



Food waste management practices in restaurants: how to prevent and reduce food waste?

Sanna-Mari Renfors, Satakunta University of Applied Sciences

Abstract

Restaurants produce significant food waste, which has major negative environmental, social, and economic impacts. Therefore, the prevention and reduction of food waste in restaurants needs to be planned, using appropriate management practices for the different stages of the process. The review will increase the understanding of food waste prevention and reduction, the stages of the management process, and the management practices involved. The results show that management practices are particularly related to menu planning, sourcing, preparation, serving, and customer service. In addition, the review identifies systematic management as an essential element in preventing food waste. However, achieving the objectives set will require raising the level of skills and integrating circular economy thinking into management practices. The suitability of management practices also depends on the geographical context, which is why more research on this topic is needed in Finnish restaurants.

Keywords: food waste, food waste management, restaurant industry, sustainable development, circular economy

Introduction

Currently, the food chain accounts for almost a third of global greenhouse gas (GHG) emissions, requires significant amounts of natural resources and leads to biodiversity loss (European Commission, 2020a). It is estimated that around 20-30% of all global GHG emissions come from food production and consumption, and a third of food production is wasted at different stages of the food chain (Dolnicar et al., 2020; Nyberg et al., 2022; Principato et al., 2018). Food production and consumption must, therefore, address what food is eaten, how it is produced and prepared, and how much of it is wasted. One effective way to mitigate these challenges is to change consumption patterns and shift to a planetary diet, i.e. sustainably produced plant-based food (Willett et al., 2019). Another approach is to prevent food waste as in Finland, 61 million kilograms (11 kg/person) of food waste, i.e., food that

is initially inedible, is generated by private and public catering services per year (Riipi et al., 2021).

Thus, restaurants produce a significant amount of food waste, which is a major societal challenge (Bux & Amicarelli, 2023; Heikkilä et al., 2016; Silvennoinen et al., 2015). Food waste has a negative impact on climate change if its prevention and reduction is not properly managed in restaurants (Camilleri, 2021). In addition to the GHG emissions from food production and consumption, food waste generates costs for the whole food chain and its actors (Papargyropoulou et al., 2014). Therefore, preventing and reducing food waste would have a significant impact on the number of resources used for food production and food security. Moreover, preventing and reducing food waste would bring crucial cost savings for restaurants (Dolnicar et al., 2020; Filimonau & De Coteau, 2019; McAdams et al., 2019).

Preventing and reducing food waste is also a topical issue as decision-makers are paying increasing attention to it. For example, the European Green Deal guides the European Union (EU) towards a green transition to achieve climate neutrality by 2050 (European Council, 2024). A key role in achieving this is played by the From Farm to Fork strategy (European Commission, 2020a), which aims to achieve a neutral or positive environmental impact of the food system and its actors. The strategy also encourages more sustainable food production and consumption and promotes sustainable food service practices. Reducing food waste has a major role, as the European Commission has committed to halving this amount per capita by 2030. In Finland, a national waste roadmap has been developed for this purpose (Luke, 2024). This map also promotes a shift towards a circular economy in production and consumption to reduce the negative environmental impacts of natural resource use, with measures to reduce food waste as also outlined in the European Union's Circular Economy Action Plan (European Commission, 2020b). Preventing food waste is, therefore, an important part of the circular economy and sustainable use of natural resources.

While the importance of this issue in practice is recognised, there is still a gap in research on the various management practices that can be used to prevent and reduce food waste in restaurants (Camilleri, 2021; Filimonau & De Coteau, 2019). Research has generally approached the topic from an agricultural perspective, rather than considering the role of restaurants as actors in the food chain (Filimonau & De Coteau, 2019). Research has also focused on the quantity and composition of food waste (Dhir et al., 2020). In addition, research has often concentrated on households and public settings such as schools and hospitals. As each actor in the food chain has a role to play in preventing and reducing food waste, this requires looking at the topic in a restaurant context and understanding restaurants' perspective.

The review will increase understanding of management practices for food waste prevention and reduction in restaurants at different stages of the food waste management process. The review focuses on the research gap in this area and aims to answer the research question: what management practices can be used to prevent and reduce food waste in restaurants? The review defines food waste as waste generated at the end stages of the food

chain, which is highly influenced by human behaviour (Stirnimann & Zizka, 2021). In this review, a restaurant is defined as a private restaurant operating in the food service sector where food is served to customers at tables or customers choose from a self-service buffet. Of course, the practices used vary from restaurant to restaurant, as the causes and amount of food waste depend to a large extent on the way the restaurant operates (Juvan et al., 2023). However, practices are not separated between restaurants offering table service or self-service buffet in this review.

