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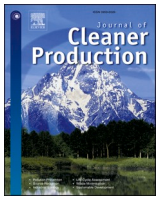

Identifying the factors affecting the implementation of food waste reduction strategies in independent restaurants: Moving towards eco-efficiency

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ABSTRACT

One of the very promising ways to improve a restaurant's eco-efficiency consists of implementing food waste reduction strategies (FWRSs) to reduce the costs and environmental impacts associated with food waste (FW). However, several factors can hamper the implementation of FWRSs, limiting a restaurant's ability to become more sustainable. Hence, the aim of this study is to identify the factors that facilitate or limit the implementation of FWRSs in independent restaurants. This will enable restaurateurs to choose the most appropriate FWRSs to implement, not only in terms of the potential economic and environmental benefits that can be achieved but also in terms of implementation feasibility, to ensure their sustainability. To achieve this, semi-structured interviews were conducted with owners, managers and chefs of independent restaurants in Quebec, Canada. They were questioned on several topics related to their perception of FW, eco-efficiency and FWRSs as well as their experiences in implementing FWRSs. The results allowed the identification of 12 factors affecting the implementation of FWRSs, which were analyzed and categorized according to social practice theory. These factors include consumer perception, management, planning and organizational skills as well as labor and food costs. Then, the factors were linked to the characteristics of the restaurants studied to identify the most promising ways to operationalize the reduction of FW according to the restaurant type. To this end, two approaches were raised: a preventive approach aimed at reducing FW at source, by adopting a limited fixed-time menu for example, and a corrective approach aimed at reusing FW to give it a second life.

1. Introduction

According to the Eat-Lancet Commission, a radical transformation of the global food system is urgently needed, as it currently drives environmental degradation and the transgression of planetary boundaries (EAT Initiative, 2015). A relevant example of food system dysfunction is the production of a huge amount of food waste (FW) every year. In fact, 31% of all the food produced is wasted worldwide representing over a billion tons of food (FAO, 2019; United Nations Environment Programme, 2021). This fact is unacceptable as two billion people in the world experience moderate or severe food insecurity (FAO et al., 2019). In addition to food inequalities, FW carries an environmental burden as the resources used to grow, process and transport discarded food are wasted and greenhouse gases (GHGs) are emitted from its decomposition (FAO, 2019). From an economic point of view, FW is an unwanted output for every actor in the food chain as it lowers their disposable income (Gooch et al., 2019). Thus, a consensus has emerged in recent years among the scientific community on the need to reduce FW throughout the food chain. The achievement of this objective is guided by the United Nations Sustainable Development Goal (SDG) 12.3, which aims to reduce FW by 50% by 2030 (Hanson, 2017).

The foodservice sector must contribute to the achievement of SDG 12.3, as 26% of FW produced from retail to the consumer is generated in this sector (United Nations Environment Programme, 2021). In addition,

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reducing FW could be a solution to increase restaurants' revenues, which were badly affected by the COVID-19 pandemic in Canada and all over the world (Filimonau, 2021; Statistics Canada, 2021). Indeed, in 2021, a full-service restaurant profit margins were −2% in Quebec (Association Restauration Québec, 2023). Recent estimations showed that a restaurant can reduce its food purchase costs by up to 15% when reducing its FW (Lee et al., 2013; Lévesque et al., 2022a). In addition, the presence of sustainable food practices in foodservices establishments tends to improve the attitude of consumers in addition to affecting their choices (Sullivan et al., 2021; Plamondon et al., 2022). Governments are also taking steps to require restaurants to reduce their environmental impact. For example, since 2021, the Canadian government has banned certain single-use plastic items such as utensils and food containers (Government of Canada, 2022). Thus, the implementation of food waste reduction strategies (FWRSs) is a promising avenue for the foodservice industry to increase its profit margin while also reducing its environmental impact, hence the interest in looking at eco-efficiency. According to the ISO 14045 standard "eco-efficiency is the aspect of sustainability relating the environmental performance of a product system to its product system value" (ISO, 2012). Various indicators have been used in the foodservice sector to measure eco-efficiency, including the amount of energy, water and cleaning products used in operations and the cost, environmental impact and nutritional quality of menus (Strasburg et al., 2017; Lins et al., 2021; Ribal et al., 2016). However, the eco-efficiency concerning to FW will be addressed specifically in this article through the implementation of FWRSs. A FWRS with a strong impact on eco-efficiency can help to maximize a restaurant's economic value (profits) while minimizing its environmental impacts by FW reduction. Indicators such as the purchasing, waste management and labor costs associated with FW were used to assess their economic hotspots, while the quantity of food thrown away and life-cycle analyses according to different impact categories demonstrated the environmental impact of their production (Lévesque et al., 2022a, 2023; Papargyropoulou et al., 2016a; Thamagasorn et al., 2019). Also, key elements for identifying FWRSs with maximum impact on a restaurant's eco-efficiency have recently been identified in the literature. These include the specificity of a FWRS, the different food categories making up FW, FW processing time by the cooks and the duration of FWRS implementation (Lévesque et al., 2022a). A major problem is that there is no guarantee that these FWRSs with a high impact on eco-efficiency can be applied in the field and be sustained over time, since several factors can make this task difficult, if not impossible. Thus, improving a restaurant's eco-efficiency requires two things: 1) identifying FWRSs that can significantly reduce the costs and environmental impacts associated with FW, and 2) understanding the factors that facilitate or complicate the implementation of these FWRSs, to identify those that are best suited to a particular type of restaurant. However, to our knowledge, this last aspect has never been studied in depth yet. Thus, this study aims to identify the factors affecting the implementation of FWRSs to promote the operationalization of FW reduction and, at the same time, to maximize restaurant eco-efficiency.

