IMPACT OF STORES AND CUSTOMERS' INVENTORY DECISIONS ON FOOD WASTE

Bouchra Bacha[1,2],Yann Bouchey[2],Mohamed,Zied Babai[2], Zied Jemai[1,3]

[1] Université Paris-Saclay, CentraleSupélec, LGI, Paris, France
{bouchra.bacha,zied.jemai}@centralesupelec.fr
[2] The Centre of Excellence for Supply Chain Innovation and Transportation (CESIT), Kedge Business School, Bordeaux, France
{bouchra.bacha,yann.bouchery,mohamed-Zied.babai}@kedgebs.com
[3] LR OASIS, ENIT, University of Tunis Elmanar, Tunisia

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1 Introduction

According to FAO report in 2010 [1], up to 50% of food grown or produced for consumption is lost and wasted along the supply chain. Each part of the food chain (production, harvest, transport, transformation, distribution, consumption) and each connection (producer, purchasing center, consumer, etc.) can give rise to food loss and waste. However, the distribution and consumption stages are particularly sensitive as product shelf life reduces and the risk of product waste rises. Moreover, because the loss is passed to all preceding levels (e.g, loss of water and energy, gas emissions, etc.) food waste has a much greater negative impact on the environment and the economy at the distribution and consumption levels.

Our work focuses on food waste at distribution and consumption levels. At these stages, food can be wasted for several reasons. We can distinguish two main causes, the first is related to inventory decisions that retailers make in order to maximize their profit (assortment planning of products, price promotions, replenishment, etc.), and the second is related to customer behavior in both stores and households (less tolerance towards products that have an unusual appearance, misunderstanding of date labeling, lack of organization and management of product purchases, etc.) [2].

The literature on perishable products in the store is vast and rich; it provides various models and opportunities to reduce food waste while maximizing store's profit. We can cite as an example the seminal work of Nahmias [5], in which he reviewed earlier research dealing with determining ordering policies for two categories of products, one with a fixed shelf life and the other with a random shelf life, and proposed various extensions of the perishable inventory management problem. More recent articles, Transchel's work, which proposed a model of assortment planning of the demand for two vertically differentiated products based on consumer choices [6] and Kouki's work, which analyzed based-stock perishable inventory systems with general lifetime and lead-time and markovian demand [4].

Through the literature and by analyzing several causes of food waste causes, we find a relationship between store decisions, consumers' behaviors, and food waste at both levels [3]. For instance, customers frequently purchase fresher products to satisfy their expectations. This behavior increases the store's inventory of old products and accelerates waste. On the

other hand, to motivate changes in consumer attitudes and behaviors, retailers may make an appropriate inventory and pricing decisions for perishable products (e.g., discount older products) to increase the number of sales of these products before they expire, which may affect household waste.

The majority of strategies proposed in the literature conducted on stock control of perishable product neglect food waste at home. All decisions that the retailer makes to manage the perishable product (e.g, replenishment, pricing, the assortment of products, etc) are based only on the level of waste in stores . However, these decisions can influence the level of waste in households, which often exceeds the level of waste in stores [4].

2 Contribution and perspectives

Our purpose is to find a trade-off between customer expectations and retail service level by proposing a unified optimization model that brings together all factors involved in food waste at the distribution and consumption levels to help retailers make the best inventory decisions that maximize their profit and minimize food waste in both stages. To achieve this objective, we model customer choice behavior based on utility-based models. The utility function considers the household's waste level (which varies according to several criteria, such as waste sensitivity, willingness to avoid waste, etc.) and the characteristics of perishable products displayed on the shelves (their quality and price). At the store level, we consider two-period perishable products; in the first period, the retailer fixes the prices of each quality of the product that remains in stock, and in the second period, he decides the quantity of new products to order and the markdown of the old product based on consumer behavior and product quality. Demand for each quality is stochastic and is generated in each period from consumers arriving in the store and consumers' choice model. The store model will incorporate this demand to determine the right prices that maximize profit.

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