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Food Waste Generation Within the Hospitality Sector in Malta

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ABSTRACT

The importance of addressing food waste has gathered momentum and is being prioritised by many countries as it enables waste management to be moved up the waste hierarchy through preventing the generation of such waste and the recycling of inevitable food waste into green resources. The amount of food waste from the hospitality sector in Malta represents an appreciable amount, and specific data is critical for policy purposes and for determining the necessary treatment infrastructure. This study explores the food waste generated by a mix of hotels and restaurants of a varying nature. Breakfast generates the least food waste per cover, whilst lunch and dinner generate a greater amount of food waste. The more expensive restaurants tend to generate more food waste per cover, and different cuisines generate different waste volumes. Likewise, 'Quality Assured' restaurants waste more food than others in order to maintain their high standards. It also emerges that food waste generated by the hospitality sector is mainly due to preparation, rather than plate waste.

KEYWORDS

Food Waste, Hospitality, Recycling, Sustainability

INTRODUCTION

Various researchers have highlighted that the catering industry is responsible for the generation of an appreciable amount of food waste (Gustavsson et al., 2011; Charlebois and Christensen Hughes, 2015). The growth of the catering industry has been on the increase (Ankaralıgil and Özdemir, 2019; Statistics Canada, 2013), and is expected to continue. Therefore, it is inevitable that with growth comes an increase in waste. Understanding food waste is important for policy and operational matters due to its detrimental environmental, social and economic impacts (Caldeira et al., 2019; Papargyropoulou et al, 2016). The EU food service sector produces about 12% of the total amount of wasted food (Fusions, 2016) whilst in the United States this amounts to 25.4% Refed, 2018) of the food supply chain whilst in China this may even rise up to 50% (Wen et al., 2017). The majority of research on food waste in the catering industry has mostly focused on consumer behaviour as well as portion sizes (Bloom, 2010; Ferreira et al., 2013). Yet, little work has been done to investigate the other

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contributors to food waste such as kitchen management and menu planning (Filimonau et al., 2020; Charlebois and Camp, 2007). Changes in the global economy have led to better cost management within the catering industry which works hand in hand with suppliers to improve the quality of the required products. As a result, there is also an increased interest in reducing avoidable food waste (Edwards and Meiselman, 2005).

Europe is striving towards transforming the way it perceives the economy, prioritising food waste in its document 'Closing the loop - An EU action plan for the Circular Economy' (2015). It highlights food waste as being a topic that concerns all Member States and urges action to create awareness and change in citizens' behaviour. The prevention of food waste also impacts natural resources, and hence the environment. Member States are encouraged to promote a shift in mentality to raise awareness, and to disseminate information on how one can reduce food waste. It also instils the idea that even when the food waste generated is unavoidable, this could still be kept in the 'loop' through recycling efforts. Similarly, the 2030 Agenda, agreed upon in the 2015 UN Summit the United Nations set up 17 Sustainable Development Goals (SDG). Goal 12 focuses on ensuring sustainable consumption and production patterns with one of its aims being to cut down by half the global food waste at both the retail and consumer levels by the year 2030 (United Nations, 2015). By understanding the generation typology of catering waste, such information could serve government in designing policy instruments such as legislation governing food waste. It could also serve resturants to better understand their portions and to optimise them accordingly whilst also providing for take-out and donation of surplus food. It could also serve as a basis for understanding the infrastructure required to manage and the costs that could be saved when reducing food waste.

The main aims of this research are to:

- Bring to the fore the role that Malta's hospitality sector plays in waste generation.
- Determine the average amount of food waste which is generated per cover during meals.
- Determine whether there is a relationship between the star rating of a hotel and the amount of food waste it generates.
- Investigate the waste generated and to note whether there is a trend in the waste produced between medium-class and high-class restaurants.
- Look into the price that is being paid by establishments in order to dispose of their waste and whether or not this fee depends on any variables.

This research dovetails with one of the key challenges outlined by Malta's Waste Management Plan (Ministry for Sustainable Development, the Environment and Climate Change, 2014), which aims to reverse the trend wherein economic growth is decoupled from waste generated.

