Investigating the Causes and Drivers of Food Waste in the Hospitality Sector in Dubai-UAE. Toward Implementing Food Waste Prevention Strategies.

التحقيق في أسباب هدر الطعام في قطاع الضيافة في إمارة دبي- الإمارات العربية المتحدة. نحو تطبيق استراتيجيات لمنع أو الحد من هدره في هذا القطاع.

by

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ABSTRACT

Saving natural resources to protect the planet and help sustain a better future for the generations requires focusing mainly on the three pillars of a sustainable society that are important for humans to live and interact. These are the social, economic and environmental pillars. The world was united to put international goals in order to reduce the recent problems that are affecting these pillars; the Sustainable Development Goals (SDGs) or the Global Goals. Goal number 12 of these 17 SDGs focuses on making consumption and production reasonable to lower the use of natural resources and decrease the waste generated consequently. The food loss and waste problem have been the focus of individuals and governments in the late few years; this is referred to as its effects on the sustainable vision of the countries as well as its impact on the social, economic and environmental sides of them. Tackling this issue needs the united efforts of the private and public sectors and is considered under goal SDG 12.3. Food loss is the decrease in food amounts before consumption, mostly in developing countries. While Food waste focuses on food thrown out after consumption, left intentionally or thrown away, and mostly in developed countries. The UAE has one of the highest per capita amounts of food waste yearly, around 224kg. Thus, efforts to tackle the problem have to start, this is in alignment with achieving international targets like SDG 12.3 and national ones such as "Zero Hunger" by 2051. Huge efforts and initiatives in the country are established. Their work is mainly focused on recovering food waste through banks, composting and animal feeds. However, source reduction is considered the top priority in solving the food waste problem. This research fills the theoretical gap, which was confirmed to be lacking in the country, in finding the causes and drivers of food waste in the hospitality sector of Dubai, and suggests prevention strategies to be implemented in food services to reduce it. The hospitality sector of the Emirate of Dubai is considered one of the major sectors contributing to food waste as Dubai is a tourist hub.

A mixed-mode methodology was used to collect the data; it distributed two surveys using jisc.com to the public food services users (guests, N=361) and the food services providers (employees, N=91), followed by interviewing seven experts with high positions to verify the results. The leading causes of food waste from the customers' side that all participants agreed on and ranked by most effective were: taking big portions and seeing abundance in types and amounts, the lack of awareness, and the cultural habits shown in generosity in over-ordering. While causes of FW from the food services are summarized mainly in their over-production and wrong planning and forecasting for numbers. Other factors were checked for their effect on food waste according to the opinion of the (guests, employers), to find that (45%, 47%) chose winter season, (93%, 71%) chose weekend days, and (71%, 64%) chose buffet type respectively. Results were checked by SPSS program for a general trend with some demographics to show that guests with higher salary and going to high-end services mainly chose "food presentation" as a major cause of FW and employees working in high-end services find FW to be depending on "meal time". The primary prevention strategies suggested by the interviewees were using smart-scales technology like Winnow, reducing portion/plate sizes, sourcing locally, using menu engineering, raising the chefs' education through awareness campaigns and training, and using encouraging

messages to remind the people to save their planet. These suggestions along with the accepted strategies by the surveyed samples were the base for developing a fundamental plan for food services to start working on and follow up with the global trend of “Target, Measure and Act”.

Key words: Food waste in UAE, Hospitality food, food waste impacts, causes of food waste.

