AMERICAN UNIVERSITY OF BEIRUT

POST-CONSUMER FOOD WASTE GENERATION IN RESTAURANTS WITHIN BEIRUT

by
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A thesis
submitted in partial fulfillment of the requirements
for the degree of Master of Science
to the Department of Nutrition and Food Sciences
of the Faculty of Agricultural and Food Sciences
at the American University of Beirut

Beirut, Lebanon
December 2020

AMERICAN UNIVERSITY OF BEIRUT

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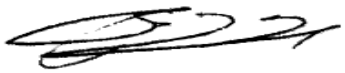
Approved by:



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ACKNOWLEDGMENTS

I would like to express my special thanks of gratitude to my thesis advisor, Dr. Samer Kharroubi, for taking over this project and for his continuous encouragement. I must admit that the completion of this study would not have been possible without his expertise, prompt support, and efficiency.

I want to express my appreciation for Dr. Mohamad Abiad, for primarily giving me the opportunity to work on this topic, for his support, especially during my first year of enrollment in the program when I served as Vice President of the USFC, and for his helpful research advice throughout.

My deep recognition and gratitude are addressed to Dr. Ammar Olabi, for his continuous assistance, cooperation, support, and patience, and for giving me the most valuable and enriching research experience and exposure as his graduate research assistant.

Many thanks to Dr. Isam Bashour, who agreed to take part in my thesis committee at short notice, and for his encouragement before and during my comprehensive exam and thesis defense.

I would like to thank my parents, Rateb and Sonia, for granting me access to the best education and for going the extra mile to give me the opportunities they never had for themselves. I would also like to thank my beloved brother, Ramy, for his endless love and support, and for his constant encouragement.

Special thanks to every friend and extended family member who supported me in any possible way anytime throughout my years of enrollment in this degree.

Last but not least, many thanks to the year 2020 and everything it brought forward, including the pandemic, for making me a little bit more patient, a little bit more resilient, and a little bit more determined to graduate. I am happy to be finally closing this chapter, even if online from home.

ABSTRACT
OF THE THESIS OF

Myra Rateb Zeineddine for Master of Science
Major: Food Technology

Title: Post-Consumer Food Waste Generation in Restaurants within Beirut

Food loss and waste occur along the food supply chain, negatively impacting the environment and the global economy. Additionally, these losses and wastes impact the global food and nutrition security, as one in eight people suffer from undernourishment worldwide. There is a recently growing focus on tackling this issue to mitigate or handle the waste generated and limit its repercussions.

In the Arab world, where the dependency on imports is rising, and the potential of increasing local food production is restricted, addressing food loss and waste is substantial. In Lebanon's case, some research has been conducted on household food waste generation, while data on post-consumer plate waste in the foodservice sector remains scarce.

In this study, managers from a representative sample of 222 restaurants within administrative Beirut were surveyed about food waste generation. Besides, post-consumer food waste – plate food waste – was measured to establish baseline information. The drivers for waste generation were examined, including the type of cuisine, kind of service, and menu planning, which were significantly associated with the amount of post-consumer food waste generated.

Based on the surveyed restaurants, it is estimated that 1,620 tons of organic waste, mainly plate waste, are generated per year, equivalent to 0.15% of Lebanon's total organic waste on average. Lebanese cuisine restaurants serving Mediterranean Mezze generate about 34 Kg of organic waste per day more than restaurants that serve international non-Lebanese cuisine. In comparison, fine diners generate 23 Kg per day more than casual diners. Finally, outlets, where menu planning is considered ineffective at reducing food waste generate 18 Kg more than outlets where menu planning is considered highly effective at plate waste reduction.

Based on our findings, the amount of plate waste generated in Beirut is alarming. Future research is still needed to create baseline information at the national level.

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CHAPTER I

INTRODUCTION

As the global population is rapidly growing, the urge for increased simultaneous food production remains a pressing issue on food security. Food loss and waste (FLW) contribute immensely to the latter and need to be addressed. The mitigation and proper handling of the FLW generated are deemed necessary as they negatively impact the environment and the livelihood of many. Food loss usually occurs in the early stages of the food supply chain, in larger amounts in the developing countries, where financial and technological limitations exist. Food waste, observed more in developed countries, occurs at the consumption stage of the supply chain in retail stores, households, and the foodservice sector. In the Arab world, the dependency on food imports coupled with the restricted capacity for increased food production due to the limited availability of natural resources increases the urgency of investigating food waste determinants to mitigate its generation. In this study, post-consumer food waste, mainly plate waste, was assessed at the foodservice level, whereby we recruited a representative sample of 222 restaurant managers within administrative Beirut, Lebanon. This work aimed to primarily quantify plate waste to create baseline information – given the absence of such data for Lebanon – and assess the food waste determinants in the foodservice sector. This study compared the amounts of post-consumer food waste generated at Lebanese/Mediterranean cuisine serving restaurants and those serving other cuisines.

CHAPTER II

LITERATURE REVIEW

One-third of the overall food production is lost or wasted yearly worldwide, approximately equivalent to 1.3 billion tons of unconsumed foodstuffs along the whole food supply chain (FSC) (Principato et al., 2018; Gustavsson et al., 2013; Barrera & Hertel, 2020; FAO, 2015). According to the Food and Agriculture Organization of the United Nations (FAO, 2013), the aforementioned waste is worth around 1 trillion USD per year, raised to 2.6 trillion USD when accounting for the environmental impacts' costs resulting from food waste. Additionally, one-eighth of the global population could be lifted from under-nourishment, given these amounts are not expended inattentively (Chalak et al., 2016; FAO, WFP & IFAD, 2012).

The amount of food lost or wasted varies between developing and developed countries due to differences in the levels of industrialization and income (Abiad & Meho, 2018; Chalak et al., 2016). In the developing countries, food is lost in the early stages of the supply chain, which primarily occurs due to financial limitations, poor technologies for agricultural practices, post-harvest storage, and refrigerated transportation for produce distribution (Abiad & Meho, 2018; Principato et al., 2018; Parfitt et al., 2010; Gustavsson et al., 2013). In contrast, food is wasted in the developed countries at the consumption level (retail, household, out-of-home), where consumer behavior and satisfaction play a major role (Campoy-Muñoz et al., 2017; Bond et al., 2013). It is indicated in an FAO study that 68% of the food is lost at the farmer level

post-harvest, whereas 32% of it is wasted during consumption (Capone et al., 2016; Gustavsson et al., 2013).

The mitigation of the enormous amounts of food being lost or wasted is deemed necessary due to the subsequent negative impacts on the environment, socio-economy, and food security (Schmidt & Matthies, 2018; Chalak et al., 2019; Matzembacher et al., 2020; Adamashvili et al., 2020). Before discussing the repercussions of wasting food, it is important to highlight the difference between food loss and waste, as distinct definitions exist in the literature. Food loss refers to the unintentionally wasted items lost during the early stages of the FSC potentially due to spoilage and quality deterioration; whereas food waste alludes to the intentionally discarded food products fit for human consumption at the retail and consumers' levels (Principato et al., 2018; Gustavsson et al., 2013; Chalak et al., 2019; Mattar et al., 2018). The latter is further classified as avoidable, which relates to the edible parts that could have been consumed but were willingly discarded, or unavoidable, representing the inedible food parts such as vegetable peels or fruit cores (Thi et al., 2015; European Commission, 2014).

At the environmental level, the footprint resulting from food wastage is assessed through the carbon footprint, water footprint, land occupation and degradation impact, and biodiversity impact according to the FAO (2013). Apart from the carbon footprint estimated at 3.3 Gtons equivalent yearly excluding land-use change, food waste disposal to landfills causes the unnecessary emissions of another greenhouse gas – methane (CH_4), 25 times more potent than carbon dioxide (CO_2) (Bilali & Hassen, 2020; FAO, 2013). A partial proportion of the waste dumped gets converted to methane under anaerobic conditions, contributing to climate change and global warming (IPCC,

2007). The water footprint – another major natural resource depletion resulting from food waste generation (Gustavsson et al., 2013; Bilali & Hassen, 2020), is estimated at 250 Km^3 in water resources used for agricultural production of total food wastage (FAO, 2013). The reduction of land capacity produced but unconsumed foodstuffs occupy almost 1.4 billion hectares, equivalent to around 30% of the world's agricultural land area (FAO & LADA, 2011). Additionally, the potential biodiversity impact is threatened at the ecosystem level through deforestation and at the species level through red-listed species – both due to agriculture (FAO, 2013).

Economically, the negative impacts affect all the stakeholders along the FSC, as farmers lose the opportunity of higher income due to wasted investments and consumers face increased expenses (Capone et al., 2016; Gustavsson et al., 2011; Lipinski et al., 2013). Consequently, as lost income is increased at the producer level, retail prices are automatically increased at the consumer level (Capone et al., 2016; LeGrand, 2018). The global economic loss resulting from the production of food never eaten is between 750 billion and 1 trillion USD (FAO, 2013). In the United States alone, approximately 218 billion USD is spent annually on food lost and wasted along the FSC (ReFED, 2018).

Food loss and waste (FLW) reduction and proper handling are hereby crucial for food security attainment (Capone et al., 2016). On account of the rising ethical predicaments, as more than 925 million people remain under-nourished around the globe, food security needs to be managed to fight hunger through reduced retail prices, enhanced affordability, and distribution, utilization, or further processing of the edible surplus (Capone et al., 2016; Girotto et al., 2015; Abiad & Meho, 2018; Oelofse & Nahman, 2013).

Given this, numerous initiatives aim to reduce FLW by developing innovative measures implemented along the FSC to mitigate the waste generated (Ruel & Alderman, 2013; Abiad & Meho, 2018). Among these is organic compost production, waste conversion to animal feed, the extraction of value-added products such as enzymes, and a special focus is directed towards waste-to-energy conversion (Abiad & Meho, 2018).

Previously conducted studies in the literature mainly target developed countries. In contrast, studies in the Arab world (Middle East-North Africa and North East-North Africa) remain scarce, where 22 countries are inhabited by 410 million people (Abiad & Meho, 2018). In the Arab region, it is roughly estimated that throughout the pre-consumption stages and at the consumption level, 44% of the food is lost and 34% of it is wasted, respectively (HLPE, 2014). On a side note, these countries are highly dependable on food imports to meet nutritional requirements, where 40% of agricultural commodities are imported in the MENA region (Capone et al., 2016; Abiad & Meho, 2018). In parallel, while facing a food deficit, the NENA region's dependence on external sources to cover the basic staple products continues to increase while generating an annual food wastage of 250 Kg per capita – greater than the global food waste average (Capone et al., 2016; FAO, 2015; Bilali & Hassen, 2020). Reducing FLW generation is then becoming more and more substantial to limit the challenges of safeguarding food security in the Middle East, especially that the potential of increasing local food production remains restricted (Capone et al., 2016; Barre, 2013; Abiad & Meho, 2018). In high-income countries of the Gulf Cooperation Council, like the Kingdom of Saudi Arabia, Kuwait, and the United Arab Emirates, which spend in a similar pattern as the developed countries, food waste largely occurs at the consumer

level in or out-of-home (Bilali & Hassen, 2020; HPLE, 2014; FAO, 2011; Lundqvist, 2010). Studies in the NENA region shed light on the severity of household food waste in middle-income countries (Arous et al., 2017; Elmenofi et al. 2015; Charbel et al., 2016; Abouabdillah et al., 2015; Sassi et al., 2016), while studies investigating consumer waste in diners remain limited for the Middle East.

