Received 26 April 2022
Revised 5 August 2022
Accepted 6 August 2022

Food waste generated by the Mauritian hotel industry

Cheetra Bhajan, Hudaa Neetoo, Shane Hardowar, Navindra Boodia, Marie Françoise Driver, Mahindra Chooneea, Brinda Ramasawmy, Dayawatee Goburdhun and Arvind Ruggoo
Faculty of Agriculture, University of Mauritius, Reduit, Mauritius

Abstract

Purpose – This study aims to shed light on the phenomenon of food waste generation by the food and beverage sector of hotels of Mauritius as well as examine the current status of food waste management.

Keywords Food waste, Hotel, Tourism industry, Hospitality sector, Consumers

Paper type Research paper

Introduction

Food production is expected to increase by 70% between 2005 and 2050 to feed a projected global population of 9.1 billion people (Silva, 2018). However, achieving this target may be hampered by the COVID-19 pandemic. Every year, roughly one-third, or approximately 1.3 billion tonnes, of the edible parts of food produced for human consumption are lost or wasted globally. Food loss and waste have become a complex phenomenon, attracting the attention of scientists and activists alike. It is a global paradox that so much emphasis is placed on agriculture to improve food security while one-third of all food produced is wasted (Conserve energy future, 2017). Although the terms "food loss" and "food waste" are sometimes used interchangeably, they have different origins and scope. According to FAO (2014), food waste is defined as food originally intended for human consumption but not consumed by humans. Food loss, on the other hand, refers to food that is considered unfit for human consumption due to a decrease in the quantity and quality of food (Irani *et al.*, 2017). The subject of food waste is a multidimensional issue with environmental, economic and social dimensions.

The environmental impact of food waste is due to the fact that the production of food is considerably resource-intensive. The overall amount of water needed for food production is estimated to be 250 cubic kilometers, which accounts for 70% of the earth's water

The authors are grateful to the University of Mauritius for funding this project (RA 010). The support of the hotel personnel who provided their time, information and insight is deeply acknowledged. The team is also thankful to Mr Vishw Mangar for assisting in data collection at selected hotels.

Tourism Critiques: Practice and Theory
Vol. 3 No. 2, 2022
pp. 120-137
Emerald Publishing Limited
2633-1225
DOI 10.1108/TRC-04-2022-0010

(Silvennoinen *et al.*, 2014). Moreover, the total amount of land used in producing food on earth is around 1.4 billion hectares, which accounts for about 28% of the world's total area. In addition, the transportation of food materials from one country to another requires a large amount of fossil fuel, and its storage uses electricity (FAO, 2013a, 2013b). Hence, food that is not consumed translates to a waste of natural resources used in its production. On the other hand, a reduction in food losses and waste automatically increases the availability of food for human consumption and reduces the burden on farmers. Mourad (2016) mentioned that food waste is accompanied by a range of environmental concomitants, such as soil erosion, deforestation, water and air pollution as well as greenhouse gas emissions that occur in the processes of food production, storage, transportation and waste management.

Apart from its adverse environmental impacts, food waste is also costly in terms of raw materials, labor, production, storage, serving as well as disposal (Waste and Resource Action Programme, WRAP, 2012). Because food waste can create unpleasant smells, attract bugs and hence give rise to diseases, it is important that the waste is properly disposed of by professional companies that are paid to collect it. Because food waste disposal is a frequent activity, this creates an overall heavy economic burden. Moreover, when any food item is discarded, the money invested in its production is also wasted. According to Baldwin and Shakman (2012), the food industry loses about 4%–10% of its investment in food production every day, and this has a significant toll on the company's turnover.

The social dimension of food waste should also not be overlooked because food insecurity is tightly linked to social problems such as famine and undernourishment. It is estimated that 795 million individuals suffer from chronic undernutrition worldwide, and this number is expected to increase in the future (World Hunger News, 2016). If the food wasted that occurs all over the world could be saved, it would be enough to feed all the hungry people that exist because most of the foods that are wasted are perfectly edible (FAO, 2017a, 2017b). If recovered, these foods could even feed animals. Reducing food loss and waste is thus garnering increased global interest and actions by governments, food supply chain actors and nongovernmental organizations (NGOs).

According to Pirani and Arafat (2016a), the tourism industry is thought to contribute toward 9% of the total food waste generated by the food sector. Worldwide, hotels produce an average of 289,700 tonnes of waste each year, including 79,000 tonnes of food waste. Indeed, recent studies have demonstrated that the food and beverage (F&B) sector contributes nearly 12% of total food waste (Tostivint *et al.*, 2016). Mauritius is a popular tourist destination, attracting an average of 1.8 million visitors per year (Statistics Mauritius, 2019). Yet, there is currently a dearth of information concerning food waste generation in the hospitality sector of Mauritius. The latter, being a member of the United Nations (UN), needs to contribute toward achieving the Sustainable Development Goals (SDGs), one of which is to "halve the per capita food waste at the retail and consumer level and reduce food loss along production and supply chains by 2030." Moreover, there is a lack of published data on food wastage specifically produced by the hospitality sector.

The study is therefore aimed at shedding light on the food waste problem of the F&B sector of the hotel industry in Mauritius through qualitative (interviews and visual observations) and quantitative methods of data collection. Given the complexity and multidimensional nature of the food wastage problem, it is hoped that baseline data gathered from the study will be an eye-opener for hoteliers and various actors in the food supply chain as well as social and environmental NGOs. Furthermore, this research may also reinforce the commitments of the different partners toward achieving several of the UN SDGs.

Literature review

Tourism has become an important springboard for economic development in a large number of Small Island Developing States (SIDS). Mauritius is an example of such a SIDS which emphasizes quality tourism and high value addition within the local economy (Wing *et al.*, 1995). In addition to the central role of the tourism sector in the local economy, Mauritius is also well positioned in the European market, having a positive gap between overall perceptions and expectations of tourists (Naidoo and Ramseook-Munhurrun, 2012). Studies measuring the brand image attributes of Mauritius as a holiday destination, have revealed several positive functional and psychological attributes such as "white beaches," "cultural and historical sites," "ecotourism and nature-based activities," "family activities," "standard of hotels," "local cuisine," "festivals, events and handicrafts," "cultural diversity," "nightlife," "spa facilities" and "golf and water sports," which together motivate tourists to travel long distances to reach the destination (Naidoo and Ramseook-Munhurrun, 2012). It is thus not surprising that the tourism industry of Mauritius represents one of the most important pillars of the country's economy.

The tourism and hotel industry is a sector that functions in annual cycles based on seasons, with the peak months spanning the months of June till August. Hotel attendance is estimated to be significantly higher during that period while the off-peak period is between the months of November to March (S. Archaraz, personal communication, November 2019). The two main factors that influence seasonality of the hotel industry are usually climate and the institution (Guinefolleau, 2019). European countries have typically been the main feeders of the Mauritian hotel industry and contributed 59% of tourist arrivals in 2018 (Price Water House Coopers, 2020). In fact, the number of international visitor arrivals has grown at a compounded annual rate of 3.9% over the past 10 years (Price Water House Coopers, 2020).

