanic who was hired to repair farm equipment would be accounted for in the direct economic impact of agricultural support services, and zeroed-out from the induced impact of crop and animal production, in order to eliminate the double-counting of his or her work in the total economic impact.

APPENDIX – B: AGRICULTURAL SECTORS – IMPLAN / NAICS COMPARISON

TABLE B.1 – IMPLAN / NAICS COMPARISON, CROP AND ANIMAL PRODUCTION

IMPLAN Sector	IMPLAN Description	6 Digit NAICS Codes Included
1	Oilseed farming	111110, 111120
2	Grain farming	111130, 111140, 111150, 111160, 111191, 111199
3	Vegetable and melon farming	111211, 111219
4	Fruit farming	111310, 111320, 111331, 111332, 111333, 111334, 111336,111339
5	Tree nut farming	111335
6	Greenhouse, nursery, and floriculture production	111411, 111419, 111421, 111422
7	Tobacco farming	111910
8	Cotton farming	111920
9	Sugarcane and sugar beet farming	111930, 111991
10	All other crop farming	111940, 111992, 111998
11	Beef cattle ranching and farming, including feedlots and dual-purpose ranching and farming	112111, 112112, 112130
12	Dairy cattle and milk production	112120
13	Poultry and egg production	112310, 112320, 112330, 112340, 112390
14	Animal production, except cattle and poultry and eggs	112210, 112410, 112420, 112511, 112512, 112519, 112910,112920, 112930, 112990
19	Support activities for agriculture and forestry	115111, 115112, 115113, 115114, 115115, 115116, 115210, 115310

TABLE B.2 – IMPLAN / NAICS COMPARISON, FOOD AND BEVERAGE PROCESSING AND MANUFACTURING

IMPLAN Sector	IMPLAN Description	6 Digit NAICS Codes Included
65	Dog and cat food manufacturing	311111
66	Other animal food manufacturing	311119
67	Flour milling	311211
68	Rice milling	311212
69	Malt manufacturing	311213
70	Wet corn milling	311221
71	Soybean and other oilseed processing	311224
72	Fats and oils refining and blending	311225
73	Breakfast cereal manufacturing	311230
74	Beet sugar manufacturing	311313
75	Sugar cane mills and refining	311314
76	Nonchocolate confectionery manufacturing	311340
77	Chocolate and confectionery manufacturing from cacao beans	311351
78	Confectionery manufacturing from purchased chocolate	311352
79	Frozen fruits, juices and vegetables manufacturing	311411
80	Frozen specialties manufacturing	311412
81	Canned fruits and vegetables manufacturing	311421
82	Canned specialties	311422
83	Dehydrated food products manufacturing	311423
84	Fluid milk manufacturing	311511
85	Creamery butter manufacturing	311512
86	Cheese manufacturing	311513
87	Dry, condensed, and evaporated dairy product manufacturing	311514
88	Ice cream and frozen dessert manufacturing	311520
89	Animal, except poultry, slaughtering	311611
90	Meat processed from carcasses	311612
91	Rendering and meat byproduct processing	311613
92	Poultry processing	311615
94	Bread and bakery product, except frozen, manufacturing	311811, 311812
95	Frozen cakes and other pastries manufacturing	311813
96	Cookie and cracker manufacturing	311821

97	Dry pasta, mixes, and dough manufacturing	311824
98	Tortilla manufacturing	311830
99	Roasted nuts and peanut butter manufacturing	311911
100	Other snack food manufacturing	311919
101	Coffee and tea manufacturing	311920
102	Flavoring syrup and concentrate manufacturing	311930
103	Mayonnaise, dressing, and sauce manufacturing	311941
104	Spice and extract manufacturing	311942
105	All other food manufacturing	311991, 311999
106	Bottled and canned soft drinks & water	312111, 312112
107	Manufactured ice	312113
108	Breweries	312120
109	Wineries	312130
110	Distilleries	312140
111	Tobacco product manufacturing	312230

