

Journal Pre-proof

Food waste management in Shanghai full-service restaurants: A senior managers' perspective

Viachaslau Filimonau, Huining Zhang, Ling-en Wang



PII: S0959-6526(20)31022-2

DOI: <https://doi.org/10.1016/j.jclepro.2020.120975>

Reference: JCLP 120975

To appear in: *Journal of Cleaner Production*

Received Date: 2 December 2019

Revised Date: 7 January 2020

Accepted Date: 6 March 2020

Please cite this article as: Filimonau V, Zhang H, Wang L-e, Food waste management in Shanghai full-service restaurants: A senior managers' perspective, *Journal of Cleaner Production* (2020), doi: <https://doi.org/10.1016/j.jclepro.2020.120975>.

This is a PDF file of an article that has undergone enhancements after acceptance, such as the addition of a cover page and metadata, and formatting for readability, but it is not yet the definitive version of record. This version will undergo additional copyediting, typesetting and review before it is published in its final form, but we are providing this version to give early visibility of the article. Please note that, during the production process, errors may be discovered which could affect the content, and all legal disclaimers that apply to the journal pertain.

© 2020 Published by Elsevier Ltd.

Note on contributions:

Viachaslau Filimonau contributed to the literature review and data analysis and wrote up the manuscript.

Huining Zhang contributed to the literature review, data collection and analysis.

Ling-en Wang contributed to the literature review and data analysis.

**Food waste management in Shanghai full-service restaurants: a senior managers'
perspective**

Viachaslau Filimonau^{1*}, Huining Zhang¹ and Ling-en Wang²

¹Faculty of Management, Bournemouth University, Talbot Campus, Fern Barrow, Poole,
Dorset, BH12 5BB, UK

²Institute of Geographic Science and Natural Resource Research, Chinese Academy of
Sciences, 11A, Datun Road, Chaoyang District, Beijing, 100101, China

Email: vfilimonau@bournemouth.ac.uk

Phone: +44(0)1202965980

*Corresponding author

**Food waste management in Shanghai full-service restaurants: a senior managers'
perspective**

Journal Pre-proof

Abstract

The challenge of food waste in the foodservice sector of China is under-examined. This paper advances knowledge by exploring the food waste management practices adopted in a sample of Shanghai full-service restaurants. Through 22 in-depth semi-structured interviews with senior managers it establishes the significance of the food waste challenge and identifies the Chinese food consumption habits as a major cause. Despite the pronounced role of consumers in food waste generation, restaurateurs largely fail to engage them in mitigation. To mitigate food waste occurring on customer plates, changes to the Chinese dining culture should be facilitated via nation-wide campaigns aiming to raise public awareness of food waste when eating out. The government of China should lead on the design of such campaigns, ideally involving celebrities for better consumer appeal and academics for the assessment of their effectiveness. The national government should also provide free-to-attend specialist training to restaurant managers and staff on how to mitigate food waste occurring in kitchens.

Keywords

Foodservice sector

Full-scale restaurant

Food waste

Mitigation

Dining culture

China

Journal Pre-proof

Highlights

- Explores food waste management in a sample of full-service restaurants in Shanghai
- Establishes the significant magnitude of food waste generation
- Pinpoints the Chinese dining culture as a major cause
- Highlights the mostly passive nature of existing mitigation approaches
- Elaborates on the interventions required for more effective mitigation

1. Introduction

The negative repercussions of wasting food have long been acknowledged (Engstrom and Carlsson-Kanyama 2004) but it was not until recently that food waste became an issue of global concern (Parfitt *et al.* 2010). This is partially attributed to grown political recognition of close relationships between wasted food and food insecurity given that, globally, a third of the food produced for human consumption is landfilled (FAO 2013) while the estimated 842 million people live in food poverty (Martin-Rios *et al.* 2018). Acknowledging the overlap between wasted food and food poverty, the United Nations (UN) have included food waste into their Sustainable Development Goals (SDG). Notably, SDG12, *Responsible Consumption and Production*, has set to halve global food wastage at the consumption stage and significantly reduce its occurrence at the stages of food production and distribution (UNSDG 2019).

The UN goal of mitigating food waste occurrence at the consumption stage concerns households and the sectors of retail and foodservice (UNSDG 2019). To aid in meeting this goal, numerous studies have examined the phenomenon of food waste in households and supermarkets (see, for instance, Filimonau and Gherbin 2017; Graham-Rowe *et al.* 2014; Parizeau *et al.* 2015). The challenge of food waste in foodservice provision has been studied less rigorously (Wang *et al.* 2017) which is a major shortcoming as available estimates suggest it is significant (Principato *et al.* 2018). For example, in Canada, the contribution of the foodservice sector to food wastage across the entire food supply chain is 9% by economic value (Zero Waste 2018) while the sectoral shares of 12% and 25% by weight have been reported for EU-28 (FUSIONS 2016) and USA (ReFED 2018), respectively.

The challenge of food waste in the foodservice sector is even more pronounced in emerging economies (Papargyropoulou *et al.* 2019). For example, Wen *et al.* (2018) posit that the foodservice sector of China generates half of the nation's total food waste. This

disproportionate share is mostly attributed to the increasing frequency of eating out driven by rising living standards among local residents (Filimonau *et al.* 2019a). Limited research on food waste occurrence within the foodservice sectors of emerging economies inhibits an understanding of the underlying causes and hampers the design of mitigation approaches underpinned by empirical market-specific analysis (Principato *et al.* 2018).

This paper advances the research agenda on food waste in the foodservice sector by exploring it within a sample of restaurants in Shanghai, China. The research questions the study has set to answer are as follows: 1) how significant is the challenge of food waste in Shanghai restaurants? 2) what are the causes of its occurrence? 3) what measures, if any, are adopted by restaurateurs for mitigation? and; 4) how can future mitigation become more effective? The study sheds light on the phenomenon of restaurant food waste in the context of a large global economy characterised by the rapidly developing patterns of out-of-home food consumption and a promptly evolving foodservice sector, thus providing insights into prospective policy and management interventions required for effective mitigation.

2. Study background

2.1. Magnitude of food waste in the foodservice sector

Although academic research acknowledges food waste as the main challenge for the short-term business profitability and the long-term environmental sustainability of the global foodservice sector (Goh and Jie 2019), accurate assessments of its magnitude are rare (Papargyropoulou *et al.* 2019). At the sectoral level, the large size and the complex structure of the sector hamper creation of comprehensive data inventories and hinder generalizations, thus impeding reliable sector-wide and/or country-representative estimates of food waste (Filimonau *et al.* 2019b). Moreover, at the organisational level, most foodservice providers

do not record the exact quantities of wasted food, while those very few operators that do keep accurate records consider these commercially sensitive with consequent unwillingness to share them publicly (Filimonau and De Coteau 2019).

In absence of scholarly research, the magnitude of food waste in the foodservice sector can be established through the estimates provided in specialised industry and/or governmental reports. For example, according to the report published by the Barilla Center for Food & Nutrition (2012), 1.9 million tonnes of food is annually wasted in the foodservice sector of Germany, which makes this country the largest offender in Europe (FUSIONS 2016). However, such specialised reports are predominantly available in developed countries and/or for large (chain) foodservice operators only. This is partially because of grown political concerns about the challenge of food waste occurrence in the national foodservice sectors of developed countries with subsequent pressures imposed on the industry to disclose measures towards its reduction (Rhou and Singal 2020). Despite this, even in developed countries the quality of food waste reporting is mediocre. For instance, FUSIONS (2016), a EU-28's initiative designed to reduce food waste occurrence across Europe's food supply chain, posits that sufficiently accurate estimates of food waste are only available for the foodservice sectors of eight EU countries, namely Austria, Denmark, Finland, France, Germany, Ireland, Sweden and the UK, while the figures for the remaining 20 member states are represented by rather crude estimates.

There are no comprehensive food waste reports available for the foodservice sectors of developing and transitional economies (Filimonau and De Coteau 2019). The main principle of [environmental] management suggests that, in order to manage [an issue], its accurate magnitude needs to be established first (Eriksson *et al.* 2019). In line with this principle, the lack of precise figures on food waste complicates an understanding of the main operational areas within foodservice provision where it occurs and makes it difficult for managers to

assign mitigation priorities (Papargyropoulou *et al.* 2016). It is therefore argued that a global database on food waste is required holding accurate, regularly updated, figures on food waste occurrence in the national foodservice sectors of as many countries as possible. Such a database should further contain examples of ‘best practices’ in mitigation adopted by various categories of foodservice operators. It should be provided in open access and in multiple languages in order to facilitate cross-boundary learning and knowledge exchange on effective management of food waste.