The tourism industry of the island Mauritius is also known for its eclectic gastronomy after its pleasant climate and picturesque scenery (Republic of Mauritius, 2018). Each tourist views food in a different way, as along with satisfying a basic human need, food can also deliver a unique experience. For some tourists, exploring a destination's cuisine can even be a primary motivator for travel because it can act to experience the cultural heritage and identity of a particular destination. Even when the reason behind travel is not food, it can serve as an enjoyable contributing factor in the tourism industry (Berbel-Pineda *et al.*, 2019). While some travellers are attracted by the authenticity of local cuisine during their journeys, others may prefer to enjoy more familiar foods to avoid unpleasant risks. Additional elements that are thought to contribute to a tourist's food consumption behavior include religious and cultural background (Mak *et al.*, 2012).

Unfortunately, a concomitant of the tourism industry is the generation of a large percentage of food waste and the expansion of Mauritian hotel sector would almost certainly contribute to an increase in food waste generation. A food item becomes waste when it fails to be used by an employee or a consumer of a food service (Santeramo and Lamonaca, 2021). Not only does it include food thrown away, but food waste also includes food consumed in excess that is more than 2,000 kcal per day (Sundin *et al.*, 2021). In the longer run, overconsumption of food causes obesity and other health problems, contributes to the country's burden of noncommunicable diseases, and is thus an unsustainable practice (Hall and Scott, 2018). Food wastage incorporates not only solid food but also liquid products such as milk and juice. Even waste generated by the kitchen, for instance, eggshells, peels of fruits and vegetables and unused animal grease, are considered food waste. In fact, food wastage can be categorized into avoidable, partially avoidable and nonavoidable (unavoidable) food wastage (Cuglin *et al.*, 2017). Avoidable food wastage represents wastage that could have been completely prevented and includes overproduction of food due to poor

planning, leftovers, serving of large portion sizes, cooking mistakes or poor inventory management leading to expiration of food (WRAP, 2020). Unavoidable food wastage includes inedible parts of food, such as eggshells. Most of these wastes are not hazardous and can be composted or separated into different categories before being sent to various waste treatment plants. Partially avoidable food wastage includes food wastage such as carcasses, which can be reused in the making of stew (Voća, 2014). In terms of the environmental impact of the hotel industry, the International Hotel Environmental Initiative estimated that on average, an amount of 0.8–1.2 kg of waste is generated daily per guest, which typically doubles on checkout days (Abdulredha *et al.*, 2018). Although most of this quantity is made up of solid waste (e.g. packaging), food waste accounts for a significant portion (more than one-third), with approximately 75% of it still being edible.

As a SIDS that is geographically isolated from major economic markets, Mauritius already faces inherent vulnerabilities and limited natural resources (UN, 2021). This is exacerbated by the country's self-sufficiency in a few food crops and highly reliance on remote markets for food supplies (Ramasawmy and Neetoo, 2021). As Pirani and Arafat (2016b) pointed out, the tourism industry should play a major role in addressing the food wastage problem by identifying the contributing inputs and factors. The tourism sector of Mauritius in particular, will need to evolve rapidly in the face of various emerging challenges such as climate change (Sultan, 2021), the COVID-19 pandemic and geopolitical conflicts which disproportionately affect SIDS economies. Actors in the F&B industry will need to adopt more sustainable practices, with a focus on food services that take into account the nuances of the local food as well as cultural food norms.

Unfortunately, to date, there is a scarcity of research on food waste management in the hospitality sector of SIDS, including Mauritius, with the majority of studies being conducted in nonisland economies and developed countries (Papargyropoulou *et al.*, 2019). Although there is a wide array of publications characterizing the tourism sector of Mauritius (Juwaheer and Lee Ross, 2003; Naidoo and Ramseook-Munhurrun, 2012) and even broad aspects of sustainable tourism (Makoondlall-Chadee *et al.*, 2021), there is a dearth of specific data on sustainable food production and management practices and food wastage in hotels. Moreover, while food waste has been extensively discussed in the local media, it has yet to receive adequate academic attention (Filimonau and De Coteau, 2018). The objectives of the study were therefore to explore the food waste generation and management strategies by the F&B sector of hotels of Mauritius having different star ratings, during both peak and off-peak seasons.

Methodology

The methodological approach adopted was a mixed method, comprising of semistructured and in-depth interviews, visual observations on-site and quantitative data collection (Figure 1). The units of analysis for the research were six hotels that were agreeable to participate in the case study, given the complexity of obtaining a random sample in this situation (Table 1). The hotels were situated in the north, east, south and west of Mauritius. Being a tropical island surrounded by the sea, most tourist hotels of Mauritius are situated along the coast. Figure 2 shows the geographical location of the hotels from which data was collected. A facility tour was done at each hotel to delineate the different departments such as the store, kitchen, buffet and dining hall and to understand the flow of food materials and food waste across these departments (Figure 3). Food waste generation was studied from the time of purchase of raw food supplies, through food storage, preparation and cooking, consumption and, finally, discarding of food waste (Papargyropoulou *et al.*, 2019).

Semistructured and in-depth interviews

Interviews were conducted with F&B managers, chefs and waiters at the six hotels to gather information on:

(1) their general knowledge and awareness of the problem of food wastage in hotels;

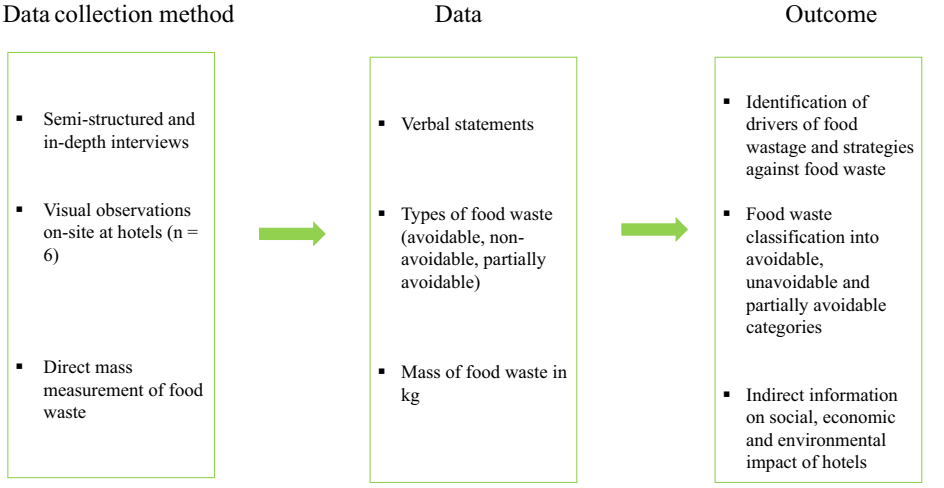

Figure 1.
Methodological approach adopted in the study

Hotel star-rating	Period of study	Type of clientele	No. of case study units
3-star hotels	Peak and off-peak seasons	Tourists mainly	2
4-star hotels			2
5-star hotels			2
Total			6

