TRADEMARK PENDING

Crowdfeeding:

matching demand to supply

Picture Credits: Safeway, Second Harvest, JotForm

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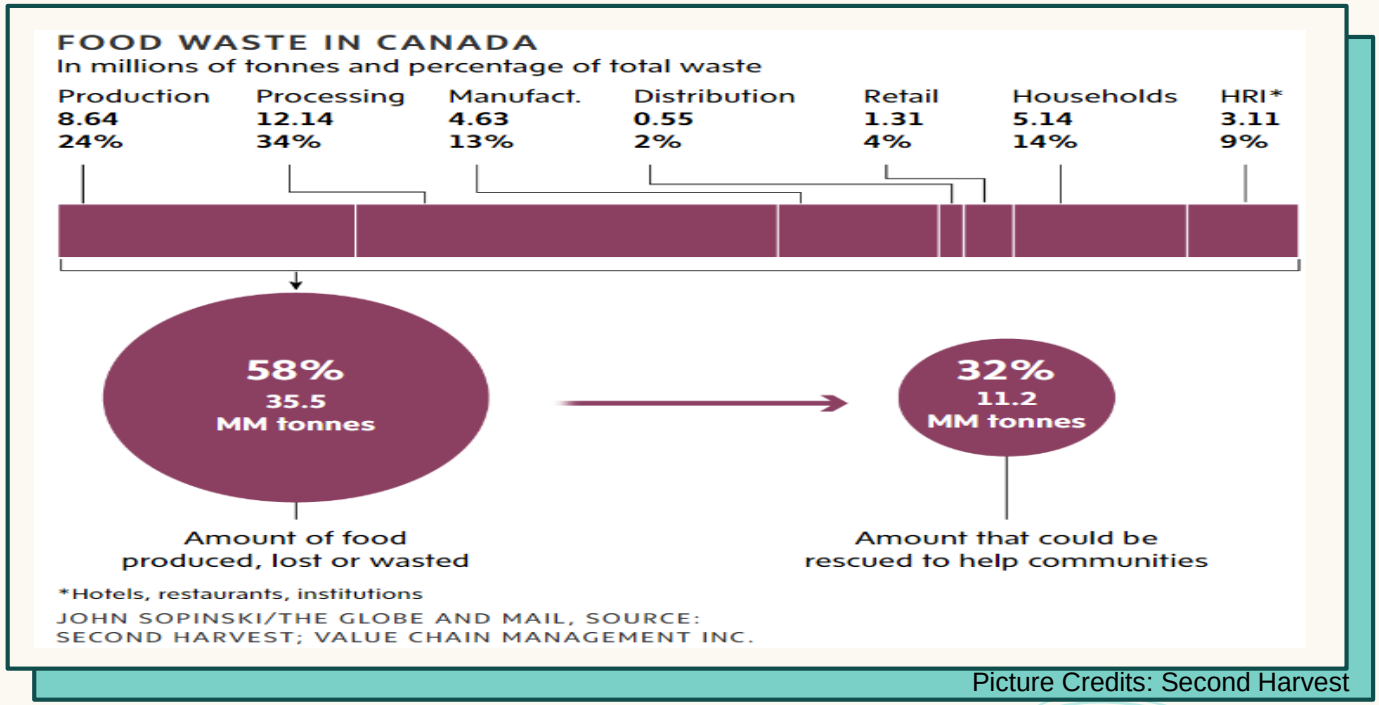
01

INTRODUCTION

Picture Credits: Second Harvest



Picture Credits: Second Harvest

“People dealing with food insecurity come to us, but we are unable to satisfy demand of everyone. “

“We do not have capacity to accept donation from retailers when they want to donate more but still, we accept donations sometimes to maintain relationship with them.”

“More than 50% of donations we receive from retailers goes to waste. Donations we receive from them is uncertain and many times we accept donations from donors to maintain relationships.”

“Now we see a lot of people are coming to foodbanks, but we do not receive enough donations to satisfy them.”

“We are donating meat after expiry by storing it in our refrigerator, but it is not possible to do this with fresh fruits and vegetables. So, we see a lot of wastage for fresh food.”

Volunteer Management

Miscommunication

Waste Management

Uncertain Demand

Uncertain Donation

Capacity Issue

Operational Challenges

02

LITERATURE REVIEW

- **Last mile delivery in commercial setting including routing and scheduling of drones and robots.**
  (Cortes et al., Mohamed et al., Michele et al.)