2.2. Drivers of food waste

Substantial efforts have been applied to establish and categorise the drivers of food waste occurrence in the foodservice sector. For example, Principato *et al.* (2018) distinguish between *kitchen food waste* and *client food waste*, arguing that the former occurs during the process of foodstuffs’ storing, meal preparing, ingredient cooking, dish plating & serving while the latter arises from customer plates. This is similar to the categorization adopted by Papargyropoulou *et al.* (2019) who divide food waste into *preparation*-related and *customer*-related with the latter category being sub-divided into *customer plate waste* and *buffet leftovers*. Pinto *et al.* (2018) split food waste into four categories claiming that food is wasted 1) because of spoilage; 2) during meal preparation; 3) due to excessive portioning and; 4) because of customer behaviour (so-called plate leftovers or plate waste). Martin-Rios *et al.* (2018) highlight three stages in food waste occurrence: *storage*, *preparation* (kitchen waste) and *consumption* (plate waste). This latter, three-stage, categorisation has been adopted in most industry and governmental reports on food waste in the foodservice sector (see, for example, WRAP 2017) that have further attempted to assign quantitative estimates to the relative magnitude of its occurrence. For instance, in the foodservice sector of Austria, 29% of food is wasted in the kitchen, mainly in the form of excess ingredients left from meal preparation and/or due to over-cooking resulting in unsold dishes (Hennchen 2019). In the

UK, 45% of food is wasted at the preparation stage, which is the responsibility of the kitchen department, 21% - due to food spoilage and quality deterioration, which is the responsibility of the kitchen and procurement departments, and 34% of food waste occurs on customer plates, which is the responsibility of consumers (WRAP 2017). The UK's Sustainable Restaurant Association provides slightly different figures for London pinpointing that most of food here is wasted in preparation (65%) followed by customer plates (30%) and then by spoilage (5%) (SRA 2010). Lastly, the data from Winnow (2019) suggest that, globally, over 70% of food waste occurs at the preparation stage. Similar conclusions are reported in academic research on food wastage within the foodservice sector in Malaysia (Goh and Jie 2019; Papargyropoulou *et al.* 2019).

The discrepancy in the estimates of how much food waste occurs at various stages of foodservice provision is partially due to the different measurement and allocation methods used (Eriksson *et al.* 2018). For example, a restaurant may decide to offer large(r) meal portions in pursuit of better consumer loyalty. Unfinished portions prompt a question about who should be held accountable for this wastage, i.e. a foodservice provider (preparation stage) or a customer (consumption stage) (Lorenz *et al.* 2017). Further, the difference in estimates occurs because of the substantial, market- but also business-specific, variations in how food is prepared, served and consumed (Pirani and Arafat 2016). For example, the *a la carte* service tends to waste more food at the preparation stage, while the '*all-inclusive*' or '*buffet*' service generates disproportionate wastage on the consumer side (Papargyropoulou *et al.* 2016). This complicates the task of producing accurate assessments and assigning the causes of food waste occurrence to specific operational areas within a foodservice business (Charlebois *et al.* 2015).

Based on this, Filimonau and De Coteau (2019) conclude that the drivers of food waste in the foodservice sector can be conceptualised as organisational (business-specific),

institutional (consumption market-specific) and (wider) societal (population- and/or consumer psychology-specific). For example, the owners of a foodservice business may decide to offer a buffet rather than a table service to its guests. Buffets are the most wasteful occasions of food consumption outside home and, hence, this corporate decision represents an organisational driver of food waste. Further, national health authorities regulate the length of storage of perishable foodstuffs in restaurants, but these regulations vary from country to country (Filimonau *et al.* 2019b), thus representing an institutional driver of food waste. Lastly, it is considered disrespectful in some cultures to leave plates clean (Wang *et al.* 2017), thus signifying a societal driver of food waste. For effective mitigation of food waste its key, business-/market-/or society-specific, drivers should be identified and appropriate measures need to be designed to reduce their occurrence.

2.3. Mitigation approaches

Approaches to managing food waste in the foodservice sector vary significantly depending on multiple factors (Papargyropoulou *et al.* 2019). These include, but are not limited to: foodservice provider type (for example, compare a hotel with limited catering facilities and a full-scale restaurant); nature of food consumption occasions (for instance, compare a la carte service and buffet), internal (financial, labour and knowledge) resources of a foodservice operator (for example, compare a small take-away and a large, chain-affiliated, restaurant) and market circumstances in which it operates (for instance, compare the EU with its strictly regulated food market and a developing country where food production and consumption standards are less established) (Filimonau and De Coteau 2019). The mitigation approaches can be linked to the main causes of food waste occurrence in foodservice operations, i.e. storage, preparation and consumption (Martin-Rios *et al.* 2018).

2.3.1. Storage

On-site spoilage due to technical failures and because of the foodstuffs over-passing their ‘best-by’ dates and/or losing their aesthetical qualities represents the most common reason for food waste generation in storage (Christ and Burritt 2017). It can be addressed by looking after the kitchen equipment well (Pirani and Arafat 2016) and adopting the *First In, First Out* (FIFO) approach in cooking, i.e. prioritise the earlier foodstuffs purchased and/or the ‘short-dated’ foodstuffs in meal preparation (Filimonau *et al.* 2019b). The food damaged in deliveries represents another contributor to food waste in storage (Kasavan *et al.* 2019). It can be avoided by building good relationships with suppliers so that the food is delivered in good shape/form and in the ‘right’ quantity while any damaged foodstuffs are taken back for off-site recycling and/or energy recovery (Filimonau and De Coteau 2019).

2.3.2. Preparation

Over-production of meals is the main reason for food waste generation at the preparation stage. It usually occurs because of mistakes in demand forecasting (Silvennoinen *et al.* 2015). To reduce its occurrence, subject to budget availability, a foodservice provider can adopt more sophisticated forecasting models rather than rely on managerial ‘guesstimates’ of the amounts of food required (Filimonau *et al.* 2019a). Further, when catering for large parties and events with their excessive food wastage, the number of guests in attendance should be reconfirmed to avoid over-cooking (Papargyropoulou *et al.* 2019). When forecasting fails and the guest numbers cannot be accurately established, excess food can be discounted and sold through the dedicated food rescue apps, such as the *Too Good To Go*, or via the digital food distribution platforms, such as Deliveroo and/or UberEats (De Almeida Oroski 2020). When this is unfeasible, unsold meals can be given to staff.

Excess ingredients represent another reason for wastage in food preparation. They can be repurposed by adopting (more) flexible menus/recipes and/or by redesigning them at short notice (Papargyropoulou *et al.* 2019). In general, long menus should be avoided to ensure

only a limited food stock is kept by a food operator at hand which can be easily replenished and/or reused (Filimonau and De Coteau 2019). If repurposing does not work, then any excess ingredients, or entire unsold meals, can be rescued and donated to charities that use them for cooking meals for the people in need (Lindberg *et al.* 2014).

Lastly, training should be provided to kitchen staff to make better use of raw materials, but also to facilitate creativity when redesigning menus and repurposing excess food ingredients. For instance, chefs can be trained to prepare portions that fit customer expectations (Betz *et al.* 2015). Likewise, plating skills of kitchen staff can be improved so that no food is wasted due to aesthetics reasons (Charlebois *et al.* 2015).

2.3.3. Consumption

Unfinished meals are the main reason behind food waste generation at the consumption stage (Pinto *et al.* 2018). To encourage more responsible consumption, portion control can be applied to design ‘ideal’ meals in terms of size (Principato *et al.* 2018). Alternatively, various portion sizes can be offered to customers with the freedom of choosing the portion size which is ‘right’ for them (Betz *et al.* 2015). Moreover, consumer food choice can be architected by, for example, reducing plate size, charging customers by weight of the food they order, rather than per portion, and/or encouraging restaurant guests to order less food at once but to order it more often (so-called down-sizing) (Kallbekken and Saelen 2013). Consumer choice architecture is particularly relevant for buffets as it arguably represents a single meaningful approach to minimise plate waste occurrence in the context of such all-inclusive, and subsequently wasteful, food consumption occasions. If consumer nudging does not work, then plate waste can be disincentivised by imposing a charge for any unfinished meals (The Local 2016). Should this be deemed inappropriate, then any meal leftovers can be proactively given to restaurant guests in take-away boxes for later consumption (Sirieix *et al.* 2017). Importantly, it is argued that all these measures should be applied by foodservice

operators in addition to educating consumers about the detrimental effect of food wastage. While the educational campaigns on food waste do not necessarily succeed in the short-term, they may nevertheless affect consumer behaviour in the long-term (Filimonau *et al.* 2020).

Figure 1 summarises findings from the literature review by mapping and quantifying the instances of food waste occurrence across the main operational stages of foodservice provision and by linking these to the key actors in charge and potential mitigation solutions.

[Insert Figure 1 here]

2.4. Food waste in the foodservice sector of China

China has long-established traditions of food consumption out-of-home (Wang *et al.* 2018). Furthermore, rapid growth of the Chinese economy in the last decade has raised country's living standards and increased the share of the middle class in country's population (Leung 2015). The Chinese middle class has developed a routine of eating out regularly, having spent on it over USD500 billion in 2016, i.e. more than the GDP of many European countries (Huang 2017). To fulfill the increasing demand for eating out, the foodservice sector in China has evolved rapidly hosting circa 350 million restaurants in 2013 (De Clercq *et al.* 2017). The growth of eating out has accelerated the related challenge of food waste (Wang *et al.* 2017). Whilst the challenge has been politically recognised, its precise magnitude, main causes, effects and approaches to mitigation remain insufficiently understood and lack systematisation (Zeng 2015).

While the research agenda on food waste management is gradually evolving in the West, it still lags behind in China (Gao *et al.* 2017). This is reflected in large discrepancies existing in estimates of how much food is wasted in China in general and specifically within its national foodservice sector. As for the total food wastage, Qi *et al.* (2014) posit that it equates to about 50 million tonnes per year albeit Mo *et al.* (2018) propose a much higher

figure of 195 million tonnes. Interestingly, within this latter estimate, circa 50 million tonnes or 26% is attributed to households (Mo *et al.* 2018). This share is significantly lower than in the EU where household food waste accounts for 53% of the total (FUSIONS 2016). This signifies substantial wastage occurring at other stages of the Chinese food supply chain, namely agriculture, food manufacturing and foodservice provision (Wen *et al.* 2018).