TABLE B.3 – IMPLAN / NAICS COMPARISON, FORESTRY

IMPLAN Sector	IMPLAN Description	6 Digit NAICS Codes Included
15	Forestry, forest products, and timber tract production	113110, 113210
16	Commercial logging	113310
134	Sawmills	321113
135	Wood preservation	321114
136	Veneer and plywood manufacturing	321211, 321212
137	Engineered wood member and truss manufacturing	321213, 321214
138	Reconstituted wood product manufacturing	321219
139	Wood windows and door manufacturing	321911
140	Cut stock, resawing lumber, and planing	321912
141	Other millwork, including flooring	321918
142	Wood container and pallet manufacturing	321920
143	Manufactured home (mobile home) manufacturing	321991
144	Prefabricated wood building manufacturing	321992
145	All other miscellaneous wood product manufacturing	321999
146	Pulp mills	322110
147	Paper mills	322121, 322122
148	Paperboard mills	322130
149	Paperboard container manufacturing	322211, 322212, 322219
150	Paper bag and coated and treated paper manufacturing	322220
151	Stationery product manufacturing	322230
152	Sanitary paper product manufacturing	322291
153	All other converted paper product manufacturing	322299
368	Wood kitchen cabinet and countertop manufacturing	337110
370	Nonupholstered wood household furniture manufacturing	337122
373	Wood office furniture manufacturing	337211

TABLE B.4 – IMPLAN / NAICS COMPARISON, LANDSCAPING

IMPLAN Sector	IMPLAN Description	6 Digit NAICS Codes Included
469	Landscape and horticultural services	561730

APPENDIX – C: ECONOMIC IMPACT BY AGRICULTURAL SECTOR

TABLE C.1 – ECONOMIC IMPACT OF THE CROP AND ANIMAL PRODUCTION INDUSTRIES IN PENNSYLVANIA

Impact Type	Employment	Earnings ($M)	Value Added ($M)	Output ($M)
Direct	80,645	$946	$4,267	$9,168
Indirect	10,164	$643	$1,271	$2,288
Induced	26,348	$1,147	$2,231	$3,767
Total	**117,157**	**$2,736**	**$7,768**	**$15,222**

Source: IMPLAN (2015)

TABLE C.2 – ECONOMIC IMPACT OF THE CROP AND ANIMAL PROCESSING INDUSTRIES IN PENNSYLVANIA

Impact Type	Employment	Earnings ($M)	Value Added ($M)	Output ($M)
Direct	90,217	$5,260	$10,360	$50,160
Indirect	78,405	$5,329	$9,369	$16,808
Induced	84,723	$3,709	$7,198	$12,185
Total	**253,345**	**$14,298**	**$26,928**	**$79,152**

Source: IMPLAN (2015)

TABLE C.3 – ECONOMIC IMPACT OF THE FORESTRY PRODUCTION AND PROCESSING INDUSTRIES IN PENNSYLVANIA

Impact Type	Employment	Earnings ($M)	Value Added ($M)	Output ($M)
Direct	64,078	$3,461	$6,135	$21,538
Indirect	38,393	$2,506	$4,391	$8,009
Induced	45,502	$1,990	$3,863	$6,534
Total	**147,973**	**$7,957**	**$14,389**	**$36,081**

Source: IMPLAN (2015)

TABLE C.4 – ECONOMIC IMPACT OF THE LANDSCAPING INDUSTRY IN PENNSYLVANIA

Impact Type	Employment	Earnings ($M)	Value Added ($M)	Output ($M)
Direct	45,569	$1,254	$1,941	$2,885
Indirect	3,449	$194	$390	$689
Induced	11,571	$505	$983	$1,651
Total	**60,588**	**$1,954**	**$3,314**	**$5,225**

Source: IMPLAN (2015)

We also developed an aggregated model using a smaller subset of agriculture industries to illustrate a narrow definition of Pennsylvania agriculture. The industries we included are crop production, animal production, crop processing, and animal processing. This aggregation of IMPLAN industries match the NAICS code industries shown in industry groups 1-3. The total annual direct output of these industries is $59.3 billion, which generates an estimated $94.4 billion in total economic impact. Each year, these agriculture industries support 370,500 jobs with $17 billion in earnings (see Table C.5).