The article is structured as follows: Section 2 presents a brief literature review of FW and FWRSs studies in the foodservice sector and describes the framework on which the study was based (development of the interview guide and results analysis): the social practice theory. Section 3 details the methodology of the study. In section 4, the results are presented according to the three components of the social practice theory. In section 5, the operationalization of FW reduction through the implementation of FWRSs is discussed by highlighting how it can be influenced by the restaurant type. It is followed by a short conclusion. Finally, as data collection took place during COVID-19, the impact of this pandemic on FW and FWRSs implementation is presented in the Supplementary material.

2. Literature review

2.1. Food waste in the foodservice sector

In recent years, the number of studies on FW has greatly increased. Some took a quantitative approach to measure its magnitude and categorize it. These have assessed the FW amount generated in various types of food establishments from petrol stations to hospital food services (Beretta et al., 2013; Betz et al., 2015; Derqui et al., 2018; Engström et al., 2004; Papargyropoulou et al., 2016b). This type of approach also allowed to identify the origin of the FW (e.g. plate waste, spoilage, preparation waste), the type of food composing it (e.g. vegetables, meat, cereals) as well as its avoidance potential (Lévesque et al., 2022b, 2023; Papargyropoulou et al., 2016b). Other studies used a qualitative methodology to identify and understand its root causes. These causes are numerous and variable, ranging from poor management practices to high consumer demands, including the lack of experience of the cooks (Abdelaal et al., 2019; Bell et al., 2020; Dagiliūtė et al., 2019; Gao et al., 2021; Goh et al., 2019). Additionally, these studies provided an in-depth understanding of the operational issues surrounding FW reduction. Some of them highlighted the perceptions and attitudes of consumers, restaurant managers and employees on FW (Aamir et al., 2018; Bharucha, 2018; Principato et al., 2018). The FWRSs already in place in restaurants have also been discussed in several studies (Okumus et al., 2020; Papargyropoulou et al., 2019; Wang et al., 2021) just like those that could be implemented following the analysis of the FW causes (Filimonau et al., 2019, 2021a; Okumus, 2019). As for the eco-efficiency concerning FW in the foodservice sector, a few studies have examined the subject. Some studies have treated the environmental and economic impacts of FW separately, without linking them via the eco-efficiency concept (Garcia-Herrero et al., 2018; Dias-Ferreira et al., 2015). Others have determined FW hotspots from an eco-efficiency point of view by linking the cost and the quantity discarded of different food categories (Papargyropoulou et al., 2016a; Thamagasorn et al., 2019). These hotspots have also been identified by quantifying the purchasing, waste management and labor costs associated with FW, while also considering their environmental impact using a life cycle assessment according to 4 impact categories (Lévesque et al., 2022a). These same indicators were used to model the eco-efficiency of different FWRSs that could be implemented in a restaurant. However, this seems to be the only study to date to have looked at the subject of eco-efficiency in relation to FWRSs (Lévesque et al., 2022a). Thus, to date, no study has looked at the perception of restaurateurs regarding the restaurant eco-efficiency improvement by the implementation of FWRSs. Regarding the identification of factors affecting the implementation of FWRSs, some studies have briefly raised awareness of the existing barriers. A few of them are related to the restaurant's external environment such as the lack of government support and incentives to reduce restaurant FW and rigid food safety standards (Engström et al., 2004; Charlebois et al., 2015; Kasavan et al., 2019; Martin-Rios et al., 2018). Internal barriers include lack of space to store food surplus, lack of time to reuse FW, non-flexible menu, negative attitude of employees and managers towards FW and costs associated with FW reduction (Engström et al., 2004; Charlebois et al., 2015; Kasavan et al., 2019; Martin-Rios et al., 2018). As for the factors facilitating the implementation of FWRS in the foodservice sector, they are scarcely discussed in the literature. Favorable cost analysis, experimentation with existing management practices, and change in the existing business model have been identified as the top three drivers for adopting FWRSs (Martin-Rios et al., 2018). Good communication between managers and staff also helps to identify the best FWRSs to adopt (Charlebois et al., 2015). Finally, it has been argued that plate size reduction is easier to adopt when customers have high levels of health and environmental awareness (Filimonau et al., 2020).

Thus, it turns out to be a major issue to explore in-depth the different factors affecting the implementation of FWRSs to better identify FWRSs

that can be successfully implemented in the foodservice sector. In addition, there has not been, to date, any study linking the factors affecting the implementation of FWRSs to different restaurant types to identify the best FWRSs to implement according to these two parameters. Also, the concept of eco-efficiency does not seem to have been used so far to know the perception of restaurateurs concerning the reduction of FW. Thus, the consideration of these different elements proves to be a further step to improve the eco-efficiency of restaurants, as it helps to maximize the economic and environmental benefits derived from the operationalization of FW reduction through the successful implementation of FWRSs.

