Research Proposal

Measuring Food Waste in Prince George Restaurant: Volume, Model, and Effects

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Introduction

Food Loss and Waste (FLW) happens everywhere.

- One-third of food is lost or wasted around the world[1].
- Around 1.3 billion tons of FWL is generated annually, and the rate is projected to grow by 44% per year by 2025[2].

- Canada creates about 35 million tons and the largest waste generator per capita in western countries in 2016[3].
- Canada's avoidable FLW is 49.5 million CAD[4].

Introduction

- In BC, 40% of the waste to landfills is organic waste, the majority is produced from domestic waste[5].
- Recent huge discoveries in the food waste research focus on waste generated by households:[6,7,8,9].
- Limited number of studies done on the food supply side.
- Even little esimations of FLW in food service industry.

Introduction

Research Questions

- What is the average volume of food that is wasted during processing and consumption in restaurants?
- What is the extent of food wastage in Japanese restaurants in Prince George?
- What are the main factors contributing to food loss and waste?
- To what extent is a social or environmental impact from food loss waste generated by a single restaurant?
- What approaches are Japanese restaurant operators taking to reduce food waste generation?

Literature Review

Definition of FLW

- No universally accepted definitions of FLW

Organizations	Definition
Food Loss by FAO	harvest/slaughter/catch
Food Waste by FAO	retail/ consumption
Food Waste by EU	Food removed from FSC
Food Loss by US	unused product from agri
Food Waste by US	Subcomponent of FL

(Source [10])

Literature Review

Definition of FLW

1	2	3	4	5
Production	Handling	Process	Distribution	Consumption
<—	—	FLW	—	—>
<—	FL	—>	<—	FW —>

Organizations	FL	FW	Subset
FAO	First 3 stages	Last 2 stages	X
EU	None	All	X
US	All	Last 2 stages	O