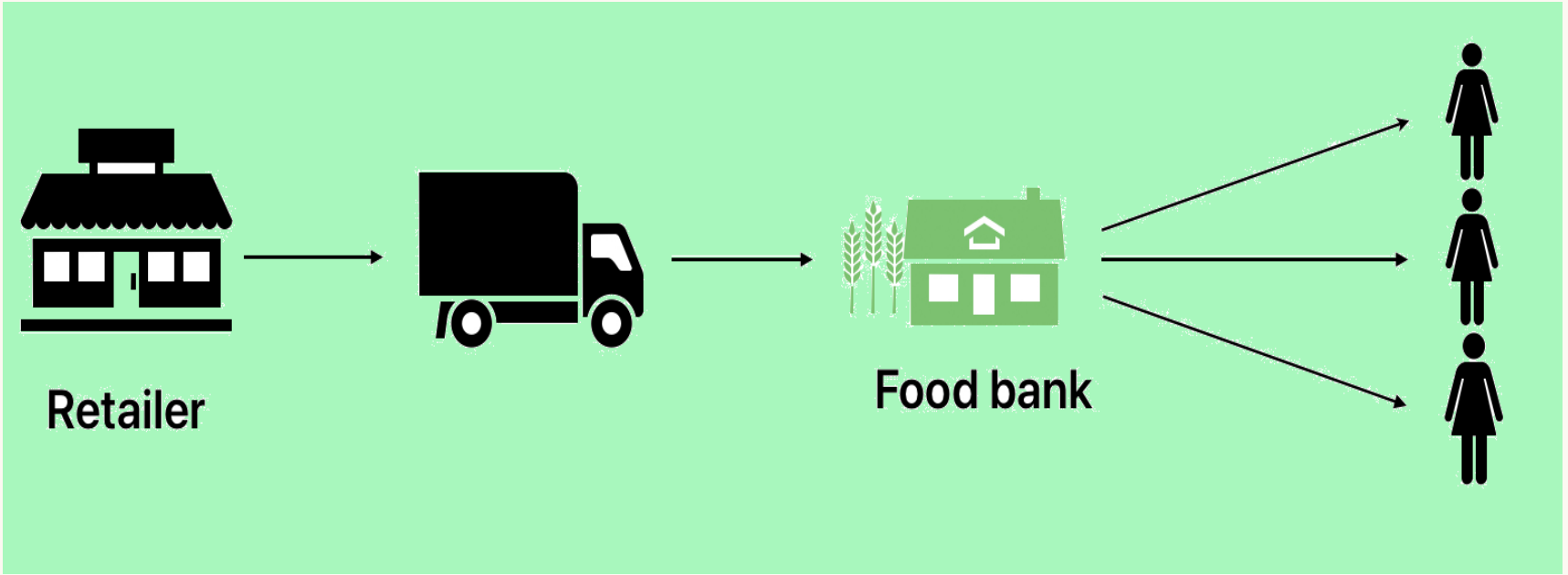
- **Scheduling foodbank collections, resource allocation, volunteer management in foodbanks.**
  (Davis et al., Mahmoudi et al., Torres et al.)

- **Delivering with use of crowdsourcing and volunteers.**
  (Vincent et al., Torres et al., Miguel et al., Soraya et al.)

