



calgary economic
development
be part of the energy™



AGRIBUSINESS MARKET STUDY

June 2020

“Go to the centre of the store, you'll find a lot of products processed elsewhere. And what's hurting is that we are actually buying a lot of food from elsewhere in the world with Canadian ingredients in them. We ship out wheat, beef, pork and buy it back in a bottle or a can at ten times the price.

We need more investments. That, to me, is the weakest link we have”¹

Sylvain Charlebois
Director, Agri-Food Analytics Lab Dalhousie University (April 17, 2020)

Table of Contents

1.0 INTRODUCTION	7
1.1 Overview of Calgary Economic Development	7
1.2 Agribusiness Overview	7
1.3 Document Purpose	7
1.4 Document Exclusions	8
2.0 SUBSECTOR ANALYSIS	9
2.1 Food, Beverage, and Meat Processing	10
Overview - Food, Beverage, and Meat Processing	10
Trends - Food, Beverage, and Meat Processing	10
Major Players - Food, Beverage, and Meat Processing	11
Required Resources in Any Region - Food, Beverage, and Meat Processing	11
2.2 Crop Science	12
Overview - Crop Science	12
Trends - Crop Science	12
Major Players - Crop Science	13
Required Resources in Any Region - Crop Science	13
2.3 Animal Genetics	14
Overview - Animal Genetics	14
Trends - Animal Genetics	14
Major Players - Animal Genetics	14
Required Resources in Any Region - Animal Genetics	15
2.4 Agricultural Food	15
Overview - Agricultural Food	15
Trends - Agricultural Food	15
Major Players - Agricultural Food	16
Required Resources in Any Region - Agricultural Food	17
2.5 Summary - Subsector Analysis	17
3.0 HORIZONTAL ANALYSIS.....	19
3.1 Agricultural Technology	20
Overview - Agricultural Technology	20
Trends - Agricultural Technology	20
Major Players - Agricultural Technology	20
Current Geographic Hubs - Agricultural Technology	21
Agricultural Technology - Market Risks	21
Most Applicable Subsector - Agricultural Technology	22
Required Resources in Any Region - Agricultural Technology	22
3.2 Artificial Intelligence	23

- Overview - Artificial Intelligence 23
- Trends - Artificial Intelligence 23
- Major Players - Artificial Intelligence 23
- Current Geographic Hubs - Artificial Intelligence 24
- Market Risks - Artificial Intelligence 24
- Most Applicable Subsector - Artificial Intelligence..... 25
- Required Resources in Any Region - Artificial Intelligence 25
- 3.3 Agri-finance, Business, and Support Services 25**
 - Overview - Agri-finance, Business, and Support Services 25
 - Trends - Agri-finance, Business, and Support Services 25
 - Major Players - Agri-finance, Business, and Support Services 26
 - Current Geographic Hubs - Agri-finance, Business, and Support Services 26
 - Market Risks - Agri-finance, Business, and Support Services 26
 - Most Applicable Subsector - Agri-finance, Business, and Support Services..... 27
 - Required Resources in Any Region - Agri-finance, Business, and Support Services 27
- 3.4 Summary - Horizontal Analysis..... 27**
- 4.0 GLOBAL AGRIBUSINESS HUBS..... 29**
- 4.1 Salinas, California, USA 29**
 - Overview 29
 - Notable Players..... 30
 - Lessons to be Learned..... 30
- 4.2 St. Louis, Missouri, USA 31**
 - Overview 31
 - Notable Players..... 31
 - Lessons to be Learned..... 31
- 4.3 Raleigh-Durham, North Carolina, USA 32**
 - Overview 32
 - Notable Players..... 32
 - Lessons to be Learned..... 33
- 4.4 Israel 33**
 - Overview 33
 - Notable Players..... 33
 - Lessons to be Learned..... 34
- 4.5 Summary - Global Agribusiness Hubs 34**
- 5.0 REGIONAL MARKET ASSESSMENT (CALGARY AND SOUTHERN ALBERTA) 36**
- 5.1 Region Overview 36**
- 5.2 Strengths 38**
 - Proximity to Agricultural Base..... 39
 - Well-Regarded Agricultural Training Institutions 39
 - Strong Research and Innovation Presence..... 39
 - Deep Talent Pool..... 39
 - Large, Established Anchor Tenants..... 39
 - Government Programs and Policies Related to Agriculture..... 39

Geographical Location	40
5.3 Weaknesses	40
Industry Perception	40
Domination of Oil and Gas in the Region	40
Lack of Champion.....	41
Silos and Limited Information Sharing	41
Industry Focused on More Traditional Agriculture and Commodities	41
Complexity Of Government Credits and Programs	41
5.4 Major Players.....	41
5.5 Minor Players and Start-Ups	43
5.6 Regulations and Government Support	43
Federal Regulation	43
Provincial Regulation.....	46
5.7 Innovation and R&D.....	48
Protein Industries Canada	49
Canadian Agri-Food Automation and Intelligence Network (CAAIN).....	49
University of Calgary Simpson Centre for Agricultural and Food Innovation and Public Education.....	49
Telus AgTech Focus.....	49
Olds SmartFarm	50
5.8 Growth Outlook	50
6.0 STRATEGIC INSIGHTS.....	51
6.1 Market Evolution.....	51
Shifting Product and Ingredient Demand	51
Increasing Demand for Food Transparency and Traceability	51
Increasing Government Interest and Investment	51
Emergence and Acceleration of Agtech	51
Industry Challenges Bringing New Business Models	51
6.2 Strategic Risks	52
Climate Change and Resulting Natural Disasters	52
Regional Dominance of The Oil and Gas Sector	52
Lack of Investor Education in Agriculture	52
Increased Nationalization.....	52
6.3 Sector vs. Horizontal Evaluation	53
6.4 Opportunities for The Region.....	53
Opportunities - Subsectors and Horizontals.....	53
Opportunities - Current Market Conditions	56
7.0 CONCLUSION.....	57
8.0 ENDNOTES	58

8.1 Definitions of Subsectors and Associated NAICS Codes..... 58

- Food, Beverage, and Meat Processing 58
- Crop Science..... 58
- Animal Genetics 58
- Agricultural Food 58

8.2 List of Agribusiness Companies in the Calgary and Southern Alberta Region (and Related Areas) 59

- Big Players 59
- Small Players 61

9.0 REFERENCES 64

Throughout this document, there are multiple global buyer profiles which are meant to provide a snapshot of the changing consumer trends in important export targets for Alberta.

1.0 Introduction

1.1 Overview of Calgary Economic Development

Calgary Economic Development (CED) works with business, government and community partners to position Calgary as the location of choice for the purpose of attracting business investment, fostering trade and growing Calgary's workforce¹. CED has a mission to "collaborate to advance opportunities in achieving economic success, embracing shared prosperity and building a strong community for Calgary"².

One of CED's focus areas for business development is the agribusiness sector. Agribusiness is the industry that encompasses farming and farming-related commercial activities, and includes businesses at all stages of the Agribusiness Value Chain.

1.2 Agribusiness Overview

Agribusiness is made up of all farming and farming-related commercial activities, across the Agribusiness Value Chain, from sourcing through sale. The industry can be organized in many different ways, but anchoring to a value chain helps depict the diversity of businesses in the industry. We see the Agribusiness Value Chain as comprised of six activities which brings a product to its final destination - consumption.

Figure 1 - Agribusiness Value Chain



1.3 Document Purpose

This Agribusiness Market Study was commissioned by CED to provide a detailed, fact-based review of the global and regional agribusiness market. Built upon both internal and available external data, it provides a broad-based information set for stakeholders to consider when identifying opportunities for the region in agribusiness, and forming a value proposition for Calgary and Southern Alberta in agribusiness moving forward.

This document takes an in-depth look at agribusiness subsectors and horizontals, leading global hubs in the space, and what is going on in our local region. It creates a foundation for future sector development by addressing the following questions:

- What is happening in the external agribusiness market?
- What do we need to know about the priority subsectors and horizontals we have developed?
- What can we learn from other global agribusiness hubs around the world in developing our own agribusiness ecosystem?
- What agribusiness activity is occurring in our regional market?

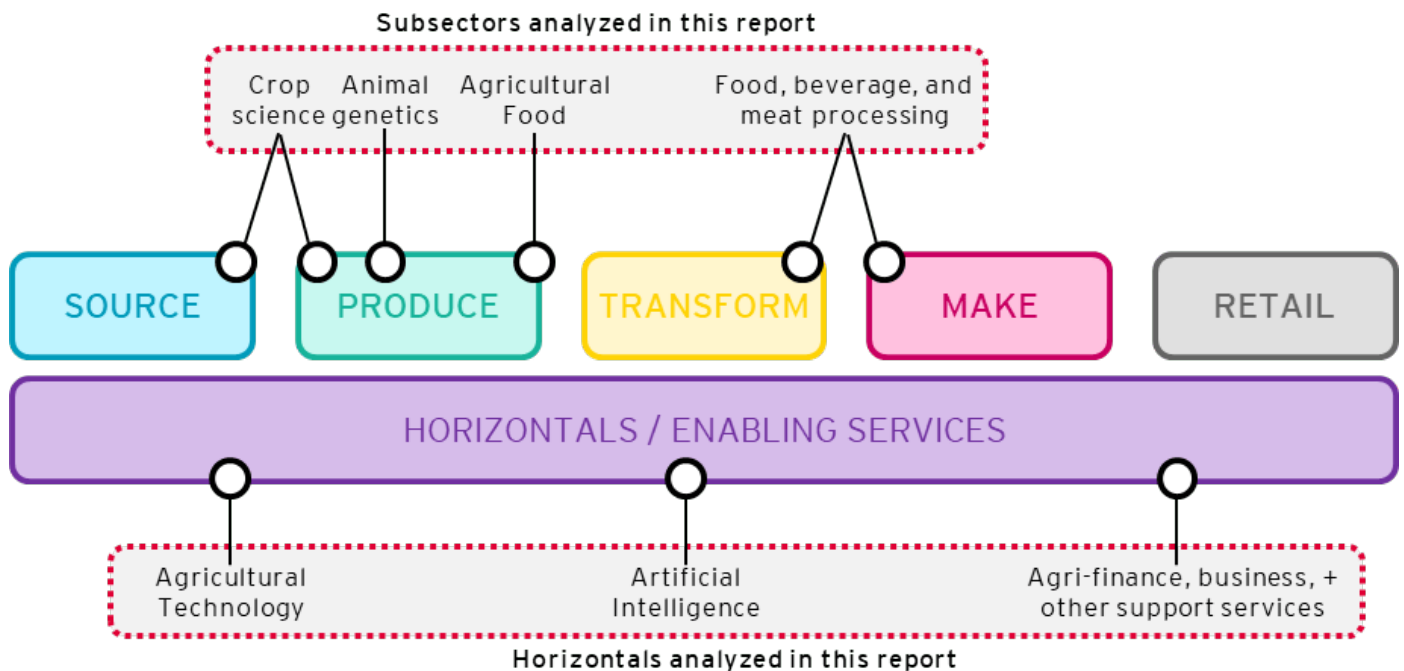
- What major market trends in agribusiness can Calgary and Southern Alberta capitalize on to grow this sector locally?
- What are the risks posed by this industry for our region?

Answering these questions and others through this market study should act as a catalyst to develop new ideas and opportunities for Calgary and Southern Alberta to capitalize on.

1.4 Document Exclusions

Prior to this report, CED started with four priority agribusiness subsectors and three priority agribusiness horizontals, which have been analyzed in-depth in this document. These subsectors are indicated below based on where they fall under the Agribusiness Value Chain.

Figure 2 - Horizontals and Subsectors Analyzed in this Report



There are many other subsectors and horizontals that make up the agribusiness industry, but this document is focused on those deemed most important by CED.





While this document provides a fact-based analysis of the agribusiness industry, it does not illustrate strategic options or provide specific strategic guidance. It is meant to inform future strategic decisions.

2.0 Subsector Analysis

CED has previously examined growing subsectors in the agribusiness industry, and identified the following as high-growth opportunities for consideration by Calgary and Southern Alberta: Food, Beverage, and Meat Processing; Crop Science; Animal Genetics; and Agricultural Food. This section looks at each of the subsectors and examines their fundamentals, emerging trends, major players, as well as required resources for the subsector to thrive. This analysis will inform a better understanding of these subsectors and provide consideration on how Calgary and Southern Alberta could potentially succeed in developing them. The specific North American Industry Classification System (NAICS) codes used to define each subsector can be found in the Endnotes section at the end of the report.

Within each subsector, niche opportunities with high growth potential have been highlighted with this icon ☺

Figure 3 - Subsectors Overview

Food, Beverage, and Meat Processing	Crop Science	Animal Genetics	Agricultural Food
			
<p>The food, beverage, and meat processing industry mainly involves the process of transforming raw agricultural commodities to manufactured products ready for consumption or further processing.</p>	<p>Crop science refers to the development of new seeds and crops, with enhanced health, disease resistance, and yield capabilities. It includes the production of seed, soil, pesticides and fertilizer products.</p>	<p>Animal genetics refers to the production and sale of products related to veterinary health of animals for food and breeding. This sub-sector includes the collection, distribution and sale of animal genetics.</p>	<p>Agricultural food refers to the creation of primary commodities such as live animals and crops (without processing).</p>
<p>Key Statistics</p> <ul style="list-style-type: none"> • Estimated global market size of US\$4.1 trillion by 2024 • Compound annual growth rate (CAGR) of 4.3% from 2019 to 2024 • C\$112 billion in production value in Canada • Accounts for 16.4% of Canadian manufacturing sector GDP 	<p>Key Statistics</p> <ul style="list-style-type: none"> • Global market size of US\$65.1 billion for crop protection and \$41.7 billion for commercial seed • Crop protection market grew 6% in 2018 	<p>Key Statistics</p> <ul style="list-style-type: none"> • Estimated global market size of US\$6.11 billion as of 2018 • Estimated CAGR of 4.9% from 2019 to 2026 	<p>Key Statistics</p> <ul style="list-style-type: none"> • Canadian farm market receipts of C\$57.6 billion in 2016 • Average net worth per Canadian farm of C\$2.8 million, as of 2015

2.1 Food, Beverage, and Meat Processing

Overview - Food, Beverage, and Meat Processing



The food, beverage, and meat processing sector is a fast-growing part of the industry. It mainly involves the process of transforming raw agricultural commodities into manufactured products ready for consumption or further processing. In Canada, the primary products in this sector are varied and include meat, dairy, grain and oilseeds, bakery and tortilla, fruit and vegetable preserving, specialty foods, animal food, sugar and confectionary, as well as fish and seafood³.

The food, beverage, and meat processing sector is expected to have an estimated global market size of US\$4.1 trillion by 2024, representing a compound annual growth rate (CAGR) of 4.3% from 2019 to 2024⁴. This sector is highly significant to the Canadian economy, generating over C\$112 billion in production value as the second largest manufacturing industry. The sector contributes C\$28.5 billion to Canada's GDP, and accounts for 16.4% of the manufacturing sector's GDP⁵.

Despite great significance to Canada's economy, investment in this sector is lagging. Canada has 11,499 food, beverage, and meat processing facilities, of which 94.4% are small operations with under 99 employees. Capital investment as a percentage of sales has dropped by half from 1998 to 2016. The same decline is also happening to Canada's R&D investment in this sector, both compared to itself over time (decline of 24% from 2008 to 2017) and compared to global competitors such as the United States and the Netherlands⁶.

Trends - Food, Beverage, and Meat Processing

Given the imbalance between the importance of the subsector and the lack of Canadian investment, many in the industry are calling for the government to step-up efforts to address the gap to create a stronger culture of innovation. The Agri-Food Economic Strategy Table is an industry-government collaboration, focused on creating strategic advantages in the agriculture / food sector in Canada. They have set ambitious goals to enable Canada to become "one of the top five competitors in the agri-food sector, recognized as the most trusted, competitive and reliable supplier of safe, sustainable, high-quality agri-food products and an innovator in value-added products to feed the dynamic global consumer"⁷. The Table has also announced plans to seize valued-added opportunities through technological advancement and innovation⁸.

In addition to the overall positive outlook and desire to grow, a few emerging industry trends also exist⁹:






- **Food Safety and Transparency:** In the foreseeable future, food processing will be increasingly driven by food safety and transparency. One recent major event in the food sector was the high profile romaine lettuce recall in the US in 2019, which was a reminder of how important food safety is. The industry needs to proactively create new solutions to ensure food safety and transparency to gain and maintain consumer trust.
- **🕒 Functional/Health Foods:** Functional foods will become a major growth source. Consumers today are very concerned about wellness. As a result, there is an increased consumer willingness to spend more on foods that fit their health requirements (e.g. weight loss, special diet, etc.)

- **Plant-Based Protein:** Demand for plant-based alternatives is growing. Many people are either adopting a vegetarian diet or adding plant-based meat products to their diet. According to research conducted by market research companies Nielsen and Spins, grocery sales of plant-based foods as a substitute of animal products have grown to US\$5 billion the past two years, or up by 29%¹⁰.
- **Increased Automation in Processing:** In a study developed by Food Engineering, 22% of the surveyed organizations reported that they adopted advanced automation technologies to help manage rising labor costs and increase efficiency¹¹. This trend will have profound impact on the bottom line and food quality/safety for food processing organizations.
- **Cannabis Products:** Cannabis food will play a bigger role. With legislation and consumer demand changes, many companies have started looking at adding cannabidiol (CBD) to food and beverage products. There is a desire among some consumers to consume food products that bring health benefits or reduce anxiety and stress levels. This trend is more relevant in Canada, US, and parts of Europe where laws permit personal-use cannabis products.

Major Players - Food, Beverage, and Meat Processing

Below are the top industry leaders in the Food, Beverage, and Meat Processing subsector.

Figure 4 - Food, Beverage, and Meat Processing Major Players

Company	Annual Revenue	Headquarters
 Nestlé	US\$93.46 billion ¹²	Switzerland
 PEPSICO	US\$67.16 billion ¹³	US
 Coca-Cola	US\$37.26 billion ¹⁴	US
 Kraft	US\$25.00 billion ¹⁵	US
 ABInBev	US\$52.33 billion ¹⁶	Belgium

Required Resources in Any Region - Food, Beverage, and Meat Processing

Several requirements or key factors that contribute to the success of attracting food, beverage, and meat processors are identified as¹⁷:

- **Business guidance and support for new businesses.** The Ontario government published a guideline for new food, beverage, and meat processing companies in the province, which can be accessed on their website.
- **Funding.** This can come in the form of grants or tax credits from governments.

- **Space.** Adequate industrial space and industry-friendly zone.
- **Transportation.** Physical infrastructure and measures to support safe and cost-efficient transportation.
- **Industry Associations and Programs.** Food industry business infrastructure like programs to address labour/talent gaps, co-packing opportunities to help small businesses, and other industry-wide initiatives. This includes adequate communication and coordination between different agencies and jurisdictions over regulation, government lobbying, inspection etc.
- **Affordable Labour.** Affordable and available labour and a favourable labour environment.
- **Population Density and Proximity to Customers.** Certain agribusinesses (e.g. fresh meat processing) require proximity to a large number of customers to succeed in a region, as their products cannot be transported long-distance typically.

2.2 Crop Science



Overview - Crop Science

Crop Science refers to the development of new seeds and crops, with enhanced health, disease resistance, and yield capabilities. It includes the production of seed, soil, pesticides and fertilizer products. The current market size of this subsector is US\$65.1 billion (crop protection) and \$41.7 billion (commercial seed)¹⁸.

Trends - Crop Science

According to IHS Markit, the global market size of crop protection is US\$65.1 billion as of 2018, up by 6% from the previous year. However, future growth is expected to

be much slower. The commercial seed market experienced a slow growth in the same time period. Increasingly complex and strict regulation was one of the major factors affecting growth and innovation in this space¹⁹.

Specific subsector trends include:






- **🔄 Crop Protection.** Crop protection is one of the fastest growing areas in Crop Science. This is mainly driven by factors such as growing population, urbanization, and a changing climate. As a result of these factors, the amount of arable land has been decreasing, with less rural people working in agriculture. The impacts of climate change need to be strongly considered, as it creates uncertainty for crop yields, giving crop protection an increasingly important role²⁰.
- **Increasing Chinese Market Presence.** There is a growing Chinese presence in this subsector, with leading Chinese organizations recently experiencing over US\$12 billion in agrochemical sales. In 2017, Swiss pesticides and seeds giant Syngenta was taken over by China National Chemical Corporation (ChemChina) for US\$43 billion to help improve China's domestic agricultural output²¹. The presence of Chinese state-owned and private organizations is growing quickly in this sector.
- **Industry Consolidation and Reshuffle.** Although the crop science sector has grown substantially in the past, the number of major players has actually decreased, due to intense consolidation activities.

The number of major agrochemical companies in the US and Europe dropped from 10 to 6 between 1990 and 2009 through M&A activities. As of today, there are 5 major players in this subsector, namely Bayer, DowDuPont (now Corteva), BASF, and Syngenta (now a part of ChemChina), and FMC. This was a response to poor business performance caused by increasingly strict regulation, growing R&D expense, and a number of other factors²².

Major Players - Crop Science

The following organizations are the largest Crop Science companies in the world. Most of them have very strong presence in either Calgary or Canada.

Figure 5 - Crop Science Major Players

Company	Annual Revenue	Headquarters
 syngenta	US\$429.21 billion (ChemChina) ²³	Switzerland
 BASF We create chemistry	US\$66.43 billion ²⁴	Germany
 BAYER	US\$48.77 billion ²⁵	Germany
 CORTEVA agriscience	US\$13.85 billion ²⁶	US
 FMC	US\$4.61 billion ²⁷	US

Required Resources in Any Region - Crop Science

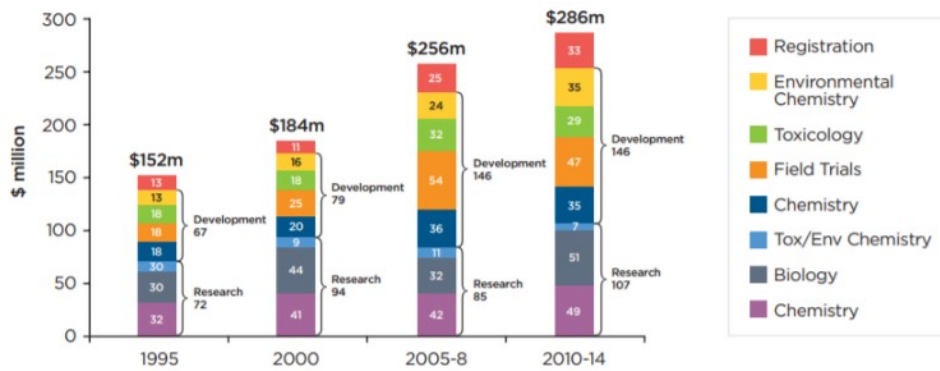
Crop science requires specialized talent and research capabilities, meaning that for crop science to thrive, it is important to have access to leading educational institutions with specific programming.

Crop science is also a capital intensive industry that is currently facing increasingly stringent regulations that are driving market uncertainty (the significant capital requirements are illustrated below in Figure 6). Because of this, organizations need to have strong operational viability to make new investments in the industry. A number of regional measures can be taken to improve operational viability, including:

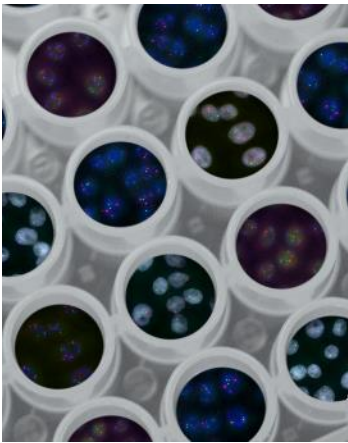
- Strong funding support
- Insurance
- Policy friendliness
- Competition protection for small start-ups from major corporations

Calgary and Southern Alberta have many of these resources required for Crop Science to be successful, such as support programs and policies, and strong educational institutions.