2.2. Social practice theory

Implementing FWRSs within restaurant operations requires a transformation of existing ways of functioning. However, these tend in particular to be strongly rooted in habits, to such an extent that they can hardly be changed (Dubuisson-Quellier et al., 2013; Sahakian et al., 2014). The adoption of new, more sustainable behaviors at the institutional level can therefore be greatly facilitated by the identification of the factors allowing the modification of these habits to facilitate the process of change (Sahakian et al., 2014). To achieve this, the present study relies on a social practice approach to better understand what promotes and what inhibits the reduction of FW and the implementation of FWRSs. This approach was chosen contrary to behavioral theories since FWRSs are practices that persist within an organization (restaurants) despite staff changes.

Practices are entities defined by a routine, which repeats over and over in a certain way. They spread by being adopted by new individuals, called "practitioners", who implement them routinely (Dubuisson--Quellier et al., 2013). According to the version of the social practice theory popularized by Shove & Pantzar, practices are a social phenomenon created by the association of three elements: meaning, competencies and skills, and material (Shove et al., 2005). The meaning can be described as the social and symbolic significance, emotions, beliefs, mental activities and aspirations associated with practice. Competence refers to practical knowledge, know-how, understanding and technical aspects. Technologies, objects, tools, materials, infrastructures, the body itself and other tangible physical entities characterize the material dimension of practices (Shove et al., 2005, 2012). The social practice approach therefore goes far beyond behavioral theories where the analysis is centered on the individual, his attitude and his values to explain a specific behavior (Spurling et al., 2013). Indeed, these elements represent only the tip of the iceberg, while behaviors are also influenced by cultural meanings, socially acquired skills, technologies, organizational culture, infrastructures and products, in particular.

The creation of a practice tends to follow the specific process illustrated in Fig. 1 (Shove et al., 2012). Meaning, competence and material must form links under a specific combination. Initially, these three elements exist in the environment independently, which forms a proto-practice. These links emerge, persist and disappear quickly, except on one occasion: when the practice is reproduced. As soon as it becomes routine and normalized, the different elements are integrated, which ensures their stable configuration. Over time, the configuration of the elements can change which leads to the evolution of the practice or its disappearance (Shove et al., 2012). The study of the elements constituting a practice thus allows one to identify the factors leading to its overhaul, substitution and anchoring to facilitate the adoption of more sustainable practices (Spurling et al., 2013), leading to FW reduction. In this sense, the transformation of practices and their entrenchment can promote the implementation of measures with a high impact on eco-efficiency such as FWRSs.

Some studies have put forward the social practice theory to analyze how FW is generated or reduced in the foodservice sector. One such study focused on how FW issues are perceived and addressed by restaurateurs by highlighting the role of knowledge (meaningful and materiality knowledge) to the competence component of social practice theory (Hennchen, 2019). Similarly, the notion of adequate portion was investigated with a focus on material and practical understanding. This brought up 7 factors influencing portion size (Hennchen, 2021). Social practice theory was also used to study how leftover lunch services became a routine in Finnish schools (Laakso, 2017). Finally, the study closest to the present work proposes a tool to guide FW management strategies. It uses a framework based on system theory and social practice theory, which allows a better understanding of the reasons, attitudes and values that influence waste-related practices (Goonan et al., 2015). The method of analysis used in the present study is inspired by the tool presented by these researchers. However, it has only been tested in school cafeterias, so it is possible to assume that new elements should emerge in the context of independent foodservices, whereas these two types of food establishments operate in very different contexts. In addition, the present study will take into account the restaurateur's perception of eco-efficiency and FWRSs as well as the impact of restaurant characteristics on the best FWRSs to implement successfully to maximize eco-efficiency.

3. Methodology

3.1. Food waste definition and boundaries

Although the term FW is commonly used in the food and scientific community, many definitions have emerged, illustrating a lack of consensus on the subject (Roodhuyzen et al., 2017). In the present study, participants were asked to give their definition of FW. Subsequently, the definition used by the researchers was disclosed to them to guide the rest of the discussion on a common base. This definition is the one presented in the FAO et al., 2019 report on food losses and waste, which states that FW is the decrease in quantity or quality of food at the retail and

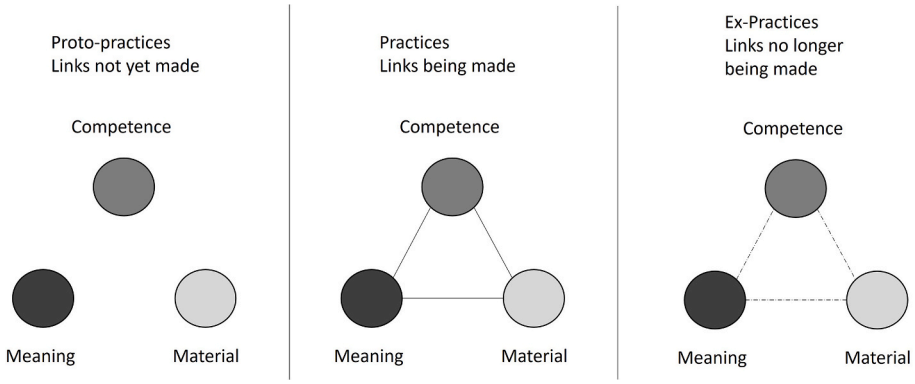

Fig. 1. Process of creation and disappearance of practices according to Shove et al. (Shove et al., 2012).

consumption level. Inedible parts of food are not considered as FW (FAO, 2019).