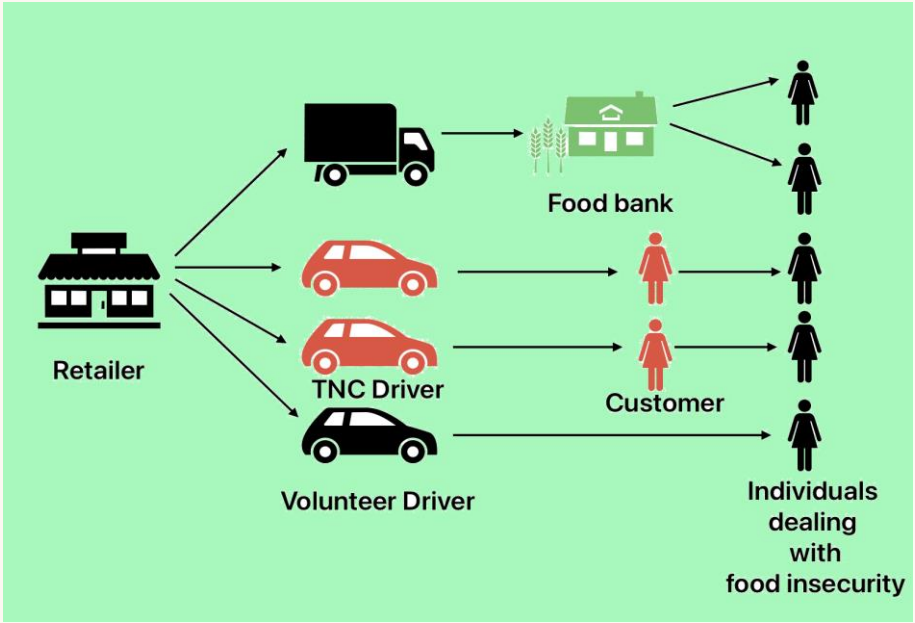
03

MODELING & ANALYSIS

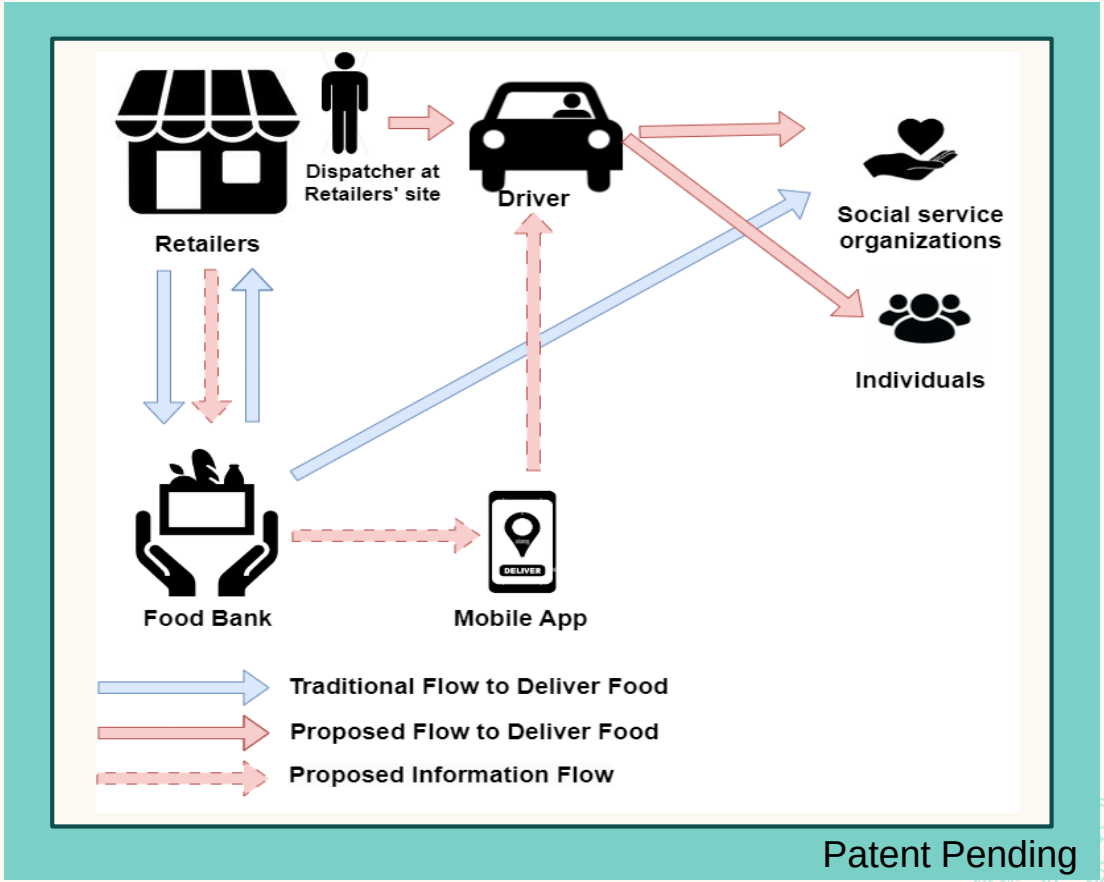
Traditional Route followed by Foodbanks



Proposed Route



Proposed Route



Patent Pending

Optimization Modelling

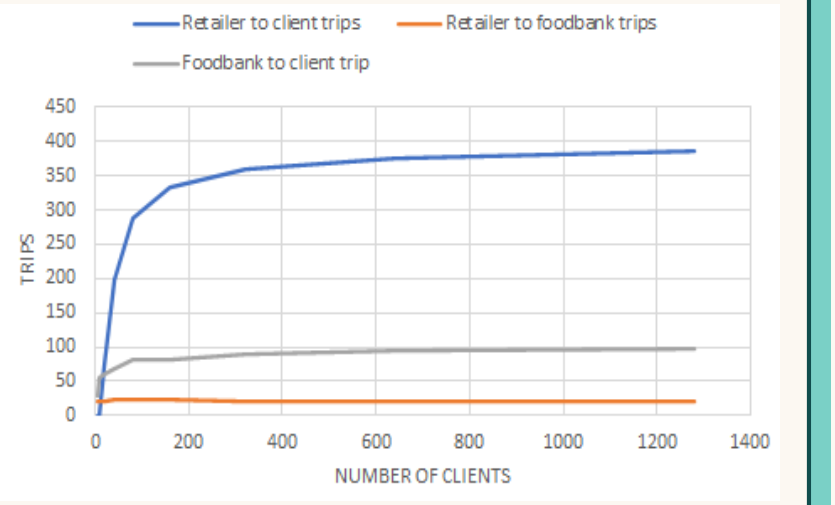
Objective

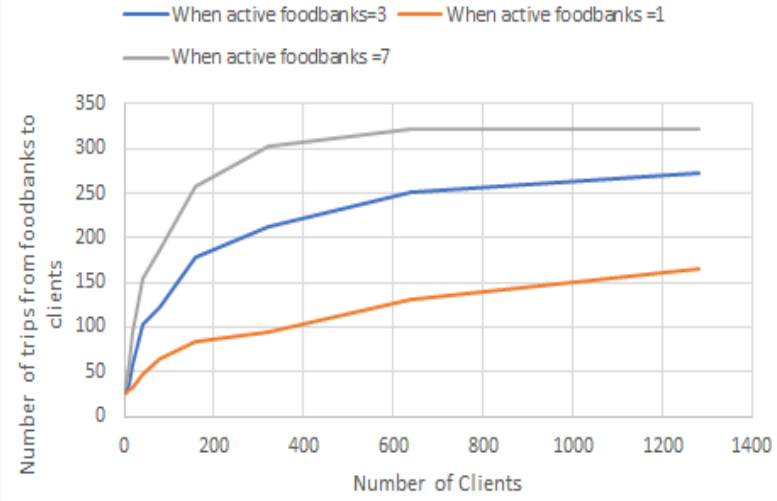