الخلاصة

يتطلب الحفاظ على الموارد الطبيعية لحماية الكوكب والمساعدة في الحفاظ على مستقبل أفضل للأجيال القادمة، التركيز بشكل أساسي على الركائز الثلاث لمجتمع مستدام والتي تعتبر مهمة للبشر للعيش والتفاعل مع الاخرين بشكل سليم. ركائز المجتمع الاساسية هي الاجتماعية والاقتصادية والبيئية. لقد اتحد العالم لوضع أهداف دولية من أجل الحد من المشاكل الأخيرة التي تؤثر على هذه الركائز وهي أهداف التنمية المستدامة (SDGs) أو الأهداف العالمية. يركز الهدف رقم 12 من أهداف التنمية المستدامة السبعة عشر على تحفيز الاستهلاك والإنتاج المعقولين وذلك لتقليل استخدام الموارد الطبيعية الزائد وتقليل النفايات الناتجة عنه. تشكل مشكلة فقد الأغذية وهدرها محور تركيز الأفراد والحكومات في السنوات القليلة الماضية؛ حيث ان لها آثار على الرؤية المستدامة للدول وعلى الجوانب الاجتماعية والاقتصادية والبيئية لها. تحتاج معالجة هذه القضية إلى تضافر جهود القطاعين العام والخاص ويتم اعتبارها ضمن الهدف 12.3 من أهداف التنمية المستدامة. فقدان الغذاء هو انخفاض كميات الطعام قبل الاستهلاك ، وتكون معظمها في البلدان النامية. بينما يعرف هدر الطعام على أنه الطعام الذي يتم التخلص منه بعد الاستهلاك ، أو تركه عن قصد، وغالبًا ما تكون في البلدان المتقدمة. دولة الإمارات العربية المتحدة لديها واحدة من أعلى معدلات هدر الطعام للفرد سنويًا، حوالي 224 كجم. وبالتالي ، يجب أن تبذل الجهود لمعالجة هذه المشكلة، ويكون هذا بالتماشي مع تحقيق الأهداف الدولية مثل SDG 12.3 والأهداف الوطنية مثل "القضاء على الجوع" بحلول عام 2051. تم بذل جهود ومبادرات ضخمة في الدولة ولكن يركزعملهم بشكل أساسي على استعادة الطعام المهدورمن خلال بنوك الطعام، أوكسماد للزراعة أوأعلاف للحيوانات. ولكن يعتبر تقليل المصدر من أساسه أولوية قصوى في حل مشكلة هدر الطعام. يقوم هذا البحث على التركيز على هذه الفجوة النظرية والتي تم التأكد من عدم وجود ابحاث عنها في الدولة، ويهدف لإيجاد أسباب ودوافع هدر الطعام في قطاع الضيافة في امارة دبي ويقترح استراتيجيات وقائية يتم تنفيذها في الخدمات الغذائية لتقليل هذا الهدر. حيث أن قطاع الضيافة هو أحد القطاعات الرئيسية التي تساهم في إهدار الطعام لاعتبارامارة دبي كمركزًا سياحيًا.

تم استخدام منهجية مختلطة لجمع البيانات؛ قامت على توزيع استبيانين باستخدام jisc.com على مستخدمي خدمات الطعام العامة (الضيوف،N = 361) ومقدمي الخدمات الغذائية (الموظفون، N = 91)، تلاها مقابلة سبعة خبراء ذوي مناصب عالية للتحقق من النتائج. كانت الأسباب الرئيسية لإهدار الطعام من جانب الضيوف والتي اتفق عليها جميع المشاركين، من الأكثر تأثيرا هي: أخذ كميات كبيرة ورؤية الوفرة في الأنواع والكميات، وقلة الوعي، والعادات الثقافية التي تظهر في الكرم في الطلب الزائد. بينما تتلخص أسباب هدر الغذاء من خدمات الطعام بشكل رئيسي هي الإفراط في الإنتاج والتخطيط والتنبؤ الخاطئين للأرقام. تم فحص عوامل أخرى لتأثيرها على هدر الطعام حسب رأي (الضيوف ، الموظفين) ، لتجد أن (45٪ ، 47٪) اختاروا فصل الشتاء ، (93٪ ، 71٪) اختاروا أيام عطلة نهاية الأسبوع ، و (71٪، 64٪) اختاروا نوع خدمة البوفيه. تم التحقق ايضا من النتائج بواسطة برنامج SPSS لمعرفة اذا ما وجد اتجاه عام للاسباب مع بعض الخصائص الديموغرافية ليظهر أن الضيوف الذين لديهم رواتب أعلى ويذهبون إلى خدمات عالية الجودة اختاروا بشكل أساسي "مكملات تقديم الطعام غير الاساسية" كسبب رئيسي ل هدر الطعام والموظفين العاملين في الخدمات ذات المستوى الرفيع يجدون ان هدر الطعام يعتمد على "وقت الوجبة".
الاستراتيجيات الوقاية الأولية التي اقترحها الأشخاص الذين تمت مقابلتهم هي: استخدام تقنية المقاييس الذكية مثل Winnow ، وتقليل أحجام الحصص / الأطباق، وتوفير المصادر محليًا ، واستخدام هندسة القوائم، ورفع مستوى تعليم الطهاة من خلال حملات التوعية والتدريب، واستخدام الرسائل التشجيعية لتذكير الناس بـأهمية إنقاذ كوكبهم. كانت هذه الاقتراحات جنبًا إلى جنب مع الاستراتيجيات المقبولة من قبل العينات التي شملتها الدراسة أساسًا لتطوير خطة أساسية للخدمات الغذائية لبدء العمل عليها ومتابعتها مع الاتجاه العالمي "الهدف والقياس والعمل""Target, Measure and Act" .

