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Analysis of Global Retail Food Waste: Proposal for Developing a Mobile Application

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Abstract:- Food supply chains refer to complex processes describing how food arrives from farm to fork. Inevitably, food is wasted and lost over the supply chain, with a clear distinction between the two. The purpose of this paper is twofold. To begin, an analysis of multiple relevant papers is presented in a brief literature review, identifying possible causes, solutions and the economics of the food supply chain. Based on information from these papers, a proposal was drafted for addressing food loss at the retail level. This proposal comes in the form of a mobile application facilitating retailers to sell suboptimal products at a discounted rate. Key beneficiaries include food insecure people. Retailers would be incentivized to offer such discounts to promote greater profitability, reduce food waste, and improve internal environmental, social and governance goals. Limitations on the proposal's effectiveness were described along with recommendations for further research.

Keywords:- *Food Supply Chain; Retail Food Waste; Mobile Application.*

I. INTRODUCTION

Food supply chains encompass the entire lifecycle of food products from production to consumption. As developing countries and their populations increase, global trade plays an increasingly important role in driving urbanization, creating increasingly complex food supply chains involving an increasing number of entities along the way. [1]. Figure 1 illustrates the food supply chain.

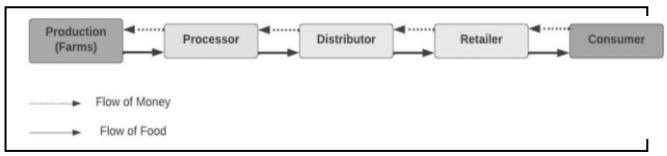

Fig. 1

Food is inevitably lost or wasted as it traverses a food supply chain. Approximately a third of all food produced as part of the global food supply chain, amounting to approximately 1.3 billion tons, is wasted. About 70% more food needs to be produced by 2050 to meet the growing global population estimates of 9.1 billion. [2] It is to be noted that there is a clear difference between food loss and food waste. Food loss refers to a drop in the quality or quantity of food during its movement through the supply chain due to factors such as malfunctioning food production and supply systems or inefficient institutional and policy frameworks. Food waste refers to the removal of food that is still suitable for human consumption from the supply chain due to factors such as poor stock management, expired food products or simply by choice. Food loss occurs primarily but not exclusively in the earlier stages of production and processing in the food supply chain while food waste occurs primarily but not exclusively at the retail and consumer levels. [1] Food that is inedible or redirected to other chains like composting or bioenergy does not count as food waste or loss. [3]

II. LITERATURE REVIEW

The work of [1] mentions that recognition of inter linkages between different stages in the food supply chain can provide solutions to decreased loss and waste of food. Social contexts and the environment must be carefully considered when designing technical interventions. Until consumers receive adequate education and proper inventory management is in place at the retail level, producers and industries in industrialized countries can only provide marginal solutions at producer levels. In another study [4], it was discussed that food waste is often the result of practices that affect all levels of the food chain, so quality standards and requirements of the later stages of the food supply chain result in a downshift of food waste towards the earlier phases. As such, there is no one entity along the chain to be blamed for the current situation of food waste based on their analysis. The goal of achieving a more sustainable food supply chain requires all stakeholders in the food supply chain to gain a new appreciation for food.

Studies by [5], [6] found that household food waste has no clear relationship with a country's GDP. In comparison to the narrative of the previous decade that food waste is an issue mostly confined to high-income countries, this convergence in household food waste statistics presents a strikingly different picture. Researchers [7] have developed a model, based on energy balance, to estimate how much food goes to waste during consumption (focusing on edible parts of food). Edible food waste appears to be lower in low-income countries than in high-income countries. For policymakers, disaggregating food waste data into edible and inedible components can help balance policies that address the prevention of food waste and circular uses for inedible parts.