3.2. Research design

This study focuses more specifically on the commercial foodservice sector in the province of Quebec (Canada). There are approximately 18,000 commercial foodservice establishments in Quebec. Of these, 58% are independent restaurants and the rest are chains. Competition is fierce in Quebec's commercial restaurant sector, with only 29% of restaurants surviving after 5 years in business, and 15% after 9 years. At the height of the tourist season, almost 3% of the population work in this industry (Association Restauration Québec, 2023).

This study adopted an exploratory qualitative approach to gain an in-depth understanding of the factors affecting the implementation of FWRSs in the commercial foodservice sector of Quebec province. Primary data were generated through semi-structured interviews with sixteen French-speaking independent restaurant owners, managers and head chefs of the province of Quebec in both remote regions and urban centers. The description of the participants is presented in Table SM1 and that of their restaurant in Table SM2. The restaurants under study were subdivided into two types, the characteristics related to these being presented in Table SM3. Restaurant chains were excluded from the study to allow a more in-depth exploration of the independent restaurant sector, which dominates the provincial culinary scene (Association Restauration Québec, 2023). Semi-structured interviews allow the researcher to be guided by the words of the interviewee and to build a common understanding of the phenomenon under study through discussion (Savoie-Zajc, 2003), hence the interest in using this methodology as part of an exploratory study.

3.3. Data collection

Snowball and convenience methods were used as sampling methods. These were chosen because their use is valued to access a group of participants that is difficult to reach, which is the case of restaurateurs (Liamputtong, 2015). The project was approved by Laval University's Research Ethics Board (Approval No, 2021-150/21-06-2021) and by HEC Montreal Ethics Board (Approval No, 2022–4662).

Recruitment was initiated using the social networks of the research units affiliated with the team members. In addition, restaurateurs were contacted via their restaurant's website and social networks to invite them to participate in the study. The recruitment criteria were to be the owner, manager or chef of an independent Quebec restaurant, to understand and speak French fluently, and to be over 18 years of age. Interviews took place from July 2021 to April 2022 and lasted approximately 60 min. At the end of each interview, the participant was asked to forward, at their discretion, the recruitment email to colleagues in the sector who might be interested in participating in the current study.

To keep the participants anonymous, each one was assigned an identification number. Each participant had to sign a consent form (in French) right away before the interview. None of the participants received a financial compensation. The interview guide is presented in the Supplementary material.

3.4. Data analysis

The interviews were transcribed in their original language (French) and coded with the assistance of NVivo software (QRS International Pty. LTD, Doncaster, Victoria, Australia). The initial codebook was built based on the three central sections of the interview guide (sections B, C and D) by deductive coding. During the analysis, new categories and subcategories were identified inductively and added to the codebook. This hybrid code method makes it possible to organize the data and develop them to complete the codes with the emergence of new themes (Fereday et al., 2006). Finally, a mind map was created for each of the three sections from the overall results to summarize the elements composing the codes and to identify the major findings resulting from the analysis. In the case of the codes associated to the factors affecting the implementation of FWRSs, each of them was then categorized according to the element of the social practice theory to which it refers.

4. Results

This section presents the statements mentioned by the participants during the interviews. They are subdivided according to the central sections of the interview guide. The last section of the interview guide, on the impacts of pandemic COVID-19 on FW generation and FWRSs implementation, is however presented in the Supplementary material.

4.1. Perception of food waste, eco-efficiency and food waste reduction strategies

The first observation of this study turns out to be that the restaurateurs interviewed are very aware of FW. They consider that its generation is reprehensible and that it is unacceptable to trivialize it in the industry. Several participants justified this thought by the ethical and social issues associated with FW such as food inequity and food insecurity. In addition, the feeling of shame related to FW seems to be amplified when food that comes from local producers that they know well is wasted. This contradicts the literature where in general, restaurateurs perceive FW as a minor and negligible problem (Filimonau et al., 2021b; Sakaguchi et al., 2018). One explanation may be that many FW awareness campaigns have been launched in recent years in Quebec and Canada. It can also be attributed to the fact that the majority of participants have a university degree (see Table A1) as a high level of education is linked to greater environmental awareness (Strieder Philippsen et al., 2017; Ziadat, 2010). However, two-thirds of the interviewed restaurateurs mentioned that FW is inevitable in the foodservice industry. The definition of FW set out by the restaurateurs was quite similar between them, contrary to the findings of a previous study (Derqui et al., 2016). All participants included in this definition the FW associated with food preparation, storage and surplus. As for consumer plate waste, the majority of participants (13/16) consider it as FW since it is an indicator of poor meal quality or inadequate portion management. However, it was mentioned that this type of FW is difficult to eliminate, as restaurateurs have no control over consumer behavior, considering that they have paid for the meal. This aspect was also raised in previous studies (Okumus et al., 2020; Hennchen, 2019). The reduction of leftovers is therefore a joint responsibility between consumers and restaurateurs. All participants agree that inedible food discarded is not FW. However, a few mentioned that these foods should be used to their maximum, making broths from bones for example. It was also raised that the inedible food parts could be revalorized by other actors of the food chain, for instance, a farmer who could use them for the fertilization of agricultural fields.