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ABBREVIATIONS

Abbreviation	*Definition*
(ABM)	Agent-Based Model
(AED)	Arab Emirates Dirhams
(AFW)	Avoidable food waste
(BRL)	Registration & Licensing
(BUiD)	British University in Dubai
(COP 27)	The Conference of the Parties
(CO2)	Carbon dioxide
(DED)	The Department of Economic Development
(DM)	Dubai Municipality
(DSF)	Dubai shopping festival
(EU)	Europe
(FAO)	The Food and Agriculture Organisation
(FL)	Food loss
(FW)	Food waste
(GCC)	The Gulf Cooperation Countries
(GDP)	gross domestic product
(GHG)	Greenhouse gas
(GME)	Generalized Maximum Entropy Estimation
(HSD)	honest significant difference
(KSA)	Kingdom of Saudi Arabia
(LCA)	Life cycle analysis
(MENA)	Middle East North Africa
(MOCCAE)	The Ministry of Climate Change and Environment
(NENA)	Near East and North Africa countries
(Q)	Question
(SDGs)	The Sustainable Development Goals
(SRA)	Sustainable Restaurant Association
(S1) & (S2)	Survey 1 and survey 2
(UAE)	United Arab Emirates
(UK)	United Kingdom
(UNFCCC)	The United Nations Framework Convention on Climate Change
(USA)	United states of America
(WRAP)	The Waste and Resources Action Programme
(WWI)	World war one
(WWII)	World war two
(yrs.)	years
(25x)	Twenty five times

CHAPTER 1: INTRODUCTION

Years pass and the earth fills up with people and new generations. Some regions accommodate high densities of people due to reduced land areas, and others with low ones. These individuals have several needs to survive and prosper, from food and water supplies to social interactions and sufficient finances. However, a particular stage in the future will be reached when there are no more available resources to be used or wasted if the same consumption rates for them are continued. Here is where the term sustainability comes in. Sustainability teaches humans to fulfil and not sacrifice their generation's needs without wasting sources so the upcoming generations will have at least the same level of their chances.

Sustainability focuses mainly on the three pillars of life that are important for humans. The social pillar is where people need to connect and communicate with others, develop relationships and feel with the less fortunate while maintaining their rights and needs for a healthy and safe life. The economic pillar concerns having access to financial sources that will allow them to meet their needs. Finally, the environmental pillar focuses on saving natural resources for all recent and future generations.

The call for sustainability came to unite the world into one main aim through achieving seventeen goals that the United Nations adopted in 2015. All countries agreed on the name of the Sustainable Development Goals (SDGs) or the Global Goals. The main aim behind these goals is to end AIDS, discrimination against females, poverty, and hunger. Goal number 12 of these 17 SDGs focuses on making consumption and production reasonable to lower the use of natural resources and decrease the waste generated consequently besides goal number 2 which targets zero hunger. (*Sustainable Development Goals | United Nations Development Programme* n.d.)

However, civilization is pushing people to change their lifestyles to follow up with the motivating work wheel and the numerous, nonstop ambitions of people to develop and improve. This leads them to be constantly engaged in their busy life without much focus on feeding themselves inside their homes. Eating outside of the house is the new trend introduced to this generation as the ease of doing it is very tempting; delivery apps and offers, the wide variety of restaurants with unique blends and creative ideas…etc. This new trend and demand, supported by many other reasons, lead to extra food waste, causing more consumption and production. Food waste is affecting our lives in all mentioned pillars; environmental, social, and economic, making it one of the biggest problems to deal with and an urgent need for immediate action through mitigating strategies to ensure a sustainable

life. This immediate action to reduce food waste and loss is already started under goal number 12 of the SDGs, which is the Champions12.3. The sub-goal focuses on halving food waste per capita at the consumption level and food losses in other phases of the supply chain by 2030. Around 115k tonnes of food waste must be reduced yearly to reach the goal (Canali et al. 2014). Table (1) shows us an example of food waste increases in the US through the past years, where the numbers are doubling. This mimics the growing problem in most countries worldwide, making the researcher focus on this problem in this research.