Table 1.
Details of hotels approached for the study

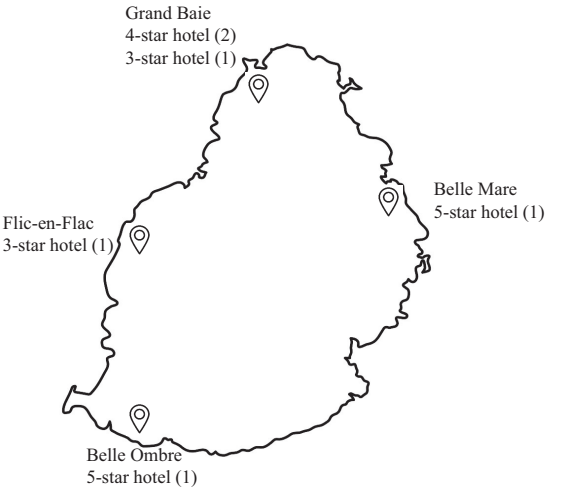

Figure 2.
Location of participating hotels belonging to different categories

(2) drivers of food wastage; and

(3) the preventive practices for food waste management.

F&B managers, chefs and waiters were the preferred participants in the interview because they had immediate access to data on food waste generated on a daily basis. At the beginning of each interview session, a brief description of the study objectives was explained. The questions of interview are summarized in Table 2.

Visual observations on-site

Data collection also involved recording and categorizing the different types of food wasted in the F&B sector of the hotels under study. Categorization is an important step in determining the best waste management option for various types of food waste. To characterize the types of food waste, qualitative assessment was performed. This was done by determining the type of food being discarded for a period of 10 consecutive days. Food wasted was classified as:

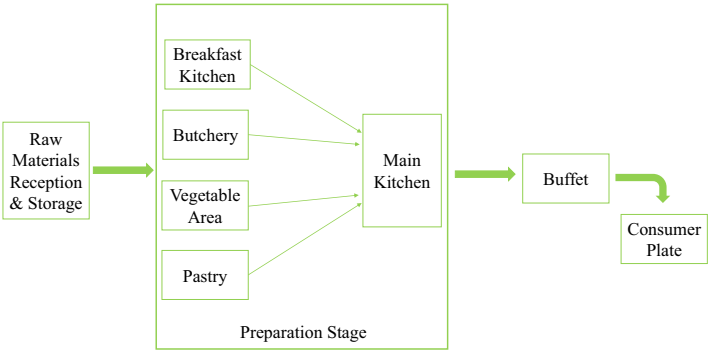

Figure 3.
Flow of raw materials and food products along the different F&B sections of studied hotels

Question no.	Questions list
1.	Do you think that there is a food wastage problem at the hotel?
2.	In which of the following categories would you classify most of the food waste? • Nonavoidable (eggs shells, vegetable skins, animal bones) • Avoidable (uneaten food from client plates, cooking mistakes) • Possibly avoidable (expired food, over ripe fruits)
3.	According to you, during which meal of the day is food most wasted?
4.	Do you think that during the period of festivities (Christmas, New Year, Diwali, etc.), the amount food waste on the buffet increases?
5.	Does difference in ethnicity usually have an impact on buffet food wastage?
6.	What according to you are the main causes of food wastage?
7.	Do you think staffs are trained enough (in terms of food preparation, food storage and cooking skills) to minimize food wastage at the hotel?
8.	Do you think that buffet leftover food is still safe for consumption?
9.	Does the hotel currently have a program in place for food waste management?
10.	We are interested in gathering the best ideas from around the country for cutting down on food waste. Do you have any to share?

Table 2.
Interview questions

- avoidable;
- partially avoidable; or
- unavoidable as described by Stenmarck *et al.* (2016).

Quantification of food waste

A material flow analysis (MFA) method as previously used by Pirani and Arafat (2016b) was adopted for quantitative data collection. MFA is a "systematic assessment of the state and change of materials flow and stock in space and time" (Brunner and Rechberger, 2017). Quantification of food waste generated by each department was monitored over a period of 10 days. The length of the waste quantification exercise exceeded the recommended three-day duration by WRAP and the Sustainable Restaurant Association, to improve data reliability (Reynolds *et al.*, 2019). Waste from the different sections of the kitchen, dining hall leftovers and buffet leftovers were manually sorted to separate food from nonfood items in bags of garbage. Food waste materials were weighed directly using a portable electronic scale(s) with a capacity of 1–150 kg (CAS).

Results and discussion

Semistructured and in-depth interviews with hotel personnel

From the interviews, most of the respondents acknowledged that there was a food wastage problem at the hotels, albeit to different extents. Most F&B managers interviewed (five out of six) indicated that prolonged storage of food raw materials, physical damage, browning, staling and fungal growth were significant causes of food waste at the preparation stage. Moreover, the general challenge felt across all hotels was being able to strike a balance between preparing the correct amount of food to satisfy all customers while keeping wastage to a strict minimum. Indeed, the contribution of overproduction to food wastage was also reiterated by the main chef of Clarion Hotel Helsinki, Finland during his interview about the causes of food waste (Linh, 2018). F&B managers further mentioned that staff behavior was another influential driver of food waste. For instance, newly recruited staffs who were still being trained had a tendency to make mistakes during food preparation thereby resulting in food wastage. In addition, F&B managers described the employees as being poorly skilled at fruit and vegetable peeling and they threw away parts of fresh produce which were still edible. Heikkilä *et al.* (2016) identified eight key elements influencing production of food waste, one of which was related to the employees' professional skills. The author explained that mistakes made by an untrained employee could be due to incorrect or heedless interpretation or reading of a recipe. Care, meticulousness and the ability to follow instructions were regarded as important considerations of professional skills (Heikkilä *et al.*, 2016). Another major driver for food waste that was mentioned during interviews was the daily provision of buffet spreads. Buffets involve having the food ready and available for customers to help themselves. Mauritius has classically been regarded as a major tourist destination with a focus essentially on the sun, sand and sea paradigm (Dabeedooal, 2021). The author indicated that this type of resort tourism relies on beachfront hotels providing excellent hospitality. With the rich cultural diversity of Mauritius, there is a strong interest to additionally position Mauritius as a culinary tourism destination (Republic of Mauritius, 2018). As such, expected standards from tourists are high and rapidly changing (Juwaheer and Lee Ross, 2003), causing hotels to invest largely on food. According to the F&B managers, hotels offer buffet spreads, especially during important events where a large variety of food is prepared to render the buffet more attractive and to satisfy customers. Not to mention that a variety of cuisine themes and decorative foods are additionally organized to give hotel residents a chance to feast, especially during periods of religious and national festivities. Interview participants also indicated