TABLE C.5 – ECONOMIC IMPACT OF NARROW AGRICULTURE INDUSTRIES IN PENNSYLVANIA[105]

Impact Type	Employment	Earnings ($M)	Value Added ($M)	Output ($M)
Direct	170,862	$6,206	$14,627	$59,328
Indirect	88,569	$5,971	$10,640	$19,096
Induced	111,071	$4,856	$9,429	$15,952
Total	**370,502**	**$17,033**	**$34,696**	**$94,375**

Source: IMPLAN (2015)

TABLE C.6 – ECONOMIC IMPACT OF NARROW AGRICULTURE INDUSTRIES IN PENNSYLVANIA[106]

Impact Type	Employment	Earnings ($M)	Value Added ($M)	Output ($M)
Direct	122,790	$3,521	$8,476	$34,170
Indirect	51,292	$3,341	$6,099	$12,581
Induced	71,371	$3,114	$6,050	$10,312
Total	**245,453**	**$9,976**	**$20,624**	**$57,063**

Source: IMPLAN (2015)

[105] This includes the crop and animal production industries, the crop and animal processing industries, and the ag-related services industry.
[106] This includes the crop and animal production industries, the crop and animal processing industries, and the ag-related services industry.

APPENDIX – D: DEEP-DIVE METHODOLOGY

E.1 OVERVIEW

The goals of the micro sub-sector analyses were two-fold: 1. to provide a detailed description of the complex and interacting parts of the chosen sub-sectors and 2. to unearth factors and trends that will change the future of agriculture in Pennsylvania. The sector insights process combined interview data, published research and databases. Each team mapped the supply and value chain for each sub-sector, explored the nature and size of demand, examined competitor dynamics, and analyzed how changes in social, economic, and technological context could impact supply chains, demand, and competitive dynamics.

E.2 GOALS OF THE MICRO SUB-SECTOR ANALYSES

Within each sector, the methods were used to:

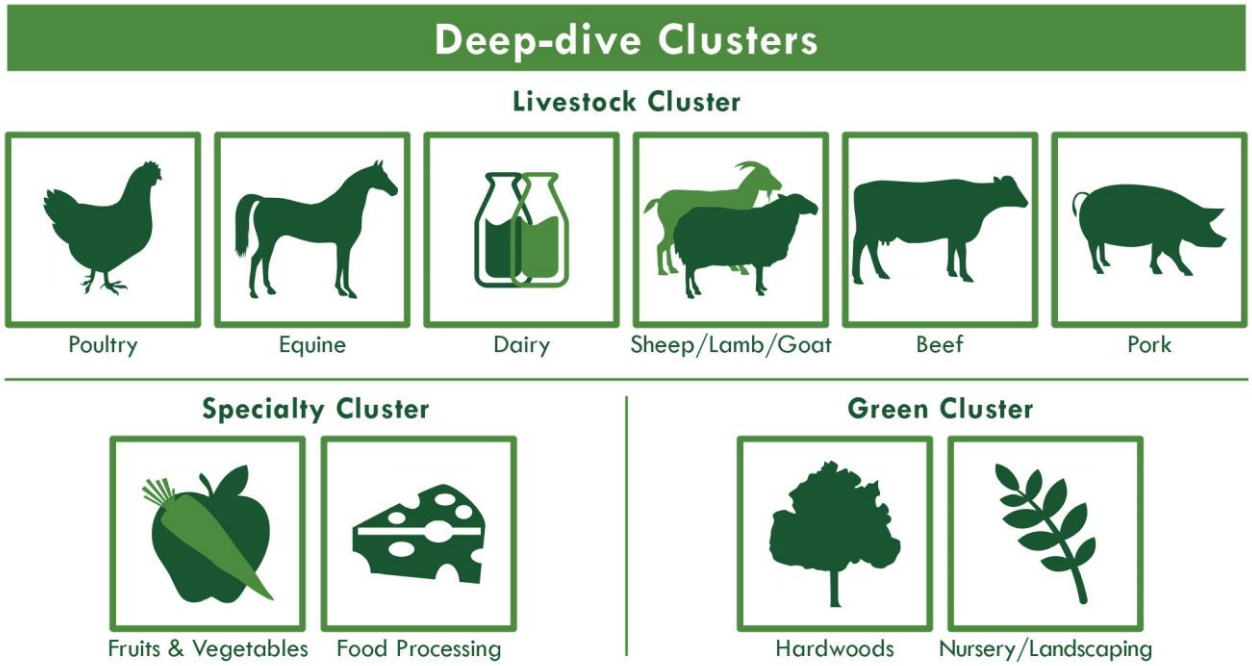
- Document the sector's value chain, with specific attention to the dynamics at the buying and selling steps in the chain of commerce – for example, from beef cattle farmers to processors, from processors to wholesalers, from wholesalers to retailers, and from retailers to consumers
- Consider how changes in consumer demand, market structure, technology and automation, workforce availability, health and safety, and environmental regulations might affect the value chain over the next 5-10 years
- Identify opportunities and challenges related to the changes, including business models or strategies that would capitalize on opportunities and mitigate challenges
- Identify policy ideas or targets that could be beneficial policy interventions