LITERATURE REVIEW

There are various definitions that can be used to describe food waste (Teigiserova et al., 2020, Gjerris & Gaiani, 2013; Porpino, Parente & Wansink, 2015) and these depend on the type of food, its origin and disposal. FAO (2011), describes food waste as food which, although intended for human consumption, is not eaten, and is either disposed of, or given to animals. The European Commission (2010) defines food waste as waste:

Composed of raw or cooked food materials and includes food loss before, during or after meal preparation in the household, as well as food discarded in the process of manufacturing, distribution, retail and food service activities. It comprises materials such as vegetable peelings, meat trimmings, and spoiled or excess ingredients or prepared food as well as bones, carcasses and organs. (p. 9)

Sometimes, the term "food waste" is used with reference to "plate waste", which refers to food remains from plates after a person finishes dining. Wrap (2009) categorises food and drink waste according to how avoidable the waste is, assigning the definitions 'Avoidable', 'Possibly Avoidable', 'Unavoidable', 'Cooked, prepared or served too much', 'Not used in time', and 'Other', which help in distinguishing the various different fractions of food waste. It also defines the terms 'kitchen waste' and 'edible waste'.

It is clear that there is no one agreed or distinct definition to which research subscribes. For the purpose of this study, the preferred definition will be that coined by the European Commission (2010) which defines it as food that is unwanted and disposed of, such as leftovers from guest plates and peels from meal preparation that occur during cooking. There are other schools of thought which contend that food waste should exclude non-edible components such as Wang et al (2017) as avoidable food waste constitutes around 73-79% of total food waste (Oliveira et al., 2016).

The lack of data available prompted the European Commission to commission a cross-sectoral, EU-wide study aiming to quantify food waste (FUSIONS, 2016). This showed that the EU27 hospitality sector produces circa 12% of the overall food waste which is the third largest figure after households (53%) and food processing industries (19%). This study highlights the significance of this waste stream, in respect of the total waste arisings, which is equally significant outside Europe (Filimonau, 2019). In fact, Liu (2014) posited that the hospitality sector in China produced more food waste than households with similar findings reported for Malaysia (Papargyropoulou et al., 2016).

When considering all the environmental, social and economic benefits of limiting the amount of food we waste, one cannot help but question why this waste is not higher up on the political agenda (SRA, 2010). In fact, Garrone, Melacini, & Perego (2014) note the detrimental effect of food waste on global socio-economic and environmental sustainability.

Food waste has been classified as a very crucial waste stream (Sara, 2018; EPA, 2012; Defra, 2011; Government of South Australia, 2010) due to associated Greenhouse Gas (GHG) emissions (WRAP, 2009). WRAP (2011) concluded that avoidable food waste in the UK amounted to 17 MT of CO_2 equivalent, a figure comparable to the emissions of about 1 in 5 cars in the UK. Estimates of annual CO_2 emissions from production of food that is lost or wasted range from 125 to 900 kg per capita (Muth et al., 2019). Moreover, if the rate of food waste in the United States were reduced by 50% according to SDG 12, the total environmental impacts and resource use of the U.S. food system could decrease by 8–10% (Read et al., 2020). GHG emissions related to food waste globally, if considered as produced by a single country, would classify as the third top emitter after the US and China (FAO, 2013).

Food waste also impacts the Earth's natural resources such as water and land (Munesue and Masui,2019; Hall, Guo, Dore, & Chow, 2009; Kummu et al., 2012) with food production using up 28% of the world's available agricultural area and the associated irrigation being 38 times that used by US households (FAO, 2013). Moreover, the amount of water used to grow food which is eventually wasted along the supply chain would suffice the domestic needs of the predicted 9 billion human population in the year 2050, alleviating pressures on global freshwater resources (Venghaus and Hake, 2018; Stuart, 2009).

The social implications revolve mainly on the ethical and moral aspects. On the one hand, we have a portion of the world's population with excess food to eat, with highly wasteful practices adopted over the years, while, on the other hand there is another portion of the population which lives in poverty (Evans, 2011; Stuart, 2009; Wrigley, 2002). This is relevant to Sustainable Development Goal 2 which talks about the eradication of hunger by 2030, where everybody, especially the vulnerable, can have a healthy lifestyle (United Nations, 2015). Bursts of activism directly related to food waste such as the 'freeganism' made their statement by eating from food that was thrown away to highlight the environmental impacts of food waste as well as the huge division in terms of access to food (Edwards and Mercer, 2007).