Figure 6 - Growing Costs in Developing New Crop Protection Products²⁸



2.3 Animal Genetics



Overview - Animal Genetics

Animal genetics refers to the production and sale of products related to veterinary health of animals for food and breeding. This subsector includes the collection, distribution and sale of animal genetics (e.g., embryos, semen, and live animals for breeding).²⁹

The global animal genetics sub-sector had an estimated market size of US\$6.11 billion in 2018.³⁰

Trends - Animal Genetics

Animal genetics is a fast-growing industry with an estimated CAGR of 4.9% from 2019 to 2026.³¹ The fastest-growing market is Asia Pacific whereas the largest market is still North America³². In Canada, the volume of animal genetic exports (for breeding purpose) grew from ~310 million units to ~330 units between 2015 and 2019. Within these, 🐾 **purebred horse** exports grew fourfold within 4 years, while 🐣 **hatching eggs** export saw a growth of ~54%. In contrast, beef cattle export saw a drastic decline, from ~23 million units in 2015 to ~8 million in 2019. As of 2019, 33% of Canada's animal genetics export products were dairy semen³³.





Some key factors that are driving the industry growth are³⁴:

- Growing population
- Rapid urbanization
- Growing preference for animal protein in emerging markets
- Adoption of progressive genetic practices (e.g. AI, embryo transfer)

Major Players - Animal Genetics

The animal genetics industry is relatively concentrated with a few major players dominating the market³⁵.

Figure 7 - Animal Genetics Major Players

Company	Annual Revenue	Headquarters
	£488.5 million ³⁶	UK
	US\$414 million ³⁷	US
	US\$6.26 billion ³⁹	US
	Private Company	The Netherlands

Required Resources in Any Region - Animal Genetics

The future of animal genetics will largely revolve around responding to global demand and adopting emerging technologies to improve product offerings. To meet these needs, top talent and research institutions are required for the industry to thrive in a region. In addition, affordable labour and techniques, and associated training programs and facilities will also contribute to the success of this sector.

2.4 Agricultural Food



Overview - Agricultural Food

Agricultural food refers to primary commodities such as live animals and unprocessed crops. According to the Government of Canada, Canadian farm market receipts were C\$57.6 billion in 2016. The average net worth per farm in Canada was C\$2.8 million as of 2015⁴⁰. While an estimated growth rate is not available due to the huge size of the agricultural food market, the Food and Agriculture Organization of the United Nations projected that the annual growth rate of production and demand for agricultural commodities is 1.6%⁴¹.

Trends - Agricultural Food

With a growing world population and a corresponding increase in food demand, agricultural commodities play vital role in ensuring world food security. There are a few emerging trends that will fundamentally impact this sector:

- **Impacts of Urbanization.** Urbanization is both accelerating diet transitions in emerging markets and changing the types of employment in the sector. According to the United Nations, 68% of the world population is expected to live in urban areas by 2050⁴². This is shift is particularly strong in




developing economies, including those in Asia and Africa. In highly urbanized areas, people consume a larger proportion of processed food and food with high nutrients. Consumption pattern changes also mean changes in sector employment: there will be a major shift from people working in primary agriculture to joining food processing, transport, vending, etc⁴³.



- **Bioenergy.** The International Renewable Energy Agency (IRENA) has developed a global renewable energy roadmap, *REmap 2030*, in an effort to drastically increase the share of renewables in the global energy usage⁴⁴. In the report, bioenergy is indicated to be the “single most important renewable resource” if all the other options have been successfully implemented by 2030. Bioenergy refers to the combustion of biomass in such forms as food, animal waste, and charcoal, and the production of biofuel from plants, making agricultural food a primary input into the production of bioenergy. By 2030, bioenergy could account for 60% of global renewable energy usage, or 20% of the global primary energy supply⁴⁵.
- **Increased Nationalization.** In recent years there has been an increasing effort by some international governments to increase nationalization and domestic production. Events such as Brexit, the US/China trade war, and the effort to bring manufacturing back to the US highlight how some countries are growing skeptical of the benefits of globalization. There is a risk that the international trade and exports of Alberta agriculture products may be impacted should this trend continue.
- **Implications of COVID-19.** Since the emergence of the COVID-19 situation, many countries started banning exports of key primary agricultural products. Russia, the world’s leading food exporter, announced a 10-day ban on buckwheat and rice. After that, Kazakhstan, Ukraine, Vietnam, and Cambodia all followed suit, to some extent. Bans on food exports during times of global crisis are not new. A similar series of events occurred in 2008/09 during the financial crisis, further threatening global food security and supply chain⁴⁶. Primary agricultural products have an important role in food security within a country, and this becomes particularly relevant at time of crisis. The response to COVID-19 will continue to evolve in 2020 and beyond, but there are sure to be implications for the agribusiness industry in the coming years.

Major Players - Agricultural Food

Traditionally, the agricultural food market was dominated by large Western corporations (Archer Daniels Midland [ADM], Bunge, Cargill and the Louis Dreyfus Company, together commonly known as “ABCD”). Recently, a Chinese company, Cofco, joined the list.

Figure 8 - Agricultural Food Major Players

Company	Annual Revenue	Headquarters
	US\$113 billion ⁴⁷	US
	US\$64.69 billion ⁴⁸	US
	US\$36.5 billion ⁵⁰	The Netherlands

	US\$41.14 billion ⁵²	US
	RMB 471.1 billion ⁵³ (~\$US 66.52 billion)	China

Required Resources in Any Region - Agricultural Food

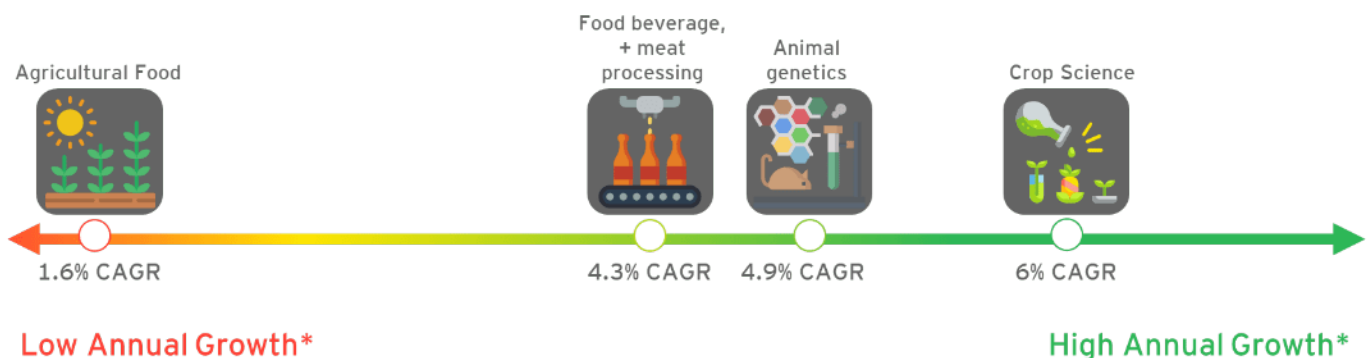
Abundant land mass, favourable climate (or supporting irrigation/greenhouses), and supporting infrastructure are the required resource for the success of primary agriculture industry. Well-functioning supply chains, business-friendly regulatory environments, and the presence of available and affordable workers are factors that will contribute to regional sector growth.

Calgary and Southern Alberta have the land mass and infrastructure required for success in this area. In order to be more competitive, the Region can create a more agribusiness-friendly regulatory environment.

2.5 Summary - Subsector Analysis

The four subsectors each have high growth potential, as compared in Figure 9 below. (Note that CAGRs + sources can be found throughout the subsectors section. The CAGR used for agricultural food is the rate of growth for commodities, and the CAGR for crop science is the rate for crop protection growth specifically).

Figure 9 - Comparison of Subsector Growth Rates



The subsectors all continue to be affected by emerging global trends, such as urbanization, the rise of developing economies, and climate change. At the macro level, the capability to address these challenges will define a region’s ability to tap into the global market of the next generation. From a micro perspective, trends creating specific growth opportunities include functional/health foods, plant-based protein, cannabis products, crop protection, purebred horses and hatching eggs, as well as bioenergy products and solutions.

In order for any subsector to grow and thrive in a region, the most commonly required resource is a concentrated effort to support subsector growth, such as business-friendly policies and programs. Funding and transportation play an important role in asset-heavy subsectors, such as Agricultural Food, and Food, Beverage, and Meat Processing, whereas access to talent, research capability, and training matter more for Animal Genetics. For Calgary and Southern Alberta to focus on developing an individual subsector, attention should be directed to ensuring that the applicable “required resources” are present to promote the growth of both existing and new players.

Global Buyer Profile | CHINA



China has nearly 1.4 billion people to feed⁵⁵. As of 2014, 45.23% of China's population live in urban areas, and that number continues to grow. China has 9.6 million km² of land and 3 million km² of offshore territory⁵⁶. As Alberta's second largest trade partner, exports to China increased by 32.4% between 2017 and 2018, totaling C\$2.6 billion⁵⁷. In the future, China will continue to play a growing role in Alberta's agriculture exports due to its ever-growing population, strong economy, and fast urbanization.

Consumer Trends

China's demand for agricultural products will continue to rise in the coming years due to supply pressure of agricultural products, growing demand from population increase and living standard improvement, and reduced motivation for domestic production⁵⁸. Some emerging trends influence consumer behaviours:

Light Eating: The low consumption of foods low in calories, sugar, and fat. Light eating a new Western trend catching on, but is also part of the traditional medicine philosophy that has become popular with the middle-class who is more conscious of health and lifestyle⁵⁹.

International Brands: Middle-class consumers who can afford higher prices of imported products are increasingly seeking products of established international brands, valuing "life quality" above price..

Internet and Cross-Industry Cooperation: Celebrity food attracts young demographics to consume food recommended by internet influencers⁶⁰. Some businesses have leveraged internet celebrities to promote their brands and products are no longer evaluated on quality and price, but on packaging and "story"⁶¹.

Relevance to Alberta

Canadian ag products have strong reputation in China. Alberta should pay attention to emerging trends, customize products to better meet modern consumer demand, and capture value by growing value-add product exports and establishing partnerships, increasing presence, and telling a unique "Alberta story."

Market Risks

Political Risk: The dynamic global political environment introduces a risk of Alberta's agriculture exports to China being adversely affected. In 2018, after a high profile arrest of a Chinese national in Canada, China revoked an import permit for one Canada's largest grain processors⁶², causing concerns among Canadian producers. Political risks will continue and Alberta must be prepared.



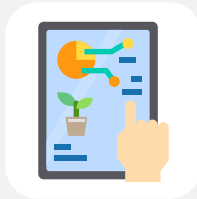
Cultural Risk: Producers who would like to expand in China need to understand the importance of showing cultural respect to the market and consumers. Other high profile importers such as Dolce & Gabbana have offended the general public in China, leading to backlash and boycotts⁶³. D&G was essentially removed from the market (which buys 1/3 of global luxury products⁶⁴) and has not returned.

3.0 Horizontal Analysis

CED has identified several priority 'horizontal' which cut across agribusiness subsectors that Southern Alberta should focus on. These horizontals were selected based on their growing importance in agribusinesses and on Southern Alberta's potential in attracting businesses operating in these horizontals. Each horizontal cuts across each subsector analyzed in the prior section and should be considered in combination with those subsectors. This section looks at three focus horizontals: Agricultural Technology, Artificial Intelligence, and the combined grouping of Agri-finance, Agri-business, and Support Services.

Within each priority subsector, niche opportunities with high growth potential have been highlighted with this icon 📌

Figure 10 - Horizontals Overview

Agricultural Technology	Artificial Intelligence (AI)	Agri-finance, Business, and Support Services
		
<p>Agricultural technology (also called "agri-technology" or "agtech") includes the development, design, testing, and production of specialized software and hardware to support core agriculture activities.</p>	<p>AI's application in agriculture includes the use of agricultural robots, predictive analytics (machine learning), and other advanced technologies and algorithms to increase the performance of agribusinesses.</p>	<p>Agri-finance, business, and support services includes specialized financial, business, and consulting services that provide critical financing, business transactions, management, and investment that enables the agribusiness sector.</p>
<p>Key Statistics</p> <ul style="list-style-type: none"> • Global smart agriculture's market size was US\$5 billion in 2016; expected to grow to US\$15 billion by 2025 • Precision farming's market size is estimated to be US\$7 billion in 2020; expected to grow to US\$12.8 billion by 2025 	<p>Key Statistics</p> <ul style="list-style-type: none"> • The global AI market produced US\$584 million in revenue in 2018 • Predicted CAGR of 38.3% going forward 	<p>Key Statistics</p> <ul style="list-style-type: none"> • Agriculture banking market size of US\$16 billion in the US; annual growth rate of 2.4% between 2014-2019 • Agriculture insurance market size of US\$32 billion worldwide; annual growth rate of 4.1% from 2021 to 2026

3.1 Agricultural Technology



Overview - Agricultural Technology

Agricultural technology (also called “agri-technology” or “agtech”) includes the development, design, testing, and production of specialized software and hardware to support core agriculture activities. As technology can apply to almost any area of agriculture, this horizontal can be considered a core enabler that crosses several sub-sectors. For example, technologies enable functions across the sector, including plant monitoring, product management, field monitoring, and biometrics.

Trends - Agricultural Technology

Growth in agtech has been significant. The global market size for Agricultural Technology was US\$ 494.9 billion in 2018. It is expected to grow at a CAGR of 8.1% and become a USD 729.5 billion industry by 2023⁶⁵.

Specifically, two high-growth areas are:

- ☺ **Smart Agriculture / Internet of Things (IoT).** Internet of Things (IoT) is a key system that makes smart agriculture possible. It leverages internet connectivity to virtually link multiple devices (e.g. sensors) together and allows farmers to manage their farm digitally and centrally. The current global smart agriculture market was worth over US\$5 billion in 2016, with an expectation to eclipse US\$15 billion by the end of 2025; a cumulative annual growth rate of 13% between 2017 and 2025.⁶⁶
- ☺ **Precision Farming.** Precision farming refers to the use of information technology, GPS, drones and other technologies to make the practice of farming more accurate⁶⁷. It is expected to grow from US\$7 billion in 2020 to US\$12.8 billion by 2025.⁶⁸






The acceleration of the rate of industry adoption of agtech is likely to continue over the coming years. Opportunity exists today to take advantage of the growing ecosystem, increased available capital, and a growing interest by traditional players in the industry⁶⁹.

In developed markets, agtech adoption amongst those at the farm level continues to rise, led largely by the US. The rate of adoption varies, with immense opportunities in some areas. For example, adoption in the bulk crop production space is much more advanced than adoption in livestock and specialty crops⁷⁰.

Major Players - Agricultural Technology

Agtech contains dozens to hundreds of players across the horizontal, covering each component of the agriculture value chain. SVG Venture’s THRIVE publishes an annual list of the top-50 firms in agtech⁷¹. The five largest (by employee count) of their top 50 firms, as outlined in the 2020 report, are outlined below.

Figure 11 - Agtech Major Players

Company	Products and Services Offerings
	<p>Zymergen is an American biotech company. It uses automation, machine learning, and genomics to research, develop, and manufacture microbes for Fortune 500 companies.</p>
	<p>Solinftec is a Brazil based digital agriculture company focused on using platform-agnostic software to improve farm management and forecasting.</p>
	<p>Farmers Business Network (FBN) empowers growers to capture and analyze their own crop data using cutting edge methods that include drones, mobile apps, embedded sensors and ground cameras.</p>
	<p>Plenty is an American indoor vertical farming company. It develops and maintains proprietary vertical farming systems that enable farmers to increase crop yields. Plenty locates their operations near city centres to ensure the freshest produce makes it to customers.</p>
	<p>Indigo is an agtech company based in Boston. It provides a broad range of services that connect buyers, growers, and carriers, as well as supporting the transition of growers to more carbon efficient farming and regenerative farming.</p>

Current Geographic Hubs - Agricultural Technology

While some hubs take a broader approach, agtech specialization can enable smaller ecosystems to outperform larger ecosystems in terms of start-ups created by the investment dollars attracted. St. Louis provides a prime example of this: by building from existing expertise of research institutions, universities, and large corporations to develop innovation infrastructure, St. Louis has been able to build a reputable specialization at the nexus of agriculture, medicine, and health care.

For a deeper look at two of the strongest agtech hubs in the world (Salinas and St. Louis), refer to section 4 of this report on Global Agribusiness Hubs.

Agricultural Technology - Market Risks

Adoption Slows: Farmers face a challenging financial environment related to low crop prices, elevated debt, and stagnating farm income. International trade wars have further exacerbated these concerns by changing the dynamics of the market. Should this continue, farmers are likely to be more cautious with how they deploy capital, including on technology-based solutions.

Connectivity: In developed and developing markets alike, rural connectivity continues to be a challenge. While satellite connectivity and low-powered wide area networks have improved the situation, there remains significant bandwidth challenges that present a hard obstacle to the use of agtech for many farmers.

Incompatibility of Solutions: As the number of competitors and offerings in the market increases, the needs for standards and improved compatibility will become essential. Handled incorrectly this risk may necessitate industry or government collaboration, or it may form a barrier to continued adoption of agtech.

Cybersecurity: As with any connected devices, cybersecurity and data will become increasingly significant risks. Some farmers may shy away from technology should high-profile breaches occur.

Most Applicable Subsector - Agricultural Technology

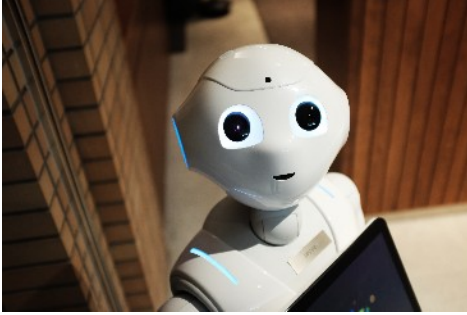
Agricultural Food, Food Processing, and Animal Genetics. Agtech is applicable to most subsectors. Its predominant usage is on Agricultural Food, where the technologies enable plant monitoring, product monitoring, animal biometrics, etc. Technology has also helped the Animal Genetics sector through new gene transfer biotechnologies, in-vitro production, and cloning and sexing of embryos⁷³. In Food, Beverage, and Processing, robotics and machines are helping food processors create efficiency and ensure safety.

Required Resources in Any Region - Agricultural Technology

As demonstrated by the world's largest agtech hubs, building momentum behind agtech requires a number of key components:

- **Early-stage funding:** Availability of government grants, endowments, and venture capital funding is critical to bringing innovators and entrepreneurs to a region
- **Access to business support and facilities:** Having a support structure in place, including service providers and government agencies, enables large agtech organizations and entrepreneurs to focus on the core of what they do
- **Access to networks:** Creating natural networking opportunities allows agtech companies to meet funders, partners, and potential customers
- **Customer accessibility:** As with access to networks, it's critical to create or ensure a potential base of viable customers in the market to attract agtech companies
- **Availability of talent:** Perhaps more than any other horizontal, the availability of experienced research and technology talent can make or break an agtech hub. Early stage agtech organizations are looking for leading talent to help them make the next leap; without that talent, they are likely to go elsewhere
- **Long-term commitment:** It's important that a region expresses a long-term commitment to agtech, including building the appropriate infrastructure (labs, hubs, districts, etc) and setting appropriate regulatory conditions.
- **Major players and critical mass:** The existence of major players in a region can often attract more companies, talents, and investment into the region.

3.2 Artificial Intelligence



Overview - Artificial Intelligence

Artificial Intelligence (AI) is the imitation of human behaviour by machines⁷⁴. Its application in agriculture includes the use of agricultural robots, predictive analytics (machine learning), and other advanced technologies and algorithms to increase the performance of agribusinesses. Examples include weather impact prediction, crop management, disease/pest identification, task automation, crop and soil monitoring, etc.

AI helps farms improve efficiency and outcomes across their operations⁷⁵. Its most popular usage in agriculture is precision farming, given the increasing desire from the agrarian community to optimize yield outcomes with minimal cost⁷⁶.

Trends - Artificial Intelligence

One of the fastest growing areas of agribusiness, the global AI market produced US\$584 million in revenue in 2018 and is estimated to grow with a CAGR of 38.3%⁷⁷.

Canada has embraced the AI trend at a national level. In 2019, Innovation, Science and Economic Development Canada invested C\$49.5 million in funding in the Canadian Agri-Food Automation and Intelligence Network (CAAIN), an industry network focused on accelerating digitization and automation for the agriculture industry in Canada⁷⁸.

Globally, there are a few emerging trends in this space⁷⁹:

- **🕒 Crop yield optimization using machine learning to manage climate change.** Scientists have used deep learning algorithms to successfully determine the genes that will contribute positively to a crop's growth, effective water use, adaptation of climate change, and resistance to disease. This technology allows superior species to be selected to improve sector performance. With growing concerns regarding climate change, AI will play a vital role in ensure stable and sustainable performance of agriculture in the future.
- **🕒 Cattle face recognition.** Advanced recognition and image classification technologies allow farmers to be able to individually monitor the behaviour of a livestock, such as body conditions to feeding patterns. This is a regional trend and is more relevant in areas where livestock is a primary industry, such as Alberta.
- **Emerging market - China.** China is fast becoming a new hotspot of AI technology application in agriculture. Individual AI projects, such as agricultural monitoring drones and an automated agricultural driving system are being rolled out to the market at a fast pace and low cost⁸⁰. In 2018, Alibaba group launched its proprietary ET Agricultural Brain, which is a cutting-edge cloud based AI platform capable of generating real-time insights of the pig farming industry chain⁸¹. A number of key Chinese organizations are located in the major cities such as Beijing, Shanghai, and Shenzhen⁸², providing easy access to talent, friendly policy, and strong local research capabilities.

Major Players - Artificial Intelligence

As industries evolve, they typically go from an early "fragmented" stage, where competition is strong without major players, to a more mature "consolidated" stage, where the market is usually dominated by very few giants. In it's current state, AI is on the more fragmented side of the spectrum. Most of the companies in this space are either small start ups or mature technology companies who are testing out new technologies or business models⁸³. Start-ups are more flexible in their products, whereas global

powerhouses (e.g. Microsoft) have the ability to make major investments through industry-shaping efforts. Large companies also have increasingly partnered and collaborated with local regional companies.

Select players in this space are listed below.

Figure 12 - Artificial Intelligence Major Players

Company	Products and Services Offerings
	<p>Microsoft has invested over US\$50 million in the AI for Earth program, partnering with top scientists and farmers to explore the use of AI in agriculture⁸⁴. Microsoft's Dynamics 365 and Azure Cognitive Services have successfully helped many clients in addressing their unique agriculture challenges, such as automating the process of pumping milk while monitoring its quality and other key information⁸⁵. Being a global leader, Microsoft also has a strong regional reach through various partnership and programs.</p>
	<p>IBM a world leader in cloud and cognitive technologies. Their flagship product Watson Decision Platform supports precision agriculture by leveraging AI, predictive analytics, and other advanced technologies to help farmers increase crop profitability, sustainability, and quality⁸⁶.</p>
	<p>Granular is a San Francisco based technology companies focusing on leveraging AI and analytics to help farms become more efficient and make better decisions⁸⁷. Granular operates in the US, Canada, Australia and Brazil.</p>
	<p>aWhere provides on-demand, software-as-a-service (SaaS) data management and analytics tool that allow agribusinesses to make data informed decisions across the value chain.⁸⁸</p>
	<p>Prospera is an Israeli agriculture AI company that leverages machine learning to help farms optimize production. It provides all-in-one digital farming system and autonomous crop management solutions.⁸⁹</p>

Current Geographic Hubs - Artificial Intelligence

Similar to agtech, the largest concentrations of AI start-ups are currently located in California, New York, and Massachusetts, due to the existing start-up ecosystems, cluster effect, and research capabilities in the region.⁹⁰ In addition, new technologies and organizations are gaining momentum in emerging economies, such as China, thanks to favourable policy⁹¹ and low labour costs.

Market Risks - Artificial Intelligence

Lack of standardization and data availability. The accuracy of AI is heavily dependent on the quality and timeliness of the data input. Currently, there is no industry-wide standardization protocols, and the sharing and collaboration of agricultural data is low. This can potentially affect the general usefulness of AI and slow down adoption of AI in agriculture. As a result, farmers' confidence in adopting and investing in AI may be low, posing a risk to the growth of this sector.