First attempts to assess the magnitude of food waste within the foodservice sector in China trace back to 2004 when a survey of food waste produced in a sample of Beijing's restaurants revealed that, on average, circa 10% of a meal was uneaten (Gao *et al.* 2017). This figure needs to however be taken with caution as it is outdated, based on a small sample and excludes any food waste generated in preparation and from spoilage. As for more recent studies, De Clercq *et al.* (2017) posit that the foodservice sector in China wasted 73 million tonnes of food in 2013 which, at the time, was circa 43% of the nation's total. The latest figure can be found in Yang *et al.* (2019) who suggest that the foodservice sector in China generated 44 million tonnes of food waste in 2016. The discrepancy in estimates is attributed to the fact that the study by Yang *et al.* (2019) only assessed food wastage in 12 (out of 26) Chinese provinces, meaning it underestimated its true magnitude. Despite the discrepancies, it is fair to suggest that the problem of food waste within the foodservice sector in China is significant and calls for urgent mitigation, especially given that an estimated 200 million people (almost 15% of the country's total) can be fed by saving the otherwise wasted food (Qi *et al.* 2014).

Although the main drivers of food waste in the foodservice sector in China are generally similar to those reported for other consumption markets (Wang *et al.* 2018), there is likely to be one notable difference. This difference relates to the Chinese dining habits in which food consumption outside home is not always seen as a means to satisfy hunger, but socialize (Qi *et al.* 2014). This brings about wasteful table manners (Zhang 2013). Indeed,

when eating out, the Chinese tend to show generosity towards other members of their dining party by ordering large amounts of food (Liao *et al.* 2018). Excessive left-overs are generated in the result (Zeng 2015) seen as symbols of abundance, value/richness, hospitality and gratitude (Zhang 2013). This closely relates to the cultural concept of '*Mianzi*' (*face*) which signifies the unwillingness of the Chinese to '*lose their face*' by ordering little/less food (Qi *et al.* 2014).

Limited research has attempted to examine approaches adopted by foodservice providers in China to mitigate food waste occurrence. As Li *et al.* (2016) suggest, to-date, foodservice operators in China have been more concerned about how food waste can be safely collected and disposed of rather than minimized at source. It can be assumed that the Chinese dining culture may prevent effective mitigation. The effect of Mianzi implies, for example, that the Chinese may be unwilling to voluntarily change their habits of eating out to make them less wasteful (Liao *et al.* 2018). It is however unknown if/how foodservice operators in China have attempted to minimise this effect in pursuit of food waste mitigation goals. Further, the mitigation practices adopted by foodservice providers in China in their back-of-house operations (kitchens) also remain insufficiently understood (Wang *et al.* 2017).

It is important to note that China has not neglected the problem of food waste (Leung 2015) and a number of initiatives have recently been undertaken by the Chinese government to promote food waste mitigation (De Clercq *et al.* 2017). For example, since 2013 such official dining out occasions as '*luxury banquets*' involving substantial food wastage have been banned in China (Leung 2015) while the '*Cleaning Your Plates*' campaign has been launched to encourage restaurant guests to order less food and/or to finish their meals when eating out (Zhang and Peters 2015). The impact of these initiatives to mitigate food waste remains however unknown as the literature review revealed no assessments of the effectiveness of such interventions. Having said this, there is some indirect evidence that

these initiatives had limited success. This is because the Chinese government is currently trialling a number of large-scale pilot projects designed to convert wasted restaurant food into biogas (De Clercq *et al.* 2017). This indicates that substantial amounts of wasted food continue to be landfilled in China and that the measures designed to reduce its occurrence at a source (restaurant) remain ineffective.

In summary, research on food waste in the foodservice sector in China is limited in scope and scale. Existing studies have attempted to quantify food waste and establish its main causes but been less rigorous in examining the primary approaches to mitigation. This paper partially plugs this important knowledge gap by exploring the challenge of food waste and its management in a sample of Shanghai restaurants.

3. Research design

To answer the four research questions set by this study (see Introduction), the interpretivist research philosophy and the qualitative research paradigm were adopted for primary data collection and analysis. Interpretivism represents a suitable research philosophy to investigate complex societal problems that already exist but require better understanding (Berg 2009). This understanding is normally shaped through opinions of the main actors involved (Jones *et al.* 2013). This fits the scope of this study given that it examines the global societal challenge of restaurant food waste through the prism of foodservice providers whose experiences are vital in its effective mitigation (Martin-Rios *et al.* 2018). The qualitative research paradigm is the cornerstone of interpretivism as it is designed for an in-depth investigation of personal opinions, perceptions and attitudes on relatively unexplored topics. This suits the scope of this project given that the challenge of food waste in the Chinese foodservice sector remains insufficiently understood (Wang *et al.* 2018) while the success of its mitigation is warranted

by the feelings, experiences and behaviour of the main actors, such as restaurants managers and staff. Further, the population of such study informants as restaurant managers is limited (Poulston and Yiu 2010) whilst there are well-known challenges in recruiting them for academic research projects due to busy and unpredictable nature of foodservice work (Filimonau and Krivcova 2017). This provides another justification towards the adoption of the qualitative research paradigm in this study as it usually takes advantages of purposeful, selective recruitment. Lastly, within an array of qualitative research methods, semi-structured interviews were chosen because of the flexibility they offer in terms of study design, exploration of research themes and depth of analysis (Jones *et al.* 2013).

An interview schedule was developed following the results of the literature review. It contained initial themes shaped around the questions on: 1) managerial knowledge of the magnitude of food waste alongside attitudes to the need for its mitigation; 2) main drivers of food wastage; and 3) current and future mitigation approaches, including the main actors whose engagement is necessary for effective mitigation. An interview schedule was developed in English (the language of the literature review) and subsequently translated into Mandarin (the language of interviews) following a back-translation technique (Brislin 1970). To ensure linguistic and thematic robustness, prior to field deployment, it was pre-tested in a pilot study with three managers of foodservice businesses in China. A copy of an interview schedule is provided in Appendix 1 (Supplementary materials).

It is important to note that qualitative research is not designed to provide generalisable results but establish certain behavioural and/or operational patterns that can subsequently be tested through the prism of more statistically robust research methods, such as surveys (Berg 2009). This notwithstanding, to enhance the analytical power of this project, study informants were purposefully recruited from among the population of senior managers in full-service

restaurants¹ in Shanghai, a major metropolitan area in China with the well-established foodservice sector. The focus on full-service restaurants is justified by the fact that these are the prime food operators catering for the growing Chinese middle class (Leung 2015). This was further because of the growing evidence pinpointing greater food wastage in full-service restaurants compared to fast food restaurants and cafes which is due to their business size and operational complexity (Charlebois *et al.* 2015). The recruitment criteria were as follows: 1) managerial position within a foodservice business; 2) at least three years of work experience in the current position in the current foodservice business; and 3) food waste/environmental management/ sustainability as one of the main operational areas of managerial responsibility. The managerial perspective was adopted in this study because restaurant managers are instrumental in tackling the challenge of food waste on the ground (Filimonau and De Coteau 2019). It was further because past research has long established the importance of managerial knowledge of and attitudes to environmental issues in the adoption of effective mitigation measures in restaurants (Kasim and Ismail 2012). It is acknowledged that such a limited, manager-focused only, perspective represents this study's main limitation as other actors, most notably restaurant guests and employees (kitchen and waiting staff), can also significantly contribute to food waste management in Shanghai restaurants. While the perspective of these actors is undoubtedly crucial, it was however excluded from the scope of this project due to time and budgetary constraints.

Recruitment took place in May 2019 and the interviews were conducted in June 2019. To reach for study informants, given their seniority, assistance of a gate-keeper, i.e. a top manager in one of the renowned full-service restaurants in Shanghai, was sought. The assistance was given in the form of enabled access to the professional managerial network of

¹ Full-service restaurants represent the foodservice businesses that provide full table and waiting service to their customers. Usually, they are divided into two major categories: fine dining and casual dining (Cognizant 2009).

the gate-keeper. Furthermore, the gate-keeper helped to, at least partially, address the problem of social desirability biases in this project. These explain the tendency of study informants to provide answers that are socially desirable (King and Bruner 2000). Social desirability biases have been proven to particularly affect research on such commercially sensitive topics as food waste (Filimonau *et al.* 2019b). Hence, to reduce their occurrence, the gate-keeper assisted in this study did not only provide researchers with access to their colleagues, but also explained the anonymous nature and the societal value of this project to prospective study informants.

In total, 22 managers partook in the study (Table 1). This sample size was determined by the saturation effect which suggests that interviewing should draw to a close once new themes no longer emerge from the material collected following the application of iterative analysis (Francis *et al.* 2010). Normally, saturation is achieved with 10-30 interviews (Thomson 2010 cited Marshall *et al.* 2013), which is in line with this study. Within the resultant sample, ten managers represented fine dining and twelve managers – casual dining restaurants. Interviews lasted 40 minutes on average; they were digitally recorded and transcribed verbatim. No financial incentives were offered to study informants.