Food waste has financial associations (Distefano, 2022; Watson and Meah, 2013,) with most linking it with a loss in profit (Goh and Ferry, 2019; SRA, 2010). Few are those who claim that they are affected by the environmental or social impacts of food waste. This goes to show that food waste plays a very important role when considering the economy (Evans, 2011; WRAP, 2011). FAO (2013), with the global cost of food waste in the year 2007being 750 billion dollars. Quested et al. (2011), suggested that food and drink wasted from UK households is valued 12 billion pounds. This shows how the cost of food waste can unnecessarily erode spending power and lead to undesired social implications.

In a pilot study conducted by the Sustainable Restaurant Association (SRA) (2010), 10 restaurants in London were analysed in order to get an idea of how much food waste they generate. Results showed that on average, a restaurant would produce 21,000 tonnes of food waste every year, an average of half a kilo of food waste per cover served. It concluded that 65% of the total food waste originated from preparation, 30% from plate waste and 5% spoilage. On their part, Engstrom and Carlsson-Kanyama (2004) established that 50% of the food waste from a restaurant is plate waste. WRAP (2013) established that the hospitality sector in the United Kingdom (UK) generated some 0.92 MT of food waste per year, of which only 0.24 MT of food waste is considered as unavoidable. This wastage corresponds to about 1.3 billion meals being thrown away every year. In addition, when considering the hospitality sector as a whole, 21% of food waste arose from spoilage, 45% from food preparation and 34% from plate waste. WRAP also concluded that, within hotels, 45% of food waste was due to food preparation, 34% is from customers' plates and 21% is spoilage (Hotels: Taking Action on Waste, n.d.). On the other hand SRA (2010) reported that in restaurants, preparation waste amounted to 65%, plate waste at 30% and only 5% is attributed to spoilage. Notwithstanding, when making the distinction between hotels and restaurants, different studies have found different results in the type of food waste that is generated.

The cost of food waste in UK's hospitality sector was estimated to be of about 3 billion pounds per year for 2016 and a 2.7 MT of CO_2 equivalent. The SRA (2010) predicted that an annual 20% cut in food waste in restaurants would result in 4 times less tonnes of food waste per establishment, over £2,000 savings from better management of avoidable food waste, and between £150-£1,700 savings in waste management fees when waste is sent for anaerobic digestion.

Chalak et al (2018) compile an interesting statistic of hospitality food waste across the globe. Figures show that the highest amount of food waste is generated in the US at 52.07 kg/c/yr followed by Australia at 39.89kg/c/yr. On the other end of the scale are Spain with 5.53kg/c/yr and Slovenia with 6.77kg/c/yr. The figure for Malta was 11.98kg/c/yr which is not insignificant. Papargyropoulou et al (2016) found that food waste averaged 1.1kg per customer varying between 0.7-1.7kg/customer throughout the week. They also found that food waste decreases with increasing number of customers, signifying that economies of scale play a part in food waste generation. They also established that 56% of such waste was avoidable.

The generation of food waste is also dependent on the type of establishment with international chains usually implementing standards for the management of their waste whilst generic hotels and restaurants often not interested in adopting and implementing waste friendly practices on the premise that the amount of food waste they produce is insignificant (Kilibarda at al, 2019). Pirani et al (2016) established that in the *a la carte* menu, 10% of waste resulted from preparation whilst 12% resulted from customers' plates. From the breakfast buffet menu, 5% was preparation waste whilst 4% was plate waste and 7% originated from serving dishes. The lunch buffet yielded 15% preparation waste, 14% plate waste and 44% from serving dishes. Where preparation waste values were unknown, food waste from plates amounted to 11% and 22% from serving dishes in one property with another property yielding corresponding values of 3% and 42% respectively.

This Maltese case study of 3 hotels and 9 restaurants can provide further evidence, specific data and add to the existing body of literature on the amount of food waste that is produced from differing typology and meal types. Restaurants and other food service establishments could play a

very important role in reducing food waste. Restaurants need to start relating the reduction in food waste with the advantage of associated savings. When establishments throw away food, it is as if they are paying twice: once when they purchase the raw materials, and secondly, when they throw away the meal leftovers (SRA, 2010). The SRA also points out various initiatives and tips which can help restaurants reduce their food waste such as conducting food waste surveys, recommendations on portion sizes and the use of doggy bags amongst others. Not only would catering establishments be saving money on food costs and disposal fees, but also contributing to lower GHG emissions. Food waste from the commercial sector can also be effectively reduced by imposing taxes such as fees on waste treatment to incentivise owners to waste less and benefit from a lower waste bill (Marthinsen et al., 2012; Watkins et al., 2012). Taxes related to landfilling or incineration mainly aim for directing less waste to landfill, whilst at the same time increasing recovery and recycling. However, they can also be effective in lowering the food waste produced (Priefer, Jörissen and Bräutigam 2016). In fact, Malta is currently working towards regularising commercial waste more effectively and this study can serve as to aid better policy making as well as to design a more appropriate collection infrastructure for such waste.

