

Prevention and valorisation of surplus bread at the supplier–retailer interface

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Abstract

The global food system is a major driver of many environmental impacts, particularly those related to climate change, biodiversity loss, and depletion of freshwater resources. These problems are aggravated by a substantial waste of food throughout the supply chain, where retailers are responsible for large quantities of waste. Although other parts of the supply chain account for relatively higher waste generation, retailers are particularly important because of their influence both downstream and upstream in the supply chain.

This thesis aims to design and evaluate strategies for food waste prevention and valorisation, particularly for bread products, by analysing food waste quantities, identifying the causes and risk factors, and proposing and evaluating measures for preventing and valorising food waste.

This aim was achieved through a variety of approaches. First, food waste was quantified for one year in a typical mid-sized urban supermarket in Sweden. This information was used to identify hotspots at the product-level in relation to mass, environmental impacts, and cost. Bread was identified as a hotspot and also as a product with a high potential for waste prevention and valorisation measures. A second quantification was performed with the goal of estimating the quantity of surplus bread throughout the Swedish supply chain and to identify the risk factors for waste generation, particularly at the supplier–retailer interface. Finally, this thesis investigated current and future circular economy strategies for the prevention, valorisation, and management of bread surplus by evaluating the environmental performance of multiple strategies and comparing them with current waste management practices.

The results from the first quantification indicated that bread was a category with significant contribution in all environmental impact categories analysed, with the greatest contribution in terms of the total mass of waste and the economic costs incurred by the supermarket. The second quantification estimated 80 500 tonnes of bread waste/year in Sweden, equivalent to 8 kg per person/year, which was mainly concentrated at household and retail levels, specifically at the supplier–retailer interface. The results provided evidence that the take-back agreement between suppliers and retailers is a risk factor for high waste generation. Therefore, current business models may need to be changed to achieve a more sustainable bread supply chain with lower waste generation. However, the currently established return system between bakeries and retailers enables a segregated flow of bread waste that is not contaminated with other food waste products. This provides an opportunity for alternative valorisation and waste management options that are not viable for mixed waste streams.

The results from the environmental assessment for the prevention, valorisation and waste management pathways supported a waste hierarchy, where prevention has the highest environmental savings, followed by donation, the use of surplus bread as animal feed, and for beer and ethanol production. Anaerobic digestion and incineration offer the lowest environmental savings, particularly in low impact energy systems. The results suggest that Sweden can make use of the established return system to implement environmentally preferred options for the management of surplus bread.

Keywords: Food waste; Life cycle assessment; Bread; Prevention; Valorisation