that the food displayed should always look fresh and appealing, thus compelling the staff to refill the buffet so that it always looks plentiful. Replenishing is typically done till the end of the buffet even when the number of customers declines. According to the interview participants, this type of service in the hospitality industry poses a major challenge with respect to food waste reduction. Juvan *et al.* (2017) also noted that the buffet-style of catering has an important influence on the amount of waste generated. The F&B managers also mentioned that as we are living in a digital age, bad reviews on sites such as Booking.com and Trip advisor can tarnish the reputation of a particular hotel. Hence, they refrain from interfering with customers' behavior, including food wasting behavior, because there is a risk of getting a poor review on online hotel rating sites. Another driver of buffet-associated wastage mentioned by the F&B personnel is the fact that many guests, especially those originating from European countries, had a tendency to make conservative choices for continental breakfast items such as toasts, pastries and pancakes, highlighting the role of familiarity and cultural proximity in food selection. As a result, the staff mentioned considerable leftover of non-Western breakfast items such as fritters, rice and curries. Similarly, occidental food items such as pizzas and pastas were found to be more appealing to guests from Western countries, resulting in large amounts of leftover of more oriental dishes on the menu. Another important consideration that was mentioned by the chefs of hotels when serving buffet spreads is the need to respect a standard "hold time" of 3 h due to food safety concerns. Thus, food left on buffet tables for longer than 3 h are no longer considered fit for consumption and have to be thrown away. The high turnover of food is also another major contributory factor of food waste.

Further to shedding light on drivers of food waste, the participants were also asked about preventive practices against food wastage. For instance, the personnel of the different hotels indicated that in the store, a color-coding system was used. Such a system tagged products that were closer to expiry dates, with a specific color to allow them to be used prior to other products. The system made sure that all products were used timeously before expiration to avoid wastage. Second, the "First-In, First-Out" approach was also used ensuring that products received earlier were given priority. This method was considered effective by the interviewees as it significantly reduces the chance for product spoilage, hence minimizing food waste. In one of the five-star hotels, the F&B manager mentioned keeping the cold storage under 24 h surveillance so that in case of power outage, the person in charge would be alerted via mail or short message service. Necessary actions could thus be taken to avoid the occurrence of temperature abuse leading to food spoilage. Furthermore, in one of the four-star hotels, the chef mentioned using ozonated water to wash food items such as meat, seafood, fruits and vegetables to extend their shelf life. Ozone washing systems are very effective at cleaning food items. This can be attributed to the capacity of ozone in creating hydroxyl radicals that inhibits the growth of pathogens on the surface of food products (Sarron *et al.*, 2021).

Visual observation on-site at hotels

In addition to interviews, visual observation of the flow of raw materials and food products along the different F&B sections (Figure 3) was also conducted. At each hotel, meat and fish were prepared in the butchery section, bread and desserts in the pastry area, fruits and vegetables in the vegetable area and the main courses in the main kitchen. The stores for raw materials were found to be equipped with chill rooms set at a temperature of 5–6°C and a deep freezer set at −20°C for the storage of chilled (fruit juice, cheese, etc.) and frozen (meat, seafood, etc.) food, respectively. From the store, the raw materials were distributed to the hotels' kitchens, which consisted of different compartments (butchery, vegetable area, pastry and main kitchen). After preparation in the kitchen, food was then displayed on the

buffet table for consumers. In all hotels studied, food was served at all three meal times of the day, i.e. breakfast, lunch and dinner.

It was generally observed that hotel guests were major contributors to food waste. In fact, customers have often been blamed for the high food waste generation rates in restaurants (Evans, 2011). In this study, they were often observed to be oblivious of the consequences of food waste and this could likely be attributed to a lack of sensitization on this sensitive matter. In fact, no notice or signs were observed in any of the dining halls of hotels discouraging this practice. Hence, lack of knowledge could likely be the principal driver of food waste among consumers.

As far as remedial measures against food wastage are concerned, it was observed that in five-star hotels, leftovers at the food preparation stage were sorted allowing some products to be used again. Indeed, "re-use" is one of the three R's of the waste hierarchy (Simon, 2013) and foods that were in good condition were transformed into other products. For example, fruits and vegetables were used to make jams and some animal carcasses were used to make stew. Similarly, offals which refer to carcasses as well as internal organs of animals were salvaged after butchering or skinning to make certain niche dishes. In international cuisine, some offal dishes such as foie gras, pâté and sweetbreads are actually considered as gourmet food (Young, 2018). Insect repelling devices were also used widely in the restaurants of hotels to prevent insects from entering food, thus avoiding contamination (Mezes, 2018) that would otherwise lead to unnecessary wastage. Moreover, hotels were also found to set up live cooking stations at buffets, where chefs prepared dishes fresh on demand. Live cooking prevents the need for producing a large amount of food as consumers only take the food item(s) of their choice with their desired portion size leading to less food waste (Sandaruwani and Gnanapala, 2016). At the same time, live cooking stations provide an opportunity for guests to interact with hotel chefs while enjoying intense visual impressions that tantalize all senses. One of the three-star hotels practiced donation of consumers' leftovers to farmers who in turn, used them as feed for livestock animals. Along with alleviating the scourge of food wastage, farmers also save money which would otherwise be spent in buying animal feed. Being an omnivorous animal, swine is usually best suited for feeding on food waste. One five-star hotel was also certified "Green Key," a leading international eco-label awarded to accommodations and other hospitality facilities that commit to sustainable business practices (Ilina *et al.*, 2019). Awarded establishments must comply with strict criteria and are independently monitored through regular on-site audits. Figure 4 represents the most to least practiced food waste management strategies observed at the studied hotels.

Characterization of food waste

The main types of food waste observed at the different stages of food preparation are listed in Table 3. Food waste that occurred during preparation was found to be mostly "unavoidable" and "partially avoidable" while food waste that occurred on buffet and consumers' plates was mostly "avoidable." The findings of the study agree with Costello *et al.* (2016), who also divided food waste into edible and inedible wastes. Inedible waste refers to food waste that occurs before consumption and includes organic material, such as animal skin, that is thrown away during food preparation. The other type is food waste after consumption, which is the food remaining on the guests' plates while still being perfectly edible. Other studies have similarly classified food waste into several categories based on the edibility and noted that food waste can be avoidable (edible parts of the food), unavoidable (inedible parts of the food, such as bones and fruit skin) or possibly avoidable (WRAP, 2020). "Possibly avoidable waste" refers to those food items that are consumed by

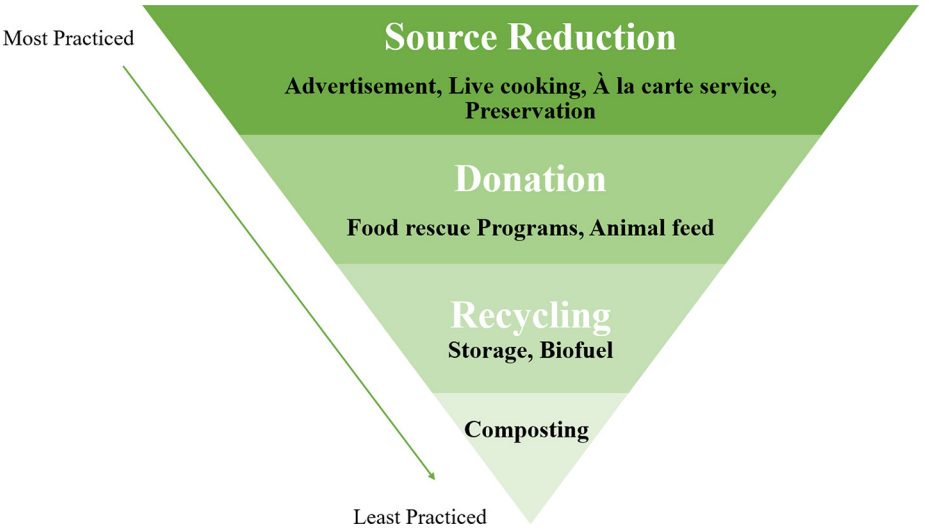

Figure 4.
Most to least practiced food waste management strategies in studied hotels