METHODOLOGY

Data on the amount of food waste generated by the hospitality sector in Malta is very scarce as it is aggregated with municipal solid waste data. Obtaining such data is essential to assess the extent of the problem of food waste generated by the hospitality sector and this had to be undertaken from first principles by obtaining weightings of food waste from different establishments. The main objectives were to:

- Obtain an insight into the amount of waste that hotels and restaurants in Malta generate, particularly the average amount of waste per cover;
- Investigate the relationship between preparation waste and plate waste, and also the differences, if any, in the food waste per cover generated at breakfast, lunch and dinner;
- Examine any differences in waste generated from hotels with different star ratings as well as restaurants of a different calibre within the limitations of the sample size;
- Quantify, in monetary terms, the cost of waste management fees of these establishments and how this can be translated into the cost that is being paid for disposal of the food waste generated per cover.

In order to fulfil the scope of the research, the sample consisted of case studies involving hotels as well as restaurants. In the case of hotels, the establishments were recruited primarily on their star rating, since for the purpose of this study, a mix of different hotels with different star ratings was required to obtain a representative spectrum of establishments.

The Malta Hotels and Restaurant Association (MHRA) and the Malta Tourism Authority (MTA) were contacted and a list of the hotels that are considered to be ‘Eco-Certified’, as well as ‘Quality Assured’ Restaurants was provided. Hotels which are already ‘Eco-Certified’ by the MTA were given priority and contacted first on the basis of the assumption that these establishments would be more willing to help with the study than others, since they already distinguish themselves from the rest in their sector in terms of environmental awareness.

On the other hand, in the case of restaurants, establishments which are ‘Quality Assured’ as per MTA regulations were also prioritised and contacted first. Furthermore, the sample consisted of both large-scale and small-scale establishments, which specialise in different cuisines and restaurants with different Trip-Advisor cost-rating were included in the sample. The aim was to get a mixture of establishments on board, from both Malta and Gozo, in order to get as much of a diverse sample as possible, which would set out the scene for the food waste generated by Malta’s hospitality sector.

As was expected, only a few hotels and restaurants replied back and found the time to meet and discuss how they can help in the study. However, an even smaller number of establishments actually accepted to take part in the study.

Although the hospitality sector encompasses various types of establishments only hotels and restaurants were considered for this study. Other establishments were not considered for logistical reasons as food may sometimes be prepared in a different location thus removing the preparation waste on site whilst when food is not consumed at the premises, any leftovers would not be disposed of at the premises, thus resulting in an inaccurate plate waste reading. Moreover, when it comes to the number of covers during each meal, hotels and restaurants would be better equipped to gather this information than smaller establishments. Furthermore, these smaller establishments when compared to hotels and restaurants would probably have a smaller number of staff members and a smaller kitchen area where the study could be conducted. This could limit their willingness to participate in the study as well as there would be the risk that preparation waste and plate waste would not be distinguished from one another, thus resulting in erroneous readings.

In order to address the cost of waste disposal per cover paid by catering establishments it was decided that only the establishments which accepted to carry out the weighting of the food waste would be included. This was mainly done since the waste management fees would then need to be compared to the number of covers and the amount of food waste generated, and clearly, only the establishments carrying out the readings would be able to provide such information.

12 food waste surveys were conducted in the selected establishments as summarised in Tables 1 and 2 respectively. Although the process of gathering data is more time consuming, food waste surveys generate more information on preparation and plate waste. This type of research methodology was also used by the SRA (Sustainable Restaurant Association, 2010) and WRAP (Hotels: Taking Action on Waste, n.d.). Similar to this study, different types of restaurants were chosen by the SRA, so that in the end, a representative average can be produced. However, the SRA only conducted readings for a day, and the data was extrapolated for a whole year in order to give a more general idea of the food waste generated. Also, the SRA provided three colour-coded bins for the previously mentioned waste fractions and fish-scales were given to the establishment a few days before the readings needed to be taken.