Social acceptance: AI makes decisions using different algorithms based on a variety of data and models. These models are usually complex and hard to understand for people who are not specialized in this field, and this becomes increasingly significant as quality data becomes available. These factors come together to

create a sense of uncertainty. Farmers may be resistant to put so much trust on AI - something they are not familiar with - to make the critical decisions that drive their business⁹².

Most Applicable Subsector - Artificial Intelligence

Agricultural Food and Crop Science: The best use of AI in agriculture is to leverage big data and analytics to support crop protection, optimize yield production, and to develop artificial robots to simplify tasks. These solutions allow farmers to manage their farms more responsibly and effectively. They also enable crop science companies to bring new innovative products to the market, such as intelligent insect detection and crop protection solutions.

Required Resources in Any Region - Artificial Intelligence

Unlike traditional capital-intensive industries with heavy physical assets, AI is an asset-light industry, and therefore requires relatively less funding as a resource. Instead, it requires high-quality AI talent, such as data scientists and farm analytics experts to create solutions. This is reflected through the number of AI related programs offered in local and regional institutions and a successful transition between schools to industry through programs such as internships and co-op programs.

Calgary and Southern Alberta have the right mix of resources for agricultural AI to be successful in the Region, though could use a greater presence of established technology companies. It would also be beneficial to try to grow and attract more talent to the Region to accelerate growth, as AI is a knowledge and talent intensive industry.

3.3 Agri-finance, Business, and Support Services



Overview - Agri-finance, Business, and Support Services

Agri-finance, business, and support services includes specialized financial, business and consulting services that enable critical financing, business transactions, management, and investment in agribusiness sector. This sector includes multi-industry service providers (e.g., banks, legal services firms, and insurance companies) with specialized staff or expertise in the agribusiness sector, as well as agricultural specific financial products and services. Another support service is agriculture traceability solutions, which involves premises identification, animal

identification, and animal movement tracing, and has faced growing demand in recent years.

Trends - Agri-finance, Business, and Support Services

Global growth in this subsector mainly comes from 2 sources:

- **🕒 Agriculture Banking.** Agriculture banking is a US\$16 billion industry in the US alone. This space had an estimated annual growth rate between 2014-2019 was 2.4%, coming mostly from increased loan activities as a result of widespread drought, disease, uncertain and fluctuating commodities prices, and foreign trade complications. These events led farmers to struggle financially, which required them to seek more loan and debt refinancing products.⁹³
- **🕒 Agriculture Insurance and Risk Management.** The global agriculture insurance market was a US\$32 billion industry. It's expected to growth at a CAGR of 4.1% from 2021 to 2026, by the end of which it will reach US\$43 billion⁹⁴. The growth comes from an increased demand for agriculture insurance, as a result of increasing volatility in the agriculture commodities market, unpredictable





demand and supply which causes production risks for farmers⁹⁵, as well as a growing level of government subsidies for crop insurance⁹⁶.

Major Players - Agri-finance, Business, and Support Services

Agriculture Finance: The Canadian Agricultural Loans Act (CALA) is a federal program designed to provide financing support to help farms establish, improve, and develop farms. It also gives an opportunity for agricultural co-operatives to improve their capacity to process and market their products⁹⁷. Most banks in Canada offer products and services related to CALA.

While many Canadian bank and financial services organization offer such services, below is a select few that have a focus in Alberta and Western Canada.

Figure 13 - Agri-finance, Business, and Support Services Major Players

Company	Products and Services Offerings
	National Bank offers a variety of financial products to Alberta farmers, such as term loans, farm mortgages, and government-guaranteed loans. They also provide farmers with farm growth, transfer, risk management, and other comprehensive solutions.
	ATB Financial offers Alberta farmers term loans, operating loans, equity agri-plan loans, among other financial products and services. It has the advantage of having a sole focus in Alberta and having more presence in small cities and towns, making itself more available to farmers.
	RBC provides Alberta farmers with term loans, farm expansion, farm risk management, and farm succession planning services.
	Farm Credit Canada offers a broad range of products and services to primary agriculture producers, agribusiness, as well as food and logistics companies. Services include credit lines, input and livestock financing, environmental solutions, and other financing services across the agribusiness value chain.

Agriculture Insurance: Most of the key players in this field are traditional insurance firms, offering agriculture insurance as part of a broader range of insurance offerings. Select global players include: PICC, Zurich (RCIS), Chubb, QBE, China United Property Insurance, AFG, Prudential and XL Catlin⁹⁸.

Agriculture Traceability: Traceability services are mostly provided by local businesses that understands the local conditions and regulations (e.g. ITS Global, located in Alberta). Other players include the Canadian Food Inspection Agency (CFIA) who regulates this field, and Canadian Cattle Identification Agency (CCIA) as the responsible administrator of the Canadian Livestock Tracking System (CLTS) database⁹⁹.

Current Geographic Hubs - Agri-finance, Business, and Support Services

There are no predominant hubs for this subsector, as agri-finance and business services tend to exist anywhere agribusinesses exist. In general, no specialized resources or talent are required.

Market Risks - Agri-finance, Business, and Support Services

Credit Risk. Risk in agri-finance is primarily driven by credit risks, which is connected to the common risks that farmers bear with regards to the viability of their businesses and their ability to repay the loan. Although finance or insurance services to the agribusiness industry don't differ significantly from any other industry, there are a few notable nuances such as specific product and market risks which affect farmers'

ability to pay back their loans. In addition, agriculture's role in ensuring food security makes it more subject to global political risks through political interventions and trade wars. These events pose significant risks to agri-finance service providers¹⁰⁰.

Most Applicable Subsector - Agri-finance, Business, and Support Services

Agricultural Food: Technically, all subsectors can leverage finance, insurance, and other business services. Particularly, primary agricultural food producers, such as farmers, are the primary users of businesses services that are designed for agriculture.

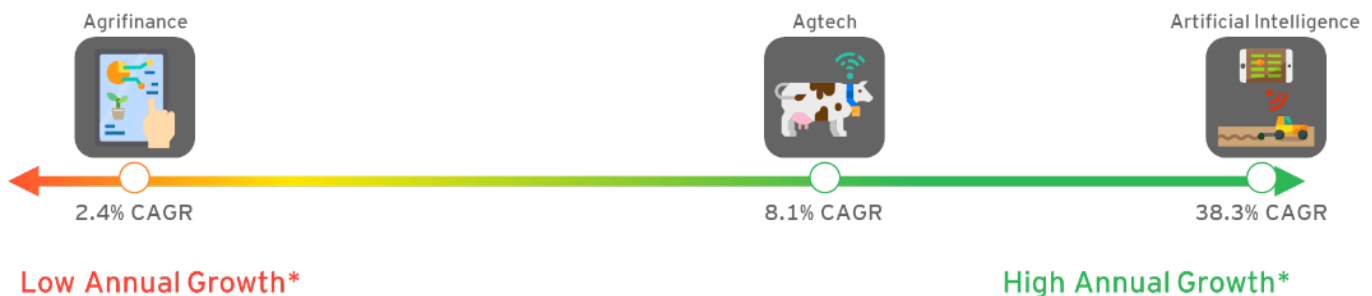
Required Resources in Any Region - Agri-finance, Business, and Support Services

Agriculture finance and business support services do not require special resources to succeed, such as high-tech talent or infrastructure support. They do, however, require access to a sufficient number customers and general business-friendly environment.

3.4 Summary - Horizontal Analysis

The specific horizontals analyzed in this report all present growth opportunities, with especially strong growth potential in agtech and artificial intelligence. The comparable growth rates of horizontals are outlined below (*Note that CAGRs + sources can be found throughout the subsectors section. The CAGR used for agrifinance, business, and support services is the rate for U.S. agrifinance growth alone).

Figure 14 - Comparison of Horizontal Growth Rates



Agribusiness organizations today are facing unprecedented challenges, from climate change and trade wars to the latest COVID-19 pandemic. Horizontals provide tools and technologies that allow agribusinesses to manage these risks, whether that be through AI-powered crop yield optimization and weather prediction, precision farming to maximize resources and labour, or a variety of financial and insurance products for farmers to weather the storm. In the foreseeable future, these horizontals will play an increasingly important role for global agriculture and agribusinesses.

For a region like Calgary and Southern Alberta to attract organizations in these horizontal groups to the region, the area should focus on the major required resources for success: specialized talent and research capability. Horizontals are relatively asset-light (compared to subsectors), which reduces the burden on funding requirements required to start a business, however SRED credits or R&D grants would be particularly appealing to businesses in agtech or artificial intelligence. However, the major focus should be placed on attracting and showcasing specialized talent, and growing research capability.

Global Buyer Profile | INDONESIA



Indonesia is the world's largest archipelago, with over 17,500 islands and a population of 268 million. Indonesia has experienced economic growth in recent years, with agriculture contributing greatly to the national economy and food security. However, there is still a large number of undernourished Indonesians: according to the United Nations Food and Agriculture Organization, "28% of Indonesia's children are underweight, and 35% of children under 5 suffer from stunted growth"¹⁰¹.

Even though Indonesia is responsible for a small share of Alberta's agricultural products export, it has grown very quickly, indicating significant opportunities going forward, once traditional market (e.g. US) demand for Alberta food products has saturated and stop growing substantially. Between 2017 and 2018, Indonesia's purchase of Alberta agri-products grew by 17.9%¹⁰². In 2015, Indonesians spent US\$179 billion on food, representing 36% of total consumer spending in the country¹⁰³.

Consumer Trends

Trust in Local Brands: According to a consumer research study conducted by McKinsey, more than two-thirds of surveyed Indonesians have a preferred local brand in mind when looking for food and beverage products. Consumers trust local businesses and take pride in using Indonesian brands, believing that they truly understand what the locals need and are able to provide better value for money. Interestingly, consumers seem to care more about the perception of being local, without excessively researching whether or not a company actually is. There were successful examples of foreign companies that localized themselves and gained substantial share of the local market¹⁰⁴.

Diet Diversification: With a rising middle class population and growing disposable income level, consumers are diversifying their diets. There has been strong growth of fruit and dairy products over the last few years, and that trend will continue to expand into other areas. In addition to the income factor, the Ministry of Health's guideline for its people to consume more protein and healthy products also helped the shift become possible¹⁰⁵.

Relevance to Alberta

Alberta agribusinesses who want to enter Indonesian markets need to spend more time understanding the local market before making a move. Opportunities exist to create localized versions of Alberta products and to engage the consumer markets through hybrid branding strategy. With a growing middle class, there will also be an opportunity to export more high-end food processing products to Indonesia.

Market Risks

Regulatory Complexity: The Indonesian government and bureaucratic system is one of the most complicated in the world¹⁰⁶. Constant regulatory revisions might cause uncertainty for foreign agribusinesses who are unfamiliar with the local environment.

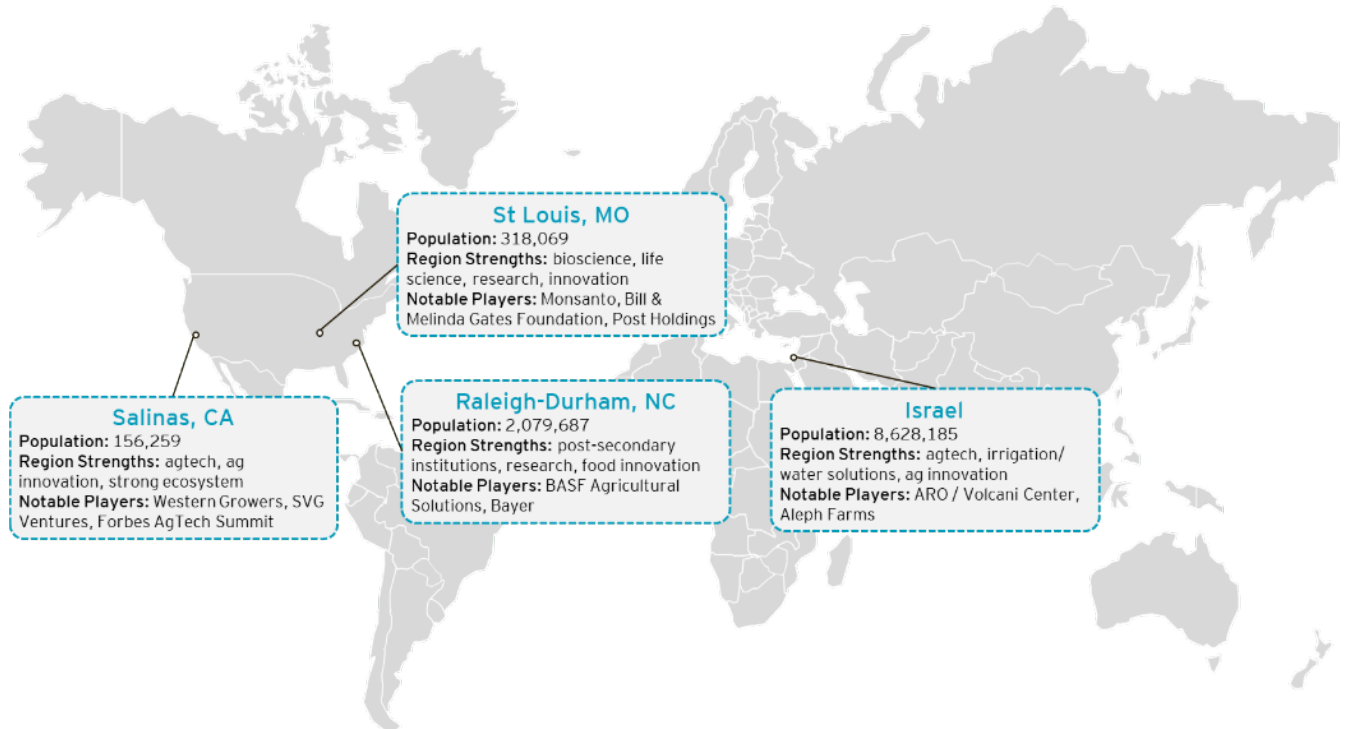
4.0 Global Agribusiness Hubs

The Calgary and Southern Alberta region exists within a broad global ecosystem of agricultural regions and consumption markets. Within a number of these markets are well-established *agribusiness hubs*.

In this context, an *agribusiness hub* is a region that is known in the international landscape for its agribusiness economy. Specifically, these hubs are specialized in agribusiness, have robust ecosystems to support the industry, and have worked to brand themselves as centres of excellence in agribusiness. Most often, they have formal ways to support the industry (through grants, tax credits, funding, etc), and educational institutions with unique programs related to agribusiness.

This report looks at four leading agribusiness hubs: three closer to home in Salinas (California), St. Louis (Missouri), and Raleigh (North Carolina), as well as the quickly emerging national agribusiness hub found in Israel. While each of these hubs is a result of its unique circumstance, there are lessons to be learned from their structure, their key players, and the journey they have taken.

Figure 15 - Global Agribusiness Hubs Analyzed



4.1 Salinas, California, USA

Overview

Located in Central California, 60 miles south of San Jose, the Salinas Valley is known as “America’s Salad Bowl” due to the rich history of growing leafy greens in the region. With a population of only 156,259, Salinas is the smallest region investigated for this report.¹⁰⁸

Despite its relatively small size, Salinas boasts a US\$8 billion industry, employing 75,000 individuals in the production of a wide range of crops that includes growing 28% of America’s strawberries, 60% of the nation’s leafy greens, and a significant proportion of America’s Pinot Noir grapes.¹⁰⁹ The region’s fertile soil

and geographic locations come together to provide significant opportunity for both growers and innovators in the area.

In recent years, innovation has become the core of Salinas' value proposition. In 2014, the region launched the THRIVE accelerator program to help discover agtech innovations on a global scale and to more formally connect agriculture experts and growers from around the world with Silicon Valley.¹¹⁰ Based in Silicon Valley, the THRIVE program forms the world's leading agri-food innovation ecosystem, with over 2,500 start-ups from 90 countries.¹¹¹

Alongside THRIVE, Salinas is home to the Western Growers Center for Innovation and Technology. Founded three years ago, this innovation hub, houses 50 global innovators looking to transform agriculture. In 3 years, the Center has connected 4,077 growers, while also supporting 55 startups, helping them raise US\$26 million in capital, and create 140 jobs.¹¹² Today, the WG Center is focused on four challenges: Water supply and use, water quality, labour supply shortages, and crop protection. Each of these is a challenge that the Salinas region is well positioned to help solve.¹¹³

Notable Players

Forbes: Each year, Forbes partners with Salinas and THRIVE program to host the AgTech Summit. Heading into its 6th year in 2020, the summit brings together over 600 global agtech leaders to build connections and present innovations. Alongside this summit, THRIVE presents their annual rankings of the top-50 agtech and foodtech companies in the world.¹¹⁴

Western Growers: Founded in 1926, Western Growers (WG) is the core industry association for agriculture in the Salinas Valley.¹¹⁵ In recent years, WG has focused on investment in the region, developing a US\$4 million investment fund based out of the WG Innovation Centre.¹¹⁶

SVG Ventures: The founding entity behind the THRIVE accelerator program, and the THRIVE ecosystem, SVG has built strong connections with ecosystem partners and is an active investor in the Salinas region, holding investments in many innovative agriculture businesses.¹¹⁷

Diverse set of funders: The Salinas Valley has drawn the attention of local, national, and international investment firms looking to be involved in the region's growth. Specialized local firms include Central Coast Angels and Angels by the Sea, while national investors like AgFunder and Better Food Ventures have also built a presence in the region.¹¹⁸

Lessons to be Learned

Salinas has taken advantage of their unique circumstances to become more than the "Salad Bowl." The region's proximity to Silicon Valley has allowed them to leverage the depth of technical knowledge and innovation happening in San Jose and San Francisco. The low cost of living compared to the region to the North has also allowed Salinas to attract young innovators to the region, resulting in a median age of 29.¹¹⁹

Though it doesn't have the proximity to a technology hub the likes of Silicon Valley, there are other ways that Southern Alberta too can take advantage of its unique circumstance. The proximity of the region to major ground, rail, and sea shipping routes (via rail/ground to Vancouver) give the southern Alberta region a direct linkage to markets around the world. Calgary's ability to attract young talent to the region also remains strong, with a low cost of living compared to other major centers.

4.2 St. Louis, Missouri, USA

Overview

Agribusiness has been a part of the St. Louis economy since the 1800s, but it has only really started to come into its own as an agribusiness hub within the last 20 years.¹²⁰ For much of the 1990s and 2000s, the St. Louis region focused on becoming a central hub for bioscience and life science. This expertise led to the establishment of significant research capacity in the region, including the establishment of the 250-acre Cortex innovation district. Given the entities in the region move into a more formal agribusiness strategy was a logical extension.

Today, agriculture is a cornerstone industry of the St. Louis region, with 50% of US Agriculture being produced within 500 miles of St. Louis. 400+ plant science ventures and their 15,000 employees call the region home, contributing to a US\$75 billion in global impact generated by St. Louis agriculture.¹²¹ The region continues to transform, leveraging 1000+ plant science PHDs to identify new and innovative ways to move agriculture forward.¹²²

A key component of agribusiness in St. Louis is the newly minted, 600 acre, 39 North innovation district. Anchored by the Danforth Plant Science Center, BRDG Park, Helix Incubator, Bayer Crop Science, and the Yield Lab, the district brings together 100 bioscience companies, researchers, public sector entities, and entrepreneurs. As of 2020, the district has US\$1.3 billion in bioscience venture capital projects under management.¹²³

Notable Players

Monsanto: With its corporate headquarters in St. Louis, Monsanto plays a critical role in attracting talent, entrepreneurs, and investment. In addition to making direct investments in startups within the region, Monsanto's presence has other knock-on impacts. Constance Brown of The Yield Lab explains these impacts: "Long-time Monsanto employees are incredibly supportive of local agtech entrepreneurship, donating their time and, in many cases, investing personally into agtech."¹²⁴

Bill & Melinda Gates Foundation: In 2017, the Gates Foundation awarded the Danforth Center a US\$6.1 million research grant to develop and deploy improved varieties of sorghum.¹²⁵ In January 2020, shortly after the conclusion of this grant, the Gates Foundation announced the establishment of their new non-profit: Bill & Melinda Gates Agricultural Innovations.¹²⁶

Post Holdings: With its headquarters in suburban St. Louis, Post Holdings is a strong example of the drawing power of the region. Post owns and manufactures known brands across the US and Canada, including: Chips-Ahoy, Honey Comb, Shreddies, Raisin Bran, PowerBar, and Weetabix.¹²⁷ While many of these goods are researched and produced in multiple locations, all corporate roles are at the head office in St. Louis.

Lessons to be Learned

The St. Louis region leveraged their existing expertise in life sciences to quickly scale their agribusiness capabilities. The presence of large entities like Monsanto provided the region the additional opportunity to attract research talent and early stage entrepreneurs. Recognizing the opportunity, St. Louis moved quickly to establish the right entrepreneurial infrastructure, including 39 North, to give these industry experts a place to come together.

Like St. Louis, Southern Alberta already has several major players in the region. As of yet, these major players don't have one single location to come together with smaller organizations, entrepreneurs, and service providers.

4.3 Raleigh-Durham, North Carolina, USA

Overview

Historically, North Carolina has been known as a source of two major crops: tobacco and cotton. In recent years, various crops have begun to take that place; namely soybeans, corn, and sweet potatoes.¹²⁸ As agriculture has undergone this shift in North Carolina, there has been a renewed push to modernize the industry. In 1960, the Research Triangle Park was established, driven by various entities in the region with the goal to achieve this modernization.¹²⁹ As of 2019, agriculture and agribusiness employ 17% of North Carolina's workforce, making up US\$87 billion of the state's economy.¹³⁰

North Carolina has one of the most diverse agriculture sectors in the United States, with farmers growing 90+ different crops and 1000+ food and beverage operations calling the state home.¹³¹ North Carolina companies play roles throughout the value-chain, with the state having deep roots in value-added manufacturing driven by the traditional tobacco and cotton crops.

What makes the Raleigh-Durham area unique is the significant driving role post-secondary institutions play in the region. Duke University, University of North Carolina (UNC), and North Carolina State (NC State) anchor the three corners of the research triangle and play a core role in moving agriculture forward in the region.¹³² NC State in particular has led the area in agriculture research, running 28 separate agricultural research units in the Raleigh area covering Animals, Plant & Environment, and Agricultural Operations.¹³³

NC State is a key partner in the North Carolina Food Innovation Lab. Both research hub and networking hub, the Lab offers R&D, Pilot Plan Production, Training & Workshops, and Food Industry Consulting services.¹³⁴ Currently, the 16,000sq foot lab is positioning itself to be at the forefront of plant-based protein development by building a leading-edge plant-based pilot facility.¹³⁵

There are a number of other labs in the region that take advantage of the expertise of the research triangle universities, including: Ag TechInventures, BioLabs North Carolina, First Flight Venture Center, and the greater NC State Centennial Campus.¹³⁶ These accelerators, businesses, government entities, and academic institutions form the Research Triangle AgTech Cluster.¹³⁷

Notable Players

NC State: NC State's agricultural research units, partnership in the Food Innovation Lab, and Centennial Park position the University at the forefront of the growth of agribusiness and agtech in the region.

BASF Agricultural Solutions: In 2019 BASF opened its Agrochemical Application Research Centre within the Research Triangle. The facility looks to focus on the on-target application of crop-science protection products that the company develops for use worldwide.¹³⁸ Additionally, BASF maintains the North American Headquarters for a number of their divisions within Research Triangle Park.¹³⁹

Bayer: Bayer plays a unique role in the region via Bayer Growth Ventures. Bayer selectively invests in early stage companies or teams that have ideas to improve agriculture across geographies.¹⁴⁰ In addition to their work via BGV, Bayer CropScience has their North American corporate headquarters in Research Triangle Park.¹⁴¹

Lessons to be Learned

The true strength in Raleigh-Durham's approach is in how they have leveraged the nexus of deep agricultural history with the presence of leading universities to build innovation and research centres of excellence. By doing so, the region has been able to expand the types of crops grown, while also attracting new players and building new techniques and technologies that can be exported elsewhere.