Area	Examples of food waste	Types of food waste
Store	Rejected items due to product expiration	Avoidable
	Product damage, presence of molds in food, dented food cans	Unavoidable
Butchery	Animal skin, carcasses, bones, fish fines	Unavoidable
Vegetable area	Fruits and vegetables skin, moldy fruits	Unavoidable
	Remnants from carved fruits, deformed whole fruits	Partially avoidable
Pastry	Fruits and vegetables skin, egg shells	Unavoidable
Main kitchen	Waste due to cooking, cutting errors, e.g. burnt food	Partially avoidable
Buffet	Food exposed but not consumed – leftovers	Partially avoidable
Consumer's plate	Uneaten food	Avoidable

Table 3.
Main types of food waste at different F&B sections of studied hotels

some based on personal preferences. For instance, bread crusts and potato skins are consumed by some people but not by others. Edible or avoidable food waste generally represents a considerable percentage of total food waste (Marthinsen *et al.*, 2012). Possible reasons for generation of a large amount of edible, avoidable waste can be because of poor sensorial quality of the food, personal preferences of consumers or incorrect judgment of the ability to consume all the food that has been dished out on the plates (Cox and Downing, 2007; Lam, 2010).

Quantification of food waste

Table 4 compares the total amount of food waste generated in the F&B section of hotels of different ratings. It can be seen from the data collected that on a daily basis, above 100 kg of food was lost in all studied hotels, both during peak and off-peak seasons. In fact, more than 200 kg of food was wasted in two of the hotels studied. One likely explanation for the sheer amount of food wasted could be because hotel guests tended to serve themselves larger amounts at hotels and restaurants than at home whereby only a limited variety of food is

prepared. Indeed, Wansink and van Ittersum (2013) indicated that people eat 45% more food and waste 135% more food at buffets when large plates are available. The tendency for hotel guests to fill up their plates could be attributed to a number of reasons, such as the feeling of "being entitled because of having paid for the service," the feeling that they can indulge on their "cheat day" as well as the perceived abundance and diversity of food, ultimately leading to greater food wastage. World Bank (2018) reported that around 1,500 people suffer from hunger in Mauritius. According to CEIC (2020), there are around 100 hotels in Mauritius. Therefore, it can be estimated that the total amount of food wasted by the hotel industry of Mauritius, if preserved correctly, could curtail food insecurity in the country.

The relative contribution of the different sections of the F&B department to food waste is shown in Figure 5 and indeed customers were by far the biggest contributors to food waste (Evans, 2011). Table 5 compares the amount of food waste at the level of consumers' plates in hotels of different ratings. Again, the quantity of food waste generated was higher during the peak season than the off-peak season. This can be related to the occupancy rates at the hotels, which were on average higher during the peak season. Because more food waste occurred on consumers' plates, a higher number of guests at the hotel would explain the increase in food waste during peak season. The amount of food wasted at the consumers' plates ranged from 0.16 kg to 0.66 kg per day per guest, with guests from three-star hotels wasting more than four- or five-star hotel residents. Although these figures are less alarming than statistics (0.8–1.2 kg) reported by the International Hotel Environmental Initiative, the impact of this phenomenon cannot be ignored for a country such as Mauritius which is a net importer of food and is still recovering from the COVID-19-induced contraction.

Table 4.
Average mass of food waste generated in the F&B section of hotels of different ratings

Rate of food wastage		3 Star		4 Star		5 Star	
		H1	H2	H1	H2	H1	H2
Total amount of food wasted over two weeks (kg)	Peak	1,294	1,378	2,372	1,774	2,521	1,239
	Off peak	1,278	1,282	1,161	1,204	1,886	1,005
Mean mass of food wasted daily (kg per day)	Peak	129 ± 5.43	138 ± 4.93	237 ± 3.34	177 ± 3.16	252 ± 2.57	123 ± 3.80
	Off peak	127 ± 1.08	128 ± 2.75	116 ± 3.58	120 ± 3.50	188 ± 6.35	100 ± 5.54

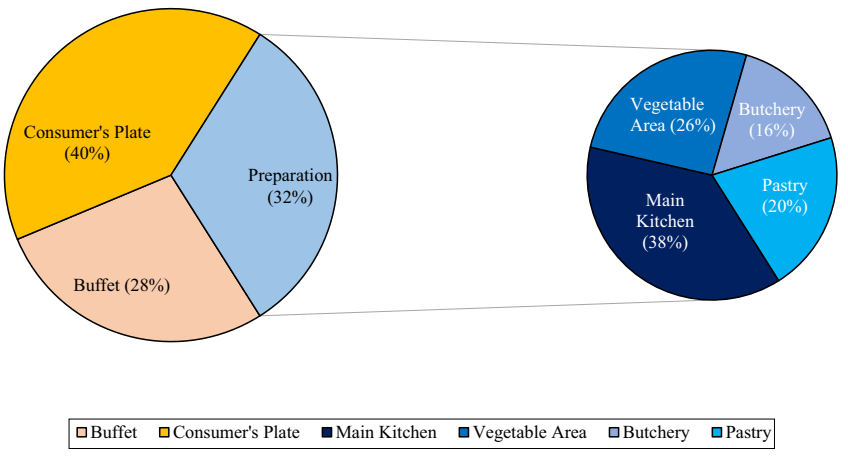

Figure 5.
Breakdown of average food wasted daily (kg) in the different food sections of six hotels

Parameter	Season	3 Star				4 Star				5 Star			
		Breakfast	Lunch	Dinner	Total	Breakfast	Lunch	Dinner	Total	Breakfast	Lunch	Dinner	Total
Rate of food wastage (kg per day)	Peak	15.9 ± 1.6	17.3 ± 1.2	18.4 ± 1.1	59.7 ± 3.5	27.0 ± 1.1	27.7 ± 1.0	27.1 ± 1.1	81.8±1.9	24.0 ± 2.41	26.7 ± 1.46	32.6 ± 3.65	98.2 ± 3.34
	Off Peak	9.4 ± 2.4	13.4 ± 2.6	17.0 ± 1.8	44.1 ± 3.6	17.9 ± 2.6	19.3 ± 2.9	28.4 ± 3.4	55.1 ± 4.0	22.8 ± 6.7	24.6 ± 2.7	30.0 ± 3.0	83.9 ± 11.4
Number of guests	Peak			95				374				317	
	Off Peak			67				334				297	
Rate of food wasted per guest (kg per day per guest)	Peak	0.17	0.18	0.19	0.63	0.07	0.07	0.07	0.22	0.08	0.08	0.10	0.31
	Off Peak	0.14	0.20	0.25	0.66	0.05	0.06	0.09	0.16	0.08	0.08	0.10	0.28

Table 5.
Average mass of food wasted at consumers' plate in hotels of different ratings

According to Papargyropoulou *et al.* (2014), food waste in hotels can be up to eight times higher among wasteful customers than less wasteful ones. However, when hotel occupancy rates are high, people with greater food wasting behavior tend to influence those who are less wasteful. In fact, Juvan *et al.* (2017) explained that hotel guests generate more food waste in restaurants when crowded due to a higher perceived anonymity (Bucciol *et al.*, 2015). With greater anonymity of customers, there is less communication among guests and hotel staffs, ultimately leading to a "let go" attitude.