Maximizing Demand of clients and foodbanks while giving priority to donation to foodbanks first from the retailers.

Constraints

- Clients' Demand constraint
- Retailers' Capacity constraint
- Foodbanks' Capacity constraints

Retailer donation is equal to or less than foodbank capacity

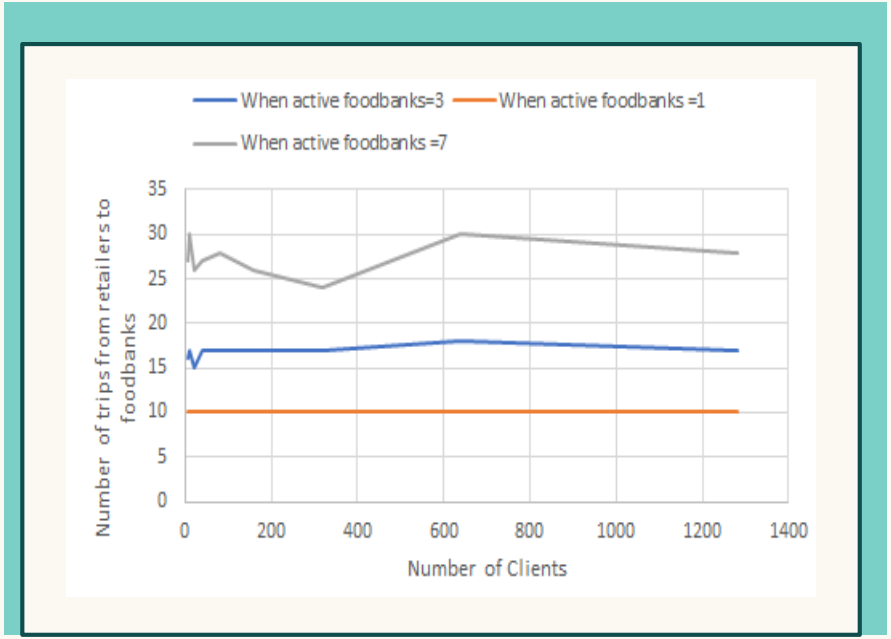




Total number of trips when clients demand increases as increase in number of clients