While the post-secondary institutions in Southern Alberta are not the same scale as those in the research triangle (though they are of similar student populations), there remains a distinct opportunity to leverage the varied expertise found within Olds College, SAIT, the University of Calgary, and the University of Lethbridge alongside existing players to develop and grow innovation hubs or accelerators.

4.4 Israel

Overview

As a nation with several hostile neighbors, Israel faces the somewhat unique necessity of being self-sufficient regarding their food sources. As a result, the nation has needed to be coordinated and focused in how they build and maintain their food system. Compounding the challenges importing goods is the arid nature of much of the land in Israel. The result is a need to do more with less.¹⁴²

In its natural state, only 13.73% of Israel's land is arable.¹⁴³ Via innovating techniques, Israel has tripled the land that can be used for farming, enabling them to produce over 90% of their domestic food requirements. One of Israel's key focus areas in this effort has been on water use and reuse; rising desertification around the world presents a significant challenge and opportunity in this area, as Israel has led the way on key advancement including drip irrigation.¹⁴⁴

In addition to drip irrigation, Israel has developed several key agricultural innovations in areas including water recycling, AI, biopesticides, biofertilizers, robotics, and sensors, with many of these breakthrough innovations being driven forward by government-funded research agencies.¹⁴⁵ As a result of these and other innovations, Israeli organizations have drawn in nearly US\$1 billion in venture capital funding in the last five years.¹⁴⁶

Notable Players

Agriculture Research Organization (ARO) / Volcani Center: Operated within the Israeli government, the Volcani Center is made up of three research centers spread throughout the country, focused on solving global issues like climate change and food production.¹⁴⁷ In addition to housing Israel's national gene and seed bank, the Volcani Center operates seven research institutes:^{148 149}

Agricultural Engineering	Plant Protection	Plant Science
Animal Science	Postharvest and Food Sciences	Agro-Nanotechnology
Soil, Water, and Environmental Sciences		

Aleph Farms: Israel is home to three of the world's nine leading cultured meat companies. With investment from many sources, including Cargill, Aleph is leading the way in growing full cuts of meat (steak for example) in the lab, which would be yet another major breakthrough for the region.¹⁵⁰

Lessons to be Learned

While Israel's circumstances are unique, there remain some lessons in how they have taken advantage of their circumstances. Israel has focused not only on exporting goods, but also on exporting their unique technologies and methods to nations facing similar circumstances. India, for instance, has become an importer of Israel's irrigation and water conservation methods.¹⁵¹ Israel also conducts research, development, testing, and manufacturing domestically, enabling them to offer other countries turnkey solutions to their problems.

Southern Alberta doesn't face the same conditions as Israel, but there may exist opportunities for the region and its most innovative companies to look to sell industrial and technological solutions to other states or nations around the world. Further assessment will be required to identify the things that Southern Alberta does to meet our own geographic needs and who potential buyers could be for these solutions, but it may present an additional avenue for development of our agribusiness hub.

4.5 Summary - Global Agribusiness Hubs

Each agribusiness hub analyzed used its own unique circumstances to become a global leader. Salinas capitalized on its proximity to Silicon Valley to become a leader in agtech and innovation, St. Louis leveraged existing expertise in life sciences to quickly scale their agribusiness capabilities, Raleigh-Durham combined a deep agricultural history with the presence of leading universities to build innovation and research centres of excellence, and Israel was forced to become self-sufficient with agriculture due to regional tension in an arid climate, developing their own methods and technologies and exporting them to other parts of the globe. While there are some similarities in global hubs (like a focus on innovation), the lesson they teach is that each region is different - and leveraging what makes a region unique can help differentiate it on the agribusiness world stage.

Global Buyer Profile | UNITED STATES



The US is consistently the largest buyer of Alberta agriculture products, accounting for 37.5% of Alberta's 2018 agriculture exports¹⁵². Some of the recent import growth areas include live animals, red meats, dairy, and grain products¹⁵³. The US economy has been growing at a steady pace, although it is expected to further slow down as a side effect of the trade war¹⁵⁴. The emergence of COVID-19 will further complicate its economy and agricultural imports.

Consumer Trends

Health and Wellness: Consumers are increasingly specific about their demand for food's health benefits. Consumers also want a much more diverse array of products and benefits associated with them, rather than only what is popular. More than ever, consumers are ready to pay higher prices for products that can truly deliver the benefits they claim¹⁵⁵.

Social Impact: People are concerned if their food producers are operating in a responsible manner. This includes factors such as local sourcing, sustainability, animal treatment, etc. According to a survey, 23% of the consumers surveyed choose their shopping destinations based on these factors¹⁵⁶.

Relevance to Alberta

Alberta's opportunity in the US market is two-fold: 1) embrace emerging consumer trends by innovating and diversifying our food processing products to better meet market demand and, 2) sustain commodities exports as its decline will have major impact to Alberta farmers. In recent years, growth was reported in exports of food processing products such as beef, processed meat, honey, prepared cereals, and more¹⁵⁷. These are excellent growth opportunities for Alberta to strengthen its position in the market. On the other hand, even though there was a decline of Alberta agriculture commodities export to the US, these products are the backbone of our agriculture economy and are vital to our agribusinesses and farms. It is important to continue to protect and sustain these exports.

Market Risks

Exchange Rate Uncertainty: Exchange rate changes between the CAD and the USA create uncertainty in Alberta agribusinesses' exports and operations. Such fluctuations impact the competitiveness of Alberta agriculture products. If the CAD continue to rise (which is a possibility as a result of reduced investor confidence in the US due to COVID-19 related concerns), Alberta exports will be inevitably more expensive for American buyers. Alberta may take a hit in exports, or Alberta farmers have to accept a much lower price to compete with domestic American supplies.

COVID-19 Disruption Risk: There is a risk that trade between Canada and the US will be disrupted by restrictions imposed at the border. As of April 2020, essential travel and transportation is still being allowed to cross the border, which includes (but not limited to) food, water, and other transportation¹⁵⁸. However, as US becomes the epicentre of COVID-19 and shows no signs of full recovery soon¹⁵⁹ at the time of this report being written, the disruption may continue to deteriorate. Canada and Alberta must prepare for potential worse and long-term impacts of trade with the US.

5.0 Regional Market Assessment (Calgary and Southern Alberta)

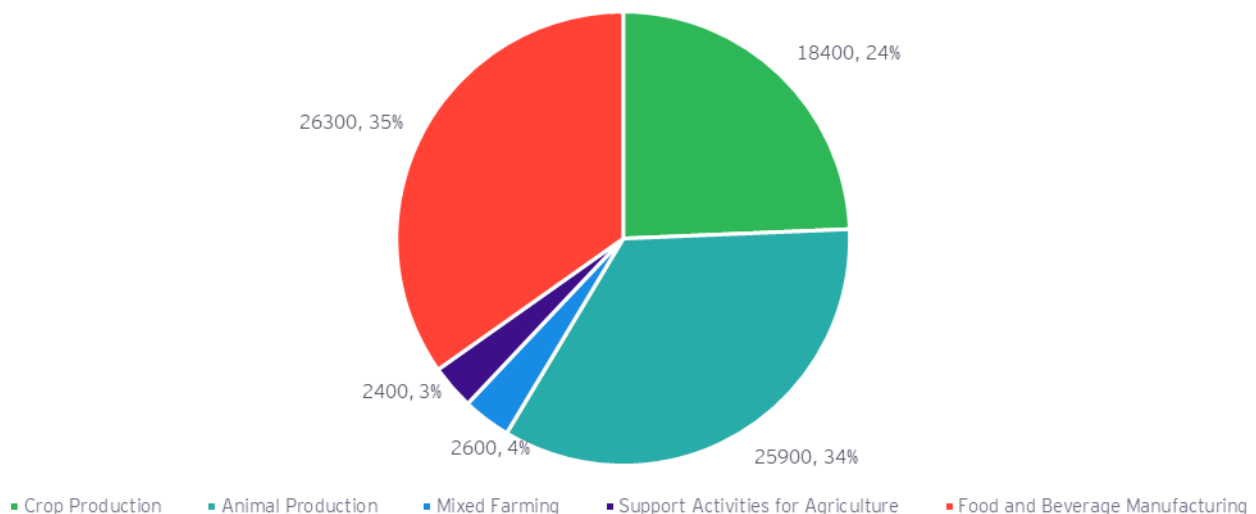
The region of Calgary and Southern Alberta boasts a number of established strengths in the agribusiness sector, with a promising amount of growth potential. This section outlines an overview of agribusiness in the region, delving into major strengths and weaknesses, key players and the regional ecosystem, occurrences of innovation and R&D, and an overview of regulations and government support.

This section is unique in the market study, as it was developed through both primary and secondary research. Similar to previous sections in this study, it relies on secondary research from credible sources, but is accented by primary research from interviews, surveys, and workshops with local industry experts who know the market intimately.

5.1 Region Overview

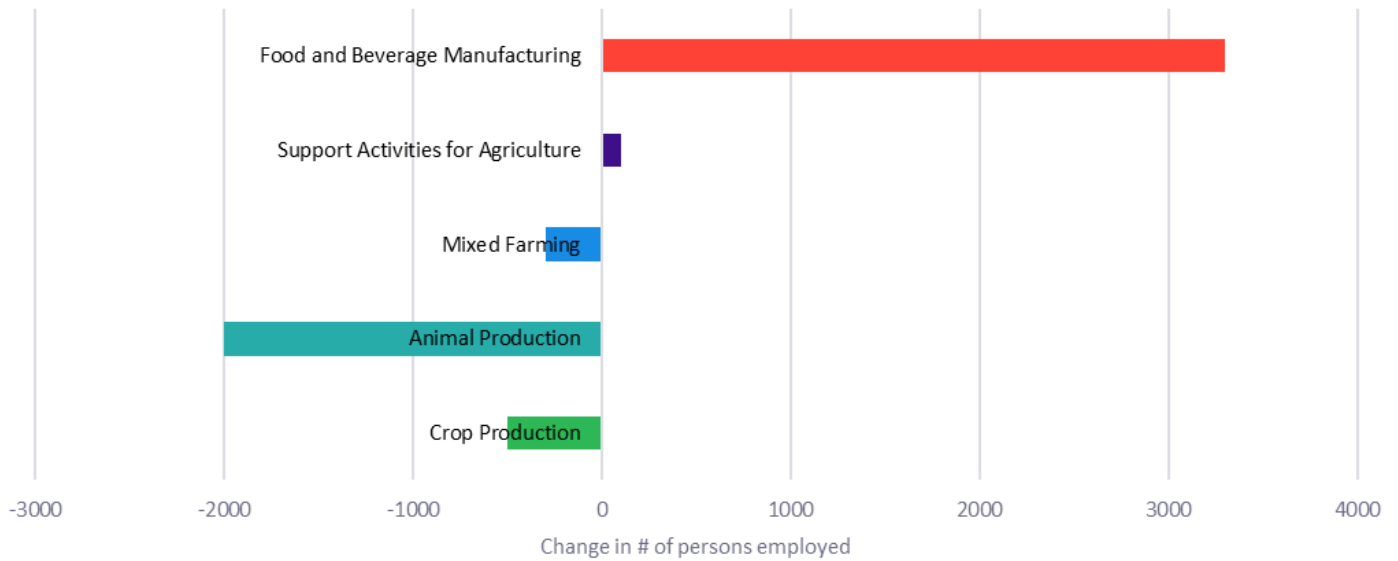
In 2018, Alberta's agri-food¹ industry employed 75,600 people¹⁶⁰, throughout various subsectors and specialties. This represented a 0.7% increase from prior year and was broken down by industry as outlined below. The changes in employment levels in the agri-food subsectors listed below highlight a trend of significant decline in farming employment (-10.3% change from 2017 to 2018) and a significant increase in food and beverage manufacturing (14.3% employment increase).

Figure 16 - Alberta Agrifood Subsector Employment (2018)



¹ The Government of Alberta includes agriculture, food manufacturing, and beverage manufacturing in its definition of agri-food.

Figure 17 - Alberta Agrifood Subsector Employment Level Change (2017-2018)



In 2018, Alberta’s real gross domestic product (GDP) for agri-food industries was C\$8.5 billion¹⁶¹, representing approximately 3% of the province’s total GDP. This GDP contribution was split between the three primary agri-food industries according to the table below:

Alberta Real GDP Contributions (\$C Millions)	
Agriculture	\$5,165.0
Food Manufacturing	\$2,770.5
Beverage Manufacturing	\$587.1
Total Agrifood	\$8,522.6

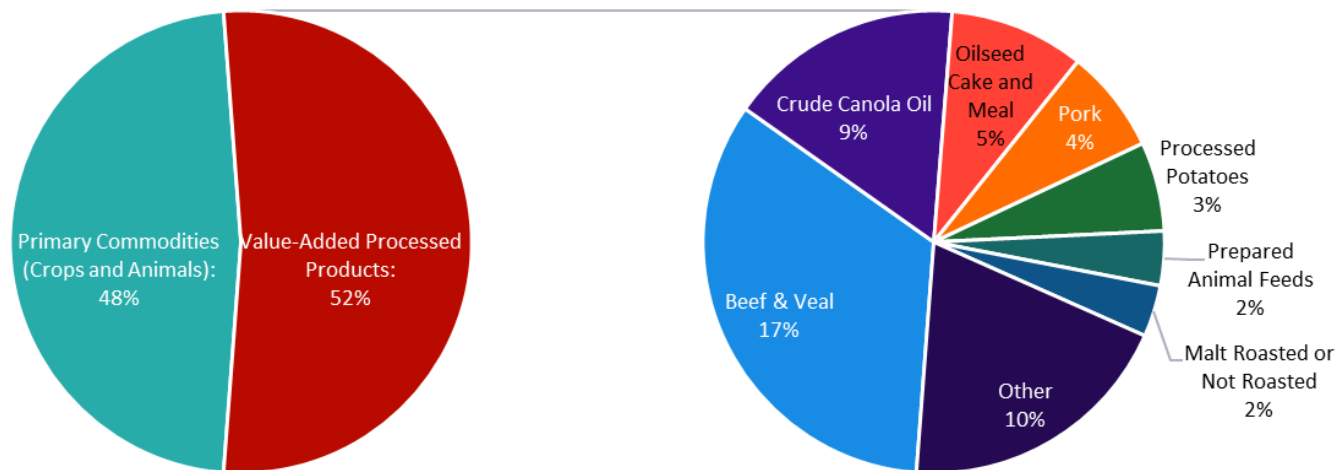
Specific to agriculture, farm land area in Alberta amounts to 50,350,183 acres of the province, covering about one-third of Alberta. This is even more concentrated in the Calgary and Southern Alberta region. Of this farm land, 62% of the land is cultivated (crop land, summerfallow, or seeded pasture), and 32% is natural pasture land.¹⁶²

The primary farm type in the region is cattle/beef farms (30% of total farms in Alberta), followed by grain and oilseed farms (26%), other animal production (16%), other field crops (16%), and wheat (7%).

In 2018, Alberta’s agrifood exports represented 19.3% of Canada’s total agrifood exports, at C\$11.2 billion. This represented a 3.2% increase from 2017, and a second consecutive record year. Exports of value-added processed products increased for a fifth consecutive year (to C\$6.0 billion), and now make up a bigger share of our exports than primary commodities, which decreased in value to C\$5.5 billion.

Alberta’s C\$11.2 billion of agrifood exports was made up of the following components:

Figure 18 - Alberta's Agriculture Exports, including breakdown of Value-Added Processed Foods (2018)



Notable areas of growth in recent years include value-added processed foods (year-over-year growth of 8.8% on average). Specific growth areas within value-added processed foods include beef and veal, crude canola oil, and oilseed cake and meal. On average, there was a year-over-year decrease in primary commodities of 2.4%. While Alberta exports to more than 140 countries, primary export markets are:

- 1) United States (37.5% of Alberta agrifood exports)
- 2) China (22.6%)
- 3) Japan (11.0%)
- 4) Mexico (4.8%)
- 5) Indonesia (2.1%)

Alberta's food and beverage manufacturing sales have continued to set records for the past four years. In 2018, YOY sales increased 2.4%, to C\$15.2 billion¹⁶³.

When looking specifically at Southern Alberta, the region boasts some of Alberta's best growing land, including almost 70% of Canada's total irrigated area¹⁶⁴. Irrigated land in a dry province such as Alberta allows for a greater variety of crops to be grown, diversifying our potential exports from wheat, oats, and pulse crops to include vegetables and some fruits. Irrigated land also helps improve yields for traditional crops. In Southern Alberta, reports indicate that for every \$1.00 of irrigation investment, there is a corresponding GDP increase of \$2.54¹⁶⁵, making Alberta's irrigated land even more attractive for growers.

5.2 Strengths

Calgary and Southern Alberta boasts a number of established strengths in the agribusiness industry. These strengths were composed directly with the help of industry experts through a survey and workshop, and supported by external research. The major strengths of the region include:

- Proximity to agricultural base
- Well-regarded agricultural training institutions
- Strong research and innovation presence
- Deep talent pool
- Large, established anchor tenants
- Government policies and programs related to agriculture
- Geographical location and proximity

Proximity to Agricultural Base

As mentioned in the regional overview above, Southern Alberta has historically been an agricultural area, with large-scale production of acreage crops, protein crops, livestock, and some greenhouses. The region boasts almost 70% of Canada's total irrigated land, has ample access to water (useful in value-added food processing), and enjoys a sunny climate favourable to growing. This strength differentiates the region from others, since many other cities with agribusiness headquarters do not enjoy this same proximity.

Well-Regarded Agricultural Training Institutions

Partly due to its historical presence in the space, Southern Alberta has a number of training institutions who offer unique agricultural programs, including Olds College, the University of Lethbridge, and Lethbridge College. These research and training institutions have demonstrated an interest in collaboration, strengthening the training offerings of the region with specific programs like agricultural heavy equipment (Olds College), agriculture studies (University of Lethbridge), agricultural business (University of Lethbridge), animal health (Olds College), meat processing (Olds College), agriculture sciences (Lethbridge College), and agricultural enterprise management (Lethbridge College), among many others. These training institutions are also home to promising research projects like the Olds SmartFarm. The technical capability these institutions bring to the region are valuable and can help stimulate sector growth, especially in areas like crop science and genetics, which require a specific skillset and training.

Strong Research and Innovation Presence

Closely linked to these institutions is a strong research and innovation presence in the region, specifically within the production element of the agricultural value chain. Experts in the region spoke of how the area is known for rapid adoption of new technology, with a strong applied research presence. Though some industry experts acknowledged that there was room to grow in fundamental research when compared to regions like Israel and Salinas, there was consensus that Calgary and Southern Alberta has a lot to offer in the research space. In 2020, the University of Calgary announced the creation of the Simpson Centre for Agricultural and Food Innovation and Public Education, highlighting significant effort to grow research capability in agrifood and agribusiness with a social and economic context¹⁶⁶. The University of Calgary also has a robust Veterinary Medicine program with focus on Production Animal Health, Veterinary Clinical and Diagnostic Sciences¹⁶⁷. More on innovation and research in the region can be found later in this section.

Deep Talent Pool

Calgary and Southern Alberta have a talented workforce, with many available from an oil and gas sector workforce which has faced a prolonged downturn in recent years. In Alberta, 64% of the province aged 25-64 has a postsecondary education, the largest proportion of Canada's Western provinces¹⁶⁸. The region's agricultural training institutions also help to create a potential workforce with relevant knowledge and training in agriculture, a key selling point for companies looking to develop a presence in a new market.

Large, Established Anchor Tenants

Relative to other cities in North America, Calgary and Southern Alberta has many established anchor companies with headquarters (or Canadian headquarters) in the region, which helps to create a productive agricultural ecosystem. Most of the largest anchor tenants are on the production side of the value chain, and include major players like Nutrien, Bayer Crop Science, and Corteva in Calgary.

Government Programs and Policies Related to Agriculture

There are a growing number of government programs (both provincial and federal) meant to support the agribusiness economy in Alberta. These include grants like those given to Protein Industries Canada (PIC) and the Canadian Agri-Food Automation and Intelligence Network (CAAIN), tax credits like the Scientific

Research and Experimental Development (SRED) program, and competitive tax rates when compared to other provinces or countries. More on regulations and government support for the industry can be found later in this section.

Geographical Location

Calgary and Southern Alberta is a central location in North America, with direct flights to most other agricultural and technology hubs through the Calgary International Airport. There is also a strong offering on air and land distribution and logistics services, including through the YYC Global Logistics Hub¹⁶⁹. Finally, the geographical location of the region is home to inexpensive energy and utilities, an appealing offering for many food manufacturers and processors looking for affordable and reliable water and energy services.

5.3 Weaknesses

Though the region has a strong case to make for agribusiness, there are still some weaknesses that must be worked on or overcome to make it a more attractive place for business to locate or grow. Like the strengths, these weaknesses were developed with the help of industry experts through a survey and workshop, and supported by external research. The major weaknesses of the region include:

- Industry perception
- Primary focus of the region is oil and gas
- Lack of champion/visionary
- Silos and limited information sharing
- Industry focused on more traditional agriculture + commodities
- Complexity of government credits and programs

Industry Perception

Traditional perceptions of agriculture that view the industry as simple farming or ranching do not consider the innovation occurring in agriculture, the agtech industry, agricultural sciences, or a host of other science behind the industry. This outdated perception is a weakness for agribusiness, leading to two significant negative impacts:

- **Access to Capital.** With many investors unfamiliar with the industry and its potential, inaccurate perceptions of agriculture negatively impact access to capital for those in the industry. Investor education about the sector is needed, to highlight its growth trajectory and encourage investment.
- **Desirability as a Career Path.** Until very recently, agriculture wasn't seen as a desirable career path for those unfamiliar with it, limiting the number and diversity of young people getting involved in agribusiness. With more companies beginning to understand the potential in the industry, and available workforce from the oil and gas sector looking to make career changes, this desirability is beginning to increase.

Lack of Champion

Industry experts pointed out that so far, the sector has lacked a networked response to the government. Without a collective vision and leadership, the industry faces an uphill battle in getting the attention of political leaders. The energy industry has done an excellent job of coming together for organization and lobbying purposes, with organizations like CAPP (Canadian Association of Petroleum Producers), EPAC (The Explorers and Producers Association of Canada), and COSIA (Canada's Oil Sands Innovation Alliance) successfully contributing to a collective vision for the industry, something agribusiness lacks.

Silos and Limited Information Sharing

Internally, agribusiness is siloed, with little information sharing or communication between organizations in different parts of the value chain. Since innovation comes largely as a result of collaboration and working together, this inhibits innovation in the region. The strongest agribusiness hubs have organizations who compete *together* on a world stage instead of focusing on competing with each other.

Industry Focused on More Traditional Agriculture and Commodities

Agriculture in Southern Alberta has traditionally been focused on commodities, with basic infrastructure historically built for homogenous commodities. Though the region has worked to diversify its crop base in recent years (irrigation has made the production of sugar beets, potatoes, pulses, soft spring wheat and other specialty crops possible¹⁷⁰), it still relies on secondary processing elsewhere. The region does not currently have the infrastructure to do large-scale processing locally; instead, items like durum wheat are shipped to Italy for processing, then sold back into our local market as a finished product¹⁷¹.








Complexity Of Government Credits and Programs

Though there are government credits, programs, and tax incentives for the agribusiness industry, they are complex and time-consuming to navigate. For entrepreneurs, this can be a significant detraction, limiting the usefulness of the credits. As an example, in a report on Tax Planning for Canadian Farmers, BDO warns that in order to take advantage of certain tax credits, “the tax rules that must be complied with are complex”¹⁷². For entrepreneurs and smaller players in the industry who do not have dedicated tax or finance personnel, this can make it increasingly challenging to access government programs.

5.4 Major Players

Within the Calgary and Southern Alberta region, there are already a number of established agribusiness companies. Through the development of this report, industry stakeholders have provided information on some of the bigger and smaller agribusiness companies in the Region. The table below is a summary of some of the larger players with a headquarters or major presence in the region, and is followed by a listing of other players mentioned in our stakeholder engagement. This list is by no means exhaustive, but provides an overview of the some of the biggest organizations in the current market.