A literature review [8] details how the early stages of the supply chain are where developing countries suffer food losses, whereas later stages are where developed countries face surpluses and wastages. Thus, in developed countries, consumers play an especially crucial role regarding food waste. In addition, the article discusses the culture of abandonment that is common in developed

countries. Consumers' household habits and grocery store choices play a key role in food waste. They influence stakeholder decision-making across the entire supply chain based on their actual or anticipated food perceptions and food purchase behaviors. The consequence is the unloading of large quantities of goods as their expiration date approaches. It is also important to establish a more homogeneous system of date labelling, combined with consumer education about date labelling and food handling. Dumping unsold products might be economically advantageous, but it can have negative social and environmental consequences. A retailer, for instance, accepts or rejects foods based on aesthetic standards with the assumption that consumers will only buy products that meet these standards. Consumers waste edible food products that are perceived as suboptimal as compared to other products, even if these products remain edible. This could be because foods may be nearing their expiration date, or they are not regarded as optimal products based on consumers' comparison through sensory perception. Consequently, suboptimal foods are the biggest drivers of food waste, along with food scraps and leftovers.

A study by the Food and Agriculture Organization of the United Nations [3] describes a business and economic case for food waste reduction. The business case states that as a result of rational decision-making regarding acceptable food waste levels, food suppliers and consumers maximize their profitability and well-being. Reducing food waste and loss benefits both suppliers and consumers. If wholesale and retail food prices decrease because food loss is reduced by suppliers, consumers may also benefit from lower food prices. How the price effects of reduced food loss ripple through the chain, however, is dependent on how big and where the reductions occur. Furthermore, reducing food waste reduces the negative environmental and social impacts caused by food waste. However, this incurs additional expenses. Such expenses would be justified if the benefits outweighed the costs. As such, there will always be some food waste, depending on factors like the perishability, distribution, and consumption of the food. Economic arguments for reducing food loss and waste extend beyond the business case to consider societal benefits, which are frequently overlooked by private stakeholders. Reductions can boost societal well-being in three different ways. Firstly, increasing productivity and increasing economic growth can be achieved by reducing food loss and waste. This economic growth benefits not only private actors, but society. Secondly, reducing food loss and waste could improve the nutrition status of people with food insecurity. In the case of food insecurity, eating patterns are disturbed because of a lack of resources and money. Thirdly, it may mitigate the impacts of food loss and waste on the environment, which may result in a reduction in greenhouse gases emissions

III. PROPOSAL

A paper [8] mentions that emphasis must shift toward how to eat purchased food rather than discuss how to prevent food waste. Retailers must consider actions such as lower prices for storage reductions, different price levels for quality classes, and other techniques to avoid over-purchasing due to consumers' desire for optimal price-quality relationships. In yet another paper [9], it is described how some companies have found that selling products close to their expiration date at a discount increases sales. Although this method sometimes does little to increase profits, it significantly increases customer satisfaction while simultaneously reducing food waste. There have been grocery stores in the past that have run a similar model. Berkeley Bowl, a popular grocery store in California, ran a similar program where they sold a significant chunk of their stock of nearly expired and damaged goods at a discount. [10] The products would normally be discarded if not for these discounts.

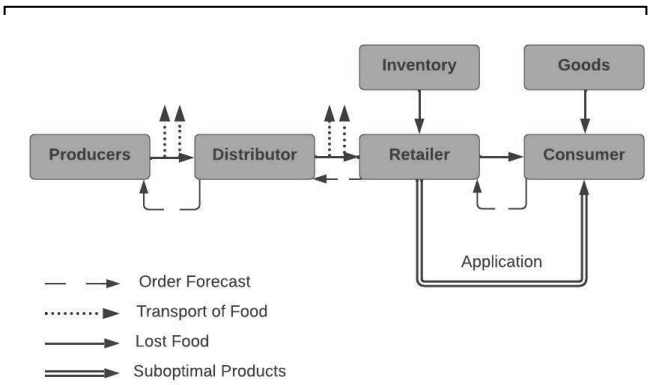

Fig. 2

Increasing and scaling this system across multiple grocery chains requires a method to connect retail stores with surplus grocery products and customers aiming to decrease food expenditures. We propose to develop a mobile application that provides users with the ability to discover grocery stores that offer products at discounted rates. Figure 2 illustrates our application's position in the food chain.