As for eco-efficiency, it is an unknown term for restaurateurs. By its composition, they understood that this word is linked to the environment and efficiency. Moreover, although all participants agree that FW has an impact on the environment, few of them were able to explain in detail the causes. On the contrary, as mentioned by another study (Goonan et al., 2014), the economic impacts of FW are very well-known to restaurateurs. They mentioned that FW has a major impact on their profit margin as it increases the cost of purchased raw materials. In addition, the profits associated with the sale of food are lost when the food is discarded. Moreover, FW may have taken staff time to process foods, which may have resulted in labor costs. The purchase or rental of garbage cans and waste collection is another cost to take into account. Overall, reducing FW sounds to participants like a logical way to improve their restaurant's profitability. This is in agreement with what is reported in the literature (Martin-Rios et al., 2018). It was raised that

FW revalorization provides value-added meals since they are composed of unique and creative products. For some restaurateurs, a low level of FW is synonymous with better competitiveness since they can sell their meals at a lower price than their competitors. In addition, many participants mentioned that FW reduction is inevitable to counter inflation and rising food costs. Finally, restaurateurs agree that FW has both an economic and an environmental impacts and that these two aspects can be improved through the implementation of FWRSs, as they are interrelated.

4.2. Factors affecting the implementation of food waste reduction strategies

As was mentioned in section 2.2, according to the social practice theory, the factors affecting the implementation of FWRSs can be subdivided into three categories: meaning, competencies and material. These are presented in three separate subsections. Resources such as time and costs have been added to the material element since these are tangible and quantifiable concepts. Table 1 identifies the main factors raised during the analysis of the interviews.

4.2.1. Meaning

Consumer perception has both negative and positive impacts on the implementation of FWRSs in a restaurant according to several restaurateurs. First, it may be desirable for FWRSs to be visible to clients, especially in fine-dining restaurants. Participants indicated that this is the case when FW is enhanced in an original way (e.g., creating decorative edible powders from vegetable peels). It is desirable that this transformation brings added value to the food and distinguishes the restaurant from its competitors. Showcasing these efforts can bring in more environmentally conscious consumers and inform them of ways to reduce their own FW. In these cases, the waiters have a particularly important role to play as they must communicate the various FWRSs put in place. However, some restaurateurs are more reluctant to do this as a lot of information is already communicated to consumers. On the contrary, it was also mentioned that consumers should not perceive some FWRSs, given the risk of offending them and losing their loyalty, which is in agreement with what is reported in the literature (Filimonau et al., 2022). This is the case when less preferred parts of food (e.g. broccoli stalks) and ugly foods are "hidden" in the dishes, these FWRSs being mostly used in family and casual type restaurants. For some participants, it is also important to think about how to apply FWRSs that are less acceptable from a food safety perspective to not affect consumers. This is also the case for FWRSs that aim to reduce portion size, which is unacceptable for some consumers according to some restaurateurs. It is this prospecting work that the owner of a fine-dining restaurant carried out to be able to reuse certain foods served to consumers:

> *P1: I'm going to go back to what I was saying about oysters and bread jars. It's been worked on how we bring it to the consumer and how to present it so it looks good while doing our job to control these losses. That was a lot of work because you have to wonder if the consumer is going to find it disgusting that I bring him a little jar of mignonette which, even if there is a small lid, was on another table before.*

Two head chefs working in hotel fine dining restaurants mentioned that senior management's lack of openness to the implementation of certain FWRSs is proving to be a major barrier. For them, this is part of a vision focused solely on the profitability of the restaurant since an increase in the labor cost to limit the FW is frowned upon. In addition, if a FWRS is not in line with the vision of the restaurant carried by the administrators, it cannot be implemented, which was also raised previously (Kasavan et al., 2019). These two participants observed that it is particularly important to demonstrate the benefits resulting from the implementation of FWRSs:

> *J: How did you get them (senior management) to change their minds?*
>
> *P4: We tripled the restaurant's turnover.*
>
> *J: Is it true that it's quite convincing!*
>
> *P4: Then after there was a huge craze around the inn table. We were full 2 to 3 weeks in advance, so they saw that they could let me do whatever I wanted in the kitchen.*

4.2.2. Competencies and skills

The competencies of the restaurant owners, managers and floor staff are an important factor to consider when implementing FWRSs. Communication between managers and the floor staff has a direct impact on FW generation. It was raised by participants that a lack of communication and follow-up from the managers will hamper the implementation of FWRSs since there will be no assurance that they will be executed in the kitchen and the service. On the contrary, a lack of information from the cooks or waiters to the managers will not allow them to properly identify the sources of FW and to follow up on the efficiency of FWRSs in place. This is consistent with the literature, which identifies communication as a success factor in change management because it provides transparency in addition to resolving conflicts and resistance (Lauer, 2021).