In the case of Lebanon, published studies related to food waste provide insights on household food wastage in terms of quantity, ethnographic effect among rural Lebanese communities, economic value – whereby approximately 5 to 10 USD are spent on food never eaten at home, association with nutrient loss – estimated at a caloric loss of 451 Kcal per day, purchase behavior, the beliefs, and attitudes that drive and affect this wastage, as well as the consumer's perceived importance of waste generation (Chalak et al., 2019; Chammas & Yehya, 2020; Mattar et al., 2018; Charbel et al., 2016; Capone et al., 2016; Abiad & Meho, 2018).

Ongoing local projects and initiatives continue to help in handling the generated waste by collecting unserved meals from food establishments and redistributing them or connecting food donors to people in need through food banks, raising awareness about the negative consequences of wasting, and testing waste management strategies to alleviate the magnitude of the environmental burdens of landfilling through recycling and composting (Abiad & Meho, 2018; Maalouf & El-Fadel, 2019; El-Fadel et al., 2001; Bilali & Hassen, 2020). Simultaneously, a lack of information in this area with a total absence of data focusing on post-consumer restaurant waste is still observed.

This study aims at quantifying the post-consumer food waste generated in restaurants in Beirut. It also aims to assess the determinants of this wastage and identify

the factors associated with it while comparing Lebanese to non-Lebanese cuisine restaurants to investigate the differences in their post-consumer food waste patterns.

CHAPTER III

MATERIALS AND METHODS

A. Research Methodology – Survey-based Data Collection

Referring to the Cadastral Districts of Municipal Beirut, administrative Beirut borders were drawn, and the areas within it were pinpointed. Based on the information provided by the management of Zomato Lebanon, a total of 1379 food establishments exist within the areas of interest, among which 514 are restaurants. Sample size calculations showed that a minimum of 221 restaurant managers should be recruited to estimate a prevalence of 50% with a 95% confidence interval and a margin error of 5%. In order to account for a 20% refusal rate, 277 restaurants were visited. To be included in the study, only managers or head chefs qualified to take the survey since they are commonly in charge of the outlet's operations. The study was reviewed and ethically approved by the Institutional Review Board (IRB) at the American University of Beirut (AUB), prior to data collection.

1. Recruitment of Research Participants

Using Zomato mobile application, outlets were located using the directions available for each restaurant's profile, which link the user to Google maps. Interested managers who met the eligibility criteria were provided with a consent form that explained the objective of the study, procedures to be undertaken, potential risks and benefits of participation, and all related information. Managers were urged to ask any questions regarding the research study or request further clarification before they agree to take part in the survey. Managers who agreed to participate had to sign the consent

form before the initiation of the study (Appendix 1). A copy of the consent form was kept with managers in case they had any complaints or concerns regarding the study. Managers were excluded if they refused to give consent for the study.

The data collection approach was conducted on the selected restaurant in a private setting. A multicomponent questionnaire was filled out by eligible managers during a face-to-face interview session which lasted between 20–30 min (Appendix 2). The interview sessions were performed by field worker who underwent intensive training on the application of the interview protocol and administration of the questionnaire before the initiation of the survey. The questionnaire was initially developed in English, subsequently translated to the Arabic language (since most of the managers talked Arabic) and then back-translated to English. The two translations were carried out to verify the parallel-form reliability of the questionnaire. Any disagreement that occurred in the back-translated version was resolved to provide a precise reading.

The questionnaire consisted of 42 questions. These relate to the restaurant characteristics, including the type of cuisine and kind of service offered, the organic and inorganic waste generated at the preparation level and the consumer level, sorting and recycling, and managers' opinions on measures to mitigate and handle the food waste generated. The relevant questions within the scope of this project, which are related to the research inquiry on post-consumer food waste among Lebanese/Mediterranean and non-Lebanese restaurants, were selected and analyzed. The remaining data will be potentially used for future work and projects of different aims and objectives.

2. Data Entry

Data entry was completed on KOBO Toolbox using the survey format implemented on the application, accessed through a generated link. The graduate student was responsible for the data entry of all the collected surveys. The hard copy surveys collected were gathered throughout the project under the responsibility of the graduate student. They will be destroyed after the publication of the study. The results were exported to Microsoft Excel from the KOBO application and imported to IBM SPSS Statistical Software and later to Stata Software for data analyses.

3. Statistical Analysis

The data were checked for completeness, and responses were coded and entered into the Statistical Package for the Social Sciences (SPSS) software version 20 for Windows, which was later used for statistical analyses; IBM: Statistical Package for the Social Sciences (SPSS Statistics 2013). For the summary of the data, descriptive statistics were presented to summarize the study variables of interest as counts and percentages for categorical variables and as means and standard deviations for the continuous ones. An independent t-test was used to compare the amounts of food waste generated per outlet per day reported in Kg. One-way ANOVA with post-hoc analysis was carried out to chart comparison of the amounts of food waste generated per outlet per day in Kg via kind of service, managers' awareness about the negative consequences of food waste on the environment, economy, and society, importance of consumer behavior on amount of food waste generated, the effectiveness of menu planning on food waste reduction, the effectiveness of different portion size availability on food waste reduction, and challenges to reducing food waste.

The associations of each variable mentioned above with the amount of food waste generated at the restaurants were assessed using Censored Regression Analysis, Tobit Model on Stata software. Simple and multiple regression models were performed. In the regression model, each of the seven variables was used as the independent variable. The dependent variable was food waste generated per day measured in Kg. All variables showing statistical significance in the simple regression model were included in the final multiple Tobit regression models as independent variables. For all analyses done, a p-value less than 0.05 was used to detect statistical significance.

CHAPTER IV

RESULTS

Out of the 277 restaurants approached within administrative Beirut, 222 agreed to participate in this study.

A. Post-Consumer Food Waste Quantification

Based on our findings, the average amount of organic waste generated is 20 Kg per day, equivalent to 4.44 tons per day or 1,620 tons per year – given our representative sample of 222 restaurants. Additionally, plate waste was calculated and amounted to 54 Kg/meal/restaurant/year or 12 tons/meal/year in Beirut, given the average number of meals served per day is 135 meals. At full restaurant occupancy, the average number of seats per outlet is 90, resulting in 0.22 Kg per capita per day or 81 Kg of food wasted per person yearly.

B. Post-Consumer Food Waste Determinants

1. Descriptive Statistics

Two hundred twenty-two restaurant managers agreed to participate in the study by filling the survey (80% response rate). The study sample showed that 58 (26.1%) restaurants offered Lebanese/mezze type cuisine, and 164 (73.9%) offered non-Lebanese cuisine. Restaurants serving non-mezze Mediterranean food, including American, Armenian, Asian, Chinese, French, German, Italian, Japanese, Mexican, South African, and Turkish cuisines were grouped under the variable "Non-Lebanese" (Figure 1).

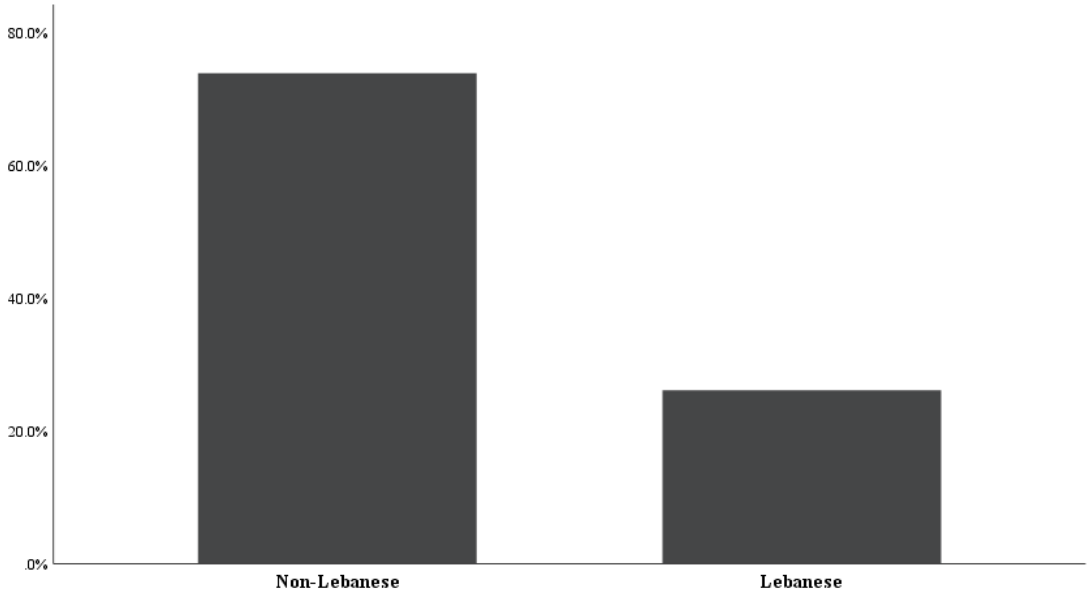

Figure 1. Type of cuisine

Most of the managers who filled the survey worked at restaurants that provide casual dining services (113 (64.2%)), while 33 (18.8%) provided fine dining services, 21 (11.9%) offered food on the go or takeaway, and 9 (5.1%) relied on self-service (Figure 2).