A food waste data sheet similar to that used by SRA for their 2010 survey was prepared, customising it accordingly to the local setting. In the case of hotels, this tool was divided into breakfast, lunch and dinner. In the case of restaurants, it was divided only into lunch and dinner. Since some restaurants do not always open for lunch, the 'Lunch' column could be omitted.

The number of covers together with the weight of the empty bins used to store waste was recorded for each of the meals. The data sheet also distinguished between preparation waste and plate

Table 1. Summary of participating hotels

	H1	H2	H3
Star Rating	5	4	3
Location	Malta	Gozo	Gozo
Eco-Certification by MTA	✓	✓	
Days studied	3	7	4
Month	August	September	January
Breakfast	✓	✓	✓
Lunch	✓		✓
Dinner	✓	✓	✓
Total Covers	2981	1581	524

Table 2. Summary of participating restaurants

	R1	R2	R3	R4	R5	R6	R7	R8	R9
Type	Fish	Med	Asian	Med	Med	Med	Med	Med	Med
Location	Malta	Gozo	Malta	Gozo	Malta	Gozo	Gozo	Gozo	Gozo
Tripadvisor Rating	4.5	4	4.5	4.5	4.5	4.5	4.5	4	4.5
Tripadvisor Cost	$$$$	$$-$$$	$$-$$$	$$-$$$	$$$$	$$-$$$	$$-$$$	$$-$$$	$$$$
Quality assured by MTA	✓	x	x	✓	x	✓	X	✓	✓
Days studied	7	4	7	5	3	7	12	1	6
Month	August	September	August	November	November	October	October	September	
Lunch	✓	x	x	✓	x	✓	X	✓	✓
Dinner	✓	✓	✓	✓	✓	✓	✓	X	✓
Total Covers	555	481	651	568	162	478	715	70	351

waste. as kitchens tend to be divided into areas, such as the cooking area and the dishwashing area. Understandably, there would be more than one bin for the preparation waste and for the plate waste. Therefore, to make things even easier for the establishments, the data sheet provided up to four slots that could be filled in for both preparation and plate waste. Unlike the studies by the SRA (2010) and WRAP (2012), spoilage was not included as one of the waste fractions under study. This was done to simplify the data collection for the establishments and also because spoilage was included in the preparation waste reading.

The study was explained to all the staff together with information on the duration of the study and some ground rules with respect to the procedures whereby no one was to take any garbage to the waste room before getting the go-ahead; clear distinction made between plate waste and preparation waste and that as much as possible, plastic and paper or cardboard were not to be mixed with the organic food waste. Waiting staff were instructed to collect the waste from their stations after breakfast and deposit it in a particular spot as they usually throw out plate waste at their stations prior to sending the plates back in the kitchen.

Since measurements needed to be taken three times a day to cover breakfast, lunch, and dinner it was important to keep the weights for each meal as a distinct value from the rest. Thus, it was decided that readings would be taken at a particular time, as soon as all the patrons would have cleared the tables. All the bins in the kitchen area, except for the dishwashing area, were then weighed, deposited in the waste marshalling area and a new waste bag fitted into each bin so that no waste was carried over from breakfast to lunch readings. Once the preparation waste was weighed, the plate waste collected from the waiter's station and was weighed. This was deposited by the staff in the area agreed to limit time wasted going to and from the waste bins and the marshalling area. Lastly, waste from the dishwashing area was also weighed. This was always the last reading taken since by the time all the other bins in the kitchen were weighed, the dishwasher would have finished washing the plates and the staff would have cleaned any remains deposited in the machine. The process was repeated for lunch as well as dinner.

RESULTS

Table 3 collates the data from the 3 different hotels for comparative purposes. Of interest was the assessment as to whether such establishments manifested a difference in the waste they produced according to any of their differentiating criteria. H2 was the only establishment which on certain

days offered dinner as a buffet while H1 and H3, always served dinner 'à la carte'. The high value of preparation waste for H2 could thus be due to the significant preparation leading to the buffet which may or may not be consumed by patrons. Furthermore, this value could reflect the over-preparation of food for such events which contributed to the preparation waste, since it never made it to the patrons' plates and thus could not be classified as plate waste.

