

# 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.

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## 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 innovative projects that have recently received funding and present their topics of discussion.

## 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?
  - Answering this question will show if Canada has the supply of food to feed its population a healthy diet. It will also reveal whether food scarcity is caused by lack of resources or poor management of the economy.
  - Metrics: Global hunger index, diet composition, food plate
  - Calculations: Food health = global hunger index, actual consumption vs. food pyramid
  - Data: Global hunger index data prepared by International Food Policy Research Institute (IFPRI), Agricultural productivity data, diet composition data
2. Who are our trade partners, how does trade affect us, what is our food availability and how secure is our food future?
  - Answering this question will show us whether Canada is dependent upon outside partner to meet food requirements.
  - KPI: Difference between total imports and exports, food supply and disposition; Metric: breakdown of food imported and exporting, food groups imported and exported, # of countries imported or exported from, amount of food supplies, total disposition, total waste
  - Calculations: Total exports/ total imports, total supply / total waste, total supplied – total disposed
  - Data requirement: Import and export data separated by countries, food availability, supply, and disposition
3. What food is wasted the most and what can be done to reduce the impact on Canadians?
  - Food waste is a major problem for societies in the modern world. Lessening our waste would not only help us to reduce our carbon emissions but would also help households and businesses save money on food items.
  - Metrics: Food waste measured in tonnes of waste produced for each specific food item.
  - Calculations: No calculations were used to answer this question.
  - Data Requirement: To answer this question, food waste quantities for the most common food items will be needed.

4. Which sectors of Canada's food industry have the highest profits? Which sectors need improvement? How would these sectors improve their performance?
  - For entrepreneurs looking to start a food business or for investors, it is important to know which businesses are doing well and how they succeed.
  - Metrics: Revenue, Costs, Cost of Sales, Indirect costs, Profit, Profit margins.
  - Calculations: Profit margin =  $((\text{Revenue} - \text{Total Cost}) / \text{Revenue}) * 100\%$
  - Data: The Canadian government has provided open data for revenues and costs across Canada's different food sectors. However, the only data available is from the year 2019.
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?
  - Answering this question will allow investors to understand the current market trends and determine whether Canadians lean more towards cooking at home since COVID disrupted the market.
  - KPIs: consumer price index, gross domestic product
  - Calculations: Rate of change in CPI every month starting from March 2020, Overall GDP for food and food services
  - Data: CPI from Jan 2020 – Current, GDP from Jan 2019 – Current
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?
  - This question is important because the solutions to the previous questions will give us the information needed to determine whether the correct technology is being researched in Canada for the needs of Canadians. This will also attempt to give new ideas for entrepreneurs and investors.
  - Metrics: Total funding, AI funding, research topics
  - Calculations: # of research topics, total funding
  - Data: Research articles, recent projects with grants

## 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 is 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 healthy food direct to customer is an area that needs to be explored further.

Another potential investment opportunity comes from the fact that Canadians are multi-cultural and enjoy going to restaurants as evidenced by the GDP and CPI graphs. Applications that build on this multi-cultural community will be able to reach potential customers across Canada.