Capstone Project Report

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# Abstract

Everyone relies on food to energize their mind and body. A balanced, healthy diet can have exponential effects on individual productivity and help drive a country's economy. Over the last 50 years, innovation in the food industry sky-rocketed the amount of processed and unhealthy foods which are causing damage to individuals' health and the country's environment. But it allowed the industry to grow incredibly large and companies gained international reach. Canada's food industry is its second largest industry with a production value of $119 billion. The demand and reach of this sector require an understanding of a wide range of markets to plan for future growth.

In this analysis, we will describe the effect of the food industry in three key factors: economy, environment, and nutrition. We will describe the current state of Canada's food industry, which includes restaurants, imports and exports, farming, fishing, and agriculture. We will find out whether Canadian are, on average, eating a healthy diet, the efficiency of the food industry, and what the trends are over the recent years. The industry also creates a lot of waste, which impacts the environment. We will look at the impact of waste on the Canadian environment and some mitigation strategies.

Additionally, we analyze the profit margins of different sectors of the food industry and highlight areas of waste and provide insights into the problems business owners face in the industry. Also in the report is an analysis of the effects of COVID-19 on the industry. Finally, the report includes initiatives and innovative ideas in industry and ideas for how to drive innovation towards a sustainable future.

# Perspective

This analysis is conducted for entrepreneurs, business owners, and investors looking to invest in Canada’s food industry. The analysis provides a deep dive into the different markets and highlights the Canadian diet as well as a look into Canada’s production and international trade to determine the country’s food security. We investigate biggest contributors to waste and highlight areas of improvement. We also analyze the effect of COVID-19 on the industry and Canadian behaviour. Finally, we present some innovate projects that have recently received funding and present their topics of discussion.

# Business Understanding

Canadians must consume food regularly to maintain their health. The government must be involved in the process of ensuring a reliable supply of food because food directly effects the health, economy, and the environment. Companies are involved in this process because there are many profitable markets for food. Food industries include grocery stores, restaurants, agriculture, farming and fishing, production, and NGOs, among many others. Entities of the Canadian government that deal with food include the Canadian Food Inspection Agency (CFIA) and the Department of Agriculture and Agri-Food (AAFC).​

Everyone must eat food of a certain quality and quantity not only to live, but to also enjoy an active healthy lifestyle. Canadian citizens are negatively affected by highly processed foods containing high levels of sugars, trans fats and saturated fats, which lead to dangerous health outcomes such as heart disease, cancer, and diabetes. The Canadian food industry employs approximately 1.2 million workers and their families (https://www.statista.com/statistics/422547/restaurant-industry-employment-in-canada/). The success or failure of these businesses has a massive impact on the wellbeing of millions of people in Canada. The Canadian food industry is responsible for approximately 10% of Canada's annual carbon emissions (https://www150.statcan.gc.ca/n1/pub/16-508-x/16-508-x2019004-eng.htm). These emissions are contributing to anthropogenic induced climate change, which affects every living organism in the world.​

Eating a healthy diet has many benefits to a person including longer life, lower chance of disease, and a more active lifestyle. Optimizing for the healthiest diet will help everyone get the most out of life. Ensuring that there is productive agriculture, stable food distribution, and reliable supply lines benefits the food industry in terms of operating profits and the ability to pay its 1.2 million workers. Innovation within the food industry, whether it's for lower energy products or better agriculture methods, benefits the entire world by lowering emissions within the food industry. ​

Excessive amounts of highly processed foods generally lead to negative outcomes for consumers. These outcomes include obesity, cancer, diabetes, and heart disease. Failure to ensure reliable food distribution for consumers would result in malnutrition, or in the worst scenario, famine. Carbon emissions in the food industry negatively affect everyone. Emissions from the food industry cause air pollution, resulting in many respiratory diseases. Food industry emissions also contribute to anthropogenic induced climate change, thereby assisting rising temperatures globally. ​

Understanding Canada's national food supply and demand and its impact on health, economy, and the environment. Finding efficiencies and areas of improvement for implementation in industry.​ The costs of growing food and the limits on the types of food Canada can grow locally. Its impact on businesses and global partners. Health of individual citizens and access to food. Global reach of the market and environmental effects.​ This topic is not like any other in terms of reach and magnitude of second and third order effects.​

Managing a proper diet will have long lasting effects on future growth of the economy and prosperity of the individual. Government regulations, grants, and initiatives can help to drive the country to a sustainable future. Companies that find innovative solutions for problems in industry stand to increase profit margins and reach more customers.​

Over the last century most of our food production has been industrialized making it relatively easy to produce and distribute with some negative consequences as well. A study found that many of the severest health conditions afflicting populations around the world - from respiratory diseases to a range of cancers - are linked to industrial food and farming practices, chemical-intensive agriculture. ​