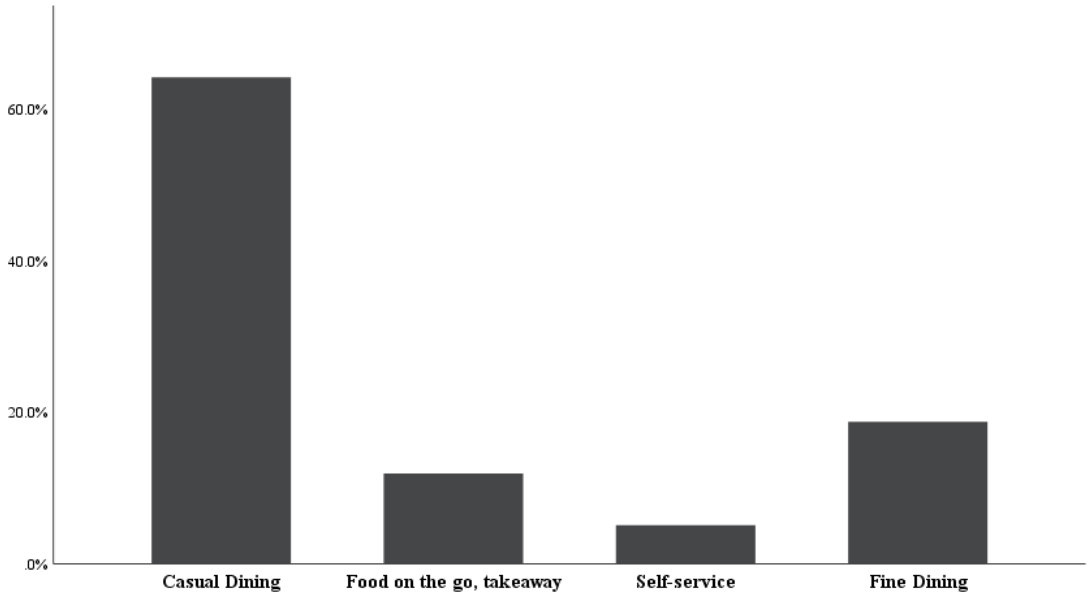

Figure 2. Kind of service

When asked about the level of awareness regarding the negative consequences of food waste on the environment, economy, and society, the majority of the surveyed managers (176; 82.7%) indicated that they are aware of the problem, 55.9% (N=119) of whom responded to be fully aware and 26.8% (N=57) somewhat aware. On the other hand, 14.1% of the respondents (N=30) indicated that they are not very aware, while 3.3% (N=7) are unaware of the negative consequences associated with food waste generation (Figure 3).

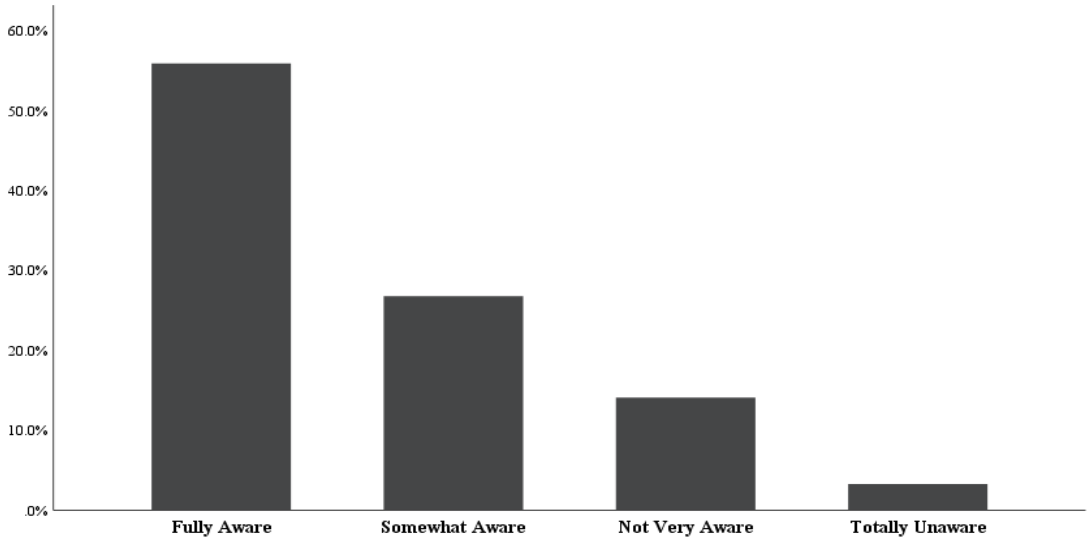

Figure 3. Awareness about the negative consequences of food waste on the environment, economy, and society

As for the question concerning the importance of the customer's behavior concerning the amount of food waste generated, 132 (60.8%) managers confirmed that it is the most important factor, 33 (15.2%) said that it has a fairly important influence, and 23 (10.6%) believed that it is important. 19 (8.8%) managers chose the least important as their answer, and 10 (4.6%) responded by slightly important (Figure 4).

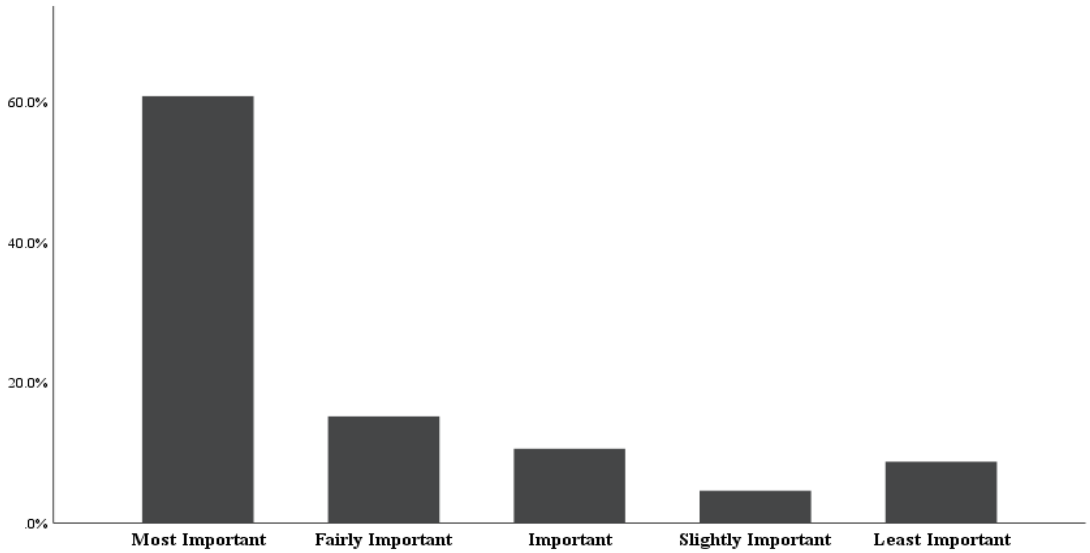

Figure 4. Importance of consumer behavior on the amount of food waste generated

Menu planning happened to be the most effective measure in post-consumer food waste reduction, according to 100 (46.1%) of the participants, while 46 (21.2%) reported menu planning was effective, 38 (17.5%) picked not effective at all as their answer, 22 (10.1%) had a neutral opinion, and 11 (5.1%) said that it is somehow effective at reducing the amount of post-consumer food waste generated at their outlets (Figure 5).

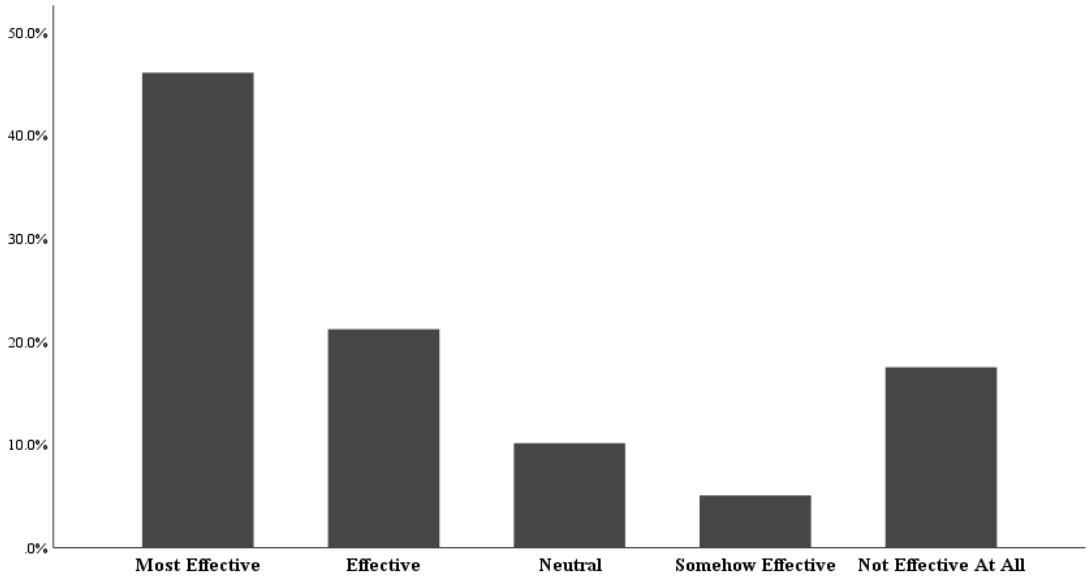

Figure 5. Effectiveness of menu planning on food waste reduction

As for the effectiveness of the availability of different portion sizes on food waste reduction, 68 (31.3%) managers reported it was most effective, 62 (28.6%) responded as effective, 36 (16.6%) had a neutral stance, 32 (14.7%) thought it is not effective at all, and 19 (8.8%) answered by somehow effective (Figure 6).

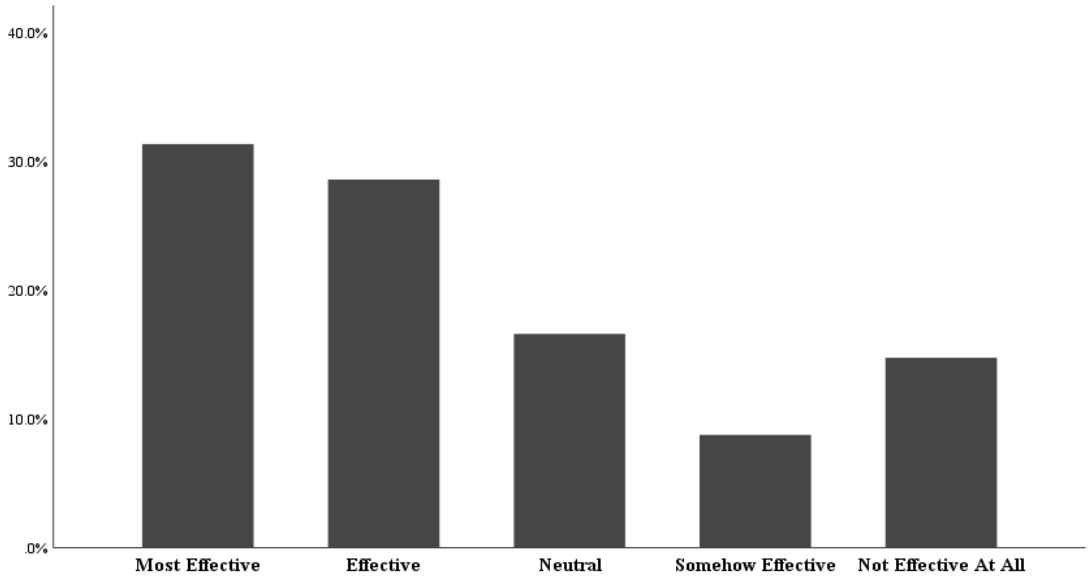

Figure 6. Effectiveness of different portion size availability on food waste reduction

Among the five options given as challenges to reduce food waste, customer behavior was picked by 26.8% of the participants (N=56) as the main challenge. To a lesser extent, food safety and hygiene regulations were the second main challenge, as indicated by 26.3% (N=55) of managers who filled the survey. On the other hand, 19.1% of the managers (N=40) considered lack of adequate food storage as the main challenge at food waste reduction, whereas 16.3% (N=34) considered lack of time primarily during rush hours as the main challenge whereas 11.5% (N=24) attribute it to insufficient labor skills (Figure 7).