The findings of the micro-sector analyses were used to identify and inform examinations of mega trends impacting Pennsylvania agriculture and develop policy recommendations.

APPENDIX – E: SUB-SECTOR ANALYSES

The goals of the sector analyses were two-fold: To provide a detailed description of the complex and interacting parts of the chosen sectors and to unearth factors and trends that will shape the future of agriculture in Pennsylvania. These analyses can help practitioners and policy makers identify areas of opportunity, and support PDA and Team Pennsylvania as they lead on policy changes to encourage the development and growth of Pennsylvania agriculture. Insights from the sub-sector analyses were integrated with the findings of this report's economic impact analysis and research on mega trends impacting agriculture in the state, and helped shape the report's industry and policy recommendations.

Pennsylvania agriculture includes at least 17 sectors – 15 listed in the 2012 USDA Census of Agriculture as well as plus hardwoods and mushrooms. After careful consideration of priorities, existing recent studies and budget constraints, and conversations with PDA, Team Pennsylvania selected 10 sub-sectors for analysis.



Five common areas stood out from the ten sub-sector analyses:

1. **Dramatic Shifts in Consumer Tastes** affect nearly every sector studied in ways that increase opportunities for more "natural" products and processes.
2. The relatively small size of most Pennsylvania farms and producers represents a tremendous opportunity to **Celebrate and Brand Pennsylvania Agriculture** as particularly wholesome and accessible, authentic and local.
3. Attention to changing consumer tastes and branding could, in turn, help realize **Targeted Export Potential**, especially to adjacent markets for perishables and farther afield for hardwoods and proteins.

4. In many sectors, there is need to **Enhance Processing Capacity** to improve volume, quality and price realization – while also increasing traceability.
5. **Workforce Supply** is a pressing concern at all skill levels, from farmers to processors to field hands, and yet there are opportunities to train new workers and retrain existing ones.

A detailed summary of these areas of challenge and opportunity, and a summary of each of the ten sector analyses can be found in Agricultural Sub-Sector Analyses: Annex to Pennsylvania Agriculture: A Look at the Economic Impact and Future Trends.

