

Full length article

Waste of fresh fruit and vegetables at retailers in Sweden – Measuring and calculation of mass, economic cost and climate impact

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ABSTRACT

Food waste is a significant problem for environmental, economic and food security reasons. The retailer, food service and consumers have been recognised as the parts of the food supply chain where the possibility of reducing food waste is greatest in industrialised countries. In this study, primary data on fresh fruit and vegetables (FFV) waste collected through direct measurements in three large retail stores in Sweden were analysed from the perspectives of wasted mass, economic cost and climate impact. A method of measuring and calculating the economic cost of FFV waste was developed and includes the cost of wasted produce, the cost of personnel time for waste management and the cost of waste collection and disposal. The results show that seven FFV categories, which have been termed “hotspot categories”, contributed to the majority of the waste, both in terms of wasted mass, economic cost and climate impact. The “hotspot categories” are apple, banana, grape, lettuce, pear, sweet pepper, and tomato. The cost benefit analysis conducted showed that it is economically wise to invest in more working time for employees in waste management to accomplish a reduction of wasted mass and climate impact without an economic loss for the store. These results are relevant for supporting the implementation of policies and initiatives aimed at food waste reduction at retail level.

1. Introduction

It is estimated that almost one third of the food produced for human consumption is lost or wasted globally (FAO, 2011). This leads to a significant environmental impact in terms of inefficient use of natural resources (Garnett, 2011), as well as an economic cost (FAO, 2013; Buzby and Hyman, 2012) and also social and moral implications (Stuart, 2009). Food waste is an issue of importance to global food security, as 795 million people suffer from undernourishment (FAO, 2015) and the world population is projected to increase to 9.6 billion by 2050 (UN, 2013). The growth of the population will lead to an intensified use of natural resources (Godfray et al., 2010) and the increase of global demand for food is projected to increase by 70% by 2050 (FAO, 2009). To make the food supply chain sustainable – both feeding the world's growing population and reducing the environmental impact – the development of strategies to reduce food loss and waste throughout the food supply chain is essential (Beddington, 2011; Garnett, 2014). The extent of food loss and waste and the unnecessary use of resources have received increased attention; it is a topic of considerable interest from both the public and private sectors. Several important actors, such as the United Nations and the European Union (UN, 2015; EC, 2015), the governments of the US and France (USDA,

2016; Ministère de la Transition écologique et solidaire, 2015) and international companies (Tesco, 2014) have recently adopted goals for food loss and waste reduction. To incorporate global agreements of halving food waste by 2030 (UN, 2015), more comprehensive and detailed information is needed to better understand which food, and how much of it, is discarded. Besides measuring the waste amount, detecting the causes and identifying the “hotspots of wastage” (Priefer et al., 2016), where large waste reduction effects could be achieved with low effort, is also a necessity in order to set and implement reduction targets.

1.1. Food waste in the food supply chain

Throughout the food supply chain, food is wasted by a large number of actors for different reasons (FAO, 2011; Parfitt et al., 2010). The definition of food waste refers to food being wasted at retail and consumer level and consists of food appropriate for human consumption being discarded or not consumed by humans. This includes food which has spoiled prior to disposal and food that was still edible when thrown away; it is often related to retailer and consumer behaviours (Thyberg and Tonjes, 2016; FAO, 2013; Parfitt et al., 2010). Food waste in Europe and North America occurs predominantly during retail and

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consumption (FAO, 2011). An estimation of European food waste levels (Stenmarck et al., 2016) reveals that 70% of the EU food waste arises in the household, food service and retail sectors. The retailer, food service and consumers have also been recognised as the parts of food supply chain where the possibility of reducing food waste is greatest in developed countries (FAO, 2011; Stenmarck et al., 2016). The environmental impact of food loss and waste adds up along the supply chain after being transported, stored, packed and processed (Beretta et al., 2013). When food is wasted at the end of the supply chain, it is more costly in terms of resources and economic cost compared to losses earlier in the supply chain.

The contribution of retail waste to the total amount of food waste is small and corresponds to a low percentage of waste compared with other steps in the food supply chain (FAO, 2013; Stenmarck et al., 2016). However, an individual retailer produces a large amount of waste at the same physical location and even a minor percentage reduction can give major reductions in terms of lowering the amount of wasted mass and lowering the economic costs. The retail sector is a strong actor in the supply chain (Beckeman and Olsson, 2011) and can put pressure on suppliers and influence consumers. A previous study (Eriksson et al., 2017) showed that take-back agreements between suppliers and retailers played a significant role in the amount of food which was wasted. At wholesalers and retail stores in Sweden, the total amount of food waste in 2012 was estimated to be 70,000 t, of which 91% was considered unnecessary or avoidable food waste (Swedish Environmental Protection Agency, 2014).