Individuals who are food insecure, such as those in labour camps and the homeless, would be major beneficiaries of such a system. We interviewed a dozen food insecure individuals and identified several characteristics that would make such a system suitable for them. The tendency of retail buyers to purchase optimal products, such as products of high aesthetic quality or longer shelf lives, results in retailers discarding sub-optimal products. However, through our interviews, it was discovered that food-insecure individuals do not maintain a standard of optimal products while shopping, however, they do tend to purchase optimal products if they're available for the same price as suboptimal products. Interestingly, many food-stable individuals exhibit similar behavior. They do prefer optimal products, but they opt for them mainly due to their similar price to suboptimal

products. Thus, it is evident that by simply introducing a price difference between products of different quality classes, consumers would be more open to purchasing sub-optimal food leading to decreased food waste at the retail level. As a result of different price levels for quality classes, the over-purchasing of food by consumers may also be decreased [8]. As such an application allows food-insecure people to find grocery stores with discounted products.

Those stores closest to food-insecure areas, such as labor camps, would experience the greatest influx of buyers from the app. This would greatly benefit such individuals financially as most of their expenditures are on food. A paper [4] describes, in detail, the main causes of food waste in four food supply chains. In short, there are consumer standards of food waste for vegetables, freshness of bakery items, production processes of dairy items and health concerns around meat products. Of these four categories, reduction in food waste would be greatest for vegetables and bakery items. Using purchase data from the application, retailers can further develop, test and evaluate different pricing strategies for suboptimal products over time. The application is designed to encourage retailers to sell suboptimal products to meet internal environmental, social, and governance goals and increase profitability.

IV. LIMITATIONS

Multiple sources [1], [4] mention that cooperation between different stages of the food supply chain is essential to reducing food loss. However, the focus of this paper has been strictly on the retail stage of the food supply chain without accounting for other stages of the food supply chain. Retail and household stages should be analyzed in conjunction to further understand the relation and impact this application could have on reducing food waste.

The increased revenue that retail businesses receive from these discounts is a key incentive for them to offer these discounts. However, an analysis [10] mentions that retailers who offer these discounts do not see an increase in revenue. They do, however, see a considerable improvement in customer satisfaction.

There is also another issue referred to as the rebound effect [8] which is described as a food waste policy that does not achieve the desired results or even backfires by having the opposite effect. The proposal, in this case, may result in retailers not managing their order forecasts appropriately and instead promoting overstocking of products, as the chances of economic loss may be minimized. No evidence is provided to support the claim that a simple application would result in a change higher up in the chain. However, it has been acknowledged that this scenario is unlikely.

Further, we have not clarified why retailers would choose this app over simply implementing such policies themselves. Large user bases and a low upfront cost would be two major incentives for retailers to use this app. However, such services can still be internally implemented by large retailers with success.

V. CONCLUSION

Food supply chains are intrinsically complex. To determine the cause of food waste and losses in a supply chain, it is critical to understand the source of the leakage. Customers' desire to buy optimal products leads to retailers ordering exactly those products. Suboptimal products are therefore discarded at the retail stage. This is achieved using a custom mobile application that leverages a waste reduction process to prevent food that is still fresh from being wasted.

The homeless and those in labor camps who suffer from food insecurity would particularly benefit from this system. Consumers tend to purchase better products, such as those that have a long shelf life or are visually appealing, resulting in retailers discarding sub-optimal products. The lack of price differentiation among products with varying quality is a major driver of this trend. By establishing a price differential, this trend can be reversed.

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