Daily average waste per cover is highest for H1 but significantly lower for H2 and H3. The values for H2 and H3 translate into a 55% and 68% reduction in waste produced respectively when compared to H1. Therefore, one notices a trend wherein food waste decreases as star rating decreases. Breakfast was the meal which generated the least waste per cover despite being served as a buffet possibly because certain food items served are pre-packed thus lowering preparation waste. Moreover, as discussed with the chef from establishment H1, it could be the case that in the morning people may have a healthier appetite and since breakfast is not a 'heavy' meal, this could result in a small value of plate waste. He also mentioned how sometimes people might have a good breakfast and decide to skip lunch. Thus, they would try to eat as much as possible during breakfast which results in minimal plate waste.

It was observed that for hotel H3, the waste produced mainly comprised of customer's plate waste, whilst for H1 and H2 it mainly consisted of preparation waste. This trend could be influenced by various reasons not least:

- MTA regulations require hotels to offer their patrons a range of pre-determined selection of items for breakfast, which decreases with star rating. This means that the more food that is to be made available every day for the patrons, the more will be wasted.
- Hotels with a higher star rating may be more selective when it comes to the quality of the products that they use in order to reflect the hotel's standard.
- Lower star hotels may be less keen to waste produce that may still look 'edible' as they are aware that people expect less from a 3-star hotel compared to a 5-star hotel.
- The lower the star rating, the more keen are establishments on serving quantity rather than quality when it comes to food. This could explain why H3 was the only hotel which had a greater percentage of plate waste when compared to preparation waste.

Thus, overall, when taking the three hotels together, it transpires that the average waste per cover stood at 0.225kg, of which preparation waste accounted for 54% and plate waste amounted to 45% of all the waste generated by the establishments.

The average waste per cover for all the 9 restaurants in this study was calculated to be 0.444kg as outlined in Table 4. The highest waste per cover was obtained from R1 which specialises in fish dishes. On the other hand, the lowest waste per cover was recorded at R3 (Asian). Such result may be attributable to the type of food which is served at the respective establishments, which varies not only

Table 3. Summary of findings from the three hotels

	H1	H2	H3
Star Rating	5	4	3
Breakfast Average Waste/Cover (kg)	0.248	0.07	0.033
Lunch Average Waste/Cover (kg)	1.532	N/A	0.149
Dinner Average Waste/Cover (kg)	0.545	0.397	0.112
Daily Average Waste/Cover (kg)	0.383	0.171	0.121
% Preparation Waste	66	72	23
% Plate Waste	34	28	77

in nature but also in the way that it is prepared and served. Restaurants such as R1 are still unlikely to attract requests for take-away leftovers. In the case of R3, as it already offers meals for takeout, its food is often prepared in such a way that is lends itself better for takeout. Consequently, people would be keener to take leftovers home with them. It is important to note that those who choose the take-out option at these establishments are still generating preparation waste, whilst they could be generating plate waste elsewhere and therefore not contributing to the true value of average plate waste per cover. Thus, the overall average waste per cover of R3 results in a low value when compared to other restaurants.

'Fine dining' restaurants ranked 1st, 2nd and 4th in the average waste per cover produced indicating a correlation between the type of restaurant and the waste it produces. Out of the 6 'Quality Assured' restaurants of the sample, these ranked as the highest producers of waste per cover, whilst the remaining two ranked the lowest. This suggests that the more expensive the restaurants are, the greater the probability that the establishment will generate a higher amount of food waste per cover when compared to medium-priced restaurants. Similarly, 'Quality Assured' restaurants also have a standard to uphold, and this is also reflected in higher waste quantities per cover.

The restaurants were also grouped according to the amount of preparation and plate waste as shown in Table 5.

Table 4. Summary of findings from the nine restaurants

Restaurant Code and Type		Average Waste/Cover (kg)
R1	Fish	0.767
R5	Med	0.648
R4	Asian	0.596
R9	Med	0.479
R7	Med	0.430
R8	Med	0.364
R2	Med	0.296
R6	Med	0.265
R3	Med	0.151
Average		**0.444**

Table 5. Preparation and plate waste generated in each restaurant

Restaurant Code	% Preparation Waste	% Plate Waste
R1	70	30
R2	58	42
R3	83	17
R4	67	33
R5	46	54
R6	55	45
R7	23	77
R8	73	27
R9	94	6
Average	**63**	**37**

It is the 'high class' restaurant R9 that has the highest percentage of preparation waste which stands at 94%. As discussed with the head chef, despite making an effort to reuse waste as much as possible (bones are used for stock and egg shells are used for clarification), in the preparation stage, a substantial amount of waste would still be generated. This is due to the head chef not being willing to serve produce which does not meet the high standards expected. The argument was that the establishment was willing to 'throw away' a whole lettuce which does not look fresh, at a cost of say €2 instead of serving that lettuce which could have negative consequence on the reputation of the establishment.