The acquisition of cooking knowledge, skills and experience allows to limit the errors of preparation (Kasavan et al., 2019). It has been mentioned by several fine-dining restaurant owners that having qualified cooks is also an asset for reusing food that would otherwise have been discarded. According to them, such knowledge can be acquired through training, gaining experience and using reference books (e.g. recipe books) and specialized websites. Creativity was also mentioned as an important skill to find original ways to reuse food and transform its unpopular parts.

In the case of restaurant owners, managers and chefs, management, planning and organizational skills were raised as being essential to minimize FW at the source. According to most participants, order planning must be carried out accurately to avoid storage waste. In some cases, a standardized process must be implemented upon receipt of raw materials to sort them according to their freshness and use. The warehouse management method should allow quick identification of foods and extend their shelf life as needed. A tour of the warehouses and sorting of the food they contain must be carried out regularly. It was also reported by several participants that the menu should be designed to reduce FW. The option suggested by the owner of a fine dining restaurant was to have a flexible menu to which it is possible to add revalorized foods and whose composition is ephemeral. Additionally, several participants mentioned that the dishes on the menu can be vague, to offer flexibility in their composition (e.g. soup of the day, meat sandwich). According to the head chef of a family-style restaurant, the menu can also be limited and fixed in time to standardize kitchen operations in to reduce FW:

Table 1
Factors affecting the implementation of FWRSs according to elements of social practice theory.

Element	Factors
Meaning	• Consumer perception • Senior management vision
Competence	• Communication between managers, cooks and waiters • Cooking knowledge, skills and experience • Creativity • Management, planning and organizational skills • Ability to educate, mobilize and raise awareness
Material and resources	• Restaurant physical infrastructures • Lack of time • Lack of staff/high staff turnover • Labor and food costs • Collaboration with local actors

P13: I find that the more you have routine and identical dishes, the better you control your orders because it's always the same products and the same production patterns. As soon as we started going to special dishes and menus, that's where FW increased.

Alternatively, the owner of a microbrewery restaurant mentioned that the menu may include a wider choice of items, but these may be prepared from a limited number of foods that intersect from one dish to another:

P11: I give you an example. Our homemade cheese sticks are made with our leftover cheese curds that we didn't spend in our poutines. So these are things like that that intertwine to ensure that, if I haven't been able to use the product, I'm able to process it and then move it elsewhere. So, it's in this way that the menu was thought out. It allows you to have a great choice, the food is very varied and it corresponds to everyone's taste, but everything is well thought out.

In the different cases, the menus should be designed in a way that the FW generated by a dish (e.g. carrot peels) can be reused elsewhere in the menu (e.g. vegetable soup) as mentioned by a previous study (Okumus, 2019).

Having skills to educate, mobilize and sensitize employees to the FW is one of the keys to success in the implementation and rooting of the FWRSs according to the participants and the literature on change management (Lauer, 2021). Many of the participants stated that having restaurant owners aware of this issue facilitates the transmission of FW awareness to employees. Some restaurateurs consider FW awareness as a criterion for employability, particularly when looking for a chef or sous chef. By their constant presence in the kitchen, they can set an example and support other employees in the application of FWRSs. Otherwise, many participants consider that the concern for FW in the restaurant must be mentioned as soon as the new employee arrives and that he must be immediately trained in the application of the FWRSs, as suggested in the literature (Okumus, 2019). However, as described in a previous study (Filimonau et al., 2019), employees lack commitment to the implementation of FWRSs because they are perceived as a burden since they only see the additional work related to them and no personal benefit to apply them. Indeed, the fear of being overwhelmed represents the third reason for fear of change by the employees of an organization (Lauer, 2021). A pedagogical approach has been identified by the participants as beneficial to make employees understand the reasons for implementing the FWRSs and facilitate their adherence. This is in agreement with a previous study (Luu, 2020), which has put forward that educating employees on the impacts of FW and the benefits of its reduction increases their intention to participate in this process. It was also raised that an employee who is particularly aware of the issue of FW can be put in charge of mobilizing the other employees. As suggested by the literature, a participatory approach is another potential way of mobilization (Okumus, 2019; Strotmann et al., 2017). Indeed, the floor staff may be more open to implement FWRSs if they participate in the identification of FW hot spots and finding solutions to reduce FW. Perseverance is also needed to turn the one-time execution of a FWRS into a habit integrated into the operation of the restaurant.

4.2.3. Material and resources

The first material aspect affecting the implementation of FWRSs is the physical infrastructure present in the restaurant. A particular issue experienced by participants is the size of the warehouses. Small warehouses are problematic for many restauranteurs since the organization of this small space is more complex. This lack of storage space limits the ability to freeze food and store fresh food and products that are processed to extend their shelf life (e.g. fermented products and preserves) as raised previously (Kasavan et al., 2019). Difficulties with access to food in warehouses (when these are full or unsuitable) discourage employees from searching for food, which causes FW. Finally, some restaurateurs mentioned that a small kitchen preparation space limits the ability to process FW. However, it was mentioned that most of these issues can be reduced by good warehouse management.