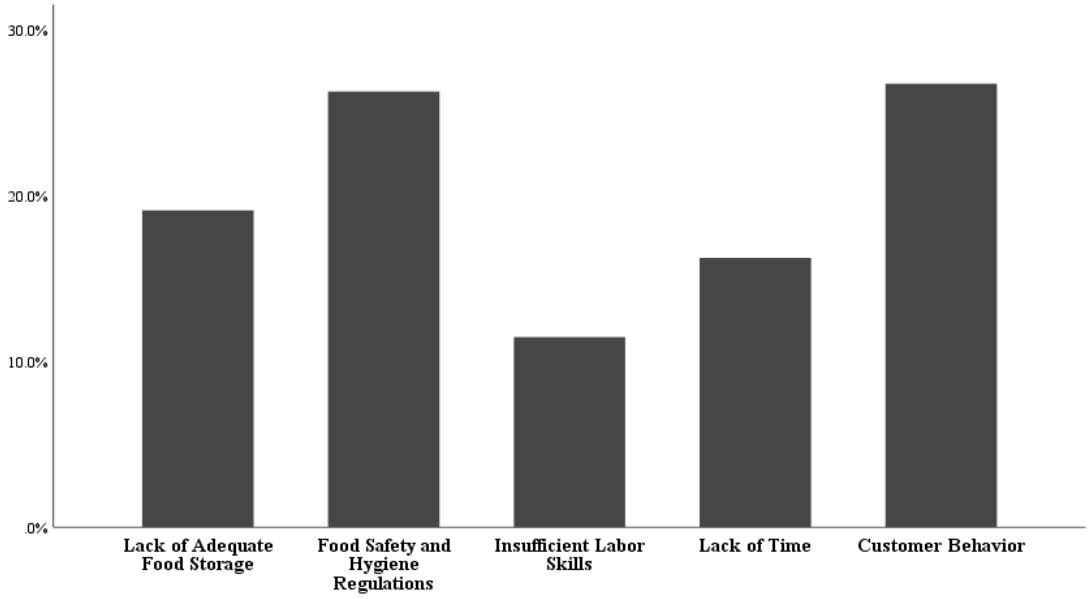

Figure 7. Challenges to reducing food waste

2. Analysis of Variance

The results presented in Table 1 below include the significance of the mean difference in the amount of post-consumer food waste generated among the following variables: type of cuisine, kind of service, managers' awareness about the negative consequences of food waste on the environment, economy, and society, importance of consumer behavior on amount of food waste generated, the effectiveness of menu planning on food waste reduction, the effectiveness of different portion size availability on food waste reduction, and challenges to reducing food waste.

Based on Table 1, the analysis revealed a statistically significant difference in the amount of post-consumer food waste generated between restaurants that serve Lebanese cuisine and those offering a Non-Lebanese food selection ($p=0.015$).

Additionally, a marginally statistically significant difference in the amount of post-consumer food waste generated obtained between restaurants that provided casual dining services and the ones that provided fine dining services ($p=0.066$).

The analysis also revealed a statistically significant difference in the amount of post-consumer food waste generated between restaurants where managers considered menu planning the most effective at food waste reduction and those who considered this measure as not effective at all (p=0.048).

No statistically significant difference in the amount of post-consumer food waste generated was observed regarding the awareness of the negative consequences of food waste on the environment, economy, and society, the importance of consumer behavior on the amount of food waste generated, the effectiveness of different portion size availability on food waste reduction, and the challenges to reduce food waste (p=0.443).

Table 1. Analysis of Variance

Characteristics (N=222)	p-value	Mean Food Waste Generated (Kg per Day)
Type of Cuisine		
	0.015	
Lebanese		39.3**
Non-Lebanese		12.7**
Kind of Service		
	0.066	
Food on the go, takeaway		16.0
Self-service		4.8
Casual dining		16.1*
Fine dining (full service)		40.6*
Awareness about the Negative Consequences of Food Waste on the Environment, Economy, and Society		
	0.687	
Fully aware		19.6
Somewhat aware		24.2
Not very aware		14.3

Totally unaware	7.1
Importance of Consumer Behavior on the Amount of Food Waste Generated	
0.923	
Most important	21.6
Fairly important	19.8
Important	13.5
Slightly important	14.1
Least important	15.2
Effectiveness of Menu Planning on Food Waste Reduction	
0.048	
Most effective	15.5**
Effective	15.7
Neutral	11.5
Somehow effective	18.1
Not effective at all	40.9**
Effectiveness of Different Portion Size Availability on Food Waste Reduction	
0.242	
Most effective	31.5
Effective	14.1
Neutral	14.4
Somehow effective	15.7
Not effective at all	17.4
Challenges to Reduce Food Waste	
0.443	
Lack of adequate food storage	10.7
Food and Hygiene regulations	24.4
Insufficient labor skills	24.9
Lack of time	25.7
Customer behavior	13.1

***: significance at 1%; **: significance at 5%; *: significance at 10%

3. Censored Regression Analysis – Tobit Model

Table 2 below displayed the results of the censored regression analysis. Simple and multiple regression models were created to explore the effect of seven food waste determinants on the amount of post-consumer food waste generated per day in the selected restaurants within administrative Beirut. In the crude case, Lebanese cuisine, fine dining, menu planning not effective at all at food waste reduction, different portion size availability effective at food waste reduction, and different portion size availability with a neutral effect on food waste reduction were all significantly associated with food waste generation. After adjusting for covariates, Lebanese cuisine, fine dining, and menu planning not effective at all at food waste reduction were all correlated with food waste generation. Different portion size availability effective at food waste reduction and different portion size availability with a neutral effect on food waste reduction are the cofounding variables, which showed a statistically significant association with food waste generation in the simple case but did not show any significance in the multiple case.

The analysis also revealed that there is no statistically significant difference in the amount of post-consumer food waste generated, in both the crude and the multiple case, among the following variables: awareness about the negative consequences of food waste on the environment, economy, and society, importance of consumer behavior on amount of food waste generated, and challenges to reducing food waste.

With regards to type of cuisine, results showed that restaurants that served Lebanese cuisine tend to have 34.1 Kg of food waste, on average, generated per day more than restaurants that serve non-Lebanese cuisine ($p<0.0001$).

As far as kind of service is concerned, analysis revealed that restaurants that provided fine dining food service tend to have 22.7 Kg of food waste, on average, generated per day, more than restaurants that provide a casual dining service ($p=0.025$). However, there is no statistically significant difference in the amount of food waste generated between restaurants that provide takeaway food service or rely on self-service compared to those that provide a casual dining service.

With regards to effectiveness of menu planning on food waste reduction, managers who reported that menu planning is not effective at all to reduce food waste tend to have 18.3 Kg of food waste, on average, generated at their outlets, more than managers who reported that menu planning is most effective to food waste reduction ($p=0.079$). However, there is no statistically significant difference in the amount of food waste generated between the restaurants where managers reported that menu planning is effective, has a neutral effect, or is somehow effective to reduce food waste, and the ones where managers reported that it is the most effective.

Table 2. Censored Regression Analysis – Tobit Model

		Crude Case (Single Regression Analysis)	**Multiple Case (Multiple Regression Analysis)**
Type of Cuisine	Non-Lebanese	Reference	Reference
	Lebanese	**26.588 (12.90, 40.28), p<0.0001**	**34.068 (18.70, 49.43), p<0.0001**
Kind of Service	Casual dining	Reference	Reference
	Takeaway	-0.085 (-22.04, 21.87), p=0.994	0.737 (-21.82, 23.30), p=0.949
	Self-service	-11.307 (-42.41, 19.80), p=0.474	-6.877 (-37.04, 23.28), p=0.653
	Fine dining	**24.545 (5.08, 44.01), p=0.014**	**22.685 (2.92, 42.45), p=0.025**
Awareness about the Negative Consequences of Food Waste on the Environment, Economy, and Society	Fully aware	Reference	Reference
	Somewhat aware	4.595 (-10.51, 19.70), p=0.549	
	Not very aware	-5.312 (-23.60, 12.97), p=0.567	
	Totally unaware	-12.445 (-46.40, 21.51), p=0.47	
Importance of Consumer Behavior on the Amount of Food Waste Generated	Most important	Reference	Reference
	Fairly important	-1.735 (-20.12, 16.65), p=0.852	
	Important	-8.011 (-28.31, 12.29), p=0.437	
	Slightly important	-7.457 (-36.21, 21.30), p=0.61	
	Least important	-6.342 (-31.03, 18.35), p=0.613	

Effectiveness of Menu Planning on Food Waste Reduction	Most effective	Reference	Reference
	Effective	0.226 (-15.81, 16.26), p=0.978	5.944 (-12.72, 24.61), p=0.53
	Neutral	-4.015 (-25.60, 17.57), p=0.714	-0.708 (-25.60, 24.18), p=0.955
	Somehow effective	2.623 (-27.21, 32.46), p=0.863	5.923 (-26.67, 38.51), p=0.72
	Not effective at all	**25.394 (8.14, 42.65), p=0.004**	**18.286 (-2.17, 38.74), p=0.079**
Effectiveness of Different Portion Size Availability on Food Waste Reduction	Most effective	Reference	Reference
	Effective	**-17.404 (-33.68, -1.13), p=0.036**	-14.404 (-32.63, 3.83), p=0.12
	Neutral	**-17.068 (-35.85, 1.72), p=0.075**	-13.838 (-36.25, 8.58), p=0.224
	Somehow effective	-15.842 (-39.22, 7.54), p=0.183	-16.436 (-40.91, 8.04), p=0.186
	Not effective at all	-14.086 (-34.58, 6.41), p=0.177	-15.888 (-39.32, 7.54), p=0.182
Challenges to Reduce Food Waste	Customer behavior	Reference	Reference
	Lack of adequate food storage	-2.360 (-22.42, 17.70), p=0.817	
	Food Safety and Hygiene regulations	11.371 (-5.92, 28.66), p=0.196	
	Lack of time	12.650 (-7.21, 32.51), p=0.21	
	Insufficient labor skills	11.849 (-10.38, 34.08), p=0.294	

CHAPTER V

DISCUSSION

This study is the first national study to quantify the post-consumer food waste generation within the catering and hospitality industry, examine the determinants driving this wastage, and explore the difference in food waste quantities across different cuisines among a representative sample of food service establishments in administrative Beirut.