Table 1 Food waste generation weight growth in thousands of tons through the years in the US (Superfood 2019)

1960–2015 Data on Food in MSW by Weight (in thousands of U.S. tons)

Management Pathway	1960	1970	1980	1990	2000	2005	2010	2014	2015
Generation	12,200	12,800	13,000	23,860	30,700	32,930	35,740	38,670	39,730
Recycled	-	-	-	-	-	-	-	-	-
Composted	-	-	-	-	680	690	970	1,940	2,100
Combustion with Energy Recovery	-	50	260	4,060	5,820	5,870	6,150	7,200	7,380
Landfilled	12,200	12,750	12,740	19,800	24,200	26,370	28,620	29,530	30,250

Food waste and loss are two terms that generally refer to foods wasted or decreased through the food supply chain. It starts from the production stage from factories or harvest, transportation, distribution, storage and handling and finally consumption. The final phase, which will be the focus of this research, makes up about 17% of the food waste and loss percentage per *SDG 2021 Progress Report (n.d.).* However, Food handling is one of the critical phases and a significant contributor to food waste. There could be many problems leading to food disposal, such as faults in storage, insect invasion…etc. Food is known to be handled an average of 33 times through the supply chain (Okumus 2019).

Food loss (FL) is concerned explicitly with lost food or decreased amounts before consumption. According to Filimonau & De Coteau (2019), it usually occurs in developing countries due to fewer technological advances. At the same time, food waste (FW) focuses

on food thrown after consumption. It is either left intentionally not eaten or thrown away in homes and hospitality sectors, figure (1). FW is mainly found in developed countries; as increased consumption reflects their rich economic status. FW amounts are also influenced by the country's industrialization, people's income, and other variables to be discussed later.

Figure 1 The definition of food waste and food loss according to the different stages within the food supply chain (QONITA 2020)

Around one-third of the food is wasted or lost through the supply chain, equivalent to 1.3 billion tons of food annually. It accounts for 940 billion dollars yearly. This is enough to feed all the needy populations worldwide, with about 820.8 million hungry people (Jones 2017). This wastage affects the three pillars of sustainability; social, environmental and economic. It results in colossal methane gas emissions, a greenhouse gas (GHG) that increases global warming, as food is described as the third emitter of GHGs after China and the US if imagined as a country. These numbers are still growing, making the environmental problem even worse.

Many countries are dealing with food waste as a global target to achieve the goals of the Paris Agreement for climate change and the target 12.3 mentioned before. Besides committing to the approach Target-Measure-Act that motivates companies to quantify food waste to ease its management as it is believed that if it cannot be measured, it cannot be managed. Each country is working on these targets according to its capabilities. Primarily, they use adaptive strategies to dispense food waste in many incremental ways. Some of them help in the circular economy by increasing the value of food waste (Food valorization) and

trying to keep it from disposing of as possible by reusing, recycling, repairing…etc. The importance of saving food comes also from the recent problem of the war between Russia and Ukraine as shortage of some sources of food was noticed in many countries around the world which adds to the idea of reducing food waste and raising the food security of countries.

Food waste is being accumulated in all parts of the society's sides; residential, industrial and the hospitality sector, which includes all food services from restaurants, hotels, canteens, catering services and cafes, besides ghost kitchens or in other names, dark or virtual kitchens, which are used through apps and does not have their dining area. This type emerged more after the Covid-19 Pandemic (winnow n.d. b). Food waste management strategies must be included in all food services regardless of the sector's complex nature, as no one plan fits all. Each food service has characteristics that make it different besides the balancing pressure with the satisfaction of their customers and not stressing them into preventing wasting by breaking their leisure time (*SDG Target 12.3 on Food Loss and Waste: 2021 Progress Report | Champions 12.3* 2021.).

People should stop considering food waste as negligible and start to work on preventing and reducing it by studying its causes and drivers in their context, contacting the people in charge and suggesting actions to help lower food insecurities and destroy natural food resources. This research will focus on food waste in the hospitality sector of Dubai, an emirate in the United Arab Emirates (UAE). It will explore the vast reasons behind the considerable food waste in the hospitality sector in the Emirate, focusing primarily on the consumption part of the food chain as it is one of the most significant contributors to food waste in Dubai. The research will conclude prevention strategies that may help managers and responsible people improve the situation in their businesses which will consequently lead to change in the country as a future plan and cut waste before it happens following the national and international sustainability goals. However, in some papers, such as in (Jones 2017), fast food restaurants were excluded from the study of the hospitality sector as these have specific strict policies that cannot be changed in the short term, so this type of food services will not be included in this paper as well.