Canadians have an increasingly urgent need for access to high-quality, nutrient-rich foods. That is why the Government of Canada is taking steps to support the farmers and businesses who provide Canadians with the food they need to keep themselves and their families healthy. support farmers, food businesses, and food processors who provide essential services to Canadians every day by ensuring a safe and reliable food supply.​

Our analysis will solely focus on food consumption and production within Canada, as well as on any food trade links with other nations. ​The patterns of food consumption differ regionally within Canada. Cities tend to have different food cultures than rural communities. Regions within Canada have varying food cultures (Quebec vs. British Columbia, etc.).  Location within Canada also influences the type of food industry that is prevalent in the area. For example, Alberta being inland influences its use of cattle farming to build a vibrant beef industry, while Nova Scotia has a vibrant fishing industry because of its coastal location.​

Initiatives that drive forward research in sustainability and innovation will secure Canada's future as its citizen become healthy and, as a result, more productive. More productive citizen will in turn generate higher income and innovate further. Reducing environmental impact will help reduce the effects of climate change and meet global climate goals. ​

​Food has a massive reach because of its first and second order effects on the country. In citizens, a healthy and balanced diet will cause the mind and body to work efficiently. A healthy citizen will be more productive in their life and will work towards securing their lifestyle.​ In business, R&D on sustainable items is costly, with the second order effect being the positive effect on its customers and the environment. But businesses must make a profit so the negative first order effect of a nutritious and sustainable product drives them away from innovation in sustainability.​

Potential investors can help the industry work towards creating a sustainable future for its citizens by driving innovation in the food industry. This will create growth opportunities from the current production value to becoming a world leader in industry. Creating products and driving growth initiatives that secure funding for innovative products and ensuring citizens have the means to enjoy a balanced diet is a challenging project that requires creative thinking and out-of-box solutions.​

Recent trends are showing a growth in sustainable and healthy products. Practices that scale manufacturing sustainable products will require innovation and creative thinking, which can be fueled with a healthy diet.​ Food affects the health of those that consume it. Rates of disease and obesity are often linked to the quantity and quality of food in our diets. Employing a healthy diet can have the effect of increasing one's lifespan, maintaining functioning organs, and increased immunity.

Maintaining profits within the food industry is essential to support the livelihood of 1.2 million Canadians. Decreasing profits would results in job losses and pay cuts for those employees, thereby leading to an increase in poverty. The success of the Canadian food industry would catalyze massive innovations across many sectors and bolster the ability of millions of Canadians to meet their basic needs. Any innovation in the food industry that results in lower emissions per amount of food produced would greatly improve our ability to meet emission reduction targets. ​

## Business Questions

Below are the six questions we chose to ask ourselves when exploring the topic:

1. What is the Canadian diet, and does it meet the guideline of health and balance? How productive is Canada’s agriculture industry, how much of Canada’s population can be fed on food grown nationally? ​
2. Who are our trade partners, how does trade affect us, what is our food availability and how secure is our food future?​
3. What food is wasted the most and what can be done to reduce the impact on Canadians?​
4. Which sectors of Canada’s food industry have the highest profits? Which sectors need improvement? How would these sectors improve their performance?​
5. What was the effect of COVID-19 on Canada’s restaurant industry? What was its effect on personal cooking? Which should Canadians invest more resources in?​
6. Which sectors of the food industry are seeing accelerated innovation? Which areas are lacking and what can be done to increase efficiency or innovation?​

# Data Understanding

There are many factors to consider when looking to invest into a market. The size of the food industry is massive and the reaches every person in the country. The below figure outlines the model of the industry and the different areas the food industry effects.

Diagram

Description automatically generated

Figure 1.1 – Conceptual model of the food industry in Canada

The next table defines all the topics discussed in this report.

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| No​ | Topic​ | Definition​ |
| 1​ | CFIA​ | It is the responsibility of the Canadian Food Inspection Agency (CFIA) to safeguard Canada's food supply and plants and animals upon which safe, high-quality food is dependent.​ |
| 2​ | AAFC​ | Is the department of the Government of Canada responsible for guiding policies for agriculture, food, and agribusiness​ |
| 3​ | NGO​ | NGOs are non-governmental organizations. NGO definitions vary, but typically they are independent non-profit organizations with a social mission.​ |
| 4​ | Sustainable Agriculture​ | Providing enough food to everyone, lifting communities out of poverty, focusing on soil health, and reducing fossil fuel reliance for environmental sustainability.​ |
| 5​ | Food Waste ​ | The decrease in quantity or quality of food as a result of decisions and actions made by retailers, food service providers, and consumers.​ |
| 6​ | Food Industry ​ | Many of the food products consumed by the world's population are produced by a complex, global network of businesses​ |
| 7​ | Sectors of Food Industry ​ | The Food and Beverage industry is divided into six main segments: Meat, Fish Processing, Dairy, Bread and Milling, Beverages, and Other Food.​ |
| 8​ | ​  Carbon Emissions ​  ​ | Almost all greenhouse gases released by the sector are carbon dioxide (CO2), although methane (CH4) and nitrous oxide (N2O) are also released in smaller amounts. ​ |
| 9​ | Nutrition ​ | Nutrients are components of all foods, but nutrition is also the study of what the body does with them.​ |
| 10​ | Agriculture ​ | In farming, soil is cultivated for the cultivation of plants and animals are raised for food, wool, and other products.​ |