A. Post-Consumer Food Waste Quantification

Quantifying food waste allows the creation of baseline information that, in turn, enables detecting, measuring, and assessing change over time. Given the absence of data related to food waste generated by food establishments in the NENA region in general and specifically in an urban setting such as Beirut, this project is a great addition to the literature.

This study revealed that the post-consumer food waste generated in the restaurants of Beirut is equal to 1,620 tons per year, equivalent to 0.15% of Lebanon's total organic wastage generated yearly. This amount is smaller than the plate waste quantities observed in the US, where 16 million tons of waste from the foodservice sector are generated per year, in Europe where 12.5 million tons are generated per year, and in European countries, namely Sweden (99 kilotons per year), Germany (1.9 million tons per year), and France (2 million tons per year) (Filimonau, Zhang, & Wang, 2020; Barilla Center for Food & Nutrition, 2012; ReFED, 2018). This can be attributed to

differences in country size, population size, restaurant capacity, income, and culture, noting that our results are not representative on the national level. Additionally, our results revealed an 81 Kg/cap/year of food waste generation as compared to 210 Kg/cap/year in the Arab world, 95-115 Kg/cap/year in Europe and North America, 139 Kg/cap/year in Singapore, and 170 Kg/cap/year in South Africa (Abiad & Meho, 2018).

However, for a small country like Lebanon, given the examined sample represents the capital only, such high levels are alarming. They are also more worrisome as Lebanon highly depends on food imports, similar to all other countries in the Arab region, with limited resources for increased food production to sustain food and nutrition security (Abiad & Meho, 2018; FAO, 2015).

B. Post-Consumer Food Waste Determinants

Concerning post-consumer food waste drivers, the results of this study showed that the type of cuisine served at the food establishment, the kind of service provided, and menu planning affect the quantity of plate waste generated.

One of this work's unique findings is that consumers tend to waste more when dining out at Lebanese cuisine restaurants, noting that our analysis revealed that these tend to have on average 34 Kg of post-consumer food waste per day more than restaurants that serve non-Lebanese cuisine. The latter can be explained by the wide variety of dishes available under the Lebanese cuisine, served in average quantities and meant to be shared, apart from the main course options. These starter dishes are known as mezze dishes. Consumers dining out at Lebanese cuisine restaurants end up over-ordering mezze dishes to share, which is in turn part of the culture, along with one or many main course meals. This leads to a higher chance of plate waste generation as

compared to other cuisines that serve one meal portion per person, where the chance of wasted leftovers from over-ordering and sharing is much less. Additionally, over-ordering is also impacted by the cultural aspect and the Lebanese people's generosity of honoring the guest, linked to having generous amounts of food with a wider variety of dishes and offering a larger quantity than needed, matching the number of individuals at the table. There are no comparative studies between post-consumer food waste generated between Lebanese and non-Lebanese cuisine restaurants to the best of our knowledge.

Moreover, restaurants that provide fine dining services tend to generate, on average, around 23 Kg of post-consumer food waste per day more than the ones that offer casual dining services based on our results. This finding is consistent with the previous research, which showed that fine diners in the US generate a difference of 3 million tons of plate waste per year more than casual diners (ReFED, 2018). In a study from Shanghai, China, interviewed managers and chefs from the fine dining foodservice sector reported that this kind of service causes not only an excessive wastage generation at the cooking stage for aesthetic purposes but also at the consumer level (Charlebois et al., 2015). It was additionally reported that plate waste at fine diners is potentially caused by the greediness of fine dining restaurant guests who commonly worry less about their expenses and end up wasting more due to over-ordering; which in turn is encouraged because of the extensive menus developed to enhance customer satisfaction and to stand out from competitors (Filimonau, Zhang, & Wang, 2020; Filimonau et al., 2019a; Filimonau et al., 2019b). This can be further explained given the traditions of our culture, where Lebanese people over-order out of generosity as a welcoming gesture.

Menu planning has been proven effective at reducing the plate waste generated based on our results. Restaurants, where managers reported that menu planning is not effective at all at post-consumer food waste reduction happened to have on average 18 Kg of food waste generated per day more than the ones where managers reported this measure to be the most effective for food waste reduction. This is in line with the literature and can be explained as long menus with a broad range of choices push customers to order more even when they know they won't be able to finish their meals, leading to more food waste (Filimonau, Zhang, & Wang, 2020; Filimonau et al., 2020; Principato et al., 2018; Sakaguchi et al., 2018). The effect of menu size is further amplified in restaurants offering Lebanese type of cuisine, where menus are diverse with a wide variety of food options. In such cuisines, customers request an excessive number of dishes for wider meal combinations, especially that mezze dishes are served in sizeable portions and a wider variety. Add to that the cultural effect and Arab generosity, which tops it all up.

CHAPTER VI

CONCLUSION AND RECOMMENDATIONS

The post-consumer food waste reduction in Beirut, given the alarming amount of 1,620 tons generated per year, is of major relevance. The diversity and broad range of options available in the Lebanese cuisine and the people's cultural generosity lead to higher plate waste generation caused primarily by over-ordering mezze dishes to share. Fine diners happened to collect larger quantities of plate waste post-consumer than casual diners, which is linked to the generosity and higher income of fine dining food service guests who tend to worry less about their expenses. Last but not least, menu planning was found to be effective at reducing food waste since long menus confuse customers and most likely push them to over-order for the sake of trying more items, which in turn contributes to waste generation further.

Ongoing initiatives in Lebanon continue to help handle the food waste generated by collecting and processing or redistributing it to people in need. Local awareness campaigns also happen actively to highlight the negative consequences of wasting on food security, the environment, and the economy. Additionally, local testing and improvement of waste management strategies such as recycling, composting, and waste conversion to animal feed alleviate the burden of landfilling on the environment, especially since Lebanon is a small country with limited landfilling spaces.

Further research is required to collect nation-wide representative data and create baseline information about the quantities of food waste generated to enable detecting and measuring change over time. It is also important to assess food waste

determinants across different country regions where people come from different backgrounds, religions, education levels, and cultures, and earn different levels of income. Local authorities' support is needed to provide financial resources to conduct the research, personnel to collect the data, and qualified individuals to train restaurant managers and launch awareness campaigns to limit the quantities of food waste generated at the food establishment level.

A. Proposed Policy Against Plate Food Waste

1. Syndicate of Restaurants, Cafes, Night Clubs, and Pastries in Lebanon

- Develop, finalize, and publish the draft of the law on food waste proposed in 2019 with GWR Consulting (SyndicateRCNP Annual Newsletter, 2019).
- Encourage restaurant owners to become members of the syndicate to have a bigger impact, as it advocates on behalf of the Food and Beverage industry and acts as a lobbying body on the governmental level.
- Push for governmental financial support or lobby for funds and grants to conduct the necessary research on the national level.
- Measure and detect a change in the quantities of post-consumer food waste generation over time after creating baseline information.
- Collaborate with food safety private sector or local authorities – such as the Ministry of Public Health, to create a team in charge of providing training for left-overs' food safety assessment for donations.
- Provide training for restaurant owners and managers to limit preparation and plate food waste generation through crew training.

- Place fridges and stations, promote food excess or left-overs deposit for public donations, and collaborate with municipalities to clean and maintain (Al-Bugamy, 2015).
- Raise awareness of the negative impacts of food waste using ads on TV, radio, and social media platforms.
- Collaborate with online local food ordering applications to incorporate the number of individuals as a factor in the amount of food selected to limit over-ordering.
- Audit restaurant managers and service area crew through mystery shoppers to assess their behavior towards over-ordering encounters and left-overs takeaway encouragement.

2. Restaurant Owners and Managers

- Provide training and continuous reinforcement for restaurant service area crew to notify customers in the case of over-ordering.
- Plan focused menus to limit over-ordering behaviors encouraged by the availability of a broad range of choices.
- Promote and encourage left-overs takeaway.
- Offer different portion sizes and offer smaller plates to limit food waste generation (Saudi Gazette, 2018).
- Identify which meals generate the most leftovers and eventually decrease its quantity.
- Suggest offering half of the plate portion for dine-in and immediate to-go packaging of the remaining half portion.

- Offer mezze dishes tray in Lebanese cuisine restaurants with smaller than average portion size meals for sharing and limited waste generation.
- Set a punitive law that charges both managers and customers with fines and penalties for unfinished plates at restaurants due to over-ordering in case of left-overs discardment instead of takeaway (Oelofse et. al, 2020; Saudi Gazette, 2018).
- Train kitchen-dedicated personnel for safe sorting and excess food separation for donations.
- Collaborate with local initiatives and organizations that collect food waste and make it accessible to food insecure people and refugees.

3. Local Municipalities

- Promote, reinforce, and incentivize sorting.
- Collaborate with local authorities to recycle.
- Organize campaigns to raise awareness of the negative consequences of food waste through informative messages and reminders.
- Oblige restaurants to contract with local charity organization to redistribute safe left-over food items to the people in need (Al-Bugamy, 2015).

APPENDIX I

CONSENT FORMS

Food Waste in Lebanese Restaurants, Bakeries, and Supermarkets: A Preliminary Assessment

Consent Form

In light of the crisis of waste in Lebanon, and in order to seek solutions to mitigate the consequences of this serious crisis, we began studies on food waste at the Household level to understand the various factors which contribute to such wastage. Furthermore, in efforts to complete our research we are conducting a study targeting 500 conveniently sampled restaurants across Lebanon to estimate post-consumer food waste also known as plate food waste and understand the consumer behavior as well as the factors contributing to such wastage. Accordingly, we will be assessing the economic cost of waste and propose recommendations to mitigate food waste and divert it away from landfills.

For this purpose, we invite you to participate in a questionnaire on food waste generation when dining out which will take no more than 20 to 30 minutes. Your participation is purely voluntary. During the questionnaire, you may refuse to answer any particular question. All data collected will be treated as confidential information, and will be disseminated in an aggregate form (your name will not be linked to your responses). To insure the confidentiality of the survey, we will ask you to meet in a private office at your premises to collect the desired data. All completed questionnaires will be kept in locked cabinets at the Faculty of Agricultural and Food Sciences and/or on a password-protected computer. The transcripts will be destroyed after the required retention period (usually three years). There are no serious risks anticipated in this study. Refusal to participate in this study will involve no penalty or loss of benefits to which you are otherwise entitled. You will not be penalized in any way for deciding to stop your participation at any time. You will be provided by a copy of the consent form for your records.

If you have any questions regarding the study, you may ask us anytime or contact the principal investigator Dr. Mohamad Abiad, Faculty of Agricultural and Food Sciences (FAFS) telephone: 01-350 000 - ext.: 4412, or email: ma192@aub.edu.lb or the Co-Investigator: Dr. Ali Chalak, Faculty of Agricultural and Food Sciences (FAFS), telephone: 01-350 000- ext.: 4502, or email: ac22@aub.edu.lb.