Figure 19 - Major Players in the Local Region

Company	Annual Revenue (US\$) ¹⁷³	Headquarters
	\$10.15 billion	US
	\$20.02 billion	Canada
	\$13.85 billion	US
	\$12.79 billion	Switzerland / China (ChemChina)
	\$113.49 billion ¹⁸¹	US
	\$49.71 billion	Brazil
	Private company	Canada

Additional big players are documented in the list below. More information about how they were identified, their products and services, as well as which Subsector or Horizontal they fit in, can be found in Section 8 - Endnotes.

- Alberta Irrigation Districts Association
- AltaGenetics
- ATB
- ATCO
- BASF
- Bonduelle
- Byblos Bakeries
- Calgary Co-op
- Cavendish Farms / Cavendish Agri Services
- Cervus Equipment
- Costco
- Decisive Farming (Telus)
- Farm Credit Canada
- Farmers Business Network
- Farmers Edge
- FMC
- John Deere
- Lamb Weston
- Lantic Sugar
- McCain Foods

- MNP
- NuFarm
- Old Dutch
- Parrish & Heimbecker
- PepsiCo
- RBC
- Red Hat Coop
- Richardson
- Rocky Mountain Equipment
- Sobeys/Safeway
- SPUD.CA
- Stantec
- Sunterra Markets
- Superstore/Loblaws
- Telus
- Tiger fertilizer
- Trimble Agriculture
- United Farmers of Alberta
- Viterra

5.5 Minor Players and Start-Ups

Like the major players section, there are too many minor players and start-ups in the region to create a comprehensive list. However, below is a shortlist of some smaller players mentioned in our stakeholder engagement, demonstrating the ecosystem of smaller agribusiness players in the Region. Again, this is not meant to serve as an exhaustive list, however depicts some of the key Agribusiness smaller players in Calgary and Southern Alberta which were specifically mentioned in our stakeholder engagement. More information about how they were identified, their products and services, as well as which subsector or horizontal they fit in, can be found in Section 8 - Endnotes.

- AdFarm
- AeroFodder Supply Company
- AgCall
- AgCapita
- Altagenetics
- Attabotics
- Botaneco
- Ceres Solutions
- CORE Ag
- CropBoss
- DeVry Greenhouses
- DeepWater Farms aquaponics facility
- EarthRenew
- Enterra
- Family Fungi
- Feedlot Management Services
- Food-x
- Future Fields
- Green Prairie International
- GrowSafe Systems
- Independent Crop Inputs
- Highwood Crossing Foods
- Livestock Water Recycling
- Minhas
- OPI Advanced Grain Management
- Provision Analytics
- Rahr Malt
- Red Fox Farms
- Rocky Mountain Shrimp Farm
- Routeique
- Rowland Farms
- Skymatics
- Whipcord

5.6 Regulations and Government Support

Federal Regulation

The parliamentary power for agriculture regulation is shared between federal and provincial governments in Canada¹⁸⁶. Federally, there are thirteen direct agriculture-related acts in Canada and over 250 direct agriculture-related regulations¹⁸⁷, in addition to provincial regulation (i.e. through environmental public health) and indirect regulation of the industry (i.e. through regulation of businesses). This regulation may be burdensome for agribusiness companies, especially for farmers of small-scale operations who must navigate a complex web of regulation. Increased regulation and safety standards can lead to higher quality products and better safety for the industry, but over-rotating on regulation can lead to increased costs and

administrative burden, reducing the competitiveness of Canadian agribusiness compared to international competitors.

In recent years, the federal government has shown a willingness to work with industry to streamline regulations and improve efficiency. If the suggestions in the Targeted Regulatory Review come to fruition, they will help the Calgary and Southern Alberta region to more effectively compete on the global stage. The new suggestions aim to maintain or improve quality and safety standards while lowering the regulatory burden on business owners. Enacting the suggestions and continuing to focus on regulatory efficiency in Canada will position the region for better success moving forward.

The Canadian Government has identified five key areas to strengthen the Canadian agri-food sector, underpinned by an agile regulatory system that promotes the competitiveness of the sector and can move at the speed of commerce:

Figure 20 - Five Key Areas to Strengthen the Canadian Agri-food Sector¹⁸⁸



While there are many regulations for the agribusiness industry in Alberta, there are a few that have had notable changes in recent years affecting the industry **as a whole**. Those federal regulations are outlined below.

Targeted Regulatory Review: Agri-food and Aquaculture

In the 2018 budget, the Government of Canada announced funding of "targeted reviews of regulatory requirements and practices that are bottlenecks to economic growth and innovation"¹⁸⁹. Agri-food and aquaculture was one of the high growth industries in need of regulatory changes pegged for review. As the Government of Canada noted, "The sector is subject to a variety of regulations that span food safety, animal and plant health, transportation, labour, and other areas. Businesses of the 21st century cut across traditional sectoral borders, which increases the complexity of navigating the regulatory system. Additionally, sector businesses may experience a cumulative regulatory burden that is not evident if individual regulations are looked at separately"¹⁹⁰. In this review, stakeholders were consulted on ways to enable regulations to be more agile, transparent, and responsive. These stakeholders included:

- Agriculture and Agri-food Canada
- The Canadian Food Inspection Agency
- Fisheries and Oceans Canada
- Health Canada
- The Public Health Agency of Canada

The outcome of this review was the *Agri-food and Aquaculture Roadmap*. This roadmap promises to address or partially address a number of identified "irritants" in regulation for the industry, through three main themes of regulatory improvements:

1. Clear, Agile, Responsive Regulations
2. Competitiveness in Domestic and International Markets
3. Risk-based, Efficient, Predictable Regulatory Programs

The government identified three novel approaches to pursue to modernize regulation in the sector:

- 1) **Sector-Specific Government-Stakeholder Collaboration on Regulations.** Focuses on “the need to engage and work with industry”¹⁹¹ to address the cumulative impacts associated with regulations and establish pilot projects to test new technologies.
- 2) **Reducing Risk and Improving Trust using Distributed Ledger Technology (Blockchain).** Recommends that the government work with industry to support the use of this technology in a regulatory setting, specifically to support traceability, risk control measure, information sharing, and supply chain management.
- 3) **Rethinking the Regulatory Relationship: Applying Innovation and Behavioural Science to Promote Compliance and Improve Risk Management.** A new regulatory oversight approach that recognizes that industry, like regulators, has a vested interest in ensuring that risks are well managed, and therefore promotes collaboration between industry and regulators.

U.S.-Mexico-Canada Trade Pact (USMCA, CUSMA)

The USMCA replaces the North American Free Trade Agreement in regulating free trade between Canada, the United States, and Mexico. After being approved by the United States and Mexico, it was ratified by Canadian parliament in March 2020¹⁹², and will likely come into effect July 1¹⁹³ (this date has been delayed due to the government’s focus on the COVID-19 pandemic). The USMCA is an essential agreement for the agribusiness industry in Canada, since the United States and Mexico represent our first and fourth largest export markets for agrifood products. We also import a significant amount of agricultural products from both trading partners, with the top agricultural imports for Canada from the United States in 2018 being fruits and nuts, food preparations, and vegetables¹⁹⁴. The agreement has a few implications for Canadian agriculture, including tariffs on agricultural products, policies for agricultural biotechnology and general promotion of cooperation and integration in agriculture.



Canada, the United States, and Mexico signed the USMCA in November 2018. The agreement was finally ratified in March 2020. Source: Tom Brenner / The New York Times Service

Under the new agreement, all agricultural products that have zero tariffs under NAFTA will remain at zero tariffs¹⁹⁵. The biggest change for agricultural products under the USMCA is that additional products will be allowed to enter Canada duty-free, including prescribed quantities of milk, cream, skim milk products, butter, and cheese. The Canadian dairy industry has long been

protected by the Canadian government. Under the new agreement, the dairy industry is opened up to competition from the United States, which could have a large impact on Canadian dairy producers. The Dairy Producers Association of Canada estimated that the additional market access from the agreement will result in a total of C\$2 billion in losses over the course of implementation¹⁹⁶. With Alberta having 472 dairy farms or approximately 5% of Canada’s dairy farms¹⁹⁷, this could lead to impacts close to C\$100 million for the industry in the coming years. Fortunately, the federal government has said it will spend C\$1.3 billion over the coming eight years to compensate dairy farmers for their losses¹⁹⁸, and Alberta is not as reliant on the dairy industry as other provinces like Quebec and Ontario.

Aside from dairy products, the USMCA has implemented policies to improve transparency related to agricultural biotechnology products. Unlike NAFTA, the agreement specifically addresses agricultural biotechnology to support innovation. These policies are meant to provide guidance and encourage growth to Canadian, American, and Mexican agribusiness companies pursuing agricultural biotechnology products such as gene editing. The USMCA also established a Working Group for agricultural biotechnology for information exchange and cooperation on policy and trade-related matters¹⁹⁹.

Farm Credit Canada (FCC)

FCC is a Crown Corporation that reports to Parliament through the Minister of Agriculture and Agri-Food²⁰⁰. FCC lends money and provides other services to primary producers, food operations and agribusinesses that provide inputs or add value to agriculture. They are a financially self-sustaining organization who are accountable to Parliament, and provide essential financing to many farmers. Their corporate office is located in Regina, Saskatchewan.

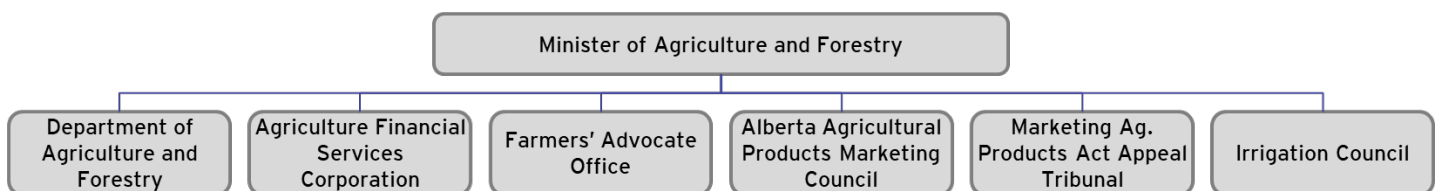
In March 2020, the federal government increased support for farmers with an additional C\$5 billion in lending capital, administered through FCC. This assistance was intended to support producers through the COVID-19 pandemic, which caused workforce issues and cashflow shortages, and includes payment deferral for producers through the crisis.

“Farmers and food producers work hard to put food on tables across our country, and they should not have to worry about being able to afford their loan payments or having enough money to support their own families. We are taking action now to give them more flexibility to meet the challenges ahead in these times of uncertainty.” - Justin Trudeau, Prime Minister of Canada (March 23, 2020)

Provincial Regulation

Ministry of Agriculture and Forestry

In Alberta, agricultural legislation and regulatory administration is governed by Agriculture and Forestry Alberta (“Agriculture and Forestry”, “the ministry”). Agriculture & Forestry is responsible for legislation, policies, regulations, programs, and services related to the sustainable development of the agriculture and forest sectors. The ministry endeavours to, in part, build public confidence in the province’s food production system safety, strengthen rural communities, support sustainable agriculture practices, and strengthen Alberta’s agriculture industry. Agriculture and Forestry also engages in research and extension services geared toward industry development. In addition to managing the Department itself, the Minister of Agriculture & Forestry oversees five agricultural public agencies²⁰¹:



The Agricultural Financial Services Corporation serves the agribusiness sector exclusively, providing crop and livestock insurance, income stabilization, and lending to agricultural producers, commercial and agribusinesses.

The Farmers' Advocate Office supports both farmers and ranchers with advocacy including energy, utility and surface rights, and rural dispute resolution.

The Alberta Agricultural Products Marketing Council is a regulatory agency that supervises the administration of the Marketing of Agricultural Products Act and advises the Minister on matters pertaining to Alberta's 20 agricultural Marketing Boards and Commissions.

The Marketing of Agricultural Products Act Appeal Tribunal hears appeals related to orders, directions, or decisions made by an agricultural Marketing Board or Commission, but does not substitute its own decision for that of a Marketing Board or Commission.

The Irrigation Council supports the Ministry through strategic recommendations and advice. It also administers regulations related to the Irrigated Districts Act and makes strategic funding decisions related to irrigation districts.

Provincial legislation and regulation - nuance and uniqueness

Alberta has 42 Acts related to agribusiness with 133 associated Regulations, resulting in a total of 11,399 Regulatory Requirements. Alberta's agribusiness legislation and regulation are largely in line with other jurisdictions, including how Agriculture & Forestry interacts with adjacent ministries such as Service Alberta and Environment and Parks Alberta. Those adjacent ministries may examine the same issue from a different vantage point (e.g. Environment and Parks may consider land conservation issues when reviewing an application to start a new farm, whereas Agriculture and Forestry may review for business viability and economic impact to the province).

While no particular legislation nor regulation set Alberta apart from other jurisdictions, there are two elements to it that are unique:

- Agriculture Finance Services Corporation (AFSC) - as part of the Alberta Government's Red Tape Reduction initiative, the AFSC was established as a lending arm with a simplified process that serves solely agribusiness clients. While other jurisdictions have similar lending arms, there appear to be none that serve *only* the agribusiness sector, making this unique to Alberta. Its aim is to improve access to capital across the agribusiness value chain and streamline the application process in order to help bring deals to fruition, to more quickly get Albertan products to market, and to create jobs.²⁰²
- The Irrigated District Act - Alberta Irrigation is critical to agriculture in Alberta and accounts for ~65% of water consumed in the province²⁰³. Alberta manages its irrigation via 13 irrigated districts which provide water to 1,419,989 assessed acres of farmland²⁰⁴. Each district is accountable to construct, operate and maintain irrigation to deliver, divert, or use water in accordance with the Water act²⁰⁵. Alberta is unique in Canada in requiring land to be classified suitable for irrigation under sustained production²⁰⁶ and in its partnership between dryland and irrigated agriculture to provide better opportunities for agriculture diversification and value-add processing²⁰⁷.

Red tape reduction

Alberta's current government has publicly stated that they wish to reduce bureaucracy affecting seven priority areas including agriculture and forestry²⁰⁸. The province's Red Tape Reduction Act aims to cut unnecessary regulations by one-third over the next three years and to prevent new red tape to encourage investment in Alberta. The province is endeavouring to streamline regulatory appeal processes, and shorten processing wait times by ~90%²⁰⁹. As part of this, the government has convened industry panels to identify regulatory burdens, give feedback on current and upcoming initiatives, and examine ways to improve the economy and stimulate growth²¹⁰. The government has also asked Albertans for input on the same matters, and in the first 100 days, received suggestions from ~2,400 people. As of July 31, 2019, the government

had completed 40 initiatives springing from the Act, two of which apply directly to the agribusiness sector. This display of dedication to reduce red tape should be encouraging to the agribusiness sector.

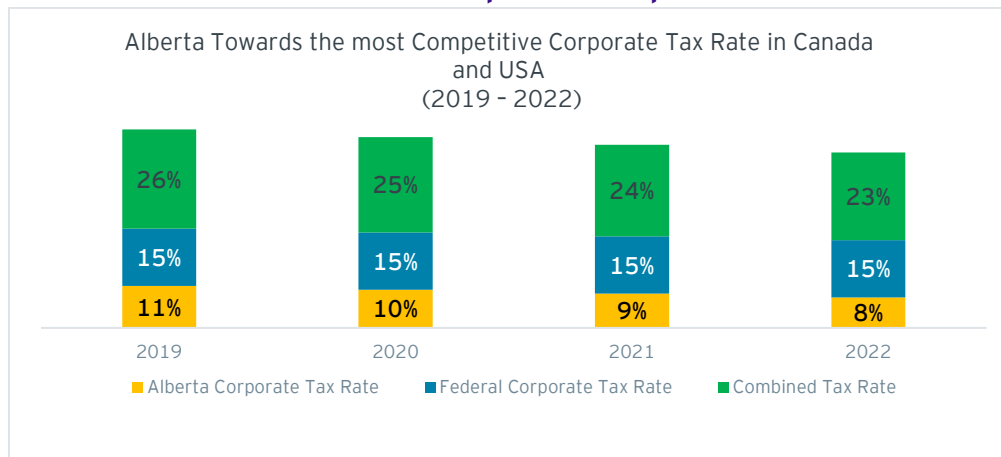
“We’re going to take Alberta from being the most over-regulated to the freest economy in Canada. We aren’t just saying we’re reducing red tape; we are making it the law.”

- Jason Kenney, Premier

Regulation as incentive or disincentive

Overall, Alberta’s legislation, regulation and administration do not appear to have any elements that are extreme enough to hinder agribusiness growth. Qualitatively, potential entrants to the Region are less concerned with regulation and more concerned with the quality of materials (e.g. land, water, and talent). Rather than regulatory bodies impeding progress, the government’s ‘single window’ service to help businesses navigate the regulatory system and willingness to bridge gaps between regulators and businesses are seen as an enabler of foreign direct investment. In addition to Canada being ranked as the best country in the G7 and the G20 for doing business for its infrastructure, market opportunities, foreign trade and exchange and low tax rates²¹¹, Alberta itself is seen as a leader in business climate for its competitive tax rates (which are projected to reduce year over year until 2022) and absence of provincial sales, capital, and payroll taxes.

Figure 21 - Alberta Towards the most Competitive Corporate Tax Rate in Canada and USA²¹²



5.7 Innovation and R&D

Within the agribusiness sector in Alberta, there are countless instances of innovation occurring, whether that be agriculture technology, financing, biotechnology, or others. The federal and provincial governments have invested in initiatives like Protein Industries Canada and the Canadian Agri-Food Automation and Intelligence Network, which have allowed for significant innovation and R&D in their respective focus areas (plant protein and agriculture technology). Alberta is also home to some of the leading agriculture research institutions in the country, including Olds College and the University of Lethbridge, and the newly established Simpson Centre for Agricultural and Food Innovation and Public Education at the University of Calgary. These educational institutions provide a backbone for continuous R&D, with one example being the Olds SmartFarm.

Though there are many instances of innovation and R&D in the region, a few notable initiatives underway are detailed below.

Protein Industries Canada

Protein Industries Canada (PIC) is an industry-led, not-for-profit organization created to position Canada as a global source of high-quality plant protein and plant-based co-products²¹³. PIC works with industry partners to co-invest in the agriculture and food production sector, focusing on projects that will help position Canada as a global leader in plant-based products. PIC is focused on the prairie provinces, and is headquartered in Regina.

PIC is one of five superclusters that are part of the Government of Canada's Innovation Supercluster Initiative (ISI). Between 2019-2023, the Government of Canada will invest C\$950 million²¹⁴ in PIC and four other superclusters to help Canadian industries do business differently, drive innovation, and overcome past barriers. Ultimately, the support from the Canadian government on ISI is meant to create new opportunities for the chosen industries to thrive. The government has estimated that the GDP impact of the PIC investment will be over C\$4.5 billion over ten years, creating 4,500 in the process²¹⁵.

Canadian Agri-Food Automation and Intelligence Network (CAAIN)

As mentioned in the Artificial Intelligence horizontal analysis, CAAIN is a group of technology and agri-food companies, universities, colleges, and research institutions working "to create new technological solutions for Canada's agricultural and food producers"²¹⁶. CAAIN projects focus on using technology to increase efficiency of the agri-food sector, specifically through technologies like artificial intelligence, sensor technologies, and blockchain application.

CAAIN was founded and funded through the Government of Canada's Strategic Innovation Fund and the Government of Alberta-sponsored "Alberta Innovates". Canada's Strategic Innovation Fund provides funding for large projects that aim to spur innovation in Canada²¹⁷, while Alberta Innovates "provides funding programs, advice, connections, technical expertise and applied research services to stimulate and grow research and innovation across Alberta"²¹⁸.

University of Calgary Simpson Centre for Agricultural and Food Innovation and Public Education

In February 2020, The University of Calgary's School of Public Policy, with the Faculty of Veterinary Medicine, announced the creation of the Simpson Centre for Agricultural and Food Innovation and Public Education. Formed with the help of a C\$5M donation from local businessman John Simpson, plus contributions from the Alberta Cattle Feeders' Association, the Alberta Beef Producers, and the Canadian Cattlemen's Association, the Centre "will advance research around public policies that strengthen and support the growth and sustainability of agri-food and agri-business, particularly in western Canada"²¹⁹.

Though recently formed, the Centre has stated its intent to become a credible voice on agri-food in Canada, with the hope of positively impacting decision-making on Canada's Farming Centre. One specific area of focus surrounds food an agriculture technology, which will contribute to innovation and R&D in the region²²⁰.

Olds SmartFarm

Olds SmartFarm is an initiative by Olds College to use a 2,000-acre farm to incorporate the latest technologies aimed at improving agricultural productivity while efficiently and sustainably using resources²²⁵. The Smart Farm “creates a place for producers, industry partners, students and faculty to look at the opportunities and challenges facing the agriculture industry and investigate solutions to evolve agriculture practices”²²⁶. Some of the features of the Olds SmartFarm include:

- stationary soil monitors
- digital weather stations
- wireless grain bin sensors
- a wireless mesh network that provides Wi-Fi to the entire farm
- a central “Smart Ag Innovation Centre” to monitor the ongoing activities of the farm using sensors
- rural narrowband connectivity to ensure high-quality internet

5.8 Growth Outlook

The clear strengths of the Calgary and Southern Alberta region when it comes to agriculture are hard to debate. The region has a history of agriculture, with a strong presence in commodity and beef markets, and is looking to diversify further into other crops and protein industries. There is a blossoming entrepreneurial network of agribusiness players, and many reasons to be excited about the growth outlook for the region in the future.

The challenge moving forward for the industry will be to change perceptions of agriculture as a traditional sector devoid of innovation and growth, and instead get government, investors, and potential employees to consider the agribusiness sector as an exciting opportunity for diversification in Alberta.

6.0 Strategic Insights

In examining the subsectors, horizontals, other global agribusiness hubs, and in assessing the regional market, insights related to market evolution, strategic risks, subsector and horizontal intersections, and overall opportunities for Calgary and Southern Alberta came to light. They are highlighted below.

6.1 Market Evolution

Shifting Product and Ingredient Demand

The demand for Southern Alberta's products and ingredients is shifting. Recently, the emergence of plant-based protein and the increase in popularity of leaner meat proteins like chicken and turkey has slightly reduced North American demand for beef²²⁷, though this is offset by the growing world-wide demand for meat in parallel with the growth of the middle class in emerging markets²²⁸. In Alberta, the agricultural mix is shifting to include more plant-based protein, in order to meet local and global demand.

Increasing Demand for Food Transparency and Traceability

Consumers are increasingly interested in understanding and tracing food sources and confirming ethical practices throughout the value chain. Consumers want to trust their food sources and because of increasing recalls of food products (e.g., the romaine lettuce recall in 2019), want traceability of the products in their homes back to original sources.

Increasing Government Interest and Investment

The federal government is showing a willingness to work with farmers, ranchers, and producers to create a regulatory environment that stimulates, not stifles, the industry. These regulatory changes were announced in 2019 after the Targeted Regulatory Review of Agri-food and Aquaculture. Although it is too soon to see how they pan out, they point to some promising changes for agriculture and agri-food industry regulation. In addition, the government's significant investment in PIC, coupled with the growing demand for plant-based proteins, well-positions Calgary and Southern Alberta (along with other prairie provinces) to become global leaders in the plant protein space, generating significant economic impact in the process.

Emergence and Acceleration of Agtech

The agribusiness sector is continuing to accelerate its adoption of technologies including AI and automation to increase efficiency, crop yields, visibility, and manage cost. There are pockets of excellence here that Alberta can capitalize on including, the strength of regional applied research and a rapid adoption of production technology. This stands to reason, given the region's current strength in that part of the agribusiness value chain.

Industry Challenges Bringing New Business Models

The agribusiness sector is facing tremendous challenges including the continuous pressure to 'do more with less'. Established agribusiness players are under pressure from new players who are redefining consumer expectations, rapidly innovating, and who are agile enough to flex. Critical to addressing these pressures will be innovating new business models in the sector.

New business models are centering on better collaboration across the value chain including with competitors, in order to protect against losing buyer and supplier leverage, and to reduce/share costs and risks.