[Insert Table 1 here]

Thematic analysis was applied to the data collected given its proven potential to identify and systematize patterns within the raw data (Berg 2009). The coding approach proposed by Braun and Clark (2006) was adopted and the NVivo professional software was employed for data organisation and coding. Thematic analysis revealed a range of themes that were added to/compared against those initially derived from the literature review. The themes and codes are presented in Table 2.

[Insert Table 2 here]

4. Findings and discussion

4.1. Quantity and character of food waste

Most study informants agreed that food waste was a major challenge for the foodservice sector in Shanghai, with the qualitative assessment of its scale ranging from being *moderate* (i.e. of a medium operational concern) to *large* (i.e. of a major operational concern), Table 2. None of the restaurateurs were able to provide exact figures on the amounts of wasted food in their business establishments. This is not surprising as Filimonau and De Coteau (2019) have established that foodservice providers do not have a habit of keeping accurate records of food wastage on file. Interestingly, however, Derqui *et al.* (2018) argue that restaurateurs tend to under-estimate the actual scale of the food waste problem in their establishments which is attributed to the lack of its visibility and poor systematisation, as per above. Given that Shanghai restaurateurs evaluated the challenge of food wastage in their businesses as being of moderate-to-large operational concern, it can be assumed that the actual scale of the problem may be even higher.

The lack of accurate data on food waste in Shanghai restaurants highlights an important barrier towards its effective mitigation as, in order to manage food waste, it has to be first precisely assessed (Eriksson *et al.* 2019). It is argued that the industry should either agree to voluntarily compile the data on food waste and then share these publicly or that the Chinese government should make food waste inventories in the foodservice sector compulsory. The former voluntary approach is preferred but, given the complexity and diversity of the foodservice sector, globally and in China, it is deemed unlikely that the industry can ever establish a voluntary agreement on food waste systematisation. In either case, there are a number of commercial solutions such as those designed by Winnow (2019) that can aid

restaurateurs in recording the amounts of wasted food. Broader adoption of such solutions should be encouraged among the industry.

As for the character of food waste, Gao *et al.* (2017) posit that vegetables were the most wasted foodstuffs in the foodservice sector in China within the period of 2011-2015. This study partially confirmed this point but also established meat and seafood as other foodstuffs with excessive wastage (Table 2 and Figure 2). This can be partially attributed to the on-going changes in the Chinese diet where traditional vegetables are being gradually replaced with meat and fish (Li *et al.* 2020) which is due to the increased living standards in China, but also because of the growing influence of ‘western’ diets (Shono *et al.* 2000). Another explanation is attributed to the Chinese dining culture which may indirectly encourage expensive food left-overs as a sign of exceptional hospitality (Zhang 2013). Given that meat and seafood are expensive to procure compared to vegetables, evidence of their extensive wastage should prompt restaurateurs in China to invest in its mitigation as a means of reducing operational costs and increasing business profit margins (Papargyropoulou *et al.* 2019).

[Insert Figure 2 here]

Study informants agreed that wasted food predominantly originated from preparation and customer plates (Table 2 and Figure 2 & 3, also see the quotes by Ernie and Fabio below). Wastage due to food over-production and irresponsible consumer behaviour is typical for other consumption markets (Papargyropoulou *et al.* 2019) but this study demonstrates that, in the Chinese context, the underpinning cause primarily rested within the national dining culture. Indeed, the nature of eating out in China prompts restaurant guests to order excessive amounts of food and then to leave this food uneaten to signify abundance, as per above. This highlights the national dining culture, as an integral part of the Chinese national culture, as a crucial barrier towards food waste

mitigation in the national foodservice sector as changes to eating habits can be extremely difficult to implement:

‘Overall, the most wasteful phase of our restaurant business is the food preparation phase. When the chef cooks the dishes, they cut the food into various shapes and only use the best cuts and portions of the food. They won’t reuse the rest of the food even if it’s still of good quality. Often that part of the food that was left unused could be used in other restaurants or in cooking other dishes, but the chefs are too lazy to transfer the food and, usually, they simply choose to throw it away (Ernie, manager of a small casual dining restaurant)

‘The problem is that people eat with their eyes and they want to see lots on their plate. As a restaurant manager, you can try and be more economical by, say, displaying only a few things on a plate and then by cooking fresher as they go, thereby reducing wastage. But the customer wants to see twenty lobsters there, and they want to see fifty shrimps, they don’t want to see one lobster and three shrimps on the table. Also, when guests order a steak, they want to have a big portion. They don’t care if they can finish the food or not, they just want to have good value for their money’ (Fabio, manager of a small fine dining restaurant)

‘Dining culture is a key driver of food waste in China. I observed that foreign customers don’t produce as much food waste as the Chinese. When the Chinese go to a restaurant, they want to enjoy the time and have a good time with friends and family, so, in order to maintain “Mianzi”, they order more food than they need. Only one out of our 10 guests actually orders food as needed. As a result, normally, 30-40% of the

food goes to waste. I'm sure that the Chinese are very food-savvy when they eat at home. However, when they go out, they over-order food' (York, manager of a large fine dining restaurant)

'In our restaurant we operate buffets and, from my experience, all Chinese buffet restaurants have a lot of food waste. I think this is due to the way we eat. Chinese people like to eat table meals, so they will use the buffet as a table meal, put many dishes on the table, and then share, which will cause much waste' (Jerry, manager of a large casual dining restaurant)

[Insert Figure 3 here]

4.2. Key drivers

Drawing upon the above, the Chinese dining culture and the related over-production of food were pinpointed by the majority of study informants as the main drivers of food waste. The cooking necessities were also blamed for food waste occurring at the stage of preparation but this factor was significantly less pronounced and concerned mostly fine dining restaurants (Table 2). Fine dining generates disproportionate wastage at the cooking stage which is due to aesthetic reasons (Charlebois *et al.* 2015). There is further wastage because of extensive menus often adopted by restaurateurs in an attempt to differentiate themselves from competition and enhance customer satisfaction (Filimonau *et al.* 2019a). Moreover, some study informants repeatedly referred to the greediness of some restaurant guests and their indifferent attitude towards the detrimental effect of subsequent wastage which is in line with the findings reported by Filimonau *et al.* (2019b). This study found that all these reasons hold true for the Chinese context:

'Customers produce most of the food waste in my restaurant. The guests always tend to order too much food. This is a cultural thing I guess... Even though our staff might advise them to order less, the guests would usually ignore that advice. We have a long menu and they always want to try more dishes even if they know they cannot finish them all. We have no choice but to cook extra which sometimes does not even get eaten' (Kelly, manager of a medium-sized fine dining restaurant)

Cooking skills of chefs as a driver of food wastage were cited by almost a third of study informants (Table 2). This is an interesting finding which shows no similarity with past research. The Chinese cuisine has a variety of regional sub-cuisines/styles (Wang *et al.* 2017), meaning it takes time for chefs to learn how to cook a specific regional dish. Further, chefs may lack those skills that are specific of fine dining cooking which is laborious and requires sophistication (Charlebois *et al.* 2015). These factors may result in dishes being refused by customers (Lorenz *et al.* 2017), as indicated by Bob below. This is in part due to high food quality standards operated by many full-service restaurants, but also because of the increasingly high expectations and varied preferences of restaurant guests in China regarding the quality of the food they order when eating out. What is more, as the quote from Ernie provided in section 1 indicates, wastage can also be caused by chef's unwillingness or even laziness to re-use the spare and left-over ingredients, thus highlighting the need to engage chefs and other kitchen staff in food waste mitigation.

'One reason [for food waste occurrence in the kitchen] is the skill of the chef. Compared with skilled chefs, junior chefs produce more waste. Because of the lack of skill, they cannot use food raw materials as fully as possible, and they cannot guarantee the required taste of their dishes. So, if the taste or the look of the dishes is not good, then you need to throw it and do it again, which will cause much waste' (Bob, manager of a small casual dining restaurant)

4.3. Mitigation approaches

Prior to exploring mitigation approaches, restaurateurs were questioned on whether or not they had any dedicated food waste reduction policies in place. At this stage, about a third of the sample, mostly large businesses, discussed the standard operating procedures (SOPs) they had adopted in-house. Interestingly, however, is that the discussion highlighted SOPs not only as a source of guidance on food waste mitigation, but also as a prospective cause of wasted food. For example, some restaurants' SOPs prescribed managers to separate food waste from packaging waste for better municipal recycling and safe(r) disposal; however, some SOPs concurrently dictated the need to over-estimate the amounts of food provided for buffets, thus generating wastage due to over-production:

'Most waste comes from the food on the buffet table. This is partly because of our in-house rules. According to our company's SOP, the amount of each dish in our buffets must be kept at 10-12 people. This means that the manager must keep enough food of each type to feed 10-12 people at once. I have no choice but to maintain this level until the end of the meal service even though at some times and

on some days there are not enough customers to eat the food provided' (Mark, manager of a small casual dining restaurant)

This is an interesting finding as the adoption of SOPs has traditionally been seen beneficial in light of environmental conservation goals in restaurants (Chu and Hsu 1999). This study shows that foodservice managers should be given sufficient flexibility to deviate from SOPs when mitigating food waste. Such deviation can, for instance, be necessary when making ad-hoc decisions on how much food needs to be prepared, accounting for such highly variable factors as the size and the structure of a dining party and food consumption occasions, for example.