At retail level, fresh fruit and vegetables have been identified as the main contributor to the amount of the wasted material, hereafter referred to as ‘wasted mass’, (Scholz et al., 2015; Stenmarck et al., 2011; Buzby et al., 2009). A recent study (Brancoli et al., 2017) showed that the most wasted products at retail level were found to be either bread or fruit and vegetables, of the total wasted mass at the retailer, 30% originated from bread and 29% from the fruit and vegetable department. Similar result was presented from a study in Italy where the wasted weight from fruit and vegetables corresponded to 34% of the total wasted mass at the retailer (Cicatiello et al., 2017). The total value of food waste at the retail and consumer levels in the United States, considering retail prices, was \$165.6 billion in 2008, where fruit and vegetables corresponded to 26% of the total value (Buzby and Hyman, 2012). In a study from Austria at retail level, the monetary value of fresh fruit and vegetables accounted for 53% of the total value of food waste (Lebersorger and Schneider, 2014). From an environmental perspective, in a study at six retail stores in Sweden, fruit and vegetable departments contributed to 46% of the total waste of the carbon footprint (Scholz et al., 2015).

1.2. Waste categories at retailer level

In the retail sector, the FFV waste are the produce subjected to rejection at delivery at store, or those which are removed from the department and discarded. Some studies on FFV waste at retailer level which have been conducted previously have described the procedures used in fruit and vegetable departments (Eriksson, 2012; Åhnberg and Strid, 2010). A flow chart for the fruit and vegetables at retailer level and the different waste categories is described in Fig. 1 (modified from Eriksson et al., 2012).

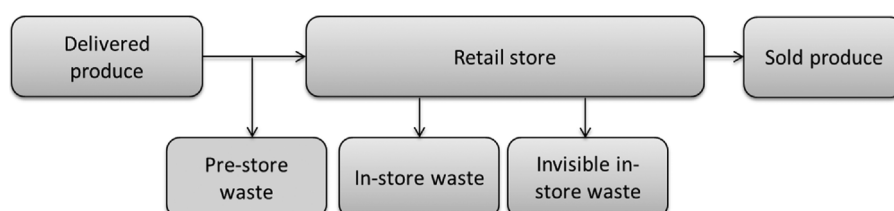


Fig. 1. A flow chart for the fruit and vegetables at retailer level and the different categories of waste.

When fresh fruit and vegetables are delivered to the store, the store can, after quality control, accept the produce or, if the produce does not comply with the quality requirement, reject it. The cost of the pre-store waste (Eriksson et al., 2012) is reimbursed by the supplier and does not contribute to a monetary loss from the retailer's point of view. The definition of in-store waste has been established in previous studies (Eriksson et al., 2012; Hanssen and Schakenda, 2011) and can be summarised as the waste which occurs in the store after the produce from the supplier has been accepted. Invisible in-store waste depends on several factors, for example, mass loss due to evaporation, theft, the produce being discarded without being recorded and an employee's capability when estimating the weight and registering the data (Eriksson et al., 2012).

1.3. Aim and scope

The scope of this study is to increase the knowledge of the in-store waste of fresh fruit and vegetables at retailer level. This will provide a better understanding and input in the assessment of which FFV categories retailers can work with in order to reduce waste, make informed decisions and implement targeted waste reduction actions. The aim of this study is to examine which FFV categories provide the highest amount of in-store waste and calculate the respective waste quotas. The economic aspects of waste are also studied, since this is the dimension that stores operate in. This has not previously been investigated in relation to specific FFV categories and food waste. Therefore, this study examines which FFV categories have the largest economic cost, including the economic loss of the wasted produce, the cost of an employee's time spent on waste management and the cost of waste collection and disposal. Moreover, the FFV categories with the highest climate impact are also studied. Additionally, the study examines if it is cost effective to spend more resources on man-power for waste management in order to reduce the wasted mass and the cost of waste. As a final point, the differences of the results in regards to whether the waste is measured in terms of wasted mass, economic cost or climate impact is discussed.

2. Materials and methods

On-site investigations were made at three large retail stores in mid-Sweden. The case study started in 2012 with an exploratory series of semi-structured interviews, (interview method is described by Kvale and Brinkmann, 2014) and participating observations (method is described by Yin, 2009) with employees in the FFV department at one store. Based on the outcome from the exploratory study, a method for measuring the waste and of calculating the economic costs was developed. Two additional stores from different cities were selected to be included in the study. The main study, which included all three stores, took place between 2013 and 2014, and the methodology was uniform for all stores. Data of in-store waste (see Fig. 1), sold quantities and purchase price were received from each store from 1 January to 31 December 2013 in the form of extracts from the stores' respective databases. To calculate the personnel cost for waste management, information regarding the stores' daily working routines and waste management procedures were obtained by participating observations at the FFV departments during three days at each store. To validate the

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