APPENDIX – F: INTERVIEWS CONDUCTED

Name	Position	Organization	Date Interviewed
Adam, Timothy	Meat Specialist	Sysco	September 4, 2017
Alberti, Chazz	Culinary Director	Brulee Catering – Spectra by Comcast Spectacor	August 10, 2017
Amos, Katie	US Farmer Marketing Outreach Lead	Animal Welfare Approved	August 18, 2017
Andrews, Patrick	Division Chief of Markets, Bureau of Market Development	PDA	October 6, 2017
Anonymous	Manager	44 Farm	August 12, 2017
Anonymous		River Run Foods	August 29, 2017
Anonymous	Farmer	Pine View Dairy in Lancaster, PA	July 24, 2017
Anonymous	Farmer	Lapp Valley Farm in Lancaster, PA	July 25, 2017
Atherholt, Keith, et al	President	Lewis Lumber Products	August 11, 2017
Badger, Mike	Director	American Pasture Poultry Processors of Association	August 8, 2017
Bailey, Scott	Account Leader	Wenger Feeds	August 10, 2017
Baker, Dudly Dr	Owner-Farmer	Baker Ranch	August 12, 2017
Barr, Ben	Farmer	Barr Farm	August 17, 2017
Bender, Wayne	Executive Director, Hardwoods Development Council	PDA	October 17, 2017
Bender, Wayne; Strathmeyer, Fred; Geyer, Jon		Hardwoods Development Council, PDA	August 4, 2017
Bergman, Glenn	Executive Director	Philabundance	August 21, 2017
Brett, Terry	Owner & Founder	Kimberton Whole Foods	August 17, 2017
Burchfield, Benjamin	Business Development Manager	Kegel's Produce	August 14, 2017
Castorani, Steve	CEO	North Creek Nurseries, PA	August 23, 2017
Chain, Bill	Agriculture Specialist	Chesapeake Bay Foundation	August 9, 2017
Chris, Ruth	General Manager	Ruth Chris's Steakhouse, Austin, TX	August 12, 2017
Cook, Cheryl	Deputy Secretary for Market Development	PDA	October 4, 2017
Crawford, Jim	Founder	New Morning Farms	August 17, 2017

Critz, Mark	Executive Director, Rural Development Council	PDA	October 2, 2017
Dise, Amanda	Loan Officer	Mid-Atlantic Farm Credit	August 10, 2017
Dunphy, Mark	Manager	7 Stars Farm	August 21, 2017
England, Laura	Director, Bureau of Market Development	PDA	October 6, 2017
Ensill, Craig	President	Clemens Food Group	August 18, 2017
Faunce, Erin	Master of Finance	Lancaster Farm Fresh Co-op	August 17, 2017
Florence, Laura			August 14, 2017
Frecon, Steve	Farmer	Frecon Farms	August 18, 2017
Gauker, Jodi	Owner-Farmer	Gauker Farms	August 12, 2017
Geyer, Jonathan	Hardwoods Development Specialist, Hardwoods Development Council	PDA	October 17, 2017
Guenther, Araceli	Executive Principal	Victrix Global	August 14, 2017
Hale, Michael	Pennsylvania Forestry Consultant	USDA Conservation Reserve Enhancement Program	August 15, 2017
Hall, Charlie	Leading Horticulture Industry Expert	Professor and Ellison Chair in International Floriculture, Dept. Horticultural Services, Texas A&M University	August 24, September 1, 2017
Hanzely, John and Sue	Large Scale Nursery Dealer	Hanzely's Greenhouse/Garden Center, PA	August 22, 2017
Harpster, A	Partner	Evergreen Farms	August 2, 2017
Hoffman, Scott	Vice Chairman, Pennsylvania Vegetable Marketing and Research Program	Furmano Foods, Inc	
Hollinger, Jason	General Manager	Four Seasons Produce	August 17, 2017
Hostetter, Gregory	Deputy Secretary for Animal Health and Food Safety	PDA	July 21, 2017
Huntington, Audrey	Director	Common Market	August 10, 2017
Ioele, Kathryn	Barn Manager	Top Flight Stables	August 13, 2017
John, Mike	COO of Milk Marketing	MD&VA	August 16, 2017
Kennedy, Karen Hawkersmith	Owner	Crimson Dale Nursery	August 1, 2017
Kitsch, Bill	Vice President, Agricultural Lending Manager	Ephrata National Bank	July 25, 2017