Literature Review

Definition of FLW

	Edible	Inedible
Solid	FL	FW
Liquid	FW	X

Literature Review

Definition of FLW

- Food Loss: generated by provider
- Food Waste: generated by consumers

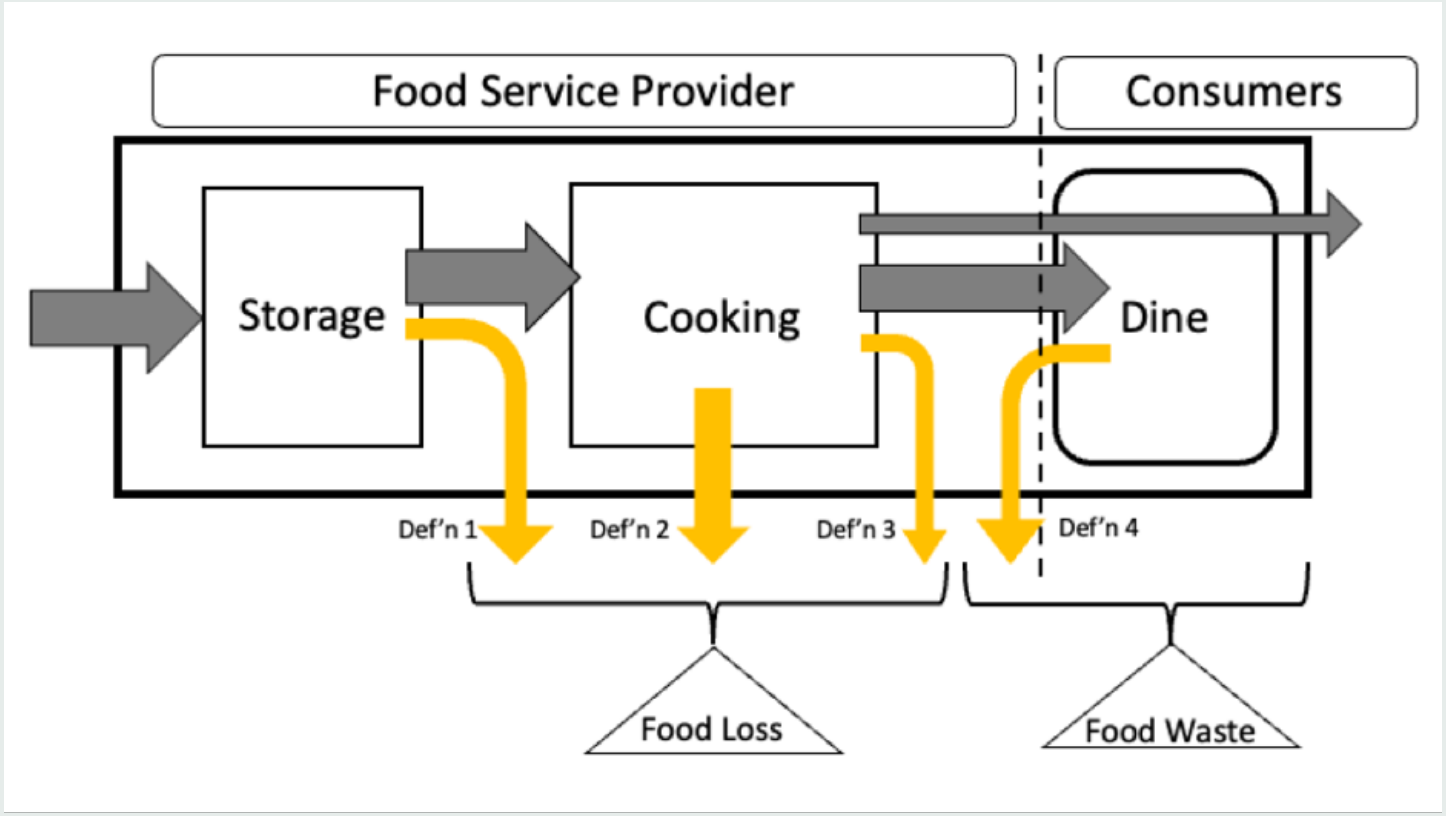


Figure 1: Flow of FLW

Literature Review

Five Measurements of FLW

Method	Note
1.Self-report	individuals report FLW
	low cost but high dropouts
2.Survey	collect FLW by interview or questionnaire
	cost-effective but not accurate
3.Composition	sample and analysis at lab
	need special knowledge and equipment
4.Mass balance	material flow analysis
	limitation in waste factor assumptions
5.**Direct weight**	directly measure FLW
	most accurate but high cost

Literature Review

Statistic Model

- **Multiple Linear Regression**
- Ad: Simple and interpretable
- Disad: Not suitable to time series
- Disad: Stationary and Spurious
- **Bayesian Modelling**
- Ad: Flexible and adaptable to time series data
- Disad: No appropriate result in some cases

Literature Review

Effects of Food Loss and Waste

- **Economic Loss**:
- labour, material resources, time, and energy
- **Environmental Impacts**:
- water pollution, deforestation, soil erosion, and GHG

Reducing FLW can mitigate these economic and environmental impacts. Through better supply chain management, reducing consumer food waste, and increasing food recovery.

Literature Review

Hypotheses

- Estimate average FLW
- Any patterns between FLW and business operations
- Any patterns between FLW and weather conditions
- Estimate economic and environmental impacts

Methods

Study Area

- Japanese restaurant located a suburban area of Prince George
- lunch and dinner for three hours each
- six days of a week: from Tuesday to Sunday