If you have any questions about your rights as a participant in this research, you can contact the AUB Social & Behavioral Science Institution Review Board at:01-350 000- ext. 5445 email: irb@aub.edu.lb.

Do you voluntarily consent to take part of the questionnaire?

□ Yes I do □ No I do not

Do you voluntarily consent to separate your plate food waste in the allocated bin on a daily basis for a period of seven days to be collected by the researchers?

□ Yes I do □ No I do not

Investigator's Statement:

I have reviewed in detail, with the participant, the informed consent document for this research study, the purpose of the study and its risks and benefits. I have answered to all the participant's questions clearly. I will inform the participant in case of any changes to the research study.

_____

Name of Investigator Signature

_____

Date

Institutional Review Board
American University of Beirut

20 DEC 2017

APPROVED

نفايات المطاعم في المناطق اللبنانية: الأنماط السلوكية، التكاليف الإقتصادية والسياسات المقترحة

موافقة لإجراء المقابلة

في ظل أزمة النفايات المستفحلة في البلد و حرصا منا للسعي في ابتكار حلول تخفف من تبعات هذه الازمة الخطيرة، بدأنا باجراء دراسات حول هدر الاكل في المنازل اللبنانية في سبيل فهم العوامل المختلفة التي تؤدي لهدر كميات كبيرة من الطعام. واستكمالا لهذه الجهود، نحن بصدد اجراء دراسة مماثلة تشمل 500 عيّنة ملائمة من المطاعم اللبنانية والتي نستطيع من خلالها تقييم التكلفة الاقتصادية للهدر وتقدير الكميات المولدة من جهة، و إلى توصيات تتماشى مع إعادة توجيه فضلات الطعام بعيدا عن مطامر النفايات من جهة أخرى، بناء على تحليلنا للعوامل التي تؤدي للهدر.
بهدف الحصول على فكرة شاملة عن كيفية إدارة الطعام ومسببات هدره، نحن ندعوك لملء استبيان يتناول عادات شراء وتخزين وإدارة وتحضير المواد الغذائية، و سوف لن تتجاوز مدة المقابلة أكثر من ٢٠ الى ٣٠ دقيقة.

مُشاركتكم في المقابلة هي مُشاركة طوعيّة. يمكنكم رفض الإجابة على سؤالٍ مُعيّن خلال المقابلة. يتمّ التّعامل مع جميع المعلوماتّ التي سيتمّ جمعها على أنّها سريّة حيث يتمُّ إبلاغها بشكلٍ عام من دون وجود تعريف يُمكنُ ربطه بإجاباتكم الشّخصيّة. ولضمان سرية المسح، سوف نطلب منك الاجتماع في مكتب خاص في مقرك لجمع البيانات المطلوبة وذلك باستخدام تطبيق كوبوتولبوكس KoboToolbox على واجهة الكمبيوتر اللوحي (Tablet) . ستُحفظ جميع المعلومات في خزانةٍ مقفلةٍ بالمفتاح في مكتبٍ مُقفلٍ في كليّة العلوم الزراعية والغذائية أو على حاسوبٍ محميٍّ بكلمة سرّ. سيتمُّ أيضاً التّخلّص من النّصوص بعد ثلاث سنوات من انتهاء الدّراسة. لا توجد أيّة مخاطر جدّيّة في هذه الدّراسة. في حال رفضتم المشاركة في المقابلة، لن تفرض عليكم أيّةعقوبة و لن تفقدوا المنافع التي هي من حقّكم. لن تتمّ معاقبتكم بأيّ شكلٍ من الأشكال لاتّخاذ قرار وقف مشاركتكم في هذه الدّراسة في أيّ وقتٍ من الأوقات. سيتم تزويدك بنسخة من نموذج الموافقة لسجلاتك.

إذا كان لديكم أيّة أسئلة ،يُمكنكم طرحها الآن.إذا كانت لديكم أسئلة في وقتٍ لاحقٍ، يمكنكم الإتّصال بالباحث الرّئيسي الدّكتور محمد الأبيض ، كلية العلوم الزراعية والغذائية ، هاتف: 01350000- مُقسّم:4412 ، أو البريد الإلكترونيّ:_____ ma192@aub.edu.lb أو المساعد الرّئيسي في البحث الدّكتور علي شلق ، كلية العلوم الزراعية والغذائية، هاتف: 01350000- مُقسّم4502.

إذا كان لديكم أيّة أسئلة حول حقوقكم كمُشاركين في هذا البحث، يمكنكم الإتّصال بمجلس المراجعة الإجتماعيّة و السّلوكيّة في العلوم في الجامعة الأميركيّة في بيروت:01-350 000 ext. 5445 أو البريد الإلكترونيّ: irb@aub.edu.lb

هل تُوافق طوعاً على المُشاركة في الاستبيان؟ □نعم □لا

هل توافق طوعا على التخلص من فضلات الطعام الخاصة بك في أكياس القمامة الموزعة يومياً لمدة سبعة أيام؟

□نعم □لا

تصريح العامل الميداني

لقد استعرضت بالتّفصيل مع المشارك وثيقة الموافقة على المشاركة في الدّراسة بالإضافة إلى هدف الدّراسة ومخاطرها وفوائدها. وقد أجبت بشكلٍ واضحٍ على أسئلة المشاركين. سأبلغُ المشاركين في حال حدوث أي تغييرٍ في الدّراسة.

إسم العامل الميداني

التّوقيع

التّاريخ

APPENDIX II

QUESTIONNAIRE

Food Waste in Lebanese Restaurants, Bakeries, and Supermarkets: A Preliminary Assessment

Questionnaire

1. Area/town: _____ 2. Street:_____

3. Governorate: _____

4. Year established: _____

5. Number of branches:_____

6. Number of full-time employees:_____

7. Number of part-time or casual employees:_____

8. Area of the premise:_____m^2

9. Number of tables and seats available: _____

10. What kind of service does your restaurant offer?

    1. Fast Food, take away
    2. Self-service
    3. Buffet
    4. Casual dining
    5. Fine dining (full service)
    6. Other; please specify _____

11. Type of cuisine: _____(e.g.: Italian, Lebanese, Japanese, French, Fusion, Fast Food,, etc.)

12. Do you have a central kitchen?

    1. Yes 2. No

13. Do you buy precut or prewashed food vegetables?

    1. Yes 2. No

14. Are you currently certified or working on achieving any internationally recognized certificate such as ISO 9001, ISO 14000, ISO 22000, or any other?

    1. Yes; please specify all _____
    2. No
    3. Certification in progress; please specify: _____

15. Total annual sales:

    1. Less than $50K
    2. Between $51K and $100K
    3. Between $101K and $200K
    4. Between $201K and $300K
    5. Between $301K and $400K
    6. Between $401K and $500K
    7. $501K or above

16. On average, how many meals (plates) do you serve per day? _____

17. On average, how many sandwiches do you prepare per day? _____

18. On average, how much food waste do you generate per day? _____kg

19. Do you separate organic and non-organic waste?

    1. Always 2. Often 3.Rarely 4. Never

20. To the best of your knowledge, what are the percentages of the different types of waste generated in your outlet?

    1. Organic: _____% 2. Non-organic: _____%

21. How much do you purchase of each of the following items:

1. Cardboard boxes: _____
2. Plastic containers: _____
3. Glass bottles: _____
4. Paper products (e.g. Napkins, etc.) _____
5. Plastic bags: _____
6. Plastic ware: _____
7. Meat, chicken & fish: _____
8. Fruits & vegetables: _____

22. What is your estimation of the average of wasted amount of the following items:

1. Cardboard boxes: _____
3. Plastic containers: _____
3. Glass bottles: _____
4. Paper products (e.g. Napkins, etc.) _____
5. Plastic bags: _____
6. Plastic ware: _____
7. Meat, chicken & fish: _____
8. Fruits & vegetables: _____

23. Is there anyone collecting valuable items from your waste such as cardboard, tin cans, glass, etc.?

1. Yes; please specify _____
2. No
99. I don't know

24. Any return for the collected items?

1. Yes, please specify_____
2. No

25. How many trash bags do you dispose of per day? _____

26. What is the size of the trash bag you use? _____

27. How much cooking oil do you consume/change per week? _____

28. Is there anyone collecting your waste cooking oil?

1. Yes 2. No

29. Does collected waste cooking oil provide any monetary or other return?

1. Yes; please specify: _____ 2. No

If you **DO NOT SORT** your waste please answer Questions 30 - 32:

30. Why are you not sorting your waste?

1. Time consuming
2. Too costly
3. Too confusing
4. My contribution has no impact
5. My neighbors do not sort
6. Other reason; please specify:_____

31. Do you think sorting will affect your operation?

1. Yes 2. No 99. I don't know

32. Please select the **most important** motivator for your company to consider sorting?

1. Financial incentives
2. Enhancing the corporate image as a pro-active sales strategy
3. An approach towards environmental sustainability
4. Preserving the corporate image – not to be perceived as the polluter

33. Please select ONE reason why you think it is important to prevent food waste:

1. Many people are poor and hungry
2. It saves money
3. A lot of people worked hard to get that food on my table
4. It cuts down on the amount of food going to landfills
5. Other, please specify:_____

34. To what extent are you aware of the negative consequences of food wastage in the environment, economy and society?

1. Fully aware 2. Somewhat aware 3. Not very aware 4. Totally unaware

35. Where do you think your food wastage comes from? Please rank from 1 to 5 with 1 being the most common reason for wastage and 5 being least common.

	Rank
a. Over ordering ingredients	
b. Food spoilage	
c. During food preparation and cooking	
d. During service (portioning and serving)	
e. Plate waste from customers	

36. How effective do you think the below measures are at reducing food wastage? (Rate from 1 to 5, 1 being most effective and 5 least effective)

	Most effective	Effective	Neutral	Somehow effective	Not effective at all
a. Menu planning	1	2	3	4	5
b. Demand forecasting	1	2	3	4	5
c. Adequate food storage (fridges, dry store, enough containers)	1	2	3	4	5
d. Labor skills set (kitchen staff and front of the house)	1	2	3	4	5
e. Offer different portion sized dishes	1	2	3	4	5

37. How effective do you think the below measures would be for handling food left on plates by patrons? (Rate from 1 to 5, 1 being most effective and 5 least effective)

	Most effective	Effective	Neutral	Somehow effective	Not effective at all
a. Compost it	1	2	3	4	5
b. Donate it to homeless or hungry	1	2	3	4	5
c. Wrap it in to go bags	1	2	3	4	5
d. Send it to landfills with biogas capture capabilities	1	2	3	4	5
e. Use as animal feed	1	2	3	4	5

38. What might be the challenges to reduce food wastage at your outlet? (choose all that apply)

    1. Lack of adequate food storage
    2. Food and Hygiene regulations
    3. Insufficient labor skills
    4. Lack of time
    5. Customer behavior
    6. Other, please specify: _____

39. Does your company have any food waste prevention strategy? [If YES, please go to question 40, if NO or I DON'T KNOW go to question 41]

    1. Yes 2. No 99. I don't know

40. Which food waste prevention strategies does your company use? (Choose all that apply).

    1. Separate food wastage bins
    2. Software or App
    3. Use surplus food for staff meals
    4. Use surplus food for making other dishes (eg: turn into soups or garnishes)
    5. Donate to charity
    6. Other, please specify:_____

41. How much effort would you put into reducing the amount of food waste generated at your facility if it was incentivized?