The mitigation approaches adopted by study informants mirrored the main drivers of food waste occurrence, i.e. in preparation (kitchen) and from customer plates. To reduce kitchen waste, the majority took advantage of ingredient repurposing (Table 2). Despite alleged simplicity, ingredient repurposing requires restaurateurs to invest heavily in menu design. For example, menus can be kept short to reduce excessive ordering of raw ingredients (Martin-Rios *et al.* 2018). This is a sound approach to food waste mitigation which should, however, be applied with caution in full-service restaurants where long menus are often used as a market differentiator. It is perhaps more feasible to design menus in such a way that any left-over foodstuffs are used as substitutes in other dishes (Okumus 2020). The dominance of ingredient repurposing in full-service restaurants in Shanghai is an interesting finding as it is normally more popular in the catering establishments with a quicker turnover of dishes, such as fast casual restaurants (Filimonau *et al.* 2019a). Further, excess food was also given to staff or used for cooking staff meals (Table 2) which is a popular approach to food waste mitigation in restaurants around the world (Sakaguchi *et al.* 2018).

To reduce food waste occurrence on customer plates, the majority of study informants attempted to raise consumer awareness of the detrimental effect of wastage in the hope that this would change guest behaviour (Table 2). The most popular measure adopted by restaurateurs in this regard was pervasive communication in the form of table signs and menu labels (Figure 4). It is important to note that many of these measures came into being because the Chinese government urges restaurateurs to save food from waste, thus highlighting an attempt of the industry to comply with the governmental expectations, rather than representing a purely industry-led initiative. What is more, the impact of these measures on plate waste reduction was however unknown as study informants claimed they did not attempt to assess their effectiveness. The main reason for why no such assessment had ever been undertaken was in the fear of customer dissatisfaction should restaurant guests be questioned about their food wasteful behaviour. This demonstrates that customer satisfaction is prioritised over the environmental sustainability considerations in Shanghai restaurants, which is in line with findings reported elsewhere (Kallbekken and Saelen 2013). This further indicates an opportunity for collaborative work between restaurateurs and academicians in China as scholars can not only aid foodservice providers in the design of more effective pervasive communication campaigns on food waste, but also in measuring their impact.

[Insert Figure 4 here]

A significant number of restaurateurs (Table 2) claimed to play with the portion size as a means of mitigating food waste occurring on customer plates. Portion size reduction (with subsequent reduction in price) has a proven potential to minimize food waste (Juvan *et al.* 2018) and contribute to healthier food choices (Wansink and van Ittersum 2013). This notwithstanding, it should be applied with caution as smaller portions can drive consumer dissatisfaction with its consequent negative impact on customer loyalty. This is particularly true for China where portion size may represent an important determinant of food choice.

Indeed, the presence of Mianzi implies that smaller portions may not be seen favourably by Chinese consumers, especially when eating out in groups (Liao *et al.* 2018). When probed on this topic, those study informants who claimed to use portion control to mitigate food waste confirmed the possible effect of Mianzi and further clarified that smaller portions would only be provided to customers on request and never proactively offered. However, according to restaurateurs, smaller portions may become a future trend in out-of-home food consumption in China, especially in the sector of fine dining. This is due to growing health considerations among the Chinese consumers, particularly among their wealthy segment who constitute the main customer base of full-service restaurants. This is further confirmed by evidence of rapidly changing dietary patterns in China (Li *et al.* 2020).

A very small number of study informants stated they offered discounts to customers for clean plates (Table 2). This is an interesting and rather unconventional approach to food waste management in restaurants. Rewarding guests for pro-environmental behaviour represents a cornerstone of equity theory (Dolnicar *et al.* 2017). This theory has been tested empirically in the context of towel reuse in hotels (Dolnicar *et al.* 2019) but found limited application in foodservice provision (Stockli *et al.* 2018). In Shanghai, restaurant guests were incentivized for clean plates with money-off vouchers (RMB5-10²) redeemable on future purchases. Interestingly, when tested on other study participants, there were mixed opinions on the feasibility of adopting this approach as ‘best practice’ in food waste management. While the majority liked the idea of rewarding guests for less wasteful behaviour, the need to secure consent of top managers to offer discounts was seen as a major constraint alongside a potential detrimental effect of adopting such practice on (long-term) business profitability. It is nevertheless argued that rewards can still be considered by Shanghai restaurateurs as a feasible means of reducing food waste by customers. The rewards do not necessarily need to

² RMB 5-10 = EURO 0.65-1.3

be directly linked to money; instead, consumer behaviour can be incentivized by offering a free drink or, for instance, a small bar of chocolate (Mirosa *et al.* 2016).

Lastly, an interesting finding was in that the list of mitigation approaches adopted by Shanghai restaurateurs (Table 2) did not feature the two popular ‘western’ practices, namely surplus food rescue/donation and provision of take-away boxes. When probed, the feasibility of offering ‘doggy bags’ to customers was rejected by all study informants as inappropriate. The effect of national culture was repeatedly referred to when explaining the reason for this rejection which is in line with Liao *et al.* (2018). Mianzi does not only hinder requests of Chinese consumers for take-away boxes, i.e. for them ‘to save face’, but also prevents restaurateurs from offering such boxes pro-actively, which is to ensure that customers ‘do not lose face’. This implies that food waste management via consumer engagement in the foodservice sector of China should probably be based upon other approaches, such as public awareness raising campaigns, (dis)incentivisation and/or consumer choice architecture. Likewise, surplus food rescue was not considered feasible by study informants due to numerous risks attributed to the provision of donated food to the people in need and the relative ‘novelty’ of this phenomenon in the Chinese context. This is in line with Liao and Hong (2019) who arrived at similar conclusions when examining food donation in the sector of grocery retail in China. The lack of charities that could lead food rescue in Shanghai was frequently cited as another important obstacle (Zeng 2015).

4.4. The future of mitigation

Study informants highlighted a number of measures that hold potential to improve food waste mitigation in Shanghai restaurants (Table 2). Raising consumer awareness of the food waste challenge with an ultimate goal of triggering more responsible consumption was cited as a

prime necessity. Concurrently, restaurateurs were well aware of the significant difficulties associated with the application of this measure, especially in light of the national (dining) culture of China. As Leung (2015) and Liao *et al.* (2018) posit, while the Chinese cultural values, especially Mianzi, encourage food waste generation when eating out they can only change in the long-term perspective. Hence, to facilitate and accelerate this change, some study informants called for more help from the national government of China. One of the key societal roles of national governments is to design, administer and monitor the implementations of country-wide public awareness raising campaigns (Filimonau *et al.* 2020). Study informants suggested that such campaigns should more explicitly focus on the problem of food waste when eating out. Although some initiatives have already been implemented by the Chinese government to raise consumer awareness of excessive food wastage occurring in the national foodservice sector (De Clercq *et al.* 2017), their effectiveness remains however unknown as no research has assessed if they have changed consumer knowledge and attitudes towards food waste in restaurants.

While governmental help is essential for more effective food waste mitigation, foodservice providers hold prime responsibility for it (Pirani and Arafat 2016). Hence, it is fair to suggest that Shanghai restaurateurs should manage food waste more (pro)actively. When probed on this point, many study informants agreed and expressed their readiness to provide dedicated staff training (Table 2). Training chefs and kitchen employees aids in the mitigation of kitchen waste (Goh and Jie 2019). Hence, it is argued that Shanghai restaurateurs should invest in specialist staff training and/or make training on food waste mitigation compulsory following recruitment of new staff. It is further argued that the Chinese government should consider organising free-to-attend training workshops for foodservice providers. This can be done following the model trialled by WRAP (2017) in the UK context. The delivery of such workshops can be facilitated by experts in food waste

management and/or by celebrity chefs. The workshops can provide a platform for restaurateurs to share good practices in food waste mitigation, thus enabling cross-learning and creating professional networks of foodservice providers who commit to environmental conservation.

Study informants were less enthusiastic when discussing the need to manage guest expectations as a means of reducing food waste from customer plates (Table 2). In part, this was attributed to the negative effect of the Chinese (dining) culture which is difficult to change in the short-term and without ‘external’ help from the government, as per above. Another reason for industry’s reluctance to engage consumers in plate waste mitigation was due to the importance assigned to customer satisfaction in corporate business strategies. Indeed, managing guest expectations in restaurants implies certain interference with a guest experience which may lead to possible dissatisfaction (Filimonau and Krivcova 2017). This notwithstanding, as demonstrated by the examples of successful applications (Kallbekken and Saalen 2013), the consumer choice architecture interventions can be adopted by foodservice providers in China to achieve this goal. Customer rewards for clean plates can become integral elements of such interventions as shown by a handful of restaurateurs in this study, for example.

Below, Rory provides a comprehensive summary of the future measures required to improve food waste management in Shanghai restaurants alongside the roles of specific actors in mitigation:

‘For a start, we need to raise public awareness [of food waste]. For this to happen, we need to have government on board. Just as the government is trying to promote solid waste separation at home, reducing food waste in restaurants

should also be promoted among the public. In China, if the government does not support it, it's not really going to work... Next, we need to engage celebrities. The best way to get people to want to do something is using the real-life models, that is people like Jack Ma and Yaoming or the sport or TV celebrities they love. When famous stars start to say 'do not do this', people start listening... On our end we can also help. For example, we can train our chefs so that they improve their cooking skills and provide smaller dishes. We can also halve portions. We can even provide small discounts to guests for not wasting food. Or, we can turn this around. In the early days, there was a rule in buffet restaurants. If a customer wastes a certain amount of food, they must pay a fine. This measure is no longer there but I am sure it would be very effective' (Rory, manager of a large fine dining restaurant)

5. Conclusions

Food waste management represents a major operational challenge in the foodservice sector of China. This challenge remains, however, understudied which is a significant shortcoming given the growing frequency of out-of-home food consumption among the Chinese. This study has advanced the research agenda by exploring the food waste mitigation approaches adopted in a sample of full-scale restaurants in Shanghai.