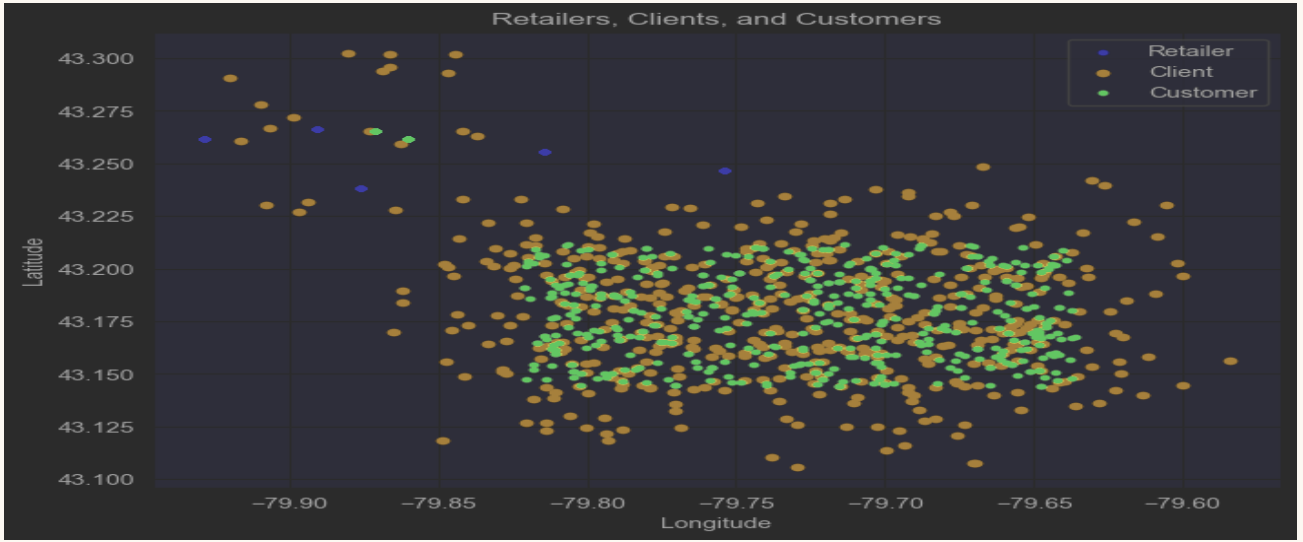
Total trips from foodbanks to clients

Retailer donation is equal to or less than foodbank capacity

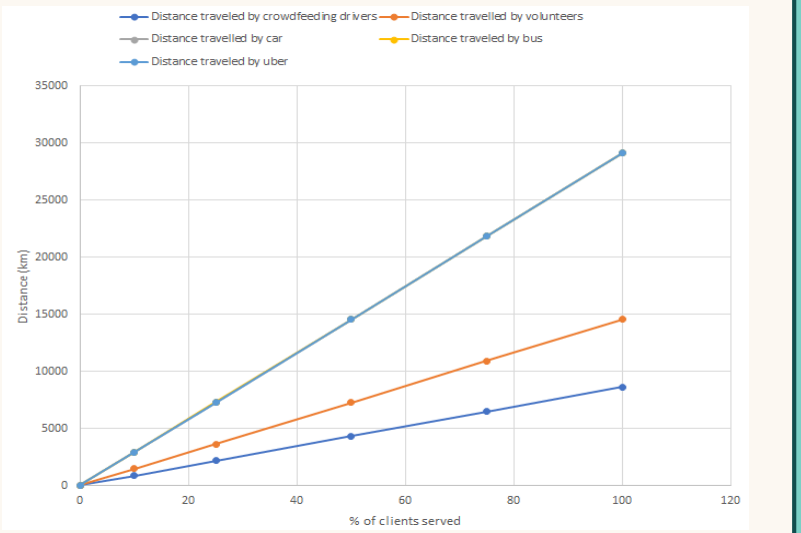


Total trips from retailers to foodbanks

Compare different modes of Deliveries



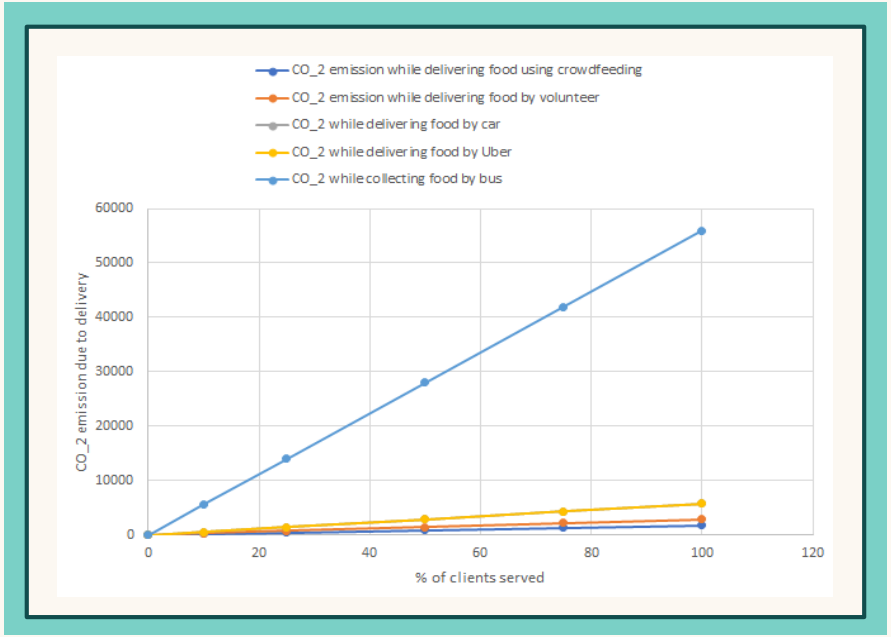
Compare different modes of Deliveries



Graph showing distance travelled by different modes to perform delivery of donated food.