1. A lot of effort 2. A fair amount 3. A little 4. Not at all

42. Do you think that adopting a waste management strategy in your restaurant will encourage customers to visit?

1. Yes 2. No 99. I don't know

Thanks for your participation in this survey!

فضلات الطعام في المطاعم

1. المنطقة:_____

2. الشارع: _____

3. القضاء:_____

4. سنة التأسيس:_____

5. عدد الفروع :_____

6. عدد الموظفينبدوام كامل :_____

7. عدد الموظفين بدوامجزئي:_____

8. مساحة المطعم:_____م^2

9. عدد الطاولات و المقاعد:_____

10. ما هو نوع الخدمة التي يقدمها مطعمك؟

1. سفري، للأكل خارج المطعم
2. الخدمة الذاتية
3. بوفيه
4. مطعم عادي (خدمة طاولة)
5. مطعم فخم (خدمة كاملة)
6. أخرى، يرجى التحديد:_____

11. نوع المطبخ:_____ (مثلا: ايطالي، لبناني، ياباني، فرنسي، وجبات سريعة...)

12. هل لديكم مطبخ مركزي؟

1. نعم
2. كلا

13. هل تشتري أي مواد غذائية مقطعة او مغسلة مسبقا؟

1. نعم

2. كلا

14. هل أنت حائز أو تعمل على تحصيل أي شهادة معترف بها دوليا مثل ISO 9001، ISO 14000، ISO 22000، أو أي شهادة أخرى؟

1. نعم، يرجى التحديد _____

2. قيد التحصيل و تحديد الشهادة:_____

3. كلا

15. إجمالي قيمة المبيعات السنوية

1. أقل من 50,000 $

2. بين 51,000$ و 100,000 $

3. بين 101,000 $ و 200,000 $

4. بين 201,000 $ و 300,000 $

5. بين 301,000$ و 400,000$

6. بين 401,000$ 500,000 $

7. أكثر من 500,000$

16. كم متوسط عدد الوجبات (الأطباق) التي تقوم بتقديمها و بيعها يوميا؟ _____

17. كم متوسط عدد السندويشات التي تقوم بإعدادها و بيعها؟ _____

18. ما هو تقديرك لكمية النفايات المتولدة يوميا في مطعمك :_____ كلغ

19. هل تفصل بين النفايات العضوية و غير العضوية؟

1. دائما

2. غالبا

3. نادرا

4. ابدا

20. على حد علمكم، ما هي نسب أنواع النفايات المختلفة في المطعم ؟

1. نفايات لعضوية: _____٪

2. نفايات غيرعضوية: _____٪

21. ما هو حجم الشراء لكل من التالي شهريا؟

1. علب الكرتون: _____

2. علب البلاستيك: _____

3. ملاعق و شوك بلاستيك: _____

4. عبوات زجاجية: _____

5. محارم وورق: _____

6. أكياس النايلون: _____

7. اللحوم والدجاج والأسماك: _____

8. الفواكه والخضروات: _____

22. ما هو تقديركم لمتوسط كمية النفايات اليومية لكل مما يلي:

1. علب الكرتون: _____

2. علب البلاستيك: _____

3. ملاعق و شوك بلاستيك: _____

4. عبوات زجاجية: _____

5. محارم وورق: _____

6. أكياس النايلون: _____

7. اللحوم والدجاج والأسماك: _____

8. الفواكه والخضروات: _____

23. هل هناك أي جهة تقوم بجمع مواد قيمة من النفايات الخاصة بك مثل الورق المقوى، علب الصفيح، والزجاج، وما إلى ذلك؟

1. نعم، يرجى التحديد:_____

2. كلا

24. هل يعطيك أي عائد؟

1. نعم، يرجى التحديد:_____

2. كلا

25. كم مرة تقوم بتغيير كيس القمامة في اليوم: _____

26. ما هو حجم الكيس المستعمل؟_____ليتر

27. كم يهدر من الزيت في الأسبوع؟ _____

28. هل هناك أي شخص يجمع الزيت المهدور؟

1. نعم

2. كلا

29. هل تتقاضى أي مبلغ مقابل الزيت المهدور؟

1. نعم, يرجى التحديد:_____

2. كلا

اذا كنت **لا تقوم بعملية الفرز**، اجب لطفا عن الاسئلة 30 - 32 :

30. لماذا لا تقوم بالفرز؟

1. يستهلك الكثير من الوقت
2. يستهلك الكثير من المال
3. مربك جدا
4. مساهمتي ليس لها تأثير
5. جيراني لا يفرزون
6. أخرى يرجى التحديد:_____

31. هل تعتقد أن الفرز سيؤثر على عملكم؟

a. نعم

b. كلا

99. لا أعلم

32. يرجى اختيار **أهم** المحفزات لشركتك للنظر في اعتماد فصل النفايات (اختيار واحد فقط)

a. المحفزات المالية
b. تعزيز صورة الشركة كاستراتيجية مبيعات استباقية
c. نهج للشركة نحو الاستدامة البيئية
d. الحفاظ على صورة الشركة - لا ينظر إليها على أنها الملوث

33. يرجى تحديد أهم سبب وراء اعتقادكم أنه من المهم عدم إضاعة الطعام.

1. كثير من الناس يجوعون
2. يوفر المال
3. الكثير من الناس يعملون بجد لتأمين هذا الطعام على مائدتي
4. يقلل من كمية الغذاء الذي ينتهي في المطامر

34. إلى أي مدى أنت على بينة من العواقب السلبية لهدر الغذاء على البيئة والاقتصاد والمجتمع؟

1. مدرك تماما
2. مدرك
3. ليس على علم تام
4. لا علم مطلقا

35. باعتقادكم ما هو مصدر هدر الطعام ؟ يرجى الترتيب من 1 إلى 5 حيث أن الرقم 1 هو السبب الأكثر شيوعا للهدر و 5 هو الأقل شيوعا.

	الترتيب
a) الافراط في شراء المكونات	
b) تلف المواد الغذائية	
c) أثناء إعداد الطعام والطبخ	
d) أثناء الخدمة (التقسيم والخدمة)	
e) فضلات الزبائن صحون	

36. ما هي الطريقة الأكثر فعالية للحد من الهدر في الطعام؟ (من 1 إلى 5، واعتبار 1 الأكثر فعالية و 5 الأقل فعالية)

	الاكثر فعالية	فعال الى حد ما	لغير مؤثر	غير فعال	غير فعال على الاطلاق
a) تخطيط قائمة الطعام	1	2	3	4	5
b) توقعات الطلب	1	2	3	4	5
c) تخزين المواد الغذائية الكافية (الثلاجات، المخازن الجافة، حاويات كافية)	1	2	3	4	5
d) ارساله الى المطامر	1	2	3	4	5
e) تقديم أطباق مختلفة الحجم	1	2	3	4	5
f) اطعامه للحيوانات	1	2	3	4	5

أخرى, يرجى التحديد:_____

37. ما هي الطريقة الافضل من الناحية البيئية بالنسبة للمطاعم للتعامل مع الطعام الذي تركه الزبائن في صحونهم؟ (من 1 إلى 5، واعتبار 1 الافضل و 5 الأقل نجاعة)

	الاكثر فعالية	فعال	لافعال و لا غير فعال	غير فعال	غير فعال على الاطلاق
a) تحويله الى سماد	1	2	3	4	5
b) التبرع به للمشردين و الجائعين	1	2	3	4	5
c) لفه في اكياس	1	2	3	4	5
d) ارساله الى مكبات النفايات التي تمتلك قدرة التقاط الغاز الحيوي	1	2	3	4	5
e) استخدامه كطعام للحيوانات	1	2	3	4	5

38. ما هي العقبات التي تحول دون الحد من هدر الطعام في مطعمك؟ (ضع علامة على أكثر من إجابة واحدة تعتبرها مناسبة)

1. عدم وجود تخزين كاف للأغذية
2. قوانين تنظيم الغذاء والنظافة
3. تدني مهارات العمال
4. ضيق الوقت
5. سلوك الزبائن
6. أخرى، يرجى التحديد: _____

39. هل لدى مطعمك أي استراتيجية لمنع هدر الأغذية؟ (إذا كانت إجابتك نعم، يرجى الانتقال إلى السؤال 40، و إذا كانت كلا او لا اعلم انتقل الى السؤال 41)

1. نعم

2. كلا

99. لا اعلم

40. ما هي الاستراتيجيات الطعام التي يتبناها مطعمك؟ (اختر كل الاجابات المناسبة).

فائض الغذاء (المكونات التي هدرت أثناء التحضير الغير مناسبة و قائمة المطعم ولكنها كافية صالحة البشري)

1. افصل صندوق النفايات الغذائية

2. استعمال البرامج أو التطبيقات

3. استخدام فائض الغذاء لوجبات الموظفين

4. استخدام فائض الغذاء لصنع صحون اخرى (على سبيل المثال: تتحول إلى الحساء أو الى زينة)

5. التبرع للجمعيات الخيرية

6. حوافز أخرى، يرجى التحديد: _____

41. كم من الجهد الذي يمكنك أن تضعه في تقليل كمية النفايات الغذائية الناتجة في المطعم الخاص بك في حال وجد الحافز؟

1. القدر الكبير

2. مستوى عادل

3. ليس كثيرا

4. لا شيئ على الإطلاق

42. هل تعتقد أن اعتماد استراتيجية لإدارة النفايات في المطعم الخاص بك سوف تكسبك زبائن جدد؟

1. نعم

2. كلا

99. لا اعلم

شكرا لمشاركتكم في هذا الاستبيان!