To foster a "Zero food wastage culture" in the hotel sector of Mauritius, a positive change in the mindset is required from both actors in the hospitality sector as well as customers. Customer education remains key and it therefore calls for aggressive sensitization on this issue of great environmental and socioeconomic importance. It is also hoped that associations of hoteliers in Mauritius take the lead to harmonize best practices for sustainable food management. These practices could include keeping a "food waste diary," shifting to "portion plates" and regular training of staff among others. Moreover, hotels should work in concert with NGOs and charity organizations to mount robust food rescue programs to allow overproduced foods to be donated to the needy in a timely and safe manner. With tourism becoming an increasingly important economic plank for the country's development, the hospitality sector will need to stay abreast of latest cutting-edge technologies such as Internet 4.0 to become more sustainable. For example, the use of Internet of Things in the management of supply chains could help to reduce food waste and reinforce our national food security strategy.

Conclusion

Food waste comes at an exorbitant cost for the hotel industry and this is more pronounced for Mauritius, a resource-limited small island developing state. This study has unveiled various factors responsible for food waste generation in the F&B departments of hotels. Moreover, findings from this research have also shed light on the habits and practices of personnel and hotel guests that contribute to food waste. To our knowledge, our study is the first to report hotel seasonality, star-ratings of hotels, food familiarity and cultural proximity of guests as factors influencing amount of food wasted. It is also worth mentioning that although food wastage occurred at all stages of the food preparation chain, as high as 40% of the overall food wasted daily occurred at the level of the consumers' plate. This could be attributed to lack of awareness and sensitization of consumers on the environmental, social and economic impacts of food waste. Baseline data gathered from this study are of immediate relevance to hoteliers and can be used to inform policymaking. Moreover, this study serves as a precursor for future research where new metrics can be devised to calculate and predict food waste based on well-characterized indicators such as planning and portion size indicators as well as new indicators reported in this study. With the growing importance of Mauritius as an increasingly popular holiday destination, this report will help the tourism industry better manage the growing problem of food waste by identifying the inputs and factors that contribute to the problem and assist hotels in acquiring a green hotel label.

References

Abdulredha, M., Al Khaddar, R., Jordan, D., Kot, P., Abdulridha, A. and Hashim, K. (2018), "Estimating solid waste generation by hospitality industry during major festivals: a quantification model based on multiple regression", *Waste Management*, Vol. 77, pp. 388-400.

Baldwin, C.J. and Shakman, A. (2012), "Food waste management", *Greening Food and Beverage Services: A Green Seal Guide to Transforming the Industry*, Green Seal, Washington, DC, pp. 57-58.

Berbel-Pineda, J.M., Palacios-Florencioa, B., Ramírez-Hurtado, J.M. and Santos-Roldánc, L. (2019), "Gastronomic experience as a factor of motivation in the tourist movements", *International Journal of Gastronomy and Food Science*, Vol. 18, p. 100171.

Brunner, P.H. and Rechberger, H. (2017), "Handbook of material flow analysis", *For Environmental, Resource and Waste Engineers*, 2nd ed., CRC Press, Taylor and Francis Group, LLC, Boca Raton, London, New York, NY.

Bucciol, A., Montinari, N. and Piovesan, M. (2015), "Do not trash the incentive! Monetary incentives and waste sorting", *The Scandinavian Journal of Economics*, Vol. 117 No. 4, pp. 1204-1229.

CEIC (2020), "Mauritius hotel statistics", available at: www.ceicdata.com/en/mauritius/hotel-statistics (accessed 10 June 2021).

Conserve Energy Future (2017), "Causes, effects and solutions to growing problem food waste", available at: www.conserve-energy-future.com/causes-effects-solutions-food-waste.php (accessed 14 September 2019).

Costello, C., Birisci, E. and Mcgarvey, R. (2016), "Food waste in campus dining operations: inventory of pre- and post-consumer mass by food category, and estimation of embodied greenhouse gas emissions", *Renewable Agriculture and Food Systems*, Vol. 31 No. 3, pp. 1-11.

Cox, J. and Downing, P. (2007), "Food behaviour consumer research: quantitative phase", available at: www.wrap.org.uk/sites/files/wrap/Food%20behaviour%20consumer%20research%20quantitative%20jun%202007.pdf (accessed 25 May 2016).

Cuglin, A.M., Petljak, K. and Naletina, D. (2017), "Exploratory research of food waste generation and food waste prevention in the hospitality industry – the case of Zagreb restaurants", *Business Logistics in Modern Management*, Vol. 17, pp. 537-554.

Dabeedooal, Y.J. (2021), "An application of scenario planning to explore the plausible future of food tourism the case of Mauritius, a small island developing state", MSc Thesis, Victoria University of Wellington.

Evans, D. (2011), "Blaming the consumer – once again: the social and material contexts of everyday food waste practices in some English households", *Critical Public Health*, Vol. 21 No. 4, pp. 429-440.

Filimonau, V. and De Coteau, D. (2018), "Food waste management in hospitality operations: a critical review", *Tourism Management*, Vol. 71, pp. 234-245.

Food and Agricultural Organization (2013a), *Food Wastage Footprint: Impacts on Natural Resources*, available at: www.fao.org/3/i3347e/i3347e.pdf (accessed 8 September 2022).

Food and Agricultural Organization (2013b), *Toolkit: Reducing the Food Wastage Footprint*, available at: www.fao.org/3/i3342e/i3342e.pdf (accessed 8 September 2022).

Food and Agricultural Organization (2014), Global Initiative on Food Losses and Waste Reduction, Rome.

Food and Agricultural Organization (2017a), *Food Loss and Food Waste*, available at: www.fao.org/policy-support/policythemes/food-loss-food-waste/en/ (accessed 8 September 2022).

Food and Agricultural Organization (2017b), *Key Facts on Food Loss and Waste You Should Know*, available at: www.fao.org/save-food/resources/keyfindings/en/ (accessed 8 September 2022).

Guinefolleau, E. (2019), "Reform on the reference system for tourist residences", Amenitiz, 23 May, available at: www.amenitiz.io/blog/reform-on-the-reference-system-for-tourist-residences (accessed 11 September 2020).