Approximately more than 200% of the travelling took place when collections were done using bus, uber or car as compared to delivery performed by crowdfeeding.

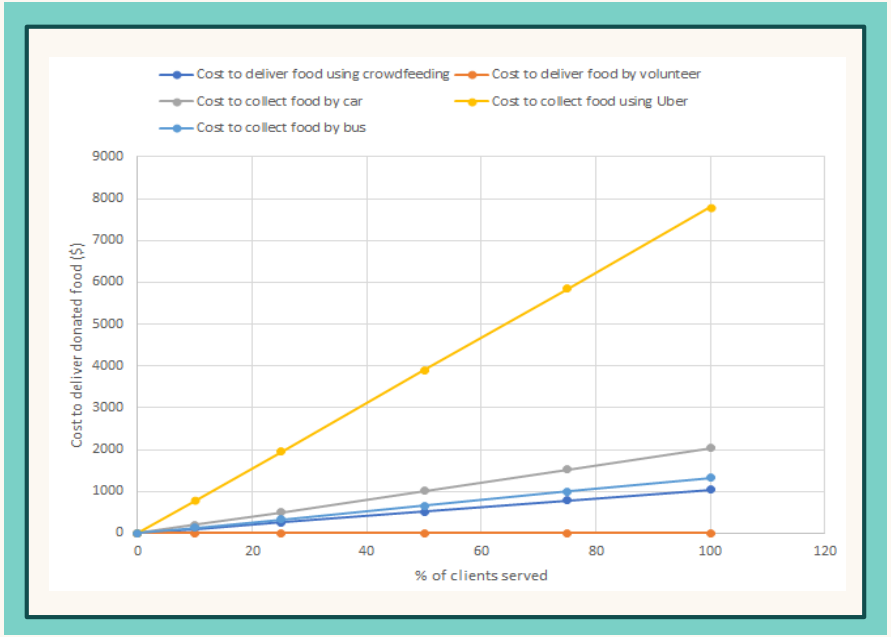
Compare different modes of Deliveries



Graph showing C O2 emission by different modes to perform delivery of donated food

- **If volunteers deliver food, then emissions increases by 69% as compared to crowdfeeding.**
- **The CO_2 emitted by car and Uber is equivalent which is 5769 kg.**
- **Use of crowdfeeding leads to the lowest CO_2 emission of 1707 kg.**

