Optimizing Food Distribution to Reduce Wastage to Achieve Zero Hunger

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Problem Statement

Major contributors to food wastage include storage time and ineffectiveness of food supply chain. This is evidenced by the long transportation time between farmers and consumers. These factors increase the risk of food spoilage and cause reduction in market value of the food produce or even health impairments when such food is consumed.

This poster presents a platform that reduces the time for food to reach the consumer, especially perishable goods in storage stage while also assigning buyers to the sellers at closest proximity.

Introduction

To eliminate hunger, we must strive to reduce food wastage. UNICEF estimates 300 million children go to bed hungry each night; and 8000 children under the age of 5 die of malnutrition every day [2]. In Nigeria, 5 in 10 children under five are malnourished (stunted, wasted or overweight); 3 in 10 children aged 6 to 23 months live on poor diets [5]. Experts and investors have also said that about N12 billion worth of agricultural produce in Nigeria perishes annually from the point of harvest to point of delivery at the markets, due to lack of storage facilities [1].

We therefore propose a system that addresses food wastage by analyzing the causal factors, monitoring food production, and identifying potential needs and efficient solutions that can be implemented on short, medium and long term bases.

Methodology

To solve the problem of Zero Hunger by eliminating wastage, we propose a system that achieves these goals base on the following objectives.

- Optimize the quantity of perishable produce in stock
- Cluster sellers and buyers to a region base on proximity
- Use First in First out to recommend sellers to buyers

The platform only contains two types of sellers, the farmers themselves, who harvest farm produce and sell directly on the platform, and the other type of seller buys from the farmers and sell on the platform.

2.1 Perishable Farm Produce

We propose the use of the newsvendor model to know the total quantity to have in stock in the face of uncertain demand before the duration of at which the produce will still be fresh ends. Based on the history of demand we can estimate the quantity of each farm produced to be stocked. And the quantity to be stocked on the platform is shared among all sellers. The will prevent overstocking of the produce which leads to wastage while preventing under-stocking of the produce, so as not to disappoint the buyers.

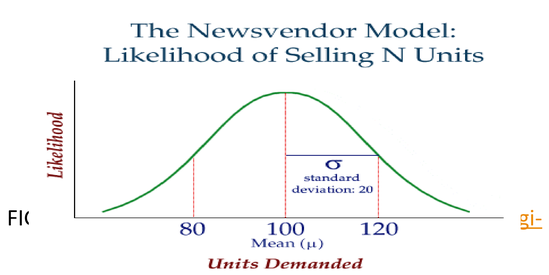

FIG gi-

2.1.1 *How do we sell farm produce of the same identity, sold by a different seller?* The approach is to sell them before they go rancid e.g. if Two sellers sell Banana, one of the seller's banana will go rancid in 3 days and the second seller in 2 days, the platform should recommend the second seller.

2.1.2 *How do we estimate the time produce should spend in storage before they go rancid?* Sellers input the harvest time (for farmers) or the purchased (acquired) time into the system. From the harvest or purchase date inputted by the farmer, we can know the exact day the produce must be sold before they go rancid.

2.1.3 *How do we ensure Trust?* Since date of harvest and purchase date can be falsified by the seller. We create a level rating system (to measure the rate of trust) based on the buyers' feedback.

if the produce is older than what the seller claims it to be, they will be penalized.

2.2 Non-Perishable Produce

These are farm produce that can last up to a year in stock if in a good condition. For these, the newsvendor model is not used. But the harvest or acquired time is also obtained by the system. Sellers are recommended to buyers using the First In First Out method.

2.3 Clustering of Sellers and Buyers

This is clustering of sellers and buyers in a region based on their proximity to each other. This ensures that farm produce in stock in a region is well managed and ensures that the buyer does not need to travel to a far distance to obtain what they want.

3 SYSTEM DESCRIPTION

The system will be built with two forms of interaction with the users (buyers and sellers). A web interface is for the buyers to type in the farm produce they want. Like a search engine where the sellers are displayed based on the metrics we described. For the sellers we want something that is easier for them to interact with and easily accessible. We propose the use of USSD and a minimalistic Mobile Application, through which the seller can submit the produce name, time of harvest/purchase and all other necessary information.

4. NEWSVENDOR MODEL

To minimize quantity in stock and have enough for demand, we propose the Newsvendor model. The newsvendor takes a simple approach to solve the issue of stocking, it tells if we should overstock or under stock.

This model is also known as the newsvendor problem or newsboy problem by analogy with the situation faced by a newspaper vendor who must decide how many copies of the day's paper to stock in the face of uncertain demand and knowing that unsold copies will be worthless at the end of the day [3]

The platform must know the quantity of perishable produce to be stocked with uncertain demand, knowing that unsold produce will be worthless at after period of palatability.

To decide the quantity we use parameters like:

1. Duration of palatability (p): Period in which the produce is good for sales.

2. Cost price (c): the cost of a seller purchasing the produce

3. Selling price (s): the price at which the seller sells the produce to the buyer

4. Salvage value (sv): can we reclaim the value of the produce after duration of palatability

5. Average purchase per P of the produce (Ap): Average sales during the period in which they are still good for sales.

6. Cost of Underage (Cu): The profit margin. It is the cost of losing a sale for a particular product. $Cu = s - c$

7. Cost of Overage (Co): It is the cost of produce not being sold before the expiration date. $Co = c - sv$

We let demand be a continuous random variable with a probability density function $f(y)$ and cumulative distribution function F (Y). This distribution can either be a Normal distribution or a Uniform distribution. The x in this distribution will be the stock value i.e. the unit the platform should stock for that value. The goal will be to find the optimal stock value that will minimize the total Understock value and the total Overstock value [4].

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