APPENDIX III

DESCRIPTIVE STATISTICS TABLE - FOOD WASTE DETERMINANTS

Characteristics (N=222)	n (Valid %)
Type of Cuisine	
Lebanese	58 (26.1)
Non-Lebanese	164 (73.9)
Kind of Service	
Food on the go, takeaway	21 (11.9)
Self-service	9 (5.1)
Casual dining	113 (64.2)
Fine dining (full service)	33 (18.8)
Awareness about the Negative Consequences of Food Waste on the Environment, Economy, and Society	
Fully aware	119 (55.9)
Somewhat aware	57 (26.8)
Not very aware	30 (14.1)
Totally unaware	7 (3.3)
Importance of Consumer Behavior on the Amount of Food Waste Generated	
Most important	132 (60.8)
Fairly important	33 (15.2)
Important	23 (10.6)
Slightly important	10 (4.6)
Least important	19 (8.8)
Effectiveness of Menu Planning on Food Waste Reduction	
Most effective	100 (46.1)
Effective	46 (21.2)
Neutral	22 (10.1)
Somehow effective	11 (5.1)
Not effective at all	38 (17.5)

Effectiveness of Different Portion Size Availability on Food Waste Reduction	
Most effective	68 (31.3)
Effective	62 (28.6)
Neutral	36 (16.6)
Somehow effective	19 (8.8)
Not effective at all	32 (14.7)
Challenges to Reducing Food Waste	
Lack of adequate food storage	40 (19.1)
Food and Hygiene regulations	55 (26.3)
Insufficient labor skills	24 (11.5)
Lack of time	34 (16.3)
Customer behavior	56 (26.8)

BIBLIOGRAPHY

Abiad, M. G., & Meho, L. I. (2018). Food loss and food waste research in the Arab world: A systematic review. Food security, 10(2), 311-322.

Abouabdillah, A., Capone, R., El Youssfi, L., Debs, P., Harraq, A., El Bilali, H., & Driouech, N. (2015, October). Household food waste in Morocco: An exploratory survey. In Book of Proceedings of the VI International Scientific Agriculture Symposium "Agrosym (pp. 1353-1360).

Adamashvili, N., Chiara, F., & Fiore, M. (2020). Food Loss and Waste, a global responsibility?! Economia Agro-Alimentare, (3), 825–846.

Al-Bugamy, M. (2015). 900 food waste containers in Jeddah.

Arous, S. A., Capone, R., Philipp, D., Haddadi, Y., El Bilali, H., Bottalico, F., & Hamidouche, M. (2017). Exploring Household Food Waste Issue in Algeria. Agrofor, 2(1).

Barilla Center for Food & Nutrition, 2012. Food waste: causes, impacts and proposals. Rome, June 2012. Available from. https://www.barillacfn.com/m/publications/food-waste-causes-impact-proposals.pdf

Barre, M. (2013). Food Loss in NENA Region. 23rd African Commission on Agricultural Statistics Session; 4-7 December. Rabat, Morocco.

Barrera, E. L., & Hertel, T. (2020). Global food waste across the income spectrum: Implications for food prices, production and resource use. Food Policy, 101874.

Bond, M., Meacham, T., Bhunnoo, R. and Benton, T.G. (2013) Food waste within global food systems. A Global Food Security report (www.foodsecurity.ac.uk).

Campoy-Muñoz, P., Cardenete, M. A., & Delgado, M. C. (2017). Economic impact assessment of food waste reduction on European countries through social accounting matrices. Resources, Conservation and Recycling, 122, 202-209.

Capone, R., El Bilali, H., Debs, P., Bottalico, F., Cardone, G., Berjan, S., ... & Ali Arous, S. (2016). Bread and bakery products waste in selected Mediterranean Arab countries. American Journal of Food and Nutrition, 4(2), 40-50.

Chalak, A., Abiad, M. G., Diab, M., & Nasreddine, L. (2019). The Determinants of Household Food Waste Generation and its Associated Caloric and Nutrient Losses: The Case of Lebanon. PLOS One, 14(12), e0225789.

Chalak, A., Abou-Daher, C., Chaaban, J., & Abiad, M. G. (2016). The global economic and regulatory determinants of household food waste generation: A cross-country analysis. Waste management, 48, 418-422.

Charbel, L., Capone, R., Grizi, L., Debs, P., Khalife, D., El Bilali, H., & Bottalico, F. (2016). Preliminary insights on household food wastage in Lebanon. Journal of Food Security, 4(6), 131-137.

Charlebois, S., Creedy, A., & von Massow, M. (2015). "Back of house"–focused study on food waste in fine dining: the case of Delish restaurants. International Journal of Culture, Tourism and Hospitality Research.

El Bilali, H., & Ben Hassen, T. (2020). Food Waste in the Countries of the Gulf Cooperation Council: A Systematic Review. Foods, 9(4), 463.

El-Fadel, M., Zeinati, M., El-Jisr, K., & Jamali, D. (2001). Industrial-waste management in developing countries: The case of Lebanon. Journal of Environmental Management, 61(4), 281-300.

Elmenofi, A. G. G., Capone, R., Waked, S., Debs, P., Bottalico, F., & El Bilali, H. (2015, October). An exploratory survey on household food waste in Egypt. In Book of Proceedings of the VI international scientific agriculture symposium "Agrosym (pp. 15-18).

European Commission, 2014. Food Waste and its Impacts: European Week for Waste Reduction.

FAO (2011). Global Food Losses and Food Waste: Extent, Causes and Prevention; FAO: Rome, Italy, 2011.

FAO (2015). Regional Overview of Food Insecurity - Near East and North Africa: Strengthening Regional Collaboration to Build Resilience for Food Security and Nutrition, Cairo, Egypt, FAO.

FAO, 2013. Food Wastage Footprint: Impacts on Natural Resources: Summary Report. Retrieved November 2020, from http://site.ebrary.com/id/10815985.

FAO, 2015. Global Initiative on Food Loss and Waste Reduction, 8.

FAO LADA, 2011. Global Land Degradation Information System (GLADIS) version 1.0. An Information Database for Land Degradation Assessment at Global Level. LADA Technical Report n. 17.

FAO, WFP, IFAD, 2012. In: The State of Food Insecurity in the World 2012. Economic Growth is Necessary but Not Sufficient to Accelerate Reduction of Hunger and Malnutrition. FAO, Rome, Italy.

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

Filimonau, V., Krivcova, M., & Pettit, F. (2019). An exploratory study of managerial approaches to food waste mitigation in coffee shops. International Journal of Hospitality Management, 76, 48-57.

Filimonau, V., Todorova, E., Mzembe, A., Sauer, L., & Yankholmes, A. (2020). A comparative study of food waste management in full service restaurants of the United Kingdom and the Netherlands. Journal of Cleaner Production, 120775.

Filimonau, V., Zhang, H., & Wang, L. E. (2020). Food waste management in Shanghai full-service restaurants: A senior managers' perspective. Journal of Cleaner Production, 120975.

Girotto, F., Alibardi, L., & Cossu, R. (2015). Food waste generation and industrial uses: a review. Waste management, 45, 32-41.

Gustafsson, J., Cederberg, C., Sonesson, U., & Emanuelsson, A. (2013). The methodology of the FAO study: Global Food Losses and Food Waste-extent, causes and prevention"- FAO, 2011.

Gustavsson, J., Cederberg, C., Sonesson, U., Van Otterdijk, R., & Meybeck, A. (2011). Global food losses and food waste.

HLPE, 2014. Food losses and waste in the context of sustainable food systems. A report by the High Level Panel of Experts on Food Security and Nutrition of the Committee on World Food Security, Rome 2014.

IPCC (2007). Climate change 2007: Impacts, adaptation and vulnerability, report of the intergovernmental panel on climate change. In M. L. Parry, O. F. Canziani, J. P. Palutikof, P. J. v. d. Linden, & C. E. Hanson (Eds.). Cambridge University Press, Cambridge.

LeGrand, T. (2018). Overviews of food systems and agro-industry, value chains, and food loss and waste in the countries of Eastern Europe and Central Asia. Retrieved November 2020, from http://www.fao.org/publications/card/en/c/I9788EN/

Lipinski, B., Hanson, C., Lomax, J., Kitinoja, L., Waite, R., & Searchinger, T. (2013). Reducing food loss and waste. World Resources Institute Working Paper, 1, 1-40.

Lundqvist, J. (2010). Producing more or wasting less? Bracing the food security challenge of unpredictable rainfall. Re-thinking Water and Food Security, 75.

Maalouf, A., & El-Fadel, M. (2019). Life cycle assessment for solid waste management in Lebanon: Economic implications of carbon credit. Waste Management & Research, 37(1_suppl), 14-26.

Mattar, L., Abiad, M. G., Chalak, A., Diab, M., & Hassan, H. (2018). Attitudes and behaviors shaping household food waste generation: Lessons from Lebanon. Journal of Cleaner Production, 198, 1219-1223.

Matzembacher, D. E., Brancoli, P., Maia, L. M., & Eriksson, M. (2020). Consumer's food waste in different restaurants configuration: A comparison between different levels of incentive and interaction. Waste Management, 114, 263-273.

Mourad, M. (2015). France moves toward a national policy against food waste.

Oelofse, S. H., & Nahman, A. (2013). Estimating the magnitude of food waste generated in South Africa. Waste Management & Research, 31(1), 80-86.

Oelofse, S., Nahman, A., Barjees Baig, M., Salemdeeb, R., Nizami, A. S., & Reynolds, C. (2020). Food Waste Within South Africa and Saudi Arabia.

Parfitt, J., Barthel, M., & Macnaughton, S. (2010). Food waste within food supply chains: quantification and potential for change to 2050. Philosophical transactions of the royal society B: biological sciences, 365(1554), 3065-3081.

Principato, L., Pratesi, C. A., & Secondi, L. (2018). Towards zero waste: An exploratory study on restaurant managers. International Journal of Hospitality Management, 74, 130-137.

ReFED, 2018. The Foodservice Food Waste Action Guide. ReFED. Available from. https://www.refed.com/downloads/Foodservice_Guide_Web.pdf

Ruel, M. T., & Alderman, H. (2013). Maternal and Child Nutrition Study Group Nutrition-sensitive interventions and programmes: how can they help to accelerate progress in improving maternal and child nutrition. Lancet, 382(9891), 536-51.

Sakaguchi, L., Pak, N., & Potts, M. D. (2018). Tackling the issue of food waste in restaurants: Options for measurement method, reduction and behavioral change. Journal of Cleaner Production, 180, 430-436.

Sassi, K., Capone, R., Abid, G., Debs, P., El Bilali, H., Bouacha, O. D., & Terras, D. S. (2016). Food wastage by Tunisian households. Agrofor, 1(1).

Saudi Gazette, 2018. National initiative to reduce food waste launched. An article appeared in the Daily Saudi Gazette. Available at: http://saudigazette.com.sa/article/528769/SAUDI-ARABIA/National-initiative-to-reduce-food-waste-launched.

Schmidt, K., & Matthies, E. (2018). Where to start fighting the food waste problem? Identifying most promising entry points for intervention programs to reduce household food waste and overconsumption of food. Resources, Conservation and Recycling, 139, 1-14.

Since 1946, we bring together entrepreneurs and owners of the most reputable F&B establishments: Syndicate of Owners of Restaurants, Cafes, Night-clubs & Pastries in Lebanon. (n.d.). Retrieved December 24, 2020, from http://www.syndicatercnp.com/

Thi, N. B. D., Kumar, G., & Lin, C. Y. (2015). An overview of food waste management in developing countries: Current status and future perspective. Journal of environmental management, 157, 220-229.