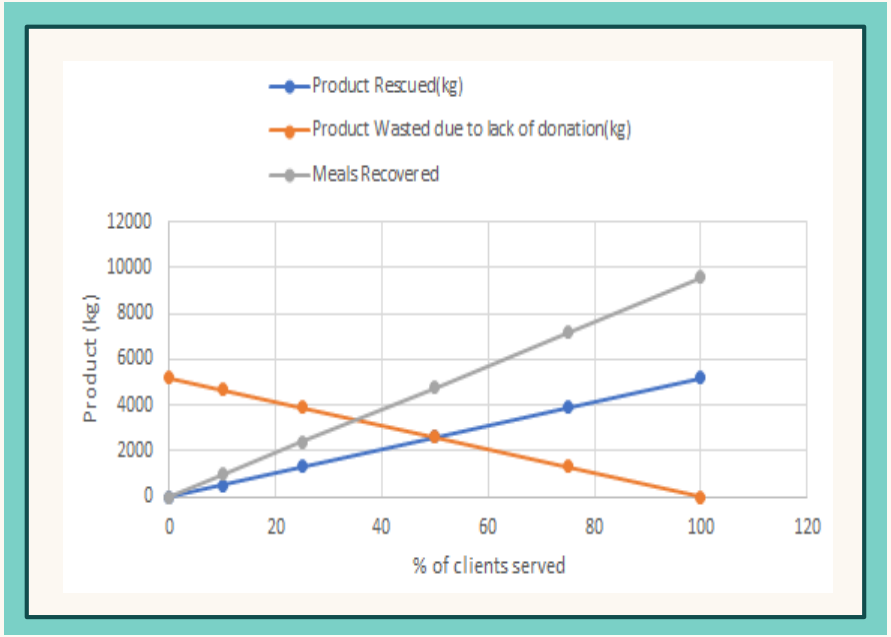
Compare different modes of Deliveries



Graph showing cost to perform delivery of donated food via disparate modes.

Using uber cost more than 6 times when compared to the use of crowdfeeding.

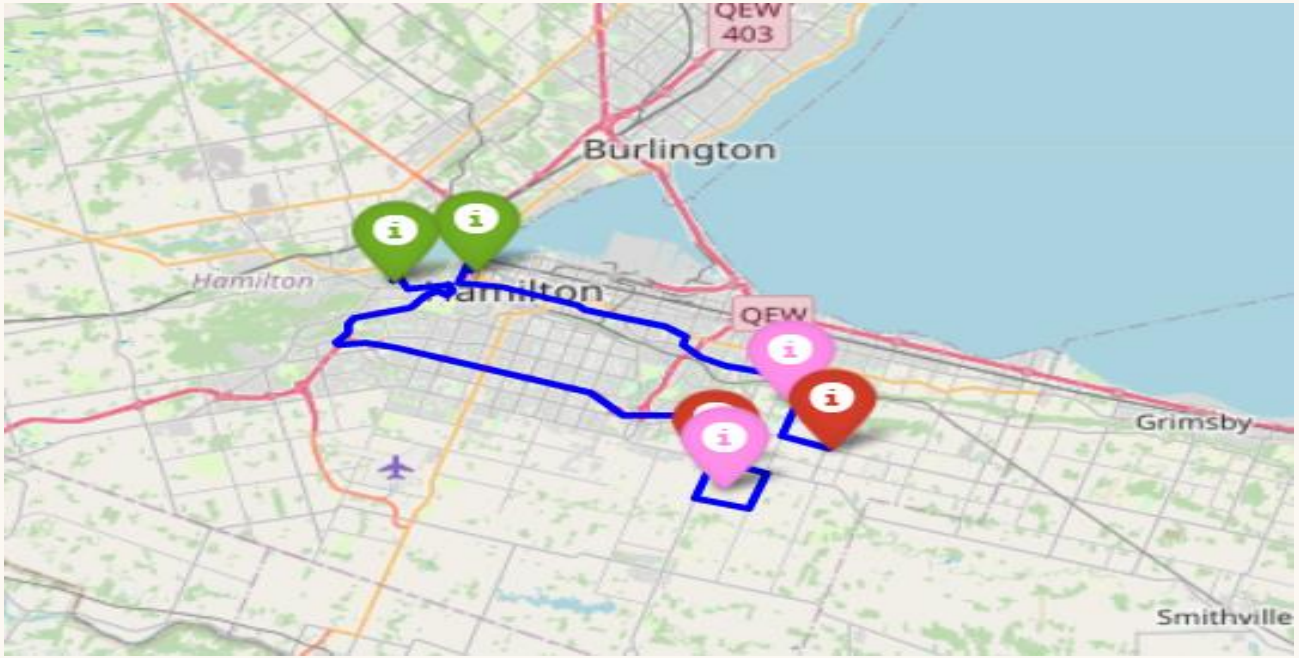
Compare different modes of Deliveries



Graph showing number of recovered meals, product rescued (kg), product wasted (kg)