The management practices for food waste prevention and reduction in restaurants proposed in the review are based on the analysis of different data in the subject area. The review draws on evidence on food waste prevention and reduction and management practices from international academic and non-academic sources. Academic sources include peer-reviewed scientific articles published on the subject. Non-academic sources include press articles and interviews on the internet about zero waste restaurants and their owners' perspectives on the topic. The data was analysed using inductive content analysis to identify the stages in the food waste prevention and reduction management process and the associated management practices in restaurants.

Food waste generation and management in restaurants

The study has identified different *approaches* to food waste management. These can be preventive, i.e., preventing the generation of food waste from the outset, or corrective, i.e., preventing prepared surplus food from becoming waste, for example, through reuse and distribution (Principato et al., 2021; Vizzoto et al., 2021). Previous research has also developed different *classifications* for food waste and its generation, depending on whether waste can be prevented. Papargyropoulou et al. (2014) group these into three categories: preventable, non-preventable and potentially preventable food waste. Preventable food waste is defined as waste that would have been edible. Non-preventable food waste is waste that cannot be eaten (e.g., banana or eggshells). Potentially preventable food waste is waste that can be eaten in some cases (e.g. potato peelings).

In general, food waste generation is defined according to *the linear stages* of its process in restaurants: preparation waste, service waste, and customer plate waste (Principato et al., 2021). In addition, food waste generation has been divided into so-called pre-kitchen, kitchen, and post-kitchen food waste (Filimonau & De Coteau, 2019; Filimonau et al., 2020; McAdams et al., 2019). The so-called pre-kitchen phase involves forecasting, selection of suppliers, sourcing, inventory management, and menu planning. In the kitchen, the storage, preparation, portioning, and serving take place. The post-kitchen phase involves customer service and the sale of surplus food.

The systematic prevention and reduction of food waste is essential to restaurant management and all its operations (McAdams et al., 2019; Pirani & Arafat, 2016; Vizzoto et al., 2021). Therefore, every restaurant should have *a system* in place to manage and control the food waste management process at different stages (McAdams et al., 2019). Most food

waste would be preventable, so restaurant management must understand that it is possible to manage food waste (Camilleri, 2021; Heikkilä et al., 2016; Vizzoto et al., 2021).

Stages in the food waste management process and the management practices they involve

The data analysis shows that the most important theme in the food waste management process is its *management*. Restaurant managers should examine their attitudes and consider whether they feel that preventing and reducing food waste is possible. Restaurants should have a food waste prevention and reduction plan, with regularly measured and monitored indicators. A prerequisite for the systematic management of food waste is understanding what daily food waste consists of and how much it accumulates. Only based on this information is it possible to make the necessary changes at different stages of the process.

Another important stage in the management process is *menu planning*, which helps prevent food waste. In this case, the menu can contain fewer options and different portion sizes according to the customers' needs. The menu can also be flexible, allowing the customer to combine the main course with the side dishes of their choice. The menu can include a special dish of the day, i.e., a dish that changes according to the ingredients as they approach their expiry date. The menu can also be designed based on what local producers have to offer and should include seasonal ingredients. It is important to use the same ingredients in different recipes and identify which can be used cross several dishes. It is also good to consider sustainability and circularity when designing the beverage menu.

The procurement of ingredients is highlighted as an important stage in the management process. Restaurants should look at their own purchasing behaviour and optimise their sourcing, which should be based on accurate sales forecasts. In addition, weighing food waste and removing ingredients identified as less popular from the menu is one way to reduce food waste. To source ingredients, restaurants can negotiate the most appropriate contracts, either centrally with specific suppliers or with local producers, which will allow the quantities and timing of orders to be best matched to the restaurant's needs. This can also be used to discuss the possibility of reducing packaging waste and negotiating the use of reusable and returnable transport containers.

In addition, the focus is on *circular preparation and cooking*. The kitchen staff should have the skills and ability to think creatively about using surplus food and reusing ingredients in other recipes. In addition, meal planning using the full range of ingredients without wasting resources and using by-products to create new meals are essential skills. For example, vegetables should be used in their entirety in a "root to leaf" concept and animals in a "nose to tail" concept. Food preparation must also consider energy use: could the menu include more dishes that do not require energy to prepare? The waste generated should also be composted, and the compost could be returned to farmers, for example.