In order to keep up with - or even be ahead of - market evolution, agribusinesses need to re-imagine their supply chains: they should be integrated and transparent to meet changing consumer expectations around sources of food and ethical farming practices.

Related to this, sales channels and customer relationships are also shifting away from transactional to strategic. Leading organizations are focusing on delivering world-class services and customer experience that reflects changing buying behaviours and needs, particularly adapted to technology. Consider the rise of interest in farm-to-table supply chain visibility, or the emergence of ready-to-make meal delivery as examples.

Figure 22 - Changing Business Models in the Future of Agriculture

	NOW	NEXT
PRODUCT DEMAND	Demand for AB exports remains high in emerging economies	Demand for AB exports will remain high, but product mix will shift
CUSTOMERS	Increasing (but passive) interest for traceability and ethical practices (e.g. reading labels)	Increased demand for traceability enabled by technology (e.g. on demand, up to date information)
INVESTMENT	Increased attention and investment in agribusiness, but as a hedge	Agribusiness seen as an exciting, important economic driver
TECH	Increased automation to drive efficiency	Digital, tech-enabled sector using operational technology on par with other industries
MODELS	Siloed and competitive; traditional models	Collaboration as a driver for new business models

6.2 Strategic Risks

Climate Change and Resulting Natural Disasters

Agriculture is subject to many of the same risks other industries see, but faces more severe consequences resulting from the risk of natural disasters and climate change. Of particular risk in Southern Alberta are hailstorms and tornados which may increase in frequency and severity as a result of climate change, and land and crops can be severely damaged or decimated.

Regional Dominance of The Oil and Gas Sector

In Alberta, much time, attention, and resources are paid to our dominant sector, with many unaware of the opportunities other sectors, including agriculture, provide. Instead, agriculture tends to be seen by policy makers and job-seekers as a 'hedge' to any fluctuations in the strength of the O&G sector. Without a change of tone and focus from stakeholders, it may be difficult to brand the agriculture sector as an exciting diversification opportunity that is important to the Canadian or Alberta economy.

Lack of Investor Education in Agriculture

Investors tend to invest in what they know and what they are comfortable with. In Alberta, investment tends to be dominated by other sectors. As a result, it may be difficult to attract the right investment into the sector, and for the sector to access the capital it requires to grow.

Increased Nationalization

Current political overtones are ones of nationalization over globalization, including from Canada's largest trade partner. With an general sense of unease and uncertainty over US policy direction, an over-reliance on the US as a trade partner could pose a risk to the agriculture industry in Southern Alberta, should trade slow or halt due to political tensions. In addition, any immigration issues could impact employment in the sector which relies on temporary foreign workers. Outside of North America, increased nationalism also poses a

similar risk: countries may elect to produce their own food or ingredients to bolster a sense of nationalism rather than import from Canada.

6.3 Sector vs. Horizontal Evaluation

Although smaller opportunities exist across subsectors (see Figure 23 below), reviewing agricultural subsectors in relation the horizontals that cut across each sector determined that the biggest opportunity that exists is at the intersection of *agricultural food* and *agtech*. Technology would have the biggest direct impact on primary agriculture over other subsectors because of the overall opportunity to enhance traditionally manual processes and functions by deploying technology.

There are related opportunities for agriculture in Southern Alberta to:

- partner with oil and gas companies to apply lessons learned and leverage existing technologies such as machine learning for predictive maintenance which can be used on mining or farming equipment alike, or determining whether sensors traditionally placed on stationary assets can be used on livestock to monitor activity levels or overall health.
- identify its niche in agtech (not attempting to compete with current full-scale agtech hubs like Silicon Valley or New York), go ‘narrow and deep’ into that technology, and set ambitious goals of creating a targeted and specialized agtech ecosystem similar to areas like St Louis. Calgary and Southern Alberta have a potential strength in applied research and can consider building agtech capabilities around that through cooperation with industries and institutions in the region.

Figure 23 - Evaluation of Subsector vs. Horizontal Opportunities

		Subsectors			
		Food, Beverage, and Meat Processing	Crop Science	Animal Genetics	Agri Food
Horizontals	Agricultural Technology	Advanced robotics and machines	-	Gene transfer biotechnologies, in-vitro production, cloning and sexing of embryos	Plant monitoring, product monitoring, animal biometrics, etc.
	Artificial Intelligence	-	Intelligent insect detection and advanced crop protection products	-	Crop protection, optimize yield production, and predictive analytics
	Support Services	-	-	-	Term loans, agriculture risk management

6.4 Opportunities for The Region

Opportunities - Subsectors and Horizontals

Learnings from other global agribusiness hubs indicate that leaders in this sector are ones who have thoughtfully used their natural and cultivated strengths as a basis for growth. Calgary and Southern Alberta

have natural and cultivated strengths they can use to help focus on opportunities across subsectors and horizontals. The potential of each is highlighted in Figure 24, with further detail listed below.

Figure 24 - Opportunities in Subsectors and Horizontals for the Region



- **Food Beverage, and Meat Processing - HIGH**
Alberta has many of the requirements to grow in this area including space, plentiful access to water, and affordable labour, and opportunities to double down in plant proteins exists.
- **Crop Science - MEDIUM**
Southern Alberta is currently home to many significant players in this area, so an opportunity to build on that critical mass exists. To capitalize on this opportunity, the Region can focus on attracting smaller companies thanks to the level of talent, interest, collaboration, and investment available in the Region, due to the existing cluster.
- **Animal Genetics - LOW/MEDIUM**
Alberta meets some of the requirements for animal genetics to grow in a region, including moderate access to specialized talents, training programs, and sufficient research capability. If Alberta can continue to meet shifting global demands, they will be better positioned to grow in this subsector.
- **Agriculture Food - HIGH**
Southern Alberta is currently strong in this area with significant market presence and proven

success across a variety of crops. Although significant growth on top of this success isn't likely in the short or medium term, there's an opportunity to better brand and differentiate Albertan products as such.

- **Agriculture Technology - MEDIUM**
An opportunity does exist in agtech within Southern Alberta, but as mentioned, focus is required here: the opportunity pursued should be narrow rather than becoming a broad agtech super-hub akin to Silicon Valley/Salinas. With many jurisdictions fighting to become hubs for agtech, competition for attention, investment, and talent will be fierce. The Region should consider augmenting its existing strengths with a specific tech play around applied research and applied innovation in production, building on local areas of expertise (primary production, local R&D institutions, and existing tech firms currently focused on other industries).
- **Artificial Intelligence - MEDIUM**
Given the proximity to an industry that uses automation, machine learning, artificial intelligence, and analytics, the agriculture sector in Southern Alberta has an opportunity to better connect with the oil and gas sector to understand how to apply existing technologies to the agriculture sector. Bolstering this opportunity is the strength of area post-secondary institutions who can provide relevant courses to students in this capacity.
- **Agriculture Finance and other support services - MEDIUM**
Opportunities to grow agri-finance or insurance institutions in Southern Alberta is medium. Alberta has a strong financial services industry thanks to its established linkage to oil and gas. Opportunities exist to expand and enhance based on this foundation, while continuing to grow niche financial or insurance solutions. In addition, traceability solutions and technology consulting for farms are great growth opportunities for the Region going forward.

Figure 25 shows a *suggested* set of activities for each of the subsectors + horizontals in the "more ideal" opportunity evaluation above. It is meant to illustrate where major efforts should be concentrated, understanding that there may be some level of each activity in all sectors.

Figure 25 - Activities to Grow “More Ideal” Subsectors and Horizontals



	Food, Beverage, and Meat Processing	Agricultural Food	Agtech (narrow)	Crop Science
Promote + Attract Market the region to bring new jobs and companies to the sector, and promote more exports to new buyers				
Invest Target companies that align to regional focus areas; provide funding opportunities to eligible projects				
Connect Find opportunities for companies to collaborate and exchange knowledge, value, and information, and				
Sustain Execute ongoing efforts to retain critical mass of agribusinesses in the subsector				

Opportunities - Current Market Conditions

Current local market conditions provide a two-fold opportunity for agriculture in Calgary and Southern Alberta:

- Capitalize on the continued low cost of living and current labour market and attract young talent to the industry who may have otherwise been attracted to other cities or industries such as oil & gas.
- Capitalize on the renewed push for the Canadian and Albertan economies to diversify significantly to attract investors who are seeking an alternative to oil and gas investment.

Calgary and Southern Alberta has a compelling story as it relates to food safety and traceability, ethical processes and labour practices, and high standards for animal treatment. There is a significant opportunity to better tell that story to trade partners and end consumers. The sector in the region can create an Alberta brand and promote Alberta products around the world via trade shows and other international cooperation. Doing so can expand the world’s perception of Canadian agriculture away from strictly maple syrup and ice wine.

The opportunity that could be the most transformative to the sector in Southern Alberta is industry collaboration. Currently, the industry is competitive with few examples of sector-wide sharing of leading practice, cooperation for innovation, or industry advocacy to policy-makers. Industry networks tend to operate more like funding arms. If the sector in Southern Alberta were to set aside competition, it could create a better functioning collaboration network for information and resource sharing. Doing so would allow the sector to better solve some of the industry’s biggest problems together, positioning the region to compete on the global stage.

7.0 Conclusion

The agribusiness industry is not the simple, traditional sector that many perceive it as. Instead, it is a complex web of businesses along the value chain from production to consumption, that everyone relies on for sustenance. Like other industries, it is growing and evolving with the help of innovative new research and development, supported with technological advancements and unique enabling services.

Agribusiness is an essential industry for the Canadian and Albertan economy. Using learnings from other global hubs, it is clear that regions who have become global players in agribusiness have played to their unique strengths, of which Calgary and Southern Alberta have many. Though Southern Alberta has traditionally been focused on agricultural production, significant opportunity exists to develop other parts of the value chain locally. By doing so, it will strengthen the local ecosystem and create an enticing offering to attract other agriculture companies.

Global demand growth for plant-protein crops (which Alberta is well-suited to lead in), an increase in consumer demand for ethically sourced and traceable products, a regional push to diversify, and a renewed focus on food security due to COVID-19 are all trends working in favour of Alberta's agribusiness sector taking centre stage.

8.0 Endnotes

8.1 Definitions of Subsectors and Associated NAICS Codes

The North American Industry Classification System (NAICS) is a standard system developed by Canada, Mexico, and the United States. We mapped key NAICS codes that CED uses to each subsector, accompanied by definitions. This report was built in considering these definitions and NAICS codes.

Food, Beverage, and Meat Processing

Value added food processing and manufacturing includes taking raw and/or semi finished vegetable, meat, grain, tobacco, sugar, animal food, and other food ingredients and applying processes, or steps that result in a higher value edible food products. This sector is inclusive of food processing and manufacturing plants, and corporate functions related to food processing and manufacturing. Beverage manufacturing includes manufacturing of non alcoholic such as fruit and vegetable juices, soft drinks, flavored water, dairy and sport drinks as well as the manufacturing and distilling of alcoholic beverages (such as beers, spirits, wines).

- 3111 Animal food manufacturing
- 3112 Grain and oilseed milling
- 3113 Sugar and confectionery product manufacturing
- 3114 Fruit and vegetable preserving and specialty food manufacturing
- 3115 Dairy product manufacturing
- 3116 Meat product manufacturing
- 3117 Seafood product preparation and packaging
- 3118 Bakeries and tortilla manufacturing
- 3119 Other food manufacturing
- 3121 Beverage manufacturing
- 3122 Tobacco manufacturing
- 3123 Cannabis manufacturing
- 3331 Agricultural, construction and mining machinery manufacturing
- 333416 Heating equipment and commercial refrigeration equipment manufacturing

Crop Science

The development of new seeds and crops, with enhanced health, disease resistance, and yield capabilities. This sub-sector includes the production of seed, soil, pesticides and fertilizer products relevant to growing.

- 3253 Pesticide, fertilizer and other agricultural chemical manufacturing

Animal Genetics

The production and sale of products related to veterinary health of animals for food and breeding. This sub-sector includes the collection, distribution and sale of animal genetics (e.g., semen, embryos, live animals for breeding).

- 115210 Support activities for animal production (partial²²⁹)

Agricultural Food

Primary commodities such as live animals and crops (without processing).

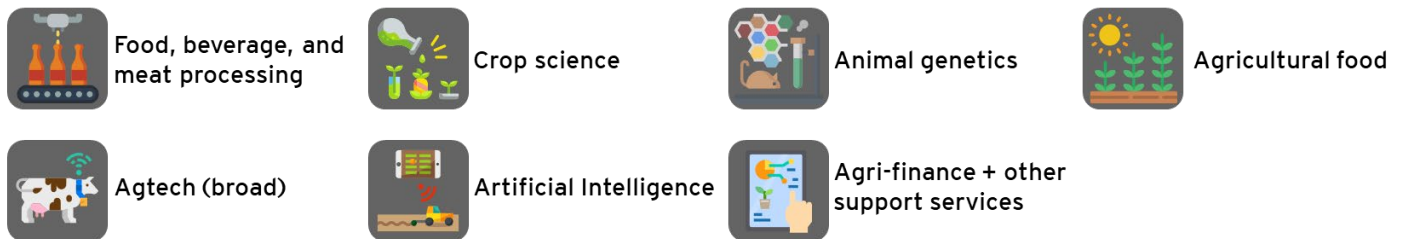
- 1111 Oilseed and grain farming
- 1112 Vegetable and melon farming
- 1113 Fruit and tree nut farming
- 1114 Greenhouse, nursery and floriculture production
- 1119 Other crop farming
- 1121 Cattle ranching and farming

- 1122 Hog and pig farming
- 1123 Poultry and egg production
- 1124 Sheep and goat farming
- 1125 Aquaculture
- 1129 Other animal production
- 1132 Forest nurseries and gathering of forest products
- 1141 Fishing
- 1142 Hunting and trapping
- 1151 Support activities for crop production
- 1152 Support activities for animal production

8.2 List of Agribusiness Companies in the Calgary and Southern Alberta Region (and Related Areas)

Through the development of this report, we had the pleasure of engaging various stakeholders in the sector. These stakeholders have provided key information on some of the bigger and smaller agribusiness companies in the Region. This is not meant to serve as an exhaustive list, however depicts some of the key Agribusiness players in Calgary and Southern Alberta which were specifically mentioned in our stakeholder engagement.








Legend:










Big Players

Company Name	Primary Products and Services							
ATB	Financial services (operates in Alberta only)							X
AltaGenetics	Genetic and reproductive solutions			X				
ATCO	Integrated energy, housing, transportation and infrastructure solutions. Customers includes agribusiness.							X
BASF	Chemicals, plastics, performance products and crop protection products.		X					
Bayer	Chemicals, plastics, performance chemicals, catalysts, coatings, crop technology, crude oil and natural gas exploration and production		X					
Bonduelle	Food processing services	X						
Byblos Bakeries	Pita bread bakeries	X						
Calgary Co-op	Retail in food, petroleum, home health care, pharmacy and cannabis							








Company Name	Primary Products and Services							
Cargill	Agricultural services, crop and livestock, food, health and pharmaceutical, industrial & financial risk management, raw materials	X		X	X			X
Cavendish Farms / Cavendish Agri Services	Food processing services, agribusiness services and solutions	X	X					X
Cervus Equipment	Agriculture, transportation and industrial equipment dealerships							X
Corteva	Agricultural chemical and seed		X					
Costco	Retail and wholesale							
Decisive Farming (Telus)	Precision agronomics, crop marketing, and information management services					X		
John Deere	Agriculture and Farming Equipment							X
Farmers Business Network	Farmer information, analytics, data storage and security					X		
Farmers Edge	Digital farming solutions, precision farming					X		
Farm Credit Canada	Specialized and personalized financial services to farming operations							X
JBS	Food processing (e.g. beef, chicken and pork)	X						
Lamb Weston	Food processing (frozen french fries and other frozen potato products)	X						
Lantic Sugar	Cane sugar refining	X						
Lethbridge Research and Development Centre	Innovative research, development, technology and knowledge transfer activities in agriculture							
McCain Foods	Frozen potato products manufacturing	X						
MNP	Chartered accountancy and business advisory							X
NuFarm	Innovative crop protection solutions		X					
Nutrien	Fertilizer producer: potash, nitrogen and phosphate products for agricultural, industrial and feed customers.(In addition, Nutrien Ag Solutions offers ag solutions and services)		X					X
Old Dutch	Potato chips / snacks manufacturing	X						
Parrish & Heimbecker	Flour milling, feed milling, grain marketing, transportation and logistics	X			X			
PepsiCo	Food, snack, and beverage manufacturing							
RBC	Retail banking, corporate banking, investment banking, mortgage loans, etc.							X

Company Name	Primary Products and Services							
Red Hat Coop	Fresh produce distribution							
Richardson	Agriculture and food processing	X						
Rocky Mountain Equipment	Agriculture and construction equipment dealerships							X
Sobeys/Safeway	Food/grocery retail							
SPUD.CA	Online grocery shopping							
Stantec	Architecture design, engineering, and environmental services							X
Sunterra Markets	Fresh food market							
Superstore/Loblaws	Supermarket / food retail chain							
Syngenta	Agrochemicals and seeds producer		X					
Telus	Telecommunications products and services including internet access, voice, entertainment, healthcare, video, and IPTV television.							X
Tiger fertilizer	Producer of sulphur bentonite, micronutrient-enhanced sulphur and other crop performance products		X					
United Farmers of Alberta	Alberta farmers co-operatives that offer farm and ranch supply, and a variety of services to agribusinesses							
Viterra	Grains, oilseeds and pulses handling	X						
FMC	Agricultural chemical manufacturing		X					
Trimble Agriculture	Precision solutions and modern agricultural management solutions					X		

Small Players

Small companies	Primary products and services							
AdFarm	Digital Marketing, communications, social media, etc.					X		
AeroFodder Supply Company	Aeroponic livestock feed production							
AgCall	Project management, data services and digital marketing services with an agriculture focus					X		X
AgCapita	Farmland portfolios and investment services							X
Altagenetics	Genomics and customized genetic plans			X				
Attabotics	3D robotic goods-to-person storage, retrieval and real-time order fulfillment					X		

Small companies	Primary products and services							
Botaneco	Natural ingredient, food, feed, and personal care manufacturing	X						
Ceres Solutions	Mushrooms and livestock feed producer with environmentally friendly solutions				X			
CORE Ag	Western Canadian crop inputs retail network							X
CropBoss	Comprehensive farm management solution					X		X
DeepWater Farms	Fresh produce and fish producer using aquaponics technology				X			
DeVry Greenhouses	Plant producing and bedding plan solutions							
EarthRenew	Innovative organic fertilizer production		X					
Enterra Feed Corporation	Sustainable insect production for animal feed							X
Family Fungi	Hemp based vertical mushroom farm				X			
Feedlot Management Services	Data-enabled customized Animal Health and Production Consulting					X		X
Future Fields	Enabling technologies and growth media for the production of cellular					X		X
Green Prairie International	Wholesale supplier of quality forage products (corn, long-fiber timothy and alfalfa hay)							X
GrowSafe Systems	Livestock decision support solutions and systems					X		X
Highwood Crossing Foods	Producer and processor of organic granola, cereals, specialty flour, baking mixes, etc.	X			X			
Independent Crop Inputs	Crop nutrition, crop protection, agronomy, sustainability, and other ag services		X					X
Livestock Water Recycling	Manure/water treatment technology					X		X
Minhas Breweries	Breweries and distillery	X						
OPI Advanced Grain Management	Technology based grain temperature monitoring and moisture monitoring solution							
Provision Analytics	Data intelligence and food supply chain					X		X
Rahr Malt	Producer and distributor malt and related supplies for breweries, distilleries, and allied industries							X
Red Fox Farms	Craft mushrooms producer				X			
Rocky Mountain Shrimp Farm	Production and sales of live and fresh shrimp				X			
Routeique	Cloud-based, end-to-end order and delivery management solutions					X		X
Rowland Farms	Diversified organic crops				X			

Small companies	Primary products and services							
Skymatics	Data analytics company transforming images to information					X		
Whipcord	Data services, cloud computing					X		
Food-x	Scaleable end-to-end eGrocery software platform (based in BC)					X		X

9.0 References

- ¹ Calgary Economic Development. n.d. "About Calgary Economic Development." Accessed April 10, 2020. <https://calgaryeconomicdevelopment.com/about-us/about-us/about/>
- ² Calgary Economic Development. n.d. "About Calgary Economic Development." Accessed April 10, 2020. <https://calgaryeconomicdevelopment.com/about-us/about-us/about/>
- ³ Government of Canada. n.d. "Food and Beverage Processing." Accessed April 10, 2020. https://www.ic.gc.ca/eic/site/026.nsf/eng/h_00117.html
- ⁴ ResearchAndMarkets. 2019. "Global Food Processing Market Report, 2019: Trends, Forecasts, and Competitive Analysis (2013-2024)." <https://www.businesswire.com/news/home/20190904005488/en/Global-Food-Processing-Market-Report-2019-Trends>
- ⁵ Food Processors Of Canada. n.d. "About the Industry." Accessed April 10, 2020. <https://foodprocessorsofcanada.ca/>
- ⁶ Government of Canada. n.d. "Report Of Canada's Economic Strategy Tables: Agri-food." Accessed April 10, 2020. <https://www.ic.gc.ca/eic/site/098.nsf/eng/00022.html#fn3>
- ⁷ Government of Canada. n.d. "Report Of Canada's Economic Strategy Tables: Agri-food." Accessed April 10, 2020. [https://www.ic.gc.ca/eic/site/098.nsf/vwapj/ISED_C_Agri-Food_E.pdf/\\$FILE/ISED_C_Agri-Food_E.pdf](https://www.ic.gc.ca/eic/site/098.nsf/vwapj/ISED_C_Agri-Food_E.pdf/$FILE/ISED_C_Agri-Food_E.pdf)
- ⁸ Government of Canada. n.d. "Report Of Canada's Economic Strategy Tables: Agri-food." Accessed April 10, 2020. <https://www.ic.gc.ca/eic/site/098.nsf/eng/00022.html>
- ⁹ Linchpin SEO. 2019. "Trends That Will Transform The Food Products Manufacturing Industry Outlook in 2020." <https://linchpinseo.com/trends-in-the-food-products-manufacturing-industry/>
- ¹⁰ The Good Food Institute. n.d. "Plant-based Market Overview." Accessed April 10, 2020. <https://www.gfi.org/marketresearch>
- ¹¹ Conner, Jeff. 2019. "Increasing Competitiveness Through Automation in the Food Industry." <https://foodindustryexecutive.com/2019/07/increasing-competitiveness-through-automation-in-the-food-industry/>
- ¹² Macrotrends. n.d. "Nestle Sa Revenue 2006-2019: Nsrgy." Accessed April 10, 2020. <https://www.macrotrends.net/stocks/charts/NSRGY/nestle-sa/revenue>
- ¹³ Macrotrends. n.d. "PepsiCo Revenue 2006-2019 | PEP." Accessed April 10, 2020. <https://www.macrotrends.net/stocks/charts/PEP/pepsico/revenue>
- ¹⁴ Macrotrends. n.d. "Coca-Cola Revenue 2006-2020 | KO." Accessed April 10, 2020. <https://www.macrotrends.net/stocks/charts/KO/coca-cola/revenue>
- ¹⁵ Macrotrends. n.d. "Kraft Heinz Revenue 2011-2019 | KHC." Accessed April 10, 2020. <https://www.macrotrends.net/stocks/charts/KHC/kraft-heinz/revenue>
- ¹⁶ Macrotrends. n.d. "Anheuser-Busch Revenue 2007-2019 | BUD." Accessed April 10, 2020. <https://www.macrotrends.net/stocks/charts/BUD/anheuser-busch/revenue>
- ¹⁷ Alberta, Ministry of Agriculture and Forestry. n.d. "Alberta's Agricultural Processing Industry." Accessed April 10, 2020. <https://www.agric.gov.ab.ca/content/Agprodir2018.pdf>
- ¹⁸ IHS Markit. n.d. "Crop Science Market Insights and Forecasting." Accessed April 10, 2020. <https://agribusiness.ihsmarkit.com/sectors/crop-science/index.html>
- ¹⁹ IHS Markit. n.d. "Crop Science Market Insights and Forecasting." Accessed April 10, 2020. <https://agribusiness.ihsmarkit.com/sectors/crop-science/index.html>
- ²⁰ Neumeister, Lars. 2010. "Climate Change and Crop Protection - Anything can happen." https://www.researchgate.net/publication/278670856_Climate_Change_and_Crop_Protection_-_Anything_can_happen
- ²¹ Shields, Michael. 2017. "ChemChina clinches landmark \$43 billion takeover of Syngenta." <https://www.reuters.com/article/us-syngenta-ag-m-a-chemchina/chemchina-clinches-landmark-43-billion-takeover-of-syngenta-idUSKBN1810CU>
- ²² Nishimoto, Ray. 2019. "Global trends in the crop protection industry" <https://www.ncbi.nlm.nih.gov/pmc/articles/PMC6718354/>
- ²³ Macrotrends. n.d. "China Petroleum & Chemical Revenue 2006-2019 | SNP." Accessed April 10, 2020. <https://www.macrotrends.net/stocks/charts/SNP/china-petroleum-chemical/revenue>
- ²⁴ Macrotrends. n.d. "BASF SE Revenue 2006-2019 | BASFY." Accessed April 10, 2020. <https://www.macrotrends.net/stocks/charts/BASFY/basf-se/revenue>
- ²⁵ Macrotrends. n.d. "Bayer Revenue 2006-2019 | BAYRY." Accessed April 10, 2020. <https://www.macrotrends.net/stocks/charts/BAYRY/bayer/revenue>
- ²⁶ Macrotrends. n.d. "Corteva Revenue 2018-2019 | CTVA." Accessed April 10, 2020. <https://www.macrotrends.net/stocks/charts/CTVA/corteva/revenue>