Table 1.1 – Data Dictionary

# Data Preparation and Modelling

Please visit <https://github.com/KrishnaCD93/DAAN-Capstone-Project> for all models and visualizations.

# Evaluation

### What is the Canadian diet, and does it meet the guideline of health and balance? How much of Canada’s population can be fed on food grown nationally? ​

Canadians meet diet guidelines but much of Canada's population is on the lower middle limits of a balanced diet. Neither location nor level of education play major roles in the Canadian diet, and throughout the country, as Canadians get older, their diet balances out and remains steady through their adult lives.​

Diet needs can be met in Canada through food produced locally such as grains, meats and vegetables. Canadians need to trade internationally for fruits and to introduce variety into the diet. Canada imports 2.5x as many unique items than we produce and export.​

### Who are our trade partners, how does trade affect us, what is our food availability and how secure is our food future?​

Food trade continues to spread throughout the world and thanks to the spread of globalization, Canada trades with many of the food producing exporters of the world. This leads to a great outlook on Canada's food security because the data extrapolated to the future shows a steady and slow increase in diet needs and national food production, as expressed by the low feature importance of date given to the Canadian diet model.

Almost 10% of the available food is lost and much more is wasted. Every year Canada produces all the food necessary for a balanced diet and much of it wasted, creating room for efficiencies and improved management of food.​

What food is wasted the most and what can be done to reduce the impact on Canadians?​

In Canada, potatoes are wasted far more than any other food, followed by pork, tomatoes, melons, and wheat flour.​

Potatoes constitute the overwhelming amount of food waste in Canada, therefore any efforts to reduce our waste consumption should focus mostly on potatoes. One way to reduce potato waste would be to design better storage systems that keep potatoes good and fresh for longer periods of time. This would ensure that people and businesses save more money by getting more use out of each purchased potato.​

Lettuce is the only major food to have trended towards less waste in Canada. More efforts should be made to study why that is and if there are any lessons to be learned.​

### Which sectors of Canada’s food industry have the highest profits? Which sectors need improvement? How would these sectors improve their performance?​

Out of all of Canada's food sectors, agriculture makes more profits than animal production and food services combined with approximately $2,346,900 in profits in 2019.​

Canada's big business food sectors generate big profits. However, in 2019 Canada's small business food sectors either lost money or were just above the profit margin. Canada's small business food sectors need improvement.​

Profit margin data across the performance distribution for all of Canada's food sectors shows that successful food businesses in Canada succeed because they can effectively reduce costs rather than earning the highest revenues. Better management would help improve Canada's struggling food sectors.​

### What was the effect of COVID-19 on Canada’s restaurant industry? What was its effect on personal cooking? Which should Canada invest more resources in?​

With so many available locations in Canada and a plethora of grants available, starting a restaurant is an easier and more affordable task. Finally, there are a lot of places you can rent that are vacant, making it easier to start up a restaurant.​

COVID caused a loss in income for restaurants because people could not enter, however, more people started cooking at home, saving money by not going out to eat and by learning how to cook. Now that restaurants are gradually opening to let more people eat in, they are returning to profitability. Data suggests that Covid considerations cannot be considered when deciding whether to start a business. ​

### Which sectors of the food industry are seeing accelerated innovation? Which areas are lacking and what can be done to increase efficiency or innovation?​

The data shows funding for technology and research on improving farm conditions to reduce diseases and research on climate resistant farming. ​

The average budget for innovative research is $517,763.94 with the average AI funding equaling $179,704.09. The largest budget was for an application for armchair ranching at $4,847,000.00 with an AI Fund of $481,000.00. The program with the largest AI budget is an application that creates a food safety plan for agri-food businesses with AI funding of $500,000.00​

The industry problems highlighted in our previous solutions show that more innovation is needed that increase management efficiency and reduce waste. Our analysis shows that Canadians naturally eat a balanced diet, so creative solutions that send heathy food direct to customer is an area that needs to be explored further.​