Serving emerges as an essential stage in the food waste management process. For example, in the self-service buffet, customers' portion sizes can be controlled by using smaller plates, and smaller utensils can be used for serving. In addition, customers should be

informed about the possibility of having more food later rather than having too much at once. Some dishes could also be served pre-portioned, in a predetermined size. For example, breakfast could use the 'on-demand' policy for certain dishes to manage overproduction and food waste better. For the self-serving buffet, customers could be offered a lower price during the last half-hour to avoid overcooking towards the end of the service.

As customers play a major role in preventing and reducing food waste, the food waste management process also includes various *customer service practices*. Customers should be informed through various information campaigns and by giving them new perspectives on food and the generation of food waste and its negative effects. When ordering from a menu, the waiter's role is to inform the customer precisely about the portion size (e.g., enough for two) and to describe the dishes, thus avoiding wrong choices. It is important to communicate the quality of the food to the customer rather than the number of different dishes. They can be offered the opportunity to take home leftovers from their own portion. Selling surplus food to customers is also a good opportunity, not only to avoid food waste, but to increase profitability. Alternatively, the surplus food can be donated to, for example, a food bank or various local organisations.

Table 1 summarises the above stages in the food waste management process. The challenges involved in each stage and the involved practices have been considered, which can also be used as research questions for further research.

Table 1. Management stages, practices, and key challenges in the food waste management process

Stage of the management process	Key challenges and related issues
Management	What is the attitude of restaurateurs and kitchen managers towards preventing and reducing food waste?
	What is the daily food waste in a restaurant and how much does it accumulate?
	How can restaurants prevent and reduce food waste by improving their planning and management?
Menu planning	How can menu planning help prevent and reduce food waste?
Procurement	How can existing data be used to analyse restaurant purchasing behaviour and optimise the sourcing of ingredients?
	What kind of networks and partnerships can the restaurant build and use to source ingredients?
Preparation	How can a restaurant use circular economy principles in food preparation?

Serving and customer service	How can customers be guided and educated to prevent the generation of plate waste?
	How can surplus food be sold/given away?

Final remarks

The review shows that management practices to prevent and reduce food waste are particularly relevant to menu planning, procurement, preparation, serving, and customer service. These practices in the initial and middle stages of its management process are largely preventive; preventing food waste generation from the outset. The review also identified corrective practices in customer service to prevent surplus food from becoming waste.

The review reinforces the idea that food waste research should be more closely integrated into circular economy thinking. Currently, in the restaurant context, circular gastronomy and its research (e.g. Nyberg et al., 2022, Renfors & Wendt, 2024) are gaining popularity. Circular economy thinking is particularly involved in food preparation and waste prevention, as suggested by the results of this review. However, this thinking could also be extended to other stages of food waste prevention and management, as well as to other types of waste, in particular the prevention of packaging waste in procurement. Various partnerships and networks could support this objective, as restaurants depend on other food chain actors.

In addition, the review identifies systematic management as an essential part of food waste prevention and management. This requires raising the level of skills of both restaurateurs and staff members, as food waste prevention and management is particularly dependent on skills (Heikkilä et al., 2016). A restaurant should weigh food waste daily to ensure a strong understanding of what food waste consists of. On this basis, the restaurant could draw up a plan for preventing and reducing food waste, with indicators and targets, and use the information gathered to make changes at different stages of the management process. Restaurants should also integrate food waste prevention and reduction into their organisational culture and train relevant staff members (Stirnemann & Zizka, 2021). In addition, digital services and applications could be integrated at different stages of the management process to support systematic management.

Previous research (e.g., Dhir et al., 2020; Filimonau et al., 2019) has found that the suitability of management practices for food waste prevention and reduction depends on the geographical context. This is because cultural and political factors have a strong influence. Therefore, Filimonau et al. (2019) suggest that the suitability of management practices for different geographical contexts should be further investigated. Further research on this topic is needed in the Finnish restaurant context, where, for example, long distances and relatively low customer volumes affect the profitable sourcing of local ingredients, food waste and plastic recycling targets are lagging behind EU targets, and legislation on this topic is constantly evolving. Therefore, a future study could seek answers to the following questions: how do Finnish restaurant and food culture as well as mindset impact food

waste prevention and reduction in restaurants in Finland? What are the best management practices for preventing and reducing food waste in Finnish restaurants? Which management practices would achieve the greatest benefit in relation to the objectives?

For more information

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