The key finding of this study is in that the national (dining) culture of China makes a large contribution to food waste occurrence on the consumption side. What is more, growing consumer expectations of the high quality of restaurant food offer and the industry's desire to meet these expectations in pursuit of customer loyalty leads to the over-production of food and, thus, drives wastage on the production side. A number of approaches are adopted by

Shanghai restaurateurs to mitigate food waste occurrence. These approaches prioritize the re-purpose of surplus ingredients and cooking meals for staff. Industry attempts to engage consumers in the mitigation are limited, do not always come directly from restaurateurs, but rather from the local authorities in China, and focus on ‘passive’ nudging of restaurant guests, such as by displaying table signs in the hope that these will encourage customers to waste less food. To ensure more effective future mitigation, restaurateurs should switch to more ‘active’ nudging which can, for example, take the form of rewards given to restaurant guests for clean plates. To aid the industry in mitigation, governmental support is instrumental. This support can be arranged through the design of new, more widespread and larger-scale, public awareness raising campaigns, including the ones delivered by celebrities, and via the provision of specialist training on food waste mitigation to restaurant managers and employees. To assess the effectiveness of various mitigation interventions, the industry and the Chinese government should collaborate with academics.

The study outlined a number of promising research opportunities. First, further research on food waste in the foodservice sector in China should focus on its different sub-sectors, such as traditional Chinese restaurants, fast food restaurants and takeaways, to quantify the magnitude of food wastage within, establish the main drivers and identify the most effective mitigation approaches. Second, given this study identified the important contribution of restaurant guests to food waste generation, future research should aim at establishing the primary causes and measuring the major effect of wasteful consumer behaviour in the foodservice sector in China. For example, the traditional Chinese (dining) culture should be more carefully studied in order to establish the relationships between its key values and wasteful food consumption behaviour of restaurant guests and identify potential solutions. In this regard, the concept of Mianzi deserves special attention and recommendations should be derived on how its effect on food waste occurring on customer plates could be reduced,

especially when consuming food in groups and/or during large social functions. Ideally, future studies on the causes and effects of wasteful consumer behaviour in the foodservice sector in China should take advantage of quantitative research techniques in order to generate more robust results. Third, to aid restaurateurs in China in the adoption of ‘active’ nudging interventions, future research should aim at designing and experimenting with various nudges in order to identify those with the largest effect on consumer behaviour, ideally minimizing possible negative influence of the Chinese (dining) culture. Guest rewards represent a particularly promising research area and future studies should strive to identify the most suitable and acceptable rewards from the industry’s and consumer’s perspectives. For example, field/social experiments could be set up to measure the restaurant guests’ reaction to certain types of active nudging interventions. Further, restaurant employees (kitchen and waiting staff) can be interviewed to seek opinions on the effectiveness of customer nudges from those directly involved in food preparation and service. Fourth, given the established importance of pro-environmental consumer behaviour in food waste mitigation, future research should be concerned with the design of effective public awareness raising campaigns on food waste, also with the engagement of celebrities, assuming that better awareness will drive positive behaviour. Such research should aim at providing evidence-based support to the development of governmental policies on food waste mitigation in the foodservice sector in China and engage in the assessment of their effectiveness. Lastly, evaluating effective food waste mitigation policies adopted in other countries in light of their possible applicability to the Chinese context also represents a promising research avenue.

References

- Barilla Center for Food & Nutrition, 2012. *Food waste: causes, impacts and proposals*. Rome, June 2012. Available from: <https://www.barillacfn.com/m/publications/food-waste-causes-impact-proposals.pdf> [Accessed 05 October 2019].
- Beretta, C., and Hellweg, S., 2019. Potential environmental benefits from food waste prevention in the food service sector. *Resources, Conservation and Recycling*, 147, 169-178.
- Berg, B.L., 2009. *Qualitative research methods for the social science*. Boston, MA: Pearson Education.
- Betz, A., Buchli, J., Gobel, C., and Muller, C., 2015. Food waste in the Swiss food service industry-Magnitude and potential for reduction. *Waste Management*, 35, 218-226.
- Braun, V., and Clarke, V., 2006. Using Thematic Analysis in Psychology. *Qualitative Research in Psychology*, 3, 77-101.
- Brislin, R.W. 1970. Back-Translation for Cross-Cultural Research. *Journal of Cross-Cultural Psychology*, 1, 185-216.
- Charlebois, S., Creedy, A., and Massow, M.V., 2015. Back of house”-focused study on food waste in fine dining: the case of Delish restaurants. *International Journal of Culture, Tourism and Hospitality Research*, 9(3), 278-291.
- Christ, K.L., and Burritt, R., 2017. Material flow cost accounting for food waste in the restaurant industry. *British Food Journal*, 119(3), 600-612.
- Chu, W., and Hsu, W., 1999. Pollution source identification and waste loading reduction at Chinese fast food restaurants. *Environment International*, 25(1), 97-107.

Cognizant 2009. *Casual dining vs. quick service. Key differences from a process-IT standpoint.* Cognizant White Paper. Available from: <https://www.hospitalitynet.org/file/152003938.pdf> [Accessed 07 January 2020].

De Almeida Oroski, F., 2020. Exploring Food Waste Reducing Apps—A Business Model Lens. In: Närvänen E., Mesiranta N., Mattila M., Heikkinen A. (eds), *Food Waste Management*. Palgrave Macmillan, Cham.

De Clercq, D., Wen, Z., Gottfried, O., Schmidt, F. and Fei, F., 2017. A Review of Global Strategies Promoting the Conversion of Food Waste to Bioenergy via Anaerobic Digestion. *Renewable and Sustainable Energy Reviews*, 79, 204-221.

Derqui, B., Fernandez, V., and Fayos, T., 2018. Towards More Sustainable Food Systems. Addressing Food Waste at School Canteens. *Appetite*, 129, 1-11.

Dolnicar, S., Cvelbar, L.K., and Grün, B., 2017. Do Pro-environmental Appeals Trigger Pro-environmental Behavior in Hotel Guests? *Journal of Travel Research*, 56(8), 988-997

Dolnicar, S., and Juvan, E., 2019. Drivers of Plate Waste. A Mini Theory of Action Based on Staff Observations. *Annals of Tourism Research*, 78, 102731.

Dolnicar, S., Cvelbar, L.K., and Grün, B., 2019. A Sharing-Based Approach to Enticing Tourists to Behave More Environmentally Friendly. *Journal of Travel Research*, 58(2), 241-252.

Engstrom, R., and Carlsson-Kanyama, A., 2004. Food losses in food service institutions: Examples from Sweden. *Food Policy*, 29, 203-213.

Eriksson, M., Osowski, C.P., Bjorkman, J., Hansson, E., Malefors, C., Eriksson, E. and Ghosh, R., 2018. The Tree Structure—A General Framework for Food Waste Quantification in Food Service. *Resources, Conservation & Recycling*, 130, 140-151.

Eriksson, M., Malefors, C., Callewaert, P., Hartikainen, H., Pietilainen, O., and Strid, I., 2019. What gets measured gets managed—or does it? Connection between food waste quantification and food waste reduction in the hospitality sector. *Resources, Conservation & Recycling:X.*, <https://doi.org/10.1016/j.rcrx.2019.100021>.

FAO-Food and Agriculture Organisation, 2013. *Food wastage footprint: impacts on natural resources*. Rome: Food and Agriculture Organization of the United Nations.

Filimonau, V., and De Coteau, D., 2019. Food Waste Management in Hospitality Operations: A Critical Review. *Tourism Management*, 71, 234-245.

Filimonau, V., and Gherbin, A., 2017. An exploratory study of food waste management practices in the UK grocery retail sector. *Journal of Cleaner Production*, 167, 1184-1194.

Filimonau, V., and Krivcova, M., 2017. Restaurant menu design and more responsible consumer food choice: An exploratory study of managerial perceptions. *Journal of Cleaner Production*, 143, 516-527.

Filimonau, V., Fidan, H., Alexieva, I., Dragoev, S., Marinova, D.D., 2019a. Restaurant food waste and the determinants of its effective management in Bulgaria: an exploratory case study of restaurants in Plovdiv. *Tourism Management Perspectives*, 32, 100577.

Filimonau, V., Krivcova, M. and Pettit, F., 2019b. An Exploratory Study of Managerial Approaches to Food Waste Mitigation in Coffee Shops. *International Journal of Hospitality Management*, 76, 48-57.

Filimonau, V., Matute, J., Kubal-Czerwińska, M., Krzesiwo, K., Mika, M., 2020. The determinants of consumer engagement in restaurant food waste mitigation in Poland: an exploratory study. *Journal of Cleaner Production*, 247, 119105.