- **In the absence of donation, a staggering 5200 kg of food is wasted, culminating the carbon dioxide emission of 1248 kg.**
- **when this equivalent amount of food is rescued, it facilitated the salvation of 9553 equivalent meals**

Optimized Route for delivering



01

CONCLUSION

Conclusion

- Crowdfeeding is efficient in reducing food waste.
- Helps increasing consumption time for the end recipients.
- Makes food rescue eco-system more robust.
- Help retailers to reduce over all food waste and save money.
- Mitigate food insecurity and provide us motivation to achieve target of zero hunger by 2030.
- Contribute towards net zero emission.

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EQUITY

- **Rescuing food early.**

Helping to feed people **fresh food** and making **food distribution more equitable**.

- Using **existing TNCs** for timely food distribution.

- **Increasing accessibility**
(Disabled, children, elderly)

OPTIMIZATION MODEL

Sets and Indices

R Set of retailers, indexed by r

F Set of foodbanks, indexed by f

C Set of clients, indexed by c

P Set of products, indexed by p

Parameters

K_r^p Capacity at retailer r to donate each product p

K_f^p Capacity at foodbank f to accept each product p

A_f^p Available products p at each foodbank f before donation

D_c^p Demand of each product p by client c

Decision Variables

x_{rc}^p Amount of donated products p from retailer r to client c

y_{rf}^p Amount of donated products p from retailer r to foodbank f

z_{fc}^p Amount of donated products p from foodbank f to client c

s_c^p Shortage of demand for products p for client c

$$Max \sum_{r \in R} \sum_{c \in C} x_{rc}^{p} + 4 * \sum_{r \in R} \sum_{f \in F} y_{rf}^{p} + 2 * \sum_{f \in F} \sum_{c \in C} z_{fc}^{p} - \sum_{c \in C} s_{c}^{p} \quad (1)$$

Subject to:

$$\sum_{r \in R} \sum_{c \in C} x_{rc}^{p} + \sum_{f \in F} \sum_{c \in C} z_{fc}^{p} + \sum_{c \in C} s_{c} = \sum_{c \in C} D_{c}^{p} \quad (2)$$

$$\sum_{f \in F} \sum_{c \in C} z_{fc}^{p} \leq \sum_{c \in C} D_{c}^{p} - \sum_{r \in R} \sum_{c \in C} x_{rc}^{p} \quad (3)$$

$$\sum_{f \in F} \sum_{c \in C} z_{fc}^{p} \leq \sum_{c \in C} D_{c}^{p} \quad (4)$$

$$\sum_{f \in F} \sum_{c \in C} z_{fc}^{p} \leq \sum_{c \in C} D_{c}^{p} \quad (5)$$

$$\sum_{r \in R} \sum_{c \in C} x_{rc}^{p} + \sum_{r \in R} \sum_{f \in F} y_{rf}^{p} \leq \sum_{r \in R} K_{r}^{p} \quad (6)$$

$$\sum_{r \in R} \sum_{c \in C} x_{rc}^{p} \leq \sum_{r \in R} K_{r}^{p} \quad (7)$$

$$\sum_{r \in R} \sum_{f \in F} y_{rf}^{p} \leq \sum_{r \in R} K_{r}^{p} \quad (8)$$

$$\sum_{r \in R} \sum_{f \in F} y_{rf}^{p} + \sum_{f \in F} A_{f}^{p} \leq \sum_{f \in F} K_{f}^{p} \quad (9)$$

$$\sum_{f \in F} \sum_{c \in C} z_{fc}^{p} \leq \sum_{f \in F} K_{f}^{p} \quad (10)$$

$$\sum_{r \in R} \sum_{c \in C} x_{rc}^{p} \geq 0, INT \qquad (11)$$

$$\sum_{r \in R} \sum_{f \in F} y_{rf}^{p} \geq 0, INT \qquad (12)$$

$$\sum_{f \in F} \sum_{c \in C} z_{fc}^{p} \geq 0, INT \qquad (13)$$