Hall, K.D. and Scott, K. (2018), "Maintenance of lost weight and long-term management of obesity", *Medical Clinics of North America*, Vol. 102 No. 1, pp. 183-197.

Heikkilä, L., Reinikainen, A., Katajajuuri, J.M., Silvennoinen, K. and Hartikainen, H. (2016), "Elements affecting food waste in the food service sector", *Waste Management*, Vol. 56, pp. 446-453.

Ilina, E.L., Miloradov, K.A. and Kovaltchuk, A.P. (2019), "Green hotel: concepts and implementation", *Journal of Environmental Management and Tourism*, Vol. 10 No. 2, pp. 300-306.

Irani, Z., Sharif, A.M., Lee, H., Aktas, E., Topaloglu, Z., Van't Wout, T. and Huda, S. (2017), "Managing food security through food waste and loss: small data to big data", *Computers and Operations Research*, Vol. 98, pp. 367-383.

Juvan, E., Grün, B. and Dolnicar, S. (2017), "Biting off more than they can chew: food waste at hotel breakfast buffets", *Journal of Travel Research*, Vol. 57 No. 2, pp. 232-242.

Juwaheer, T.D. and Lee Ross, D. (2003), "A study of hotel guest perceptions in Mauritius", *International Journal of Contemporary Hospitality Management*, Vol. 15 No. 2, pp. 105-115, doi: 10.1108/09596110310462959.

Lam, Y. (2010), "Why do UC Berkeley students waste food at dining halls?", available at: http://nature.berkeley.edu/classes/es196/projects/2010final/LamY_2010.pdf (accessed 25 October 2016).

Linh, N. (2018), "Food waste management in the hospitality industry case study: Clarion Hotel Helsinki", Bachelor thesis, University of Applied Sciences, Haaga-Helia.

Mak, A., Lumbers, H.N. and Eves, A. (2012), "Globalisation and food consumption in tourism", *Annals of Tourism Research*, Vol. 39 No. 1, pp. 171-196.

Makoondlall-Chadee, T., Goolamally, N.P., Ramasamy Coolen, P.V. and Bokhoree, C. (2021), "Sustainable tourism, technology and Internet 4.0: opportunities and challenges for small island developing states", IEEE IoT Vertical and Topical Summit for Tourism.

Marthinsen, J., Sundt, P., Kaysen, O. and Kirkevaag, K. (2012), "How to increase prevention of food waste in restaurants, hotels, canteens and catering: report prepared for the Nordic Council of Ministers", available at: http://norden.diva-portal.org/smash/record.jsf?pid=diva2%3A701203&dswid=−7274 (accessed 19 December 2021).

Mezes, M. (2018), "Food safety aspect of insects: a review", *Acta Alimentaria*, Vol. 47 No. 4, pp. 513-522.

Mourad, M. (2016), "Recycling, recovering and preventing food waste: competing solutions for food systems sustainability in the United States and France", *Journal of Cleaner Production*, Vol. 126, pp. 461-477.

Naidoo, P. and Ramseook-Munhurrun, P. (2012), "The brand image of a small island destination: the case of Mauritius", *Global Journal of Business Research*, Vol. 6 No. 1, pp. 55-64, available at: SSRN:https://ssrn.com/abstract=1947093

Papargyropoulou, E., Lozano, R., Steinberger, K., Wright, J., Ujang, N. and Bin, Z. (2014), "The food waste hierarchy as a framework for the management of food surplus and food waste", *Journal of Cleaner Production*, Vol. 76, pp. 106-115.

Papargyropoulou, E., Steinberger, J.K., 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", *Environmental Sustainability and Applications*, Vol. 11 No. 21, p. 6016.

Pirani, S. and Arafat, H. (2016a), "Reduction of food waste generation in the hospitality industry", *Journal of Cleaner Production*, Vol. 132, pp. 129-145.

Pirani, S. and Arafat, H. (2016b), "Interplay of food security, agriculture and tourism within GCC countries", *Global Food Security*, Vol. 9, pp. 1-9.

Price Water House Coopers (2020), "Hotels outlook: 2019-2023", available at: www.pwc.com/na/en/publications/hospitality-outlook.html (accessed 23 December 2020).

Ramasawmy, B. and Neetoo, H. (2021), "The role of Mauritian universities in supporting translational research: the case of the SmartBite project", Charles Telfair Centre Newsletter, available at:

http://charlestelfaircentre.com/the-role-of-universities-in-supporting-translational-research-the-case-of-the-smartbite-project/

Republic of Mauritius (2018), "Adapting to the changing global environment-strategic plan 2018-2030", available at: https://tourism.govmu.org/Documents/publication/STRATEGIC_Plan_2018-2021.pdf (accessed 8 September 2022).

Reynolds, C., Goucher, L., Quested, T., Bromley, S., Gillick, S., Wells, V.K., Evans, D., Koh, L., Kanyama, A.C., Katzeff, C., Svenfelt, A. and Jakson, P. (2019), "Review: consumption-stage food waste reduction interventions – what works and how to design better interventions", *Food Policy*, Vol. 83, pp. 7-27.

Sandaruwani, J. and Gnanapala, W. (2016), "Food wastage and its impacts on sustainable business operations: a study on Sri Lankan tourist hotels", *Procedia Food Science*, Vol. 6, pp. 133-135.

Santeramo, F. and Lamonaca, E. (2021), "Food loss – food waste – food security: a new research agenda", *Sustainability*, Vol. 13 No. 9, pp. 1-7.

Sarron, E., Gadonna-Widehem, P. and Aussenac, T. (2021), "Ozone treatments for preserving fresh vegetables quality: a critical review", *Foods*, Vol. 10 No. 3, p. 603.

Silva, G. (2018), "Feeding the world in 2050 and beyond – part 1: productivity challenges", MSU Extension Agriculture, 3 December, available at: www.canr.msu.edu/news/feeding-the-world-in-2050-and-beyond-part-1 (accessed 23 September 2021).

Silvennoinen, K., Katajajuuri, J.-M., Hartikainen, H., Heikkilä, L. and Reinikainen, A. (2014), "Food waste volume and composition in Finnish households", *British Food Journal*, Vol. 116 No. 6, pp. 1058-1068.

Simon, J.M. (2013), "From the 3Rs to the zero waste hierarchy", Zero Waste Europe.

Statistics Mauritius (2019), "International travel and tourism year 2019", available at: https://statsmauritius.govmu.org/SitePages/Index.aspx (accessed 5 September 2021).

Stenmarck, A., Jensen, C., Quested, T. and Moates, G. (2016), "Estimates of European food waste levels", [online], available at: www.eu-fusions.org/phocadownload/Publications/Estimates%20of%20European%20food%20waste%20levels.pdf (accessed 18 April 2022).

Sultan, R. (2021), "Economic impacts of climate change on agriculture: insights from the small island economy of Mauritius", in Moncada, S., Briguglio, L., Bambrick, H., Kelman, I., Iorns, C. and Nurse, L. (Eds), *Small Island Developing States, the World of Small States*, Springer, Cham, Vol. 9, doi: 10.1007/978-3-030-82774-8_7.