Francis, J.J., Johnston, M., Robertson, C., Glidewell, L., Entwistle, V., Eccles, M.P., and Grimshaw, J.M., 2010. What is an Adequate Sample Size? Operationalizing Data Saturation

for Theory-Based Interview Studies. *Psychology and Health*, 25(10), 1229-1245.

FUSIONS, 2016. *Estimates of European food waste levels*. FUSIONS, Stockholm.

Gao, L.W., Cheng, S.K., Xu, S.W., Li, Z.M., Liu, X.J., Zhang, D., Yu, W., Cao, X.C., Wang, L.E., Liu, Y., Wang, Y. and Qin, Q., 2017. Impacts of National Policy on Catering Food Waste in Urban China—A Case Study of Lhasa City. *Food and Nutrition in China*, 23(3), 44-48.

Goh, E. and Jie, F., 2019. To Waste or not to Waste: Exploring Motivational Factors of Generation Z Hospitality Employees towards Food Wastage in the Hospitality Industry. *International Journal of Hospitality Management*, 80, 126-135.

Graham-Rowe, E., Jessop, D., and Sparks, P., 2014. Identifying motivations and barriers to minimising household food waste. *Resources, Conservation and Recycling*, 84, 15-23.

Hennchen, B., 2019. Knowing the Kitchen: Applying Practice Theory to Issues of Food Waste in the Food Service Sector. *Journal of Cleaner Production*, 225, 675-683.

Huang, E., 2017. The amount China spends eating out is greater than the GDP of Sweden. *Quartz*, 12 May 2017. Available from: <https://qz.com/982340/china-spent-507-billion-eating-out-in-2016-greater-than-the-gdp-of-sweden/> [Accessed 12 November 2019].

Jones, I., Holloway, I., and Brown, L. 2013. *Qualitative Research in Sport and Physical Activity*. London: Sage

Juvan, E., Grun, B., and Dolnicar, S., 2018. Biting Off More Than They Can Chew: Food Waste at Hotel Breakfast Buffets. *Journal of Travel Research*, 57(2), 232-242.

Kallbekken, S., and Saelen, H., 2013. Nudging hotel guests to reduce food waste as a win-win environmental measure. *Economics Letters*, 119(3), 325-327.

- Kasavan, S., Mohamed, A.F., and Halim, S.A., 2019. Drivers of food waste generation: Case study of island-based hotels in Langkawi, Malaysia. *Waste Management*, 91, 72-79.
- Kasim, A., and Ismail, A., 2012. Environmentally friendly practices among restaurants: drivers and barriers to change. *Journal of Sustainable Tourism*, 20(4), 551-570.
- King, M.F., and Bruner, G.C., 2000. Social desirability bias: a neglected aspect of validity testing. *Psychology and Marketing*, 17(2), 79-103.
- Leung, H., 2015. *No Doggy Bag Please: Chinese Attitudes on Food Waste*. MA Dissertation at Royal Roads University, Victoria, British Columbia, Canada.
- Li, Y., Jin, Y., Li, J., Chen, Y., Gong, Y., Li, Y., and Zhang, J., 2016. Current situation and development of kitchen waste treatment in China. *Procedia Environmental Sciences*, 31, 40-49.
- Li, Y., Filimonau, V., Wang, L., and Cheng, S., 2020. Tourist food consumption and its arable land requirements in a popular tourist destination. *Resources, Conservation & Recycling*, 153, 104587.
- Liao, C., Hong, J., Zhao, D., Zhang, S., and Chen, C., 2018. Confucian Culture as Determinants of Consumers' Food Leftover Generation: Evidence from Chengdu, China. *Environment Science and Pollution Research*, 25(15), 14919-14933.
- Liao, C., and Hong, J., 2019. Understanding corporate surplus food donation in China: testing the roles of environmental concern, altruism, past experience, and perceived risk. *Environment Science and Pollution Research*, 26(16), 16628-16640.
- Lindberg, R., Lawrence, M., Gold, L., and Friel, S., 2014. Food rescue-an Australian example. *British Food Journal*, 116(9), 1478-1489.

- Lorenz, B.A., Hartmann, M., and Langen, N., 2018. What Makes People leave Their Food? The interaction of Personal and Situational Factors Leading to Plate Leftovers in Canteens. *Appetite*, 116, 45-56.
- Marshall, B., Cardon, P., Poddar, A., and Fontenot, R., 2013. Does sample size matter in qualitative research?: A review of qualitative interviews in IS research. *Journal of Computer Information Systems*, 54(1), 11–22.
- Martin-Rios, C., Demen-Meier, C., Gossling, S. and Cornuz, C., 2018. Food Waste Management Innovations in the Foodservice Industry. *Waste Management*, 79, 196-206.
- Mirosa, M., Munro, H., Mangan-Walker, E., and Pearson, D., 2016. Reducing waste of food left on plates: Interventions based on means-end chain analysis of customers in foodservice sector. *British Food Journal*, 118(9), 2326-2343.
- Mo, W.Y., Man, Y.B. and Wong, M.H., 2018. Use of Food Waste, Fish Waste and Food Processing Waste for China's Aquaculture Industry: Needs and Challenge. *Science of the Total Environment*, 613-614, 635-643.
- Mousa, T.Y. and Freeland-Graves, J.H., 2017. Organizations of Food Redistribution and Rescue. *Public Health*, 152, 117-122.
- Okumus, B., 2020. How Do Hotels Manage Food Waste? Evidence from Hotels in Orlando, Florida. *Journal of Hospitality Marketing & Management*, 29(3), 291-309.
- Sakaguchi, L., Pak, N., and Potts, M., 2018. Tackling the Issue of Food Waste in Restaurants: Options for Measurement Method, Reduction and Behavioral Change. *Journal of Cleaner Production*, 180, 430-436.
- Shono, C., Suzuki, N., and Kaiser, H.M., 2000. Will China's diet follow western diets? *Agribusiness: An International Journal*, 16(3), 271-279.

- Silvennoinen, K., Heikkilä, L., Katajajuuri, J.-M., and Reinikainen, A., 2015. Food waste volume and origin: Case studies in the Finnish food service sector. *Waste Management*, 46, 140-145.
- Sirieix, L., Lala, J., and Kocmanova, K., 2017. Understanding the Antecedents of Consumers' attitudes towards Doggy Bags in Restaurants: Concern about Food Waste, Culture, Norms and Emotions. *Journal of Retailing and Consumer Service*, 34, 153-158.
- Stockli, S., Dorn, M. and Liechti, S., 2018. Normative Prompts Reduce Consumer Food Waste in Restaurants. *Waste Management*, 77, 532-536.
- Papargyropoulou, E., Wright, N., Lozano, R., Steinberger, J., Padfield, R., and Ujang, Z., 2016. Conceptual framework for the study of food waste generation and prevention in the hospitality sector. *Waste Management*, 49, 326-336.
- Papargyropoulou, E., Steinberger, J., Wright, N., Lozano, R., Padfield, R., and Ujang, Z., 2019. Patterns and Causes of Food Waste in the Hospitality and Food Service Sector: Food Waste Prevention Insights from Malaysia. *Sustainability*, 11, 6016.
- Parfitt, J., Barthel, M., and Macnaughton, S., 2010. Food waste within food supply chains: quantification and potential for change to 2050. *Philosophical Transactions of the Royal Society B: Biological Sciences*, 365(1554), 3065-3081.
- Parizeau, K., von Massow, M., and Martin, R., 2015. Household-level dynamics of food waste production and related beliefs, attitudes, and behaviours in Guelph, Ontario. *Waste Management*, 35, 207-217.
- Pinto, S.R., Pinto, S.R.M., Melo, S.F.F., Campos, S.S., and Cordovil, C.M., 2018. A Simple Awareness Campaign to Promote Food Waste Reduction in a University Canteen. *Waste Management*, 76, 28-38.
- Pirani, S., and Arafat, H., 2016. Reduction of Food Waste Generation in the Hospitality

Industry. *Journal of Cleaner Production*, 132, 129-145.

Poulston, J., and Yiu, A.K, 2010. Profit or principles: why do restaurants serve organic food? *International Journal of Hospitality Management*, 30, 184–191.

Principato, L., Pratesi, C., and Secondi, L., 2018. Towards Zero Waste: an Exploratory Study on Restaurant managers. *International Journal of Hospitality Management*, 74, 130-137.

ReFED, 2018. *The Foodservice Food Waste Action Guide*. ReFED. Available from: https://www.refed.com/downloads/Foodservice_Guide_Web.pdf [Accessed 04 October 2019].

Rhou, Y., and Singal, M., 2020. A review of the business case for CSR in the hospitality industry. *International Journal of Hospitality Management*, 84, 102330.

Qi, F., Sun, B.L., Ge, S.A. and Cui, S.P., 2014. Stop Food Waste without Delay. *Social Perspective*, 12, 185-189.

SRA- Sustainable Restaurant Association, 2010. *Too good to waste: restaurant food waste survey report*. SRA, London.

The Local, 2016. *The restaurants punishing guests for not finishing meals*. Available from: <https://www.thelocal.de/20160816/eat-up-or-pay-up-why-guests-are-charged-for-leftovers> [12 November 2019].

UNSDG-United Nations' Sustainable Development Goals, 2019. *Sustainable Development Goal 12. Sustainable Development: UNSDG*. Available from: <https://sustainabledevelopment.un.org/sdg12> [Accessed 7 March 2019].