-
- ²⁷ Macrotrends. n.d. "FMC Revenue 2006-2019 | FMC." Accessed April 10, 2020. <https://www.macrotrends.net/stocks/charts/FMC/fmc/revenue>
- ²⁸ Phillips McDougall. 2018. "Evolution of the Crop Protection Industry since 1960." <https://croplife.org/wp-content/uploads/2018/11/Phillips-McDougall-Evolution-of-the-Crop-Protection-Industry-since-1960-FINAL.pdf>
- ²⁹ Calgary Economic Development. 2017. "Agribusiness Value Chain Study: Phase 1 Report." <https://calgaryeconomicdevelopment.com/assets/dmsdocument/Agribusiness-Value-Chain-Study.pdf>
- ³⁰ Grand View Research. 2019. "Animal Genetics Market Size, Share, & Trends Analysis Report By Live Animals (Porcine, Bovine, Poultry, Canine) By Genetic Material (Embryos, Semen), By Services (Genetic Trait Test, Genetic Diseases Test, DNA Typing), By Region, And Segment Forecasts, 2019 - 2026." <https://www.grandviewresearch.com/industry-analysis/animal-genetics-market>
- ³¹ Grand View Research. 2019. "Animal Genetics Market Size, Share, & Trends Analysis Report By Live Animals (Porcine, Bovine, Poultry, Canine) By Genetic Material (Embryos, Semen), By Services (Genetic Trait Test, Genetic Diseases Test, DNA Typing), By Region, And Segment Forecasts, 2019 - 2026." <https://www.grandviewresearch.com/industry-analysis/animal-genetics-market>
- ³² Mordor Intelligence. n.d. "Animal Genetics Market - Growth, Trends, And Forecast (2020 - 2025)." Accessed April 10, 2020. <https://www.mordorintelligence.com/industry-reports/animal-genetics-market>
- ³³ Government of Canada. n.d. "Canada's animal genetic exports (for breeding purpose)." Accessed April 10, 2020. <http://www.agr.ca/eng/animal-industry/animal-genetics/statistics-publications-and-reports/canada-s-animal-genetic-exports/?id=1382649715183>
- ³⁴ Grand View Research. 2019. "Animal Genetics Market Size, Share, & Trends Analysis Report By Live Animals (Porcine, Bovine, Poultry, Canine) By Genetic Material (Embryos, Semen), By Services (Genetic Trait Test, Genetic Diseases Test, DNA Typing), By Region, And Segment Forecasts, 2019 - 2026." <https://www.grandviewresearch.com/industry-analysis/animal-genetics-market>
- ³⁵ AP News. 2019. "Global Animal Genetics Market 2020-2024 | Evolving Opportunities with Animal Genetics Inc. and AquaGen AS | Technavio." <https://apnews.com/b6ffcb4456f840f6b134cc9387b362ea>
- ³⁶ Genus Plc. n.d. "Annual Report 2019." https://www.genusplc.com/media/1589/genus_annual_report_2019_interactive.pdf
- ³⁷ Macrotrends. n.d. "Neogen Revenue 2006-2020 | NEOG." Accessed April 10, 2020. <https://www.macrotrends.net/stocks/charts/NEOG/neogen/revenue>
- ³⁸ NEOGEN. 2019. "NEOGEN acquires Canadian animal genomics laboratory." <https://www.neogen.com/neocenter/press-releases/neogen-acquires-canadian-animal-genomics-laboratory/>
- ³⁹ Macrotrends. n.d. "Zoetis Revenue 2011-2019 | ZTS." Accessed April 10, 2020. <https://www.macrotrends.net/stocks/charts/ZTS/zoetis/revenue>
- ⁴⁰ Government of Canada. n.d. "An Overview of the Canadian Agriculture and Agri-Food System 2017". Accessed April 10, 2020. <http://www.agr.gc.ca/eng/canadian-agri-food-sector/an-overview-of-the-canadian-agriculture-and-agri-food-system-2017/?id=1510326669269>
- ⁴¹ Food and Agriculture Organization of the United Nations. n.d. "Part I - Overview Of Main Findings, Including Trade And Food Security Issues." Accessed April 10, 2020. <http://www.fao.org/3/y5143e/y5143e04.htm>
- ⁴² United Nations. 2018. "68% of the world population projected to live in urban areas by 2050, says UN" <https://www.un.org/development/desa/en/news/population/2018-revision-of-world-urbanization-prospects.html>
- ⁴³ Food and Agriculture Organization of the United Nations. 2017. "The future of food and agriculture - Trends and challenges." <http://www.fao.org/3/a-i6583e.pdf>
- ⁴⁴ IRENA. 2014. "REmap 2030: A Renewable Energy Roadmap." https://www.irena.org/-/media/Files/IRENA/Agency/Publication/2014/IRENA_REmap_summary_findings_2014.pdf
- ⁴⁵ IRENA. 2014. "Global Bioenergy: Supply and Demand Projections." https://www.irena.org/-/media/Files/IRENA/Agency/Publication/2014/IRENA_REmap_2030_Biomass_paper_2014.pdf
- ⁴⁶ Hendrix, Cullen. 2020. "Wrong tools, wrong time: Food export bans in the time of COVID-19." <https://www.piie.com/blogs/realtime-economic-issues-watch/wrong-tools-wrong-time-food-export-bans-time-covid-19>
- ⁴⁷ Cargill. n.d. "Five-Year Financial Summary." Accessed April 10, 2020. <https://www.cargill.com/about/financial/five-year-financial-summary>
- ⁴⁸ Market Watch. n.d. "Annual Financials for Archer Daniels Midland Co." Accessed April 10, 2020. <https://www.marketwatch.com/investing/stock/adm/financials>
- ⁴⁹ ADM. "Canada." Accessed April 10, 2020. <https://www.adm.com/adm-worldwide/canada>
- ⁵⁰ Wikipedia. n.d. "Louis Dreyfus Company." Accessed April 10, 2020. https://en.wikipedia.org/wiki/Louis_Dreyfus_Company

-
- ⁵¹ Realagriculture. 2019. "P&H acquires 10 Louis Dreyfus locations across Western Canada." <https://www.realagriculture.com/2019/09/ph-acquires-10-louis-dreyfus-locations-across-western-canada/>
- ⁵² Macrotrends. n.d. "Bunge Revenue 2006-2019 | BG." Accessed April 10, 2020. <https://www.macrotrends.net/stocks/charts/BG/bunge/revenue>
- ⁵³ COFCO. n.d. "About COFCO." Accessed April 10, 2020. <http://www.cofco.com/en/AboutCOFCO/>
- ⁵⁴ Reuters News Agency. 2016. "China's COFCO Agri hiring grain traders, opening Canadian office" <https://www.producer.com/daily/chinas-cofco-agri-hiring-grain-traders-opening-canadian-office/>
- ⁵⁵ Databank.Worldbank. 2019. "Population 2018." <https://databank.worldbank.org/data/download/POP.pdf>
- ⁵⁶ Food and Agriculture Organization of the United Nations. n.d. "China at a glance." Accessed April 10, 2020. <http://www.fao.org/china/fao-in-china/china-at-a-glance/en/>
- ⁵⁷ Alberta Open Government Program. 2019. "2018 Agriculture Statistics Factsheet." <https://open.alberta.ca/dataset/79f01912-5e5c-469e-8cf4-97cfc6901cea/resource/db11092f-10a6-436f-a205-de514b94901d/download/af-2018-agriculture-statistics-factsheet.pdf>
- ⁵⁸ Ren, Tianzhi. n.d. "China Agriculture: Challenge & Countermeasures." Accessed April 10, 2020. https://sustainabledevelopment.un.org/content/documents/ren_5may_agriculture.pdf
- ⁵⁹ Peverelli, Peter. 2019. "Six trends to shape China's food market in 2020." https://www.just-food.com/comment/six-trends-to-shape-chinas-food-market-in-2020_id142676.aspx
- ⁶⁰ CBNData. 2019. "Tmall Food Industry Trends and Insights." (Translated from Chinese) <https://www.cbndata.com/report/1393/detail?isReading=report&page=1&readway=stand>
- ⁶¹ Koe, Tingmin. 2019. "Tmall reveals the top seven food and beverage trends driving China's consumer market." <https://www.foodnavigator-asia.com/Article/2019/04/09/Tmall-reveals-the-top-seven-food-and-beverage-trends-driving-China-s-consumer-market#>
- ⁶² Wong, Catherine. 2019. "China denies block on Canadian canola firm is retaliation for Meng Wanzhou case." <https://www.scmp.com/economy/china-economy/article/2188824/china-blocks-canadian-canola-exporter-tension-sabrina-meng>
- ⁶³ Qiu, Shan. 2019. "What can we learn from the Dolce & Gabbana incident in China?" <http://www.baldwinboyle.com/news/dolce-gabbanachina>
- ⁶⁴ Cristoferi, Claudia. 2019. "Dolce & Gabbana sees sales slowdown in China after ad backlash." <https://www.reuters.com/article/us-dolce-gabbana-results/dolce-gabbana-sees-sales-slowdown-in-china-after-ad-backlash-idUSKCN1VH1EV>
- ⁶⁵ ResearchAndMarkets. 2019. "Global \$725+ Billion Food & Agriculture Technology and Products Market Analysis 2018-2019 & Forecast to 2023." <https://www.prnewswire.com/news-releases/global-725-billion-food--agriculture-technology-and-products-market-analysis-2018-2019--forecast-to-2023-300816481.html>
- ⁶⁶ Zion Market Research. 2018. "Global Smart Agriculture Market Worth \$15,344 Million by 2025" <https://www.globenewswire.com/news-release/2018/08/07/1548245/0/en/Global-Smart-Agriculture-Market-Worth-15-344-Million-by-2025.html>
- ⁶⁷ Schmaltz, Remi. 2017. "What is Precision Agriculture?" <https://agfundernews.com/what-is-precision-agriculture.html>
- ⁶⁸ Marketsandmarkets. n.d. "Precision Farming Market by Technology (Guidance, VRT, Remote Sensing), Application (Crop Scouting, Field Mapping, Variable Rate Application), Offering (Hardware–Sensors, GPS, Yield Monitors; Software; Services) and Geography - Global Forecast to 2025." Accessed April 10, 2020. <https://www.marketsandmarkets.com/Market-Reports/precision-farming-market-1243.html>
- ⁶⁹ FitchSolutions. 2019. "AgTech 2019 Adoption Trends, Opportunities And Challenges." <https://www.fitchsolutions.com/corporates/commodities/agtech-2019-adoption-trends-opportunities-and-challenges-23-09-2019>
- ⁷⁰ FitchSolutions. 2019. "AgTech 2019 Adoption Trends, Opportunities And Challenges." <https://www.fitchsolutions.com/corporates/commodities/agtech-2019-adoption-trends-opportunities-and-challenges-23-09-2019>
- ⁷¹ Thriveagrifood. 2020. "2020 Thrive Top 50: 50 Growth Stage Companies Disrupting the Future of Food and Agriculture." https://thriveagrifood.com/wp-content/uploads/2020/03/3.24.20_FINAL-TOP-50-AGTECH-REPORT-.pdf
- ⁷² Mao, Cass and Nolet, Sara. 2019. "Building A Globally Recognised Agtech Ecosystem In Australia." <https://www.ussc.edu.au/analysis/building-a-globally-recognised-agtech-ecosystem-in-australia>
- ⁷³ Department of Meat and Animal Science. 1990, "New animal breeding techniques and their application." <https://www.ncbi.nlm.nih.gov/pubmed/2213713>
- ⁷⁴ Merriam-Webster. n.d. "Definition of artificial intelligence." Accessed April 10, 2020. <https://www.merriam-webster.com/dictionary/artificial%20intelligence>

- ⁷⁵ Gupta, Jyoti. 2019. "The Role of Artificial intelligence in Agriculture Sector." <http://customerthink.com/the-role-of-artificial-intelligence-in-agriculture-sector/>
- ⁷⁶ ResearchAndMarkets. 2020. "Global Artificial Intelligence in Agriculture Market Expected to Grow in Value Over the Coming Years, with a CAGR of 38.3%." <https://www.businesswire.com/news/home/20200205005339/en/Global-Artificial-Intelligence-Agriculture-Market-Expected-Grow>
- ⁷⁷ ResearchAndMarkets. 2020. "Global Artificial Intelligence in Agriculture Market Expected to Grow in Value Over the Coming Years, with a CAGR of 38.3%." <https://www.businesswire.com/news/home/20200205005339/en/Global-Artificial-Intelligence-Agriculture-Market-Expected-Grow>
- ⁷⁸ Canadian Agri-Food Automation And Intelligence Network. n.d. "What Is CAAIN?" Accessed April 10, 2020. <https://caain.albertainnovates.ca/>
- ⁷⁹ Mordor Intelligence. n.d. "Artificial Intelligence In Agriculture Market - Growth, Trends And Forecasts (2020 - 2025)." Accessed April 10, 2020. <https://www.mordorintelligence.com/industry-reports/artificial-intelligence-in-agriculture-market>
- ⁸⁰ Campbell, Charlie. 2019. "'AI Farms' Are at the Forefront of China's Global Ambitions." <https://time.com/5518339/china-ai-farm-artificial-intelligence-cybersecurity/>
- ⁸¹ Businesswire. 2018. "Alibaba Cloud Launches ET Agricultural Brain at the Shanghai Computing Conference." <https://www.businesswire.com/news/home/20180606006487/en/Alibaba-Cloud-Launches-Agricultural-Brain-Shanghai-Computing>
- ⁸² CBRE. n.d. "Identifying China's Up -And-Coming Tech Hubs." Accessed April 10, 2020. https://www.cbre.com/-/media/images/asia-pacific/2019/Tech-Clusters/Featured-Articles/Feature_article_Identifying_Chinas_up_and_coming_tech_hubs.pdf
- ⁸³ Mordor Intelligence. n.d. "Artificial Intelligence In Agriculture Market - Growth, Trends And Forecasts (2020 - 2025)." Accessed April 10, 2020. <https://www.mordorintelligence.com/industry-reports/artificial-intelligence-in-agriculture-market>
- ⁸⁴ CNET. n.d. "AI Enables the Future of Farming." Accessed April 10, 2020. <https://www.cnet.com/paid-content/features/ai-enables-the-future-of-farming/>
- ⁸⁵ Courtois, Jean-Philippe. 2019. "Harnessing the power of AI to transform agriculture." <https://blogs.microsoft.com/blog/2019/08/07/harnessing-the-power-of-ai-to-transform-agriculture/>
- ⁸⁶ IBM. n.d. "Watson Decision Platform for Agriculture." Accessed April 10, 2020. <https://www.ibm.com/downloads/cas/ONVXEB2A>
- ⁸⁷ Granular. n.d. "About Us." Accessed April 10, 2020. <https://granular.ag/company/>
- ⁸⁸ aWhere. n.d. "About Us." Accessed April 10, 2020. <https://www.awhere.com/about/>
- ⁸⁹ Prospera. n.d. "About Us." Accessed April 10, 2020. <https://home.prospera.ag/about>
- ⁹⁰ Mao, Cass and Nolet, Sara. 2019. "Building A Globally Recognised Agtech Ecosystem In Australia." <https://www.ussc.edu.au/analysis/building-a-globally-recognised-agtech-ecosystem-in-australia>
- ⁹¹ Future of Life Institute. n.d. "AI Policy - China." Accessed April 10, 2020. <https://futureoflife.org/ai-policy-china/?cn-reloaded=1>
- ⁹² Agrifutures. 2016. "Artificial Intelligence." <https://www.agrifutures.com.au/wp-content/uploads/publications/16-038.pdf>
- ⁹³ IBISWorld. 2020. "Agricultural Banks Industry in the US - Market Research Report." <https://www.ibisworld.com/united-states/market-research-reports/agricultural-banks-industry/>
- ⁹⁴ MENAFN. 2020. "Global Agriculture Insurance Market Report 2020." <https://menafn.com/1099580018/Global-Agricultural-Insurance-Market-ShareSize-2020-Global-Business-Growth-Industry-Revenue-Demand-and-Applications-Market-Research-Report-to-2026>
- ⁹⁵ Market Watch. n.d. "Agriculture Crop Insurance Market Global Industry Analysis." Accessed April 10, 2020. <https://www.marketwatch.com/press-release/agriculture-crop-insurance-market-global-industry-analysis-size-share-growth-trends-and-forecast-2018-2025-2019-12-03>
- ⁹⁶ Technavio. 2018. "Global Crop Insurance Market 2018-2022." <https://www.technavio.com/report/global-crop-insurance-market-analysis-share-2018?tnplus>
- ⁹⁷ Government of Canada. 2009. "Canadian Agricultural Loans Act program - Lenders guidelines." <http://www.agr.gc.ca/eng/agricultural-programs-and-services/canadian-agricultural-loans-act-program/for-lenders/lenders-guidelines/?id=1369846155609>
- ⁹⁸ Market Watch. n.d. "Global Agricultural Insurance Market Share Size." Accessed April 10, 2020. <https://www.marketwatch.com/press-release/global-agricultural-insurance-market-sharesize-2020-global-business-growth-industry-revenue-demand-and-applications-market-research-report-to-2026-2020-01-21>

-
- ⁹⁹ Canadian Cattle Identification Agency. n.d. "Who We Are." Accessed April 10, 2020. <https://www.canadaid.ca/about/who-we-are/>
- ¹⁰⁰ Maurer, Klaus. 2014. "Where Is the Risk? Is Agricultural Banking Really More Difficult than Other Sectors?" https://link.springer.com/content/pdf/10.1007%2F978-3-642-54034-9_7.pdf
- ¹⁰¹ The Food and Agriculture Organization of the United Nations. n.a. "Indonesia at a glance." Accessed April 10, 2020. <http://www.fao.org/indonesia/fao-in-indonesia/indonesia-at-a-glance/en/>
- ¹⁰² Alberta Agriculture and Forestry. 2019. "2018 Agriculture Statistics Factsheet." <https://open.alberta.ca/dataset/79f01912-5e5c-469e-8cf4-97cfc6901cea/resource/db11092f-10a6-436f-a205-de514b94901d/download/af-2018-agriculture-statistics-factsheet.pdf>
- ¹⁰³ European Commission. 2016. "The Food and Beverage Market Entry Handbook: Indonesia." https://ec.europa.eu/chafea/agri/sites/chafea/files/handbook-indonesia-2018_en.pdf
- ¹⁰⁴ McKinsey & Company. n.d. "The evolving Indonesian consumer." Accessed April 10, 2020. <https://www.mckinsey.com/business-functions/marketing-and-sales/our-insights/the-evolving-indonesian-consumer>
- ¹⁰⁵ Fitch Solutions. 2018. "Indonesia Food Spending Trends: Growing Westernisation Of Diets." <https://www.fitchsolutions.com/corporates/retail-consumer/indonesia-food-spending-trends-growing-westernisation-diets-18-09-2018>
- ¹⁰⁶ Cekindo. n.d. "Potential and Risks of Investing in Indonesia." Accessed April 10, 2020. <https://www.cekindo.com/blog/potential-and-risks-of-investing-in-indonesia>
- ¹⁰⁷ Asean Up. 2019. "Top 10 e-commerce sites in Indonesia 2019." <https://aseanup.com/top-e-commerce-sites-indonesia/>
- ¹⁰⁸ United States Census Bureau. n.d. "QuickFacts Salinas city, California." Accessed April 10, 2020. <https://www.census.gov/quickfacts/fact/table/salinascitycalifornia/PST045218>
- ¹⁰⁹ Salinas. n.d. "The Epicenter of AgTech." Accessed April 10, 2020. <http://agtechsalinasca.com>
- ¹¹⁰ The Lempert Report. 2015. "Agriculture Innovation in Salinas Valley." <https://www.youtube.com/watch?v=fgRfMPxWSIM>
- ¹¹¹ SVG Ventures. n.d. "About." Accessed April 10, 2020. <http://svgventures.com>
- ¹¹² KSBW Action News 8. 2019. "Salinas-based AgTEch celebrates milestone." <https://www.youtube.com/watch?v=kc-ERVQxFWc>
- ¹¹³ WG Innovation. n.d. "Overview." Accessed April 10, 2020. <http://www.wginnovation.com>
- ¹¹⁴ Forbes. n.d. "2020 Agtech Summit." Accessed April 10, 2020. <https://www.forbes.com/forbes-live/event/2020agtechsummit/>
- ¹¹⁵ Western Growers. n.d. "About Western Growers." Accessed April 10, 2020. <https://www.wga.com/about-western-growers>
- ¹¹⁶ Cendese, Alexander. 2015. "Western Growers Launches \$4M AgTech Fund." <https://agfundernews.com/western-growers-launches-4m-agtech-fund.html>
- ¹¹⁷ SVG Ventures. n.d. "About." Accessed April 10, 2020. <http://svgventures.com>
- ¹¹⁸ Salinas. n.d. "Funding the Seeds of Your Ideas." Accessed April 10, 2020. <http://agtechsalinasca.com/entrepreneurship/capital/>
- ¹¹⁹ Salinas. n.d. "The Epicenter of AgTech," Accessed April 10, 2020. <http://agtechsalinasca.com>
- ¹²⁰ Parilla, Joseph. 2018. "Rethinking Cluster Initiatives." https://www.brookings.edu/wp-content/uploads/2018/07/201807_Brookings-Metro_Rethinking-Clusters-Initiatives_CICP.pdf
- ¹²¹ 39 North. 2016. "2016 Master Plan." https://39northstl.com/wp-content/uploads/2019/10/39-north-master-plan_compressed.pdf
- ¹²² 39 North. n.d. "Like Silicon Valley, 39 North Is A Physical Place, And A Distinct Idea." Accessed April 10, 2020. <https://39northstl.com>
- ¹²³ 39 North. n.d. "Like Silicon Valley, 39 North Is A Physical Place, And A Distinct Idea." Accessed April 10, 2020. <https://39northstl.com>
- ¹²⁴ Cosgrove, Emma and Burwood-Taylor, Louisa. 2017. "Is St. Louis the Silicon Valley of Agtech?" <https://agfundernews.com/stlouis-silicon-valley-for-agtech.html>
- ¹²⁵ Cosgrove, Emma and Burwood-Taylor, Louisa. 2017. "Is St. Louis the Silicon Valley of Agtech?" <https://agfundernews.com/stlouis-silicon-valley-for-agtech.html>
- ¹²⁶ Bill & Melinda Gates Foundation. 2020. "Bill & Melinda Gates Foundation Statement on Creation of Nonprofit Agricultural Research Institute." <https://www.gatesfoundation.org/Media-Center/Press-Releases/2020/01/Gates-Foundation-Statement-on-Creation-of-Nonprofit-Agricultural-Research-Institute>
- ¹²⁷ Post Holdings. n.d. "Post Consumer Brands." Accessed April 10, 2020. <https://www.postholdings.com/businesses/post-consumer-brands-us/>