Lack of time is a major barrier to the implementation of FWRSs according to all the participants. Indeed, the first step in reducing FW is to observe its sources, identify the causes and find appropriate FWRSs (Kasavan et al., 2019), which restaurateurs generally do not take the time to carry out. In addition, the implementation of some FWRSs requires additional staff time (Engström et al., 2004), e.g. processing food waste and monitoring warehouse inventory. Managers and owners also need to take the time to follow up on FWRSs to ensure their implementation by employees. One participant noted that it is beneficial to implement these FWRSs little by little over time to ensure proper integration of each of them before implementing a new one. Despite everything, several restaurateurs have confessed that the glaring lack of staff in the industry makes this process difficult since the priority of a restaurant turns out to take good care of the consumer and not to reduce FW. In addition, the lack of staff can easily lead to a loss of control in the production of FW. Many restaurateurs have decided to reduce their opening hours, among other things, to avoid this situation. High staff turnover is also present, which makes it more difficult to perpetuate FWRSs over time. It was raised by some participants that the recruitment and retention of employees are facilitated by the consciousness of environmental issues of their restaurants, which includes being concerned with reducing FW.

The labor time required to implement certain FWRSs is directly related to costs, which greatly affect restaurateurs' adherence to FWRSs according to several participants. Their opinion differs on this subject: for some participants whose reduction of FW is integrated into their values, it is not necessary to make profits with the reduction of FW as long as it does not bring economic losses. Other restaurateurs consider that the recovery of FW is not worth the effort when it requires additional work time because of the associated costs. It was also raised that the additional costs associated with the FWRSs are not problematic, as these are factored into the overall restaurant operating costs in a way that does not affect the profit margin. Another issue is the rising cost of food, which causes restaurateurs to stock up at a lower cost. A widely used way to solve this problem by the participants is to create collaborations with local actors. By purchasing food directly from producers, restaurateurs can order smaller quantities of raw materials suited to their needs. As mentioned in the literature (Filimonau, 2021), producers can also sell food surplus and ugly food at reduced prices. One participant also started contacting a retailer to buy his soon-to-be-expired food at a discount. Through these relations, exchanges of tips and tricks to limit FW and recover it can be transmitted. However, it was mentioned that creating these relationships requires additional efforts to connect these actors, collect the food if necessary, sort and transform it. One restaurant manager suggested that this could be facilitated by platforms for connecting players in the agri-food sector and by pooling resources between them.

5. Discussion

5.1. Recommendations for operationalizing FW reduction

Several observations emerge from the analysis of the results. These are therefore detailed in this section to issue recommendations to promote the reduction of FW.

As demonstrated, many factors that affect the implementation of FWRSs are present in the restaurant ecosystem. These vary from one restaurant to another, which will have an impact on the choice of the best FWRSs to implement to maximize eco-efficiency. From the results of this study, it was drawn that the restaurant type is a key element allowing to distinguish the best way of operationalizing the reduction of FW. Indeed, the factors affecting the implementation of FWRSs diverge according to the characteristics of a restaurant, which makes it possible to identify the best FWRSs to put in place. For example, it is unrealistic to

ask cooks to reuse wasted food if they do not have developed cooking skills that would enable them to perform such an operation. On the contrary, it is possible to implement this FWRS with very creative cooks having the necessary skills.

Based on the results of this study, both a preventive and a corrective approach can be adopted in fine dining restaurants while family-style and casual restaurants should instead consider adopting a predominantly preventive approach. A corrective approach requires qualified staff with great culinary knowledge, skills and creativity, which fine dining restaurants usually possess (Zopiatis, 2010). These assets are essential to be able to transform ugly, unappreciated and soon-to-expire foods or reuse surpluses. All of this can lead to obtaining original dishes with added value, as desired by the consumers of these establishments. This added value should, as far as possible, be communicated to consumers so that they can perceive it. A flexible menu, which chefs and cooks can adapt according to the FW generated daily, is a facilitating factor for this type of FWRSs since the composition of the resulting dishes is variable depending on the FW generated.