R3 was the establishment with the 2nd highest value of preparation waste. One should keep in mind that this was the same establishment that offers takeaway meals. Therefore, this means that some covers were not for dining at the establishment and their plate waste was not accounted for in the readings. Had they dined at the establishment and their plate waste recorded, this would have increased the average waste per cover and also reduced the difference between plate and preparation waste. However, one has to consider the fact the usually Asian takeout does not normally contain inedible food such as bones etc. These would have been removed prior to serving, and thus end up as preparation waste rather than plate waste. This could be the reason for a high percentage of preparation waste.

R7 resulted to be the restaurant with the highest percentage of plate waste. In fact, the owner admitted that given that his clientele are mainly Maltese people, he prefers quantity over quality and thus serves large portions. This contrasts significantly with R9 which has the lowest plate waste at 6%. In this case, the chef said that they prefer quality over quantity to keep their establishment's standard. Due to its cuisine, plate waste from R3 is the second lowest as patrons are more likely to eat what they have ordered or else they take their leftovers home and any home-based plate waste generated thereafter is unaccounted for. Nonetheless, this still contributes towards a reduction in food waste. One should note that the value obtained from R8 should be viewed with great caution since this depends on only one day of readings and thus may not be reliable.

When the overall average percentage of the preparation waste and plate waste for all the restaurants was calculated, this resulted in a 63% preparation and 37% plate waste divide. This suggests that the majority of waste produced by an establishment is made up of food that never makes it to the patrons' plates. While it is understandable that a portion of the preparation waste is unavoidable, preparation waste still contains a considerable amount of edible food which does not meet the high standards expected. This was mainly depicted by those restaurants which are classified as being more expensive and therefore would normally follow the same argument brought up by establishment R9.

DISCUSSION

Research shows that 22% of the food which is purchased by Maltese households ends up being wasted amounting to 0.38kg per capita per day. (National Statistics Office, 2013); (Ministry for Sustainable Development, the Environment and Climate Change 2014). This study permits policy makers, facility operators and academics to be better informed on the current situation regarding food waste generated by a significant economic sector as well as to design appropriate policy and regulatory measures for such waste and to better understand the most appropriate collection infrastructure. Similar to the SRA (2010) and WRAP (2012) studies with a sample size comparable to the one of this study, a distinction was made between the amount of waste which was attributed to either preparation or plate waste.

The value of 0.444kg per cover obtained from this study is quite comparable to that obtained by the SRA (2010) when a similar study was conducted. In fact, the value obtained by the SRA was that of 0.480kg per cover. The SRA also found that preparation waste is the dominant fraction of waste, which is also the case for local establishments.

The results suggest that as the Hotel star rating decreases, so does the value of the average waste generated per cover for all meals. Furthermore, it can be noted that for H1 and H3, the meal which generated the largest amount of average waste per cover was Lunch. When compared to a similar