Wang, L., Liu, G., Liu, X., Liu, Y., Gao, J., Zhou, B., Gao, S. and Cheng, S., 2017. The Weigh of Unfinished Plate: A Survey Based Characterization of Restaurant Food Waste in Chinese Cities. *Waste Management*, 66, 3-12.

Wang, L., Xue, L., Li, Y., Liu, X., Cheng, S., and Liu, G., 2018. Horeca Food Waste and Its Ecological Footprint in Lhasa, Tibet, China. *Resources, Conservation and Recycling*, 136, 1-8.

Wansink, B., and van Ittersum, K., 2013. Portion size me: Plate-size induced consumption norms and win-win solutions for reducing food intake and waste. *Journal of Experimental Psychology: Applied*, 19(4), 320-332.

Wen, Z., Hu, S., Clercq, D., Beck, M. B., Zhang, H., Zhang, H., Fei, F. and Liu, J., 2018. Design, Implementation, and Evaluation of an Internet of Things (IoT) Network System for Restaurant Food Waste Management. *Waste Management*, 73, 26-38.

Winnow, 2019. *Uncovering the kitchen of the future at GRIF 2019*. Available from: <https://blog.winnowsolutions.com/uncovering-the-kitchen-of-the-future-at-grif-2019> [Accessed 20 July 2019].

WRAP-Waste and Resources Action Programme, 2017. *Overview of waste in the hospitality and food service sector*. Banbury: WRAP. Available from: <http://www.wrap.org.uk/content/overview-waste-hospitality-and-food-service-sector> [Accessed 05 October 2019].

Yang, Y., Bao, W., and Xie., G.H., 2019. Estimate of Restaurant Food Waste and its Biogas Production potential in China. *Journal of Cleaner Production*, 211, 309-320.

Zeng, M., 2015. How to Create a Consumption Environment Where Food is not Wasted. *Social Perspective*, 33, 214-215.

Zero Waste, 2018. *A Food Loss and Waste Strategy for Canada*. National Zero Waste Council. Available from: <http://www.nzwc.ca/focus/food/national-food-waste-strategy/Documents/NZWC-FoodLossWasteStrategy.pdf> [Accessed 05 October 2019].

Zhang, G.Q., 2013. On the Present Situation and Countermeasures of Food Waste in China. *Journal of Heibei University of Economics and Business (Comprehensive Edition)*, 13(2), 94-97.

Zhang, X., and Peters, M., 2015. *Fight Against Food Waste Takes Carrot-and-Stick Approach*. Available from: http://www.chinadaily.com.cn/food/2015-06/02/content_20883152_3.htm [Accessed 18 May 2019].

Table 1. Interview participants (n=22)

Pseudonym	Gender	Restaurant type <i>FD = Fine Dining</i> <i>CD = Casual Dining</i>	Restaurant seating capacity	Length of employment in current managerial role (years)
Antony	Male	CD	101-500	3-10
Andrew	Male	CD	50-100	3-10
Angel	Female	CD	50-100	3-10
Bob	Male	CD	50-100	11-20
Ernie	Male	CD	50-100	3-10
Fabio	Male	FD	50-100	11-20
Gary	Male	CD	>500	3-10
Harriet	Female	FD	50-100	3-10
Henry	Male	FD	50-100	3-10
Jack	Male	CD	>500	11-20
Jacqueline	Female	FD	50-100	3-10
Jerry	Male	CD	>500	11-20
John	Male	FD	101-500	3-10
Kelly	Female	FD	101-500	11-20
Mark	Male	CD	50-100	3-10
Nelly	Female	CD	50-100	3-10
Peng	Male	CD	101-500	3-10
Rory	Male	FD	>500	11-20
Ryan	Male	FD	>500	11-20
Shawn	Male	CD	50-100	3-10
Terry	Male	FD	>500	11-20
York	Male	FD	>500	11-20

Table 2. Coding structure with themes and codes. The figures highlight the number and proportion of quotes assigned to each code. Red colour denotes the most popular codes.

Themes		Codes	Number of mentions
Quantity and character of wasted food	Magnitude (qualitative assessment of the significance of the food waste problem)	Large	17 (77%)
		Moderate	4 (18%)
		Small	1 (5%)
	Most wasteful food categories	Meat and fish	15 (68%)
		Fruit and vegetables	13 (59%)
		Bread and bakery	1 (5%)
	Most wasteful element of the business cycle	Customer plate	15 (68%)
		Preparation	15 (68%)
		Storage	5 (23%)
Key drivers of wastage	Consumer behaviour / Plate waste	Chinese dining culture	16 (73%)
		Customers ordering more food than required	12 (55%)
	Issues in preparation / Unsold meals and meal parts	Cooking necessities (fine dining)	8 (36%)
		Cooking skills of chefs	6 (27%)
		Large portions	4 (18%)
		Excessive menus (casual dining)	4 (18%)
	Suboptimal food	Spoilage and expiration	3 (14%)
Current mitigation approaches	-	Repurpose leftover / excess ingredients	15 (68%)
		Excess food is given to staff / Cook staff meals	13 (59%)
		Raise customer awareness / Educate customers by communicating the problem of wasted food directly (via waiting staff) OR indirectly (via menu reminders and table signs)	11 (50%)
		Provide smaller portions (on request only)	10 (45%)
		Reconfirm the number of food orders required prior to cooking	6 (27%)
		Train kitchen staff and chefs on how to waste less when cooking and plating	4 (18%)

Themes		Codes	Number of mentions
		Promote / discount surplus meals for quicker turnover	4 (18%)
		Regular monitoring of food expiration dates / freshness	3 (14%)
		Cook food on demand and/or if and when required only	2 (9%)
		Offer discounts to customers for clean plates	2 (9%)
The future of mitigation	Key measures required	Customer awareness to be raised	15 (68%)
		Chef / staff awareness to be raised and cooking / plating skills to be improved	7 (32%)
		Guest expectations to be managed	6 (27%)
		National government to support foodservice providers in mitigation	4 (18%)

Figure 1. The map of the main drivers, underpinning causes and primary approaches to mitigate food waste occurrence across the different operational stages of foodservice provision.

Map key	Food waste		
Element of the business cycle	Miscellaneous e.g. storage	Production related	Consumption related
Operational area	Back-of-house		Front-of-house
Type of waste	Suboptimal food	Unsold meals and meal parts	Plate waste
Main drivers	a) Damage in delivery b) Quality deterioration (spoilage) in storage	c) Over-production d) Excess and/or left-over ingredients	e) Unfinished portions and parts of portions
Underpinning causes	a) Poor relationship with suppliers b) Technical faults; poor monitoring of ‘best by’ dates	c) Poor demand forecasting d) Excessive menus; poor portioning, trimming and plating skills	e) Excessive portion size; cooking issues; palatability issues; general mood of consumers; social pressures; food consumption occasion
Relative magnitude	5-21%	29-70%	30-34%
Primary mitigation approaches	a) Optimise procurement strategies b) Invest in technical infrastructure; reinforce the application of the First In First Out (FIFO) approach	c) Use of demand forecasting models; use of digital food delivery platforms d) Menu and recipe (re)design; cooking staff meals; food rescue/donation to charities; staff training	e) Raise consumer awareness; architect consumer choice; (dis)incentivise (ir)responsible consumer behaviour; offer choice of portion sizes; provide take-away boxes
Actor in charge	Senior management team, procurement team (if applies), chefs and kitchen staff		Senior management team; junior management team (floor managers) and waiting staff

References
Charlebois <i>et al.</i> (2015); Christ and Burritt (2017); Martin-Rios <i>et al.</i> (2018); Papargyropoulou <i>et al.</i> (2016), (2019); Pirani and Arafat (2016); Principato <i>et al.</i> (2018); Soares Pinto <i>et al.</i> (2018)
Beretta and Hellweg (2019); Cruwys <i>et al.</i> (2015); Dolnicar and Juvan (2019); Filimonau <i>et al.</i> (2019a), (2019b); Juvan <i>et al.</i> (2018); Kasavan <i>et al.</i> (2019); Lorenz <i>et al.</i> (2017); Papargyropoulou <i>et al.</i> (2016), (2019); Pirani and Arafat (2016); Principato <i>et al.</i> (2018); Sakaguchi <i>et al.</i> (2018); Wang <i>et al.</i> (2017), (2018)
Goh and Jie (2019); Hennchen (2019); SRA (2010); WRAP (2017)
Derqui <i>et al.</i> (2018); Filimonau and De Coteau (2019); Filimonau <i>et al.</i> (2019c); Kallbekken and Saelen (2013); Mousa and Freeland-Graves 2017; Papargyropoulou <i>et al.</i> (2016), (2019); Pirani and Arafat (2016); Principato <i>et al.</i> (2018); Sakaguchi <i>et al.</i> (2018); Sebbane and Costa 2018; Sirieix <i>et al.</i> (2017); Stockli <i>et al.</i> (2018); Wen <i>et al.</i> (2017)

Journal Pre-proof

Figure 2. A dining table with excessive food waste from customer plates in one of the studied restaurants. Note the dominance of wasted seafood.



Figure 3. A dining table with excessive food waste due to over-cooking / an excessive food order in one of the studied restaurants. Note the dominance of wasted meat.



Figure 4. Example of a customer information card used in one of the studied restaurants to encourage consumers to waste less food. Added in white are English translations.



The authors hereby declare no conflict of interest

Journal Pre-proof