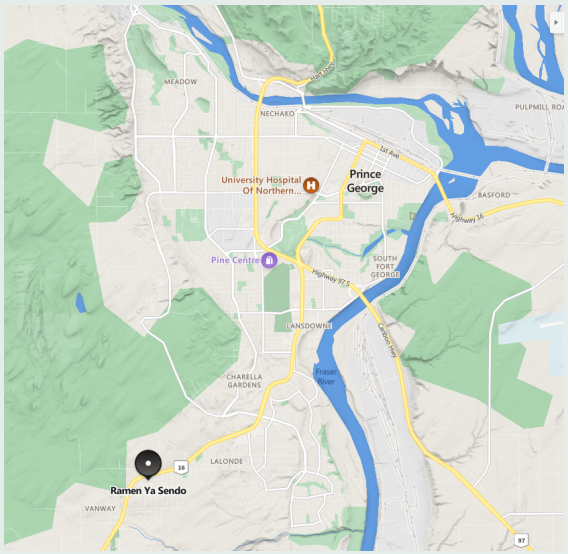


Figure 2: Research Location Site

Methods

Sample Collection

Busket for Food Loss	Busket and Strainer for Food Waste
	

Methods

Sample Size

- **Power analysis**, 95% CI and 20% margin of error with 10 explanatory variables says 110 samples.
- **Rule-of-thumb**, one in ten rule suggests 100 observations with 10 predictors[11]
- Green's rule states 130 samples with 10 predictors[12]

Methods

Variables

Variables	Note
1.Food Loss	Daily disposed food by kitchen
2.Liquid Food Waste	Daily disposed liquid food by customers
3.Solid Food Waste	Daily disposed solid food by customers
4.Number of Customers	Daily Number of dine-in customers
5.Sales	Daily sales
6.Liquor	Daily Number of liquors sold
7.Takeouts	Daily Number of takeout sold
8.Orders	Daily Number of orders sold
9.Temperature	Hourly mean temperature each day
10.Humidity	Hourly mean humidity each day
11.Precipitation	Precipitation each day

Methods

Multiple Linear Regression Model (additive)

$$Y = X\beta + \epsilon$$

$$\epsilon_i \overset{\text{i.i.d.}}{\sim} N(\mu = 0, \sigma^2).$$

Baysian Modelling

$$Y = X\beta_i + \epsilon$$

$$\beta_i \sim N(\beta_{i-1}, \sigma_\beta^2)$$

$$\epsilon_i \sim N(0, \sigma_y^2).$$

Expected Results

Expected Results

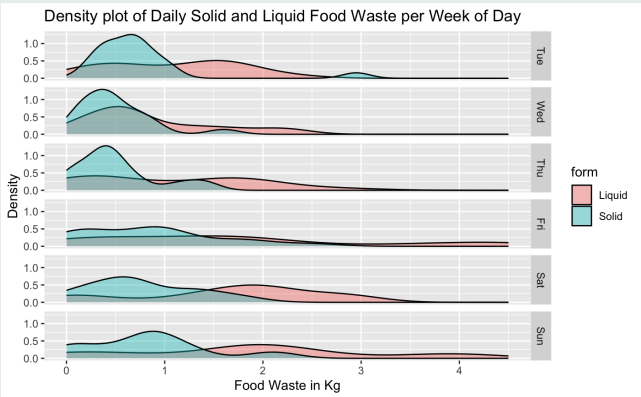
- Estimations of FLW in a restaurant
- Patterns of FLW
- Implications of FLW reduction

Expected Results

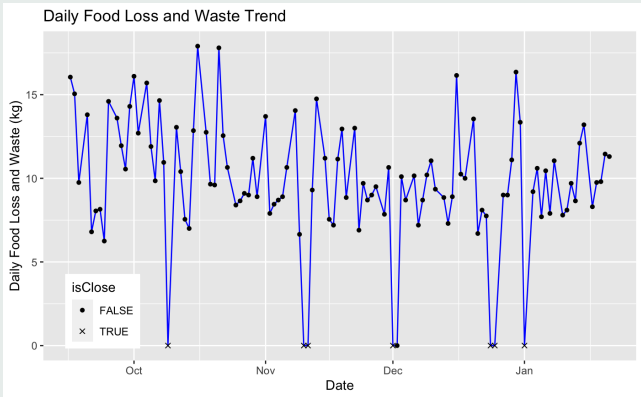
Current Progress

- From Sept. 16, four months.
- Collected over 100 samples.
- Basic analysis (Histogram, Time series plots)

Food Waste per Week of Day



Food Loss and Waste Trend



Expected Results

TODO

- Develop potential causes of FLW (Weather and Calendar Effects)
- Calculate the average rate of food loss and waste
- Estimate econbomic and environmental effects

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