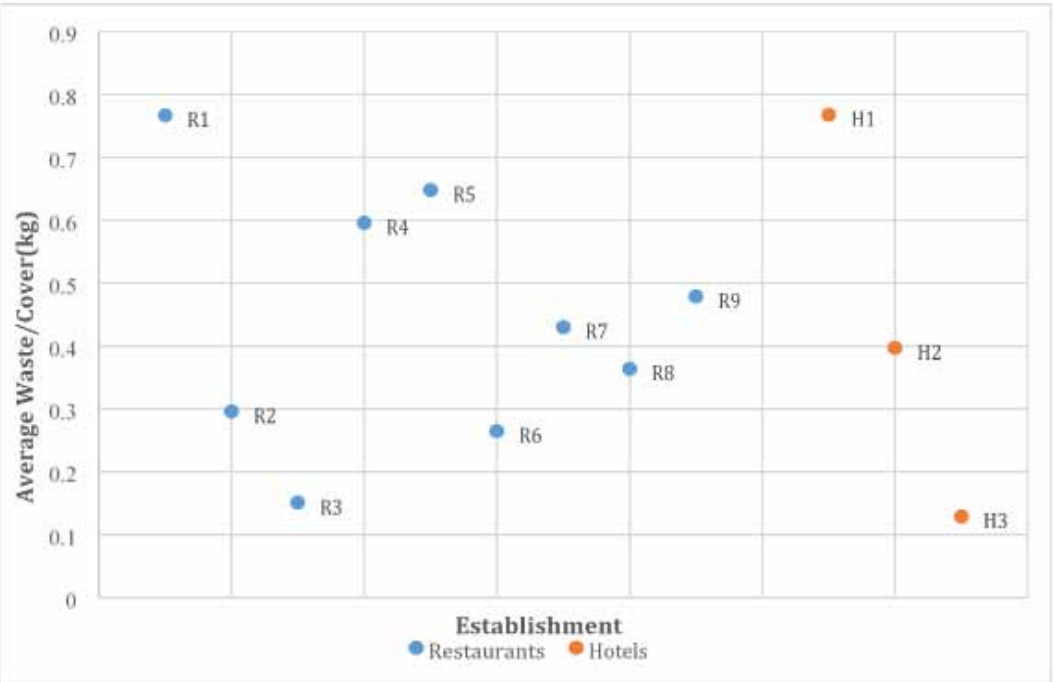
study conducted by WRAP (2012), in both cases, preparation waste is the most dominant fraction. When keeping in mind that in the case of this study the spoilage was added to the preparation waste, locally, hotels waste less food in preparation and more from customers' plates when compared to the sample from WRAP (2012). However, this study is only based on data gathered from 3 hotels and thus this also needs to be taken into consideration.

Restaurants showed a similar trend with the more expensive restaurants tending to generate the highest amount of waste. This is due to the level of service they provide, when compared to mainstream restaurants, and the expectations that need to be met which, in turn, does not allow restaurants to compromise the quality of food prepared and its appearance. Whilst the majority of restaurants have a higher amount of preparation waste when compared to plate waste, some establishments had a higher percentage of plate waste. This high value of plate waste could either be attributed to the serving of large portions, or else to kitchen staff being more attentive when planning the menu, choosing the best produce for their recipes whilst also being more creative with left overs in order to incorporate them in specialty dishes.

In conclusion, as Figure 1 shows, the average daily waste per cover excluding the readings of breakfast are highest with respect to restaurant and hotel rating. One can also note that the 5-star hotel and the 3-star hotel set the upper and lower limits for waste generation respectively, which encapsulate the average waste per cover of the restaurants.

R1, R5 and R4 are the restaurants whose average waste per cover is similar to H1. All of them were given a rating of 4.5 from Trip Advisor users yet, R1 and R5 were reviewed as expensive, whilst R4 was said to be medium-priced reconfirming the influence of price and quality of food waste generation. In the region of H2, there are R2, R6, R7, R8 and R9 with the latter being the expensive restaurant and the rest being medium-priced. This sparks the thought that R9 is able to uphold its 'high standards', yet keeping its average waste per cover within the regions of other medium-priced establishments and a 4 star hotel. On the other hand, H3 was mirrored by R3 even though the types

Figure 1. Average daily waste generated (lunch-dinner)



of cuisines that are served are entirely different. When looking at R3 and the rest of the sample which are mainly Mediterranean restaurants, it is noticeable that the Asian restaurant generates the least average waste per cover. Yet, H3 still managed to get similar values and this may be because the establishment stated that it adopts certain kitchen practices which aim at reducing the waste produced, especially during preparation.

There is more granular data associated with the scope of this study, but the aforementioned data and considerations can be key in estimating the amount of hospitality waste that is likely to be generated even more so given Malta's seasonality patterns in tourism. It can also offer scope for the competent authorities to elicit certain messages that can be passed on to the industry in a dedicated campaign aimed to address food waste by first preventing that waste and subsequently ensuring that it is recycled if its generation is unavoidable.

With Malta embarking to introducing the pay as you throw concept for commercial establishments, this data provides insight into the amount of waste that is currently being generated in the hospitality sector and what this will cost when pay as you throw measures come into force. It will also enable Government to anticipate the organic waste that is generated and which can be treated in a soon to be designed plant for organic waste processing. It is therefore an important contribution to further the knowledge on the amount of waste generated by the hospitality sector as a basis for future waste management policy-making. Further waste audits for establishments within the sector can enrich the data that has been collected so far so as to further fine tune the waste management landscape from this sector.

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