A preventive approach rather aims to reduce FW at the source, even before it is generated. Thus, it requires an excellent sense of organization and tight planning of restaurant operations. Restaurant managers and the head chef therefore have a major role to play in limiting FW upstream. The first element to consider in this approach is the menu design. A good way to reduce FW is to offer consumers a menu composed of a limited quantity of raw materials to facilitate warehouse management and order planning. In the case of a fine dining restaurant, the menu may consist of a single (or limited), meal choice that will be served to all consumers. As mentioned above, this menu can be adapted daily to include foods that would otherwise be discarded, such as surplus or less appreciated foods (e.g. vegetable peelings). For family-style and casual dining restaurants, the ideal would be for the menu to include a limited choice of items and for them to be fixed (always on the menu) or present in rotation (return to the menu after a set amount of time). This allows to implement standardized work methods that would limit FW and incorporate FW into routine restaurant operations so that everything is imperceptible to consumers. For example, a restaurant that generates large amounts of root vegetable peels can reuse them in another menu item such as soup or imperial rolls. If a menu with a wide choice of items is desired, it should be made from limited raw materials that can intersect (e.g. cheese sticks made from cheese curds that are no longer fresh and normally used in another dish). The same rule applies when it is desired to add a new item to the menu. In the case of a fine dining restaurant where complete menu changes are made repeatedly, a good practice is to plan the menu according to the FW that will be generated. For example, if it is desired to have beef tartare on the menu, there will be pieces of browned beef that will be discarded. It would seem possible to plan ahead for their reuse in another dish rather than discard them. Thus, the chef of this type of restaurant must have the skills to plan the menus in both a creative and rational way. If a restaurant (no matter the type) offers several services (banquets, take-out, ready-to-eat, etc.) these should consist of a limited quantity of food. Surpluses and soon-to-expire foods should be able to be reused between services.

In any case, mobilizing employees to reduce FW is essential to facilitate the implementation of FWRSs. Several methods can be used in complementarity, but some have more potential than others depending on the type of restaurant. As fine dining restaurants have a hierarchy that is generally highly respected by the staff (Ganter, 2004), it could be beneficial to hire a head chef or sous-chefs who are highly aware of FW. Thus, this could facilitate the implementation of work methods in the kitchen that promote the incorporation of FWRSs and the education of employees on this issue. In addition, their constant presence in the kitchen facilitates the anchoring of FWRSs in the work routine of employees. In the case of family-style and casual dining restaurants, a participatory process seems to be a potential way to mobilize employees in the reduction of FW. It has been shown that the integration of employees in participatory organizational processes reduces resistance to change and promotes their commitment to solving organizational problems (Strotmann et al., 2017; Nielsen, 2013). In addition, it promotes the well-being of employees, group cohesion and job satisfaction (Nielsen, 2013), which may thereby promote staff retention. Moreover, FWRSs emerging from this process have a greater chance of being easily implemented as floor staff can easily identify whether a FWRS can fit into the standardized operations already present in the restaurant. It should be noted that this approach could also be adapted to a fine dining restaurant. The organization of a co-creation workshop is a possible way to implement this participatory process as realized previously (Strotmann et al., 2017). FW reduction targets can also be issued to provide an additional motivational factor.

5.2. Study limitations

This study was carried out only with independent restaurateurs. The results therefore do not shed light on the factors affecting the implementation of FWRSs in other food establishments such as chain restaurants, hospital and school food services, and corporate cafeterias. Furthermore, as the interviews took place in Quebec (Canada), the results were necessarily affected by the local environment. Finally, this study was carried out during the COVID-19 pandemic. It is therefore possible that certain factors raised are specific to this period.

6. Conclusion

The present study aims to to guide restaurateurs in implementing FWRSs by highlighting 12 factors affecting their implementation. Based on these factors, it has been identified that family-style and casual dining restaurants should opt for a preventive approach to reducing FW, while fine-dining restaurants may also use a corrective approach. The most promising ways to operationalize the reduction of FW according to the restaurant category were raised. Thus, this study is leading to the creation of new knowledge about issues related to FWRSs implementation, which can be used in future research. Also, through the visibility of many chefs, highlighting their efforts in the fight against FW could influence consumers to reduce FW at home. For restaurateurs, this study provides the tools they need to identify adapted FWRSs. Ultimately, this will help to maximize a restaurant's eco-efficiency by identifying which of the FWRSs with a high impact on eco-efficiency have the greatest potential for successful implementation. Profits from reducing the costs associated with FW can have several other benefits (e.g. they can be used to improve employee wages or purchase local and/or sustainable foods) while the reduction of the environmental impact of FW can be communicated to consumers and can lead to certification. However, the interviews revealed that the participants had a lack of knowledge of the environmental impacts of FW and FWRSs, which limits the identification of FWRSs with a high impact on eco-efficiency. Future studies could therefore focus on the best ways to provide restaurateurs with more information about the environmental impacts of FW and FWRSs since this task can be difficult given the complexity of environmental impact analyses. It would also be interesting to carry out a similar study on a national or international scale and with other foodservice types (e.g. restaurant chains, collective catering) to identify the best ways to operationalize FW reduction on a larger scale for a variety of food establishments. Finally, to document other elements of a restaurant's eco-efficiency than FW would also be possible, for example, by looking at the barriers to the creation of healthy, low-price menus with low environmental impact.

CRediT authorship contribution statement

Jade Lévesque: Conceptualization, Data curation, Formal analysis, Methodology, Writing – original draft, Writing – review & editing. **Laurence Godin:** Conceptualization, Resources, Validation, Writing – review & editing. **Véronique Perreault:** Conceptualization, Funding

acquisition, Resources, Writing – review & editing. **Sergey Mikhaylin:** Conceptualization, Funding acquisition, Methodology, Project administration, Resources, Supervision, Validation, Writing – review & editing.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

Data will be made available on request.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.jclepro.2024.140765.

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