1.1 Background and Key Milestones

Based on the work of Kang (2018) and Evans, Campbell & Murcott (2012), a brief background on food- wasting through the centuries is studied. The journey of food waste

concerns has fluctuated through the centuries, with short periods of high worries and others with high ignorance and neglect. On the one hand, people were mainly conservative in food in harsh times like wars or depressions, especially when the food was not incalculably in hand. While on the other hand, the feeling of the normality of wasting food without deeper thinking of its consequences, as what is out of sight will be out of mind, led to more wasting. This invisibility was the cause of invisibility in political laws, besides the unease of measuring food waste in the past.

Food waste was first spotted in the 1800s when hunting techniques, such as "the buffalo jump", were used for entire herds of animals. This technique hunted more food than needed, but the hunted animals' parts were fully used, including using the bones for digging and the stomach as cooking pots. In the late 1800s and the start of the 1900s, after industrialization, things started to change in some cities in America. By that time, FW increased because of food overproduction and cans' production, which extended foods' shelf life. People started throwing extra food everywhere, leading to unhealthy conditions and causing diseases. Thus, laws were passed to save lives from these conditions. Eatable food waste was used for animal feed, and non-eatable waste was used for road filling. Moreover, schools offered courses for women to learn how to manage food excess under "domestic science" and "home economics".

During world war 1 (WWI) between 1914-1918, saving food waste was considered patriotic. Food organizing institutes such as The US Food Administration were formed then. This institute held successful campaigns encouraging people to lower their consumption of meat, wheat and sugars in America. Around the 1930s, food availability got worse because of the Dust Bowl, which happened in the area in America that suffered from substantial dust storms that led to the death of people, livestock and farms crops, leading to accumulated food waste (Editors 2009). This was followed by the Great Depression time when people reached poverty and needed to become imaginative and creative in managing food to not waste it, as all farms' products rotted by then. People started using refrigerators to extend food lifetime and reduce wasting of it while lowering food consumption was still encouraged even during world war two (WWII). However, post-war was a milestone for food waste. Fertilizers, pesticides and farming technologies were used after discovering the importance of the chemical produced during the wars, Ammonium Nitrate. This discovery was the start of modern fertilizing compounds, which led to the overproduction of food and the growth of

exporting. This development awakened the need for policy frameworks as food waste will increase when food safety measures were to be applied.

After the 1960s, work was done more extensively on food waste, where it was the concern of many pioneers such as Mary Douglas, who talked about the categorization of dirt. William Rathje, who pointed out the importance of studying the garbage "garbology", and Michael Thompson's Rubbish Theory which related waste with social values. Several other authors in the 19th century also advised not throwing any food that could be turned into valuable items. The need for raising concerns was linked to the vast food processing that developed with the technology, which led to the opening of extensive food production, food franchises and branding, contributing to vast amounts of waste accompanied by the invisibility of it.

Policies about harmful landfill waste were starting to be formed. The 1999 Landfill Directive Law in The European Union and the WRAP in 2000 in the United Kingdom (UK) are concerned about the efficiency of resources and waste in the whole supply chain, especially in the hospitality, food and retail sectors. Reaching the current century, policies and campaigns are making significant efforts in Europe and all over the world, from halving the food waste programs and zero waste to reducing poverty…etc., which will be covered briefly in later chapters.

1.2 Research Motivation

The motivation of the research branches into all aspects of life in the Emirate; the economic, social, and environmental, linked to the international, concerted efforts to limit the food waste problem. The Emirate of Dubai is one of the seven Emirates in the country UAE. It started as a small village before expanding to become a cosmopolitan metropolis that evolved explicitly in hospitality and tourism. It occupies the second place in having five stars' hotels globally with having the highest tower, Burj Khalifa. It is located between the Arabian Peninsula and the Persian Gulf, which helped in making it a centre for international trading, aviation transit and tourism. In 2018, Dubai was ranked the fourth most visited city (*Dubai - Wikipedia* n.d.). These features made it more prone to food waste as tourists tend to try more restaurants and varieties of food as part of satisfaction leading to having the highest percentages of food waste (Papargyropoulou et al. 2016), beside the high contribution of the residents.