Larson, Ben	Director of Sustainability	Enviva Biomass	August 18, 2017
Liss, Jon	President	Michel's Bakery, Inc	August 29, 2017
Livengood, Dwain	Owner-Farmer	Livengood Family Farm	August 12, 2017
Long Earl, Caryn	Director, Bureau of Food Distribution	PDA	October 6, 2017
Mazza, Mario	General Manager, Enologist	Mazza Vineyards	August 18, 2017
McGinty, Tim	GM	North Creek Nurseries, PA	August 23, 2017
Miller, P		Organic Valley	August 18, 2017
Moore, Jessica	Industry Expert	Kitchen Table Consultants	August 12, 2017
Morrow, Bill	Meat Manager		August 17, 2017
Moyer, Brian	Program Assistant	Penn State Extension	August 17, 2017
O'Brien, Dominic	Senior Marketing Manager	PhilaPort: The Port of Philadelphia	August 24, 2017
Pierce, Chris	President	Heritage Poultry	August 14, 2017
Porter, Holly	Assistant Executive Director	Delmarva Poultry Industry	August 17, 2017
Redding, Russell	Secretary	PDA	July 27, 2017
Rekeweg, Matthew	US Industry Relations & Food Chain Leader	Dow AgroSciences	August 11, 2017
Rickert, James	President	Prather Ranch	August 15, 2017
Sauder, Mark	President & CEO	Sauder, Inc	August 17, 2017
Sheely, Scott	Special Assistant for Workforce Development	PDA	October 10, 2017
Shields, Pat	PR Representative	Capital Farm Investment	August 12, 2017
Shimer, Zach	General Manager	Weis Markets	August 19, 2017
Smith, Michael	Executive Deputy Secretary	PDA	July 19, 2017
Smith, Ron	Owner	English Home and Garden	August 21, 2017
Smith, Seth	Owner-Farmer	SFI, Inc	August 12, 2017
Smucker, Mike	Co-owner	Smuckers Meats	August 18, 2017
Strathmeyer, Fred	Deputy Secretary for Plant Industry and Consumer Protection	PDA	October 13, 2017
Tait, Kim	Owner and Operator	Tait Farms	August 24, 2017
Thompson, Patrick	President & CEO	EnergyWorks	August 22, 2017
Vaylay, Ravi Ravi, PhD	Founder/CEO/Grower	SAI Fresh Farms, Inc	August 17, 2017
Witmer, Ryan	Co-Founder	Philly Food Works	August 19, 2017

APPENDIX – G: ABOUT ECONSULT SOLUTIONS

This report was co-produced by Econsult Solutions, Inc. ("ESI"). ESI is a Philadelphia-based economic consulting firm that provides businesses and public policy makers with economic consulting services in urban economics, real estate economics, transportation, public infrastructure, development, public policy and finance, community and neighborhood development and planning, as well as expert witness services for litigation support. Its principals are nationally recognized experts in urban development, real estate, government and public policy, planning, transportation, non-profit management, business strategy and administration, as well as litigation and commercial damages. Staff members have outstanding professional and academic credentials, including active positions at the collegiate level, vast experience at the highest levels of the public policy process and extensive consulting experience.

APPENDIX – H: ABOUT FOX MANAGEMENT CONSULTING

This report was co-produced by Fox Management Consulting (Fox MC). Fox MC, part of the Temple University's Fox School of Business offers cost-effective, research-based consulting to clients within the private, public, and social sectors across the globe. We've completed nearly 400 consulting projects for a diverse group of organizations – Fortune 500 firms, small & mid-sized enterprises, startups, national nonprofits, government organizations, and a dozen agricultural entities. Our research and recommendations have helped clients raise over $400 million in capital investment, startup capital, and grant funding. Each engagement is completed in the context of an MBA-level course. The course provides our MBA Associates with academic content, practical consulting support, and faculty oversight to guide them through the engagement. In addition, each engagement is closely supervised by a project executive, an experienced business leader who brings substantial expertise to the project. These project executives ensure that MBA Associates deliver top-quality work to our clients. This structure, refined over the past 16 years, provides lasting value to our clients.