- ¹²⁸ United States Department of Agriculture. n.d. "2019 State Agriculture Overview." Accessed April 10, 2020. https://www.nass.usda.gov/Quick_Stats/Ag_Overview/stateOverview.php?state=NORTH_CAROLINA
- ¹²⁹ Research Triangle Park. n.d. "History." Accessed April 10, 2020. <https://www.rtp.org/history/>
- ¹³⁰ NC Food Innovation Lab. n.d. "About the NC Food Innovation Lab." Accessed April 10, 2020. <https://www.ncfoodinnovationlab.org/about>
- ¹³¹ NC Food Innovation Lab. n.d. "Meet America's plant-based food partner." Accessed April 10, 2020. <https://www.ncfoodinnovationlab.org>
- ¹³² Research Triangle Regional Partnership. n.d. "Our Region." Accessed April 10, 2020. <https://www.researchtriangle.org/>
- ¹³³ College of Agriculture and Life Sciences. n.d. "About Raleigh Area Agriculture Units." Accessed April 10, 2020. <https://cals.ncsu.edu/research/research-facilities/raleigh-area-agriculture-units/>
- ¹³⁴ NC Food Innovation Lab. n.d. "Meet America's plant-based food partner." Accessed April 10, 2020. <https://www.ncfoodinnovationlab.org>
- ¹³⁵ NC Food Innovation Lab. n.d. "About the NC Food Innovation Lab." Accessed April 10, 2020. <https://www.ncfoodinnovationlab.org/about>
- ¹³⁶ Research Triangle Regional Partnership. n.d. "AgTech." Accessed April 10, 2020. <https://www.researchtriangle.org/industries/agribusiness/>
- ¹³⁷ Research Triangle Regional Partnership. n.d. "About the Research Triangle Agtech Cluster." Accessed April 10, 2020 <https://www.researchtriangle.org/wp-content/uploads/2019/09/AgTech-Brochure.pdf>
- ¹³⁸ Research Triangle Regional Partnership. n.d. "About the Research Triangle Agtech Cluster." Accessed April 10, 2020 <https://www.researchtriangle.org/wp-content/uploads/2019/09/AgTech-Brochure.pdf>
- ¹³⁹ Research Triangle Park. n.d. "BASF Corporation." Accessed April 10, 2020. <https://www.rtp.org/company/basf-corporation/>
- ¹⁴⁰ Research Triangle Regional Partnership. n.d. "About the Research Triangle Agtech Cluster." Accessed April 10, 2020 <https://www.researchtriangle.org/wp-content/uploads/2019/09/AgTech-Brochure.pdf>
- ¹⁴¹ Research Triangle Park. n.d. "Bayer CropScience." Accessed April 10, 2020. <https://www.rtp.org/company/bayer-cropscience/>
- ¹⁴² Rajya Sabha TV. 2018. "Special Report-Israel: A Miracle in Agriculture." <https://www.youtube.com/watch?v=LQ3192n9KVU>
- ¹⁴³ Purdy, Chase. n.d. "To Understand the future of food, look to the Holy Land." Accessed April 10, 2020. <https://qz.com/1623575/israel-is-a-growing-hub-of-food-and-water-technology/>
- ¹⁴⁴ Agriculture Technology. 2018. "Israel Agriculture No.1 On the World - AGRITECH 2018." <https://www.youtube.com/watch?v=lt1vnLJu1GU>
- ¹⁴⁵ State of Israel. 2019. "7 Israeli Agriculture Technologies." <https://www.youtube.com/watch?v=v1DT4yvxpMw>
- ¹⁴⁶ Purdy, Chase. n.d. "To Understand the future of food, look to the Holy Land." Accessed April 10, 2020. <https://qz.com/1623575/israel-is-a-growing-hub-of-food-and-water-technology/>
- ¹⁴⁷ Volcani Center. 2014. "Volcani Center English Short." <https://www.youtube.com/watch?v=dmWJ4roZaOQ>
- ¹⁴⁸ Agricultural Research Organization (ARO) Volcani Center. 2014. "About ARO." <https://www.agri.gov.il/en/pages/1023.aspx>
- ¹⁴⁹ Agricultural Research Organization (ARO) Volcani Center. n.d. "Institutes." Accessed April 10, 2020. <https://www.agri.gov.il/en//units/institutes/default.aspx>
- ¹⁵⁰ Rowland, Michael. 2019. "Israeli Startup Aleph Farms Raises \$11.65 Million To Create Steaks." <https://www.forbes.com/sites/michaelpellmanrowland/2019/05/14/aleph-3dprintingmeat/#79a379655e0c>
- ¹⁵¹ Rajya Sabha TV. 2018. "Special Report-Israel: A Miracle in Agriculture." <https://www.youtube.com/watch?v=LQ3192n9KVU>
- ¹⁵² Alberta Agriculture and Forestry. 2019. "2018 Agriculture Statistics Factsheet." <https://open.alberta.ca/dataset/79f01912-5e5c-469e-8cf4-97cfc6901cea/resource/db11092f-10a6-436f-a205-de514b94901d/download/af-2018-agriculture-statistics-factsheet.pdf>
- ¹⁵³ Kenner, Bart. 2020. "U.S. Agricultural Trade Data Update." <https://www.ers.usda.gov/data-products/foreign-agricultural-trade-of-the-united-states-fatus/us-agricultural-trade-data-update/>
- ¹⁵⁴ Amadeo, Kimberly. 2019. "The U.S. Agriculture Industry and How It Works." <https://www.thebalance.com/us-agriculture-stats-facts-history-4776144>
- ¹⁵⁵ Steingoltz, Maria, Picciola, Manny and Wilson, Rob. 2018. "Consumer Health Claims 3.0: The Next Generation of Mindful Food Consumption." <https://www.lek.com/insights/ei/next-generation-mindful-food-consumption>

- ¹⁵⁶ Renner, Barb and Ringquist, Jack. n.d. "Capitalizing on the shifting consumer food value equation." Accessed April 10, 2020 <https://www2.deloitte.com/us/en/pages/consumer-business/articles/us-food-industry-consumer-trends-report.html>
- ¹⁵⁷ Government of Alberta. 2019. "2018 Agri-Food Exports Alberta Highlights." <https://open.alberta.ca/dataset/d2476e36-1e8c-43fb-a4b2-15bd09c13773/resource/764d36d5-4f2a-4535-b317-9dc1f8228792/download/exp-19-1.pdf>
- ¹⁵⁸ Canada Border Services Agency. 2020. "Statement from the Office of the Prime Minister on COVID-19 U.S.-Canada joint initiatives: Temporary restriction of travellers crossing the U.S.-Canada border for non-essential purposes." <https://www.cbsa-asfc.gc.ca/agency-agence/pm-covid19-eng.html>
- ¹⁵⁹ McLaughlin, Elliott and Vera, Amir. 2020. "Model predicts Covid-19 pandemic will 'peter out' by May, but experts are skeptical." <https://www.cnn.com/2020/04/13/health/us-coronavirus-updates-monday/index.html>
- ¹⁶⁰ Alberta Agriculture and Forestry. 2019. "2018 Agriculture Statistics Factsheet." <https://open.alberta.ca/dataset/79f01912-5e5c-469e-8cf4-97cfc6901cea/resource/db11092f-10a6-436f-a205-de514b94901d/download/af-2018-agriculture-statistics-factsheet.pdf>
- ¹⁶¹ Alberta Agriculture and Forestry. 2019. "2018 Agriculture Statistics Factsheet." <https://open.alberta.ca/dataset/79f01912-5e5c-469e-8cf4-97cfc6901cea/resource/db11092f-10a6-436f-a205-de514b94901d/download/af-2018-agriculture-statistics-factsheet.pdf>
- ¹⁶² Alberta Agriculture and Forestry. 2019. "2018 Agriculture Statistics Factsheet." <https://open.alberta.ca/dataset/79f01912-5e5c-469e-8cf4-97cfc6901cea/resource/db11092f-10a6-436f-a205-de514b94901d/download/af-2018-agriculture-statistics-factsheet.pdf>
- ¹⁶³ Alberta Agriculture and Forestry. 2019. "2018 Alberta Agriculture Statistics Yearbook." <https://open.alberta.ca/dataset/da3573a5-465c-4dc1-8793-36e9dc02b775/resource/f2018668-e8c0-41c2-a989-fa6ed2d31e51/download/af-2018-agriculture-statistics-yearbook.pdf>
- ¹⁶⁴ Earth, Paterson and Water Consulting Ltd. 2015. "Economic Value of Irrigation in Alberta." [https://www1.agric.gov.ab.ca/\\$department/deptdocs.nsf/all/irr15523/\\$file/economic-value-irrigation-alberta.pdf](https://www1.agric.gov.ab.ca/$department/deptdocs.nsf/all/irr15523/$file/economic-value-irrigation-alberta.pdf)
- ¹⁶⁵ Earth, Paterson and Water Consulting Ltd. 2015. "Economic Value of Irrigation in Alberta." [https://www1.agric.gov.ab.ca/\\$department/deptdocs.nsf/all/irr15523/\\$file/economic-value-irrigation-alberta.pdf](https://www1.agric.gov.ab.ca/$department/deptdocs.nsf/all/irr15523/$file/economic-value-irrigation-alberta.pdf)
- ¹⁶⁶ The University of Calgary School of Public Policy. 2020. "About the Simpson Centre for Agricultural and Food Innovation and Public Education." <https://www.policyschool.ca/simpsoncentre/>
- ¹⁶⁷ The University of Calgary Faculty Of Veterinary Medicine. n.d. "Departments & Units". Accessed May 04,2020. <https://vet.ucalgary.ca/>
- ¹⁶⁸ Statistics Canada. 2019. "Education Highlights Tables, 2016 Census Highest Level of educational attainment (general) by selected age groups 25 to 64, both sexes, % distribution 2016, Canada, provinces and territories, 2016 Census - 25% Sample Data." <https://www12.statcan.gc.ca/census-recensement/2016/dp-pd/hltfst/edu-sco/Table.cfm?Lang=E&T=11&Geo=00&View=2&Age=2&SO=10D>
- ¹⁶⁹ YYC Calgary International Airport. n.d. "YYC Global Logistics Park." Accessed April 10,2020. <https://www.yyc.com/en-us/calgaryairportauthority/businessatyyc/aircargo/yycgloballogisticspark.aspx>
- ¹⁷⁰ Open Government Program. n.d. "Development and Diversification." Accessed April 10, 2020. <https://open.alberta.ca/dataset/ff52b09e-49d5-4a74-9e96-39bb61d84107/resource/66f94275-a565-43f2-bb1e-1b11a5f2af2b/download/2002-irrigation-alberta-part-3.pdf>
- ¹⁷¹ Pratt, Sean. 2019. "Italy's return to market pushes durum exports." <https://www.producer.com/2019/10/italys-return-to-market-pushes-durum-exports/>
- ¹⁷² BDO Canada LLP. 2019. "Tax Planning for Canadian Farmers." https://www.bdo.ca/BDO/media/Misc-Documents/Tax-Planning-for-Canadian-Farmers_1.pdf
- ¹⁷³ Macrotrends. n.d. "Macrotrends - The Premier Research Platform for Long Term Investors." Accessed April 10, 2020. <https://www.macrotrends.net/>
- ¹⁷⁴ Bayer. 2020. "Annual Reports." <https://www.bayer.com/en/integrated-annual-reports.aspx>
- ¹⁷⁵ Realagriculture. 2018. "Bayer CropScience reaffirms commitment to Calgary-based headquarters." <https://www.realagriculture.com/2018/10/bayer-cropscience-reaffirms-commitment-to-calgary-based-headquarters/>
- ¹⁷⁶ Nutrien. n.d. "Nutrien 2019 Annual Report." Accessed April 10, 2020. https://www.nutrien.com/sites/default/files/uploads/2020-03/Nutrien_2019_Annual_Report_Enhanced.pdf
- ¹⁷⁷ Corteva Agriscience. 2020. "4Q/FY 2019 Earnings Conference Call." https://s23.q4cdn.com/505718284/files/doc_financials/2019/q4/Q4-Earnings-Presentation-Slides-FINAL.pdf
- ¹⁷⁸ Corteva Agriscience. n.d. "Helping Canadian Agriculture Thrive." Accessed April 10, 2020. <https://www.corteva.ca/en/about-corteva/corteva-in-canada.html>
- ¹⁷⁹ Syngenta. n.d. "Company." Accessed April 10, 2020. <https://www.syngenta.com/company>

- ¹⁸⁰ Syngenta. n.d. "About Syngenta." Accessed April 10, 2020. <https://www.syngenta.ca/about-syngenta/syngenta-in-canada>
- ¹⁸¹ Cargill Incorporated. n.d. "Five-Year Financial Summary." Accessed April 10, 2020. <https://www.cargill.com/about/financial/five-year-financial-summary>
- ¹⁸² Cargill Incorporated. n.d. "About Cargill." Accessed April 10, 2020. <https://www.cargill.ca/en/about-cargill>
- ¹⁸³ JBS Canada. n.d. "JBS Food Canada." Accessed April 10, 2020. <https://jbsa.com/our-business/canada/>
- ¹⁸⁴ JBS. n.d. "Management Report JBS 2019." Accessed April 10, 2020. <https://ri.jbs.com.br/enu/5854/RAeDFInglFinal2.pdf>
- ¹⁸⁵ Harmony Beef. n.d. "Our Story." Accessed April 10, 2020. <https://harmonybeef.ca/our-story>
- ¹⁸⁶ Parliament of Canada. n.d. "The Division of Powers." Accessed April 10, 2020. https://lop.parl.ca/about/parliament/education/ourcountryourparliament/html_booklet/division-powers-e.html
- ¹⁸⁷ Government of Canada. 2015. "List of Regulators." <http://www.agr.gc.ca/eng/about-our-department/acts-and-regulations/list-of-regulations/?id=1362055475035>
- ¹⁸⁸ Government of Canada. n.d. "Report Of Canada's Economic Strategy Tables: Agri-food." Accessed April 10, 2020. <https://www.ic.gc.ca/eic/site/098.nsf/eng/00022.html>
- ¹⁸⁹ Government of Canada. 2019. "Targeted Regulatory Review: Agri-food and Aquaculture Roadmap." <https://inspection.gc.ca/about-the-cfia/acts-and-regulations/forward-regulatory-plan/agri-food-and-aquaculture-roadmap/eng/1558026225581/1558026225797>
- ¹⁹⁰ Government of Canada. 2019. "Targeted Regulatory Review: Agri-food and Aquaculture Roadmap." <https://www.inspection.gc.ca/about-the-cfia/acts-and-regulations/forward-regulatory-plan/agri-food-and-aquaculture-roadmap/eng/1558026225581/1558026225797>
- ¹⁹¹ Government of Canada. 2019. "Targeted Regulatory Review: Agri-food and Aquaculture Roadmap." <https://inspection.gc.ca/about-the-cfia/acts-and-regulations/forward-regulatory-plan/agri-food-and-aquaculture-roadmap/eng/1558026225581/1558026225797>
- ¹⁹² Ljunggren, David. 2020. "Canadian Parliament rushes through ratification of USMCA trade pact." <https://www.reuters.com/article/us-usa-trade-usmca-canada/canadian-parliament-rushes-through-ratification-of-usmca-trade-pact-idUSKBN210215>
- ¹⁹³ McGregor, Janyce. 2020. "Mexico joins Canada, notifies U.S. it's ready to implement new NAFTA." <https://www.cbc.ca/news/politics/saturday-nafta-notification-1.5522007>
- ¹⁹⁴ Government of Canada. 2019. "The United States' trade with Canada and Canada's trade with the United States." <http://www.agr.gc.ca/eng/international-trade/market-intelligence/canada-united-states-bilateral-trade/the-united-states-trade-with-canada-and-canada-s-trade-with-the-united-states/?id=1386857446891>
- ¹⁹⁵ Krug, Kathy. 2018. "USMCA - Impact on agriculture." <https://www.nortonrosefulbright.com/en/knowledge/publications/f3a05b3f/usmca---impact-on-agriculture>
- ¹⁹⁶ Canadian Dairy Information Centre. 2020. "Number of farms, dairy cows and dairy heifers." <https://www.dairyinfo.gc.ca/eng/dairy-statistics-and-market-information/farm-statistics/farms-dairy-cows-and-dairy-heifers/?id=1502467423238>
- ¹⁹⁷ Edwards, Kyle. 2018. "The truth about dairy farming in Canada." <https://www.macleans.ca/economy/the-truth-about-dairy-farming-in-canada/>
- ¹⁹⁸ Coletta, Amanda. 2019. "For Canada, USMCA ends uncertainty, but concern lingers for the dairy and aluminum industries." https://www.washingtonpost.com/world/the_americas/in-canada-relief-at-a-north-american-trade-deal-but-concerns-for-the-dairy-and-aluminum-industries/2019/12/11/dd53c514-1c24-11ea-977a-15a6710ed6da_story.html
- ¹⁹⁹ Office of the United States Trade Representative. n.d. "Chapter 3: Agriculture." Accessed April 10, 2020. https://ustr.gov/sites/default/files/files/agreements/FTA/USMCA/Text/03_Agriculture.pdf
- ²⁰⁰ Federal Crown Corporation (FCC). n.d. "About FCC." Accessed April 10, 2020. <https://www.fcc-fac.ca/en/about-fcc.html>
- ²⁰¹ The Ministry of Agriculture and Forestry, Alberta. n.d. "Agriculture public agencies." Accessed May 20, 2020. <https://www.alberta.ca/agriculture-public-agencies.aspx>
- ²⁰² Government of Alberta. n.d. "Cutting red tape. The first one hundred days." Accessed May 20, 2020. <https://open.alberta.ca/dataset/ac53aea4-013e-4f2f-a08f-2abe8e619bc3/resource/4f5bc155-d12d-4c16-a921-e8e6c8a30b03/download/cutting-red-tape-report-first-100-days.pdf>
- ²⁰³ Alberta Water Portal Society. n.d. "Agriculture and Irrigation in Alberta." Accessed May 20, 2020. <https://albertawater.com/what-is-water-used-for-in-alberta/agriculture-in-alberta>
- ²⁰⁴ Government of Alberta. n.d. "Irrigation in Alberta." Accessed May 20, 2020. <https://www.farmingsmarter.com/wp-content/files/2017/08/Woods-Posters-FSFS-2017-min.pdf>

-
- ²⁰⁵ Government of Alberta. n.d. "Irrigation Districts Act." Accessed May 20, 2020. <https://open.alberta.ca/publications/i11#detailed>
- ²⁰⁶ Government of Alberta. n.d. "Irrigation in Alberta." Accessed May 20, 2020. [https://www1.agric.gov.ab.ca/\\$department/deptdocs.nsf/all/irr7197/\\$FILE/irrigationinalta-part1.pdf](https://www1.agric.gov.ab.ca/$department/deptdocs.nsf/all/irr7197/$FILE/irrigationinalta-part1.pdf)
- ²⁰⁷ Alberta Agriculture and Rural Development. 2014. "Alberta's irrigation - a strategy for the future." <https://open.alberta.ca/dataset/749d1022-74a5-4779-9c33-b57fcd05109c/resource/45061279-1f9c-4df4-bcfb-b77479de4355/download/6734585-2014-albertas-irrigation-strategy-future-2014-06-03.pdf>
- ²⁰⁸ Government of Alberta. n.d. "Red Tape Reduction Act." Accessed May 20, 2020. <https://www.alberta.ca/red-tape-reduction-act.aspx>
- ²⁰⁹ Government of Alberta. n.d. "Cutting red tape. The first one hundred days." Accessed May 20, 2020. <https://open.alberta.ca/dataset/ac53aea4-013e-4f2f-a08f-2abe8e619bc3/resource/4f5bc155-d12d-4c16-a921-e8e6c8a30b03/download/cutting-red-tape-report-first-100-days.pdf>
- ²¹⁰ Government of Alberta. n.d. "Red tape industry panels." Accessed May 20, 2020. <https://www.alberta.ca/red-tape-industry-panels.aspx>
- ²¹¹ Government of Alberta, Department of Agriculture and Forestry. 2019. "Choose Alberta for Agri-Investment."
- ²¹² Government of Alberta and Canada Revenue Agency
- ²¹³ Protein Industries Canada. n.d. "Who We Are." Accessed May 20, 2020. <https://www.proteinindustriescanada.ca/who-we-are>
- ²¹⁴ Protein Industries Canada. n.d. "What Is A Supercluster?" Accessed May 20, 2020. <https://www.proteinindustriescanada.ca/supercluster>
- ²¹⁵ Government of Canada. n.d. "Protein Industries Supercluster." Accessed May 20, 2020. <https://www.ic.gc.ca/eic/site/093.nsf/eng/00012.html>
- ²¹⁶ Canadian Agri-food Automation and Intelligence Network. n.d. "What is CAAIN?" Accessed May 20, 2020. <https://caain.albertainnovates.ca/>
- ²¹⁷ Government of Canada. n.d. "Strategic Innovation Fund." Accessed May 20, 2020. <https://www.ic.gc.ca/eic/site/125.nsf/eng/home>
- ²¹⁸ Alberta Innovates. n.d. "Our Story." Accessed May 20, 2020. <https://albertainnovates.ca/who-we-are/>
- ²¹⁹ University of Calgary. 2020. "Gift from Alberta rancher John Simpson creates new agricultural research centre." <https://www.ucalgary.ca/news/gift-alberta-rancher-john-simpson-creates-new-agricultural-research-centre>
- ²²⁰ Calgary Herald. 2020. "\$5M donation will help create new agricultural research centre at U of C." <https://calgaryherald.com/business/local-business/5m-donation-will-help-create-new-agricultural-research-centre-at-u-of-c/>
- ²²¹ Burwood-Taylor, Louisa. 2019. "Canadian telecoms giant Telus acquires Decisive Farming." <https://agfundernews.com/breaking-exclusive-canadian-telecoms-giant-telus-acquires-decisive-farming.html>
- ²²² CTV News Edmonton. 2019. "'Game changer': Telus announces \$16B investment in Alberta over five years." <https://edmonton.ctvnews.ca/game-changer-telus-announces-16b-investment-in-alberta-over-five-years-1.4608158>
- ²²³ GlobeNewswire. 2020. "UFA Co-operative Announces Partnership with Zone Startups Calgary." <https://www.globenewswire.com/news-release/2020/04/28/2023506/0/en/UFA-Co-operative-Announces-Partnership-with-Zone-Startups-Calgary.html>
- ²²⁴ Burwood-Taylor, Louisa. 2019. "Canadian telecoms giant Telus acquires Decisive Farming." <https://agfundernews.com/breaking-exclusive-canadian-telecoms-giant-telus-acquires-decisive-farming.html>
- ²²⁵ Olds College. n.d. "Smart Farm." Accessed May 20, 2020. <https://www.oldscollege.ca/olds-college-smart-farm/index.html>
- ²²⁶ Olds College. n.d. "Smart Farm." Accessed May 20, 2020. <https://www.oldscollege.ca/olds-college-smart-farm/index.html>
- ²²⁷ Cardello, Hank. 2019. "Why The Beef and Dairy Industries Are On A Cow Path to Oblivion." <https://www.forbes.com/sites/hankcardello/2019/09/30/why-the-beef-and-dairy-industries-are-on-a-cow-path-to-oblivion/#e8c6bcb74e9b>
- ²²⁸ OECD/FAO. 2016. "Meat." <http://www.fao.org/3/a-BO100e.pdf>
- ²²⁹ Statistics Canada. n.d. "North American Industry Classification System (NAICS) Canada 2017 Version 1.0." <https://www23.statcan.gc.ca/imdb/p3VD.pl?Function=getVD&TVD=307532&CVD=307548&CPV=115210&CST=01012017&CLV=5&MLV=5>