As mentioned in *dcce* (2019), food waste averaged 38% annually in UAE and reached around 60% during the Holy month of Ramadan. Regardless of the high percentage of food waste, the rate of opening new restaurants and cafes businesses in Dubai increased by 9.7% in 2018 to the report of the Business Registration & Licensing (BRL) sector in the Department of Economic Development (DED) to reach more than 20,000 outlets in 2022 (DubaiMunicipality 2022). This rapid increase in food services is due to the ease of the licensing system, lowered municipality restrictions, developed infrastructure and the growing population of more than 200 nationalities to accommodate their needs. The densest area in restaurants is Bur Dubai, followed by Deira, and the most investing nationality is Indian. Therefore, studying food waste in Dubai is essential as it affects economics, the environment and the social lives of all.

Food uses many types of natural resources that are lost together with wasted food, such as land and water. Regardless of the global issue of water scarcity, the demand in Dubai and UAE is still increasing and becoming more than the supply as the least fresh water sources are found there, leading to high water stresses in the country, table (2). It is forecasted to increase by 60% in 2045 in the Middle East North Africa (MENA) region (Seguela, Littlewood & Karani 2017). However, the water wasted from the wasted and lost food in UAE was studied by Berjan et al. (2018) and was estimated to be about 790 m3/capita/year, the highest in the Near East and North Africa (NENA) countries. At the same time, the agricultural water footprint is 84% of the total water footprint, which is very high and must be considered. (*Dubai's restaurant numbers continue to grow - News | Khaleej Times* n.d.)

Table 2 Water stress levels in the UAE and other countries (World Food and Agriculture – Statistical Yearbook 2021 2021)

COUNTRY	2000	2005	2010	2013	2014	2015	2016	2017	2018
Togo	2.6	3.4	3.4	3.4	3.4	3.4	3.4	3.4	3.4
Tonga									
Trinidad and Tobago	19.0	18.7	20.1	20.3	20.3	20.3	20.3	20.3	20.3
Tunisia	66.0	72.8	79.1	86.9	89.4	92.0	94.6	89.5	96.0
Turkey	31.2	29.9	34.9	38.1	38.6	39.9	44.3	43.7	45.4
Turkmenistan	127.9	143.6	143.6	143.6	143.6	143.6	143.6	143.6	143.6
Tuvalu									
Uganda	3.0	4.6	5.8	5.8	5.8	5.8	5.8	5.8	5.8
Ukraine	23.7	19.5	19.2	15.4	14.1	11.8	12.1	13.9	13.9
United Arab Emirates	1 555.9	1 866.7	1 817.9	1 788.6	1 778.8	1 769.1	1 759.3	1 708.0	1 667.3
United Kingdom of Great Britain and Northern Ireland	21.3	22.0	14.1	13.0	12.4	13.9	14.4	14.4	14.4
United Republic of Tanzania	10.7	13.0	13.0	13.0	13.0	13.0	13.0	13.0	13.0
United States of America	30.0	30.3	26.5	27.5	27.8	28.2	28.2	28.2	28.2
Uruguay	9.8	9.8	9.8	9.8	9.8	9.8	9.8	9.8	9.8
Uzbekistan	153.1	141.0	143.1	144.3	144.7	158.1	156.4	168.9	168.9
Vanuatu									
Venezuela (Bolivarian Republic of)	3.0	6.0	7.5	7.5	7.5	7.5	7.5	7.5	7.5
Viet Nam	15.9	18.1	18.1	18.1	18.1	18.1	18.1	18.1	18.1
Yemen	161.1	169.8	169.8	169.8	169.8	169.8	169.8	169.8	169.8
Zambia	2.9	2.8	2.8	2.8	2.8	2.8	2.8	2.8	2.8
Zimbabwe	35.7	35.9	32.9	32.3	32.1	31.9	31.9	31.3	35.4

On the humanitarian side, it was mentioned in The Holy Quran that ‘‘Allah says: ‘‘O children of Adam! Beautify yourselves for every act of worship, and eat and drink (freely), but do not waste: he does not love the wasteful!” (7:31), mentioned in Baig et al. (2019). Religions are also encouraging people to enjoy food without wasting, as there are many people in hunger everywhere, including UAE, which is considered a Muslim country that follows The Holy Quran’s teachings. Despite the rich situation of the country, the poor rate is about 19.5%, including people gaining below 80 AED (approx. 22 USD) per day (*Long 2018*). Therefore, it is unethical for people to throw food while others need it.

Additionally, the Emirate is working on national plans to reduce food waste by the name of zero hunger by 2051, proposed by The Emirates Council for Food Security; an institute launched by the UAE Cabinet to ensure the achievement of food security and meeting the set goals such as National Food Security Strategy and other campaigns and