Sundin, N., Rosell, M., Eriksson, M., Jensen, C. and Bianchi, M. (2021), "The climate impact of excess food intake – an avoidable environmental burden", *Resources, Conservation and Recycling*, Vol. 174, p. 105777.

Tostivint, C., Östergren, K., Quested, T., Soethoudt, J.M., Stenmarck, A., Svanes, E. and O'Connor, C. (2016), "Food waste quantification manual to monitor food waste amounts and progression", FUSIONS – European Commission (FP7), Coordination and Support Action – CSA – Contract number: 311972.

Troubat, J.J. (2014), "Mauritius as a potential culinary destination: as assessment of the local cuisine for tourism development".

United Nations (2021), "About small island developing states", available at: www.un.org/ohrlls/content/about-small-island-developing-states (accessed 8 September 2022).

Voća, N. (2014), "Sprjecavanje nastanka otapda od hrane prilikom obavljanja turisticko- ugostiteljske djelatnosti", Agencija za okolis, Zagreb.

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*, Vol. 19 No. 4, pp. 320-332.

Wing, P., Conlin, M. and Baum, T. (1995), "Tourism development in the South Indian Ocean: the case of Mauritius", in Conlin, M.V. and Baum, T. (Eds), *Island Tourism: management Principles and Practice*, John Wiley &, Sons Inc., New Jersey, NJ, pp. 229-235.

World Bank (2018), "Prevalence of severe food insecurity in the population (%) – Mauritius", available at: https://data.worldbank.org/indicator/SN.ITK.SVFI.ZS?locations=MU (accessed 30 October 2021).

World Hunger News (2016), "World hunger and poverty facts and statistics", available at: www.worldhunger.org/2015-world-hunger-and-poverty-facts-and-statistics/ (accessed 29 December 2017).

WRAP (2012), "Household food and drink waste in the United Kingdom 2012 final report", available at https://wrap.org.uk/sites/default/files/2020-12/Household-Food-and-Drink-Waste-in-the-United-Kingdom-2012.pdf (accessed 14 September 2019).

WRAP (2020), "Food", [online], available at: https://wrap.org.uk/resources/guide/waste-prevention-activities/food (accessed 15 December 2020).

Young, J. (2018), "The offal truth", *Gastronomica*, Vol. 18 No. 1, pp. 76-82.

Further reading

Abeliotis, K., Lasaridi, K. and Chroni, C. (2014), "Attitudes and behaviour of Greek households regarding food waste prevention", *Waste Management and Research: The Journal for a Sustainable Circular Economy*, Vol. 32 No. 3, pp. 237-240.

Babar, Z. and Mirgani, S. (2014), *Food Security in the Middle East*, Oxford University Press, Oxford.

Basher, S., Raboy, D., Kaitibie, S. and Hossain, I. (2013), "Understanding challenges to food security in dry Arab micro-states: evidence from Qatari micro data", *Journal of Agricultural and Food Industrial Organization*, Vol. 11 No. 1, pp. 1-19.

Brian, L., Craig, H., James, L., Lisa, K., Richard, W. and Tim, S. (2013), *Reducing Food Loss and Waste Installment 2 of 'Creating a Sustainable Food Future'*, World Resource Institute, Washington, DC.

Broer, S. and Titheridge, H. (2010), "Eco-self-build housing communities: are they feasible and can they lead to sustainable and low carbon lifestyles?", *Sustainability*, Vol. 2 No. 7, pp. 2084-2116.

Canali, M., Amani, P., Aramyan, L., Gheoldus, M., Moates, G., Östergren, K., Silvennoinen, K., Waldron, K. and Vittuari, M. (2017), "Food waste drivers in Europe from identification to possible interventions", *Sustainability*, Vol. 9, p. 37.

Cohen, E. and Avieli, N. (2004), "Food in tourism: attraction and impediment", *Annals of Tourism Research*, Vol. 31 No. 4, pp. 755-778.

Food and Agricultural Organization (2011), Global Food Losses and Food Waste, Düsseldorf, Germany.

Heinemann, B. (2003), *Food Tourism around the World: Development, Management and Markets*, in Hall, C.M.Y., Sharples, L., Mitchell, R., Macionis, N. and Cambourne, B. (Eds), Routledge, London.

Kivela, J. and Crotts, J. (2006), "Tourism and gastronomy: gastronomy's influence on how tourists experience a destination", *Journal of Hospitality and Tourism Research*, Vol. 30 No. 3, pp. 354-377.

Kuo, C. and Shih, Y. (2016), "Gender differences in the effects of education and coercion on reducing buffet plate waste", *Journal of Foodservice Business Research*, Vol. 19 No. 3, pp. 223-235.

Lanfranchi, M., Calabro, G., De Pascale, A., Fazio, A. and Giannetto, C. (2016), "Household food waste and eating behavior: empirical survey", *British Food Journal*, Vol. 118 No. 12, pp. 3059-3072.

Meat cutting and processing for food service (2019), "Offal (variety meats)", available at: https://opentextbc.ca/meatcutting/chapter/offal-variety-meats/ (accessed 27 September 2021).

Mondejar-Jimenez, J.-A., Ferrari, G., Secondi, L. and Principato, L. (2016), "From the table to waste: an exploratory study on behaviour towards food waste of Spanish and Italian youths", *Journal of Cleaner Production*, Vol. 138, pp. 8-18.

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*, Vol. 365 No. 1554, pp. 3065-3081.

Quan, S. and Wang, N. (2004), "Towards a structural model of the tourist experience: an illustration from food experience in tourism", *Tourism Management*, Vol. 25 No. 3, pp. 297-305.

Quested, T.E., Parry, D., Easteal, S. and Swannell, R. (2011), "Food and drink waste from households in the UK", *Nutrition Bulletin*, Vol. 36 No. 4, pp. 460-467.

Secondi, L., Principato, L. and Laureti, T. (2015), "Household food waste behaviour in EU-27 countries: a multilevel analysis", *Food Policy*, Vol. 56, pp. 25-40.

Smil, V. (2004), "Improving efficiency and reducing waste in our food system", *Environmental Sciences*, Vol. 1 No. 1, pp. 17-26.

Thi, N.B.D., Kumar, G. and Lin, C.Y. (2015), "An overview of food waste management in developing countries: current status and future perspective", *Journal of Environmental Management*, Vol. 157, pp. 220-229.

United States Environmental Protection Agency (2019), "Reduce wasted food by feeding hungry people", available at: www.epa.gov/sustainable-management-food/reduce-wasted-food-feeding-hungry-people#fooddonation2 (accessed 14 September 2019).

Zotesso, J. (2016), "Analysis of solid waste generation in a university cafeteria in Brazil: a case study", *Environmental Engineering and Management Journal*, Vol. 15 No. 10, pp. 2327-2336.

Corresponding author
Hudaa Neetoo can be contacted at: s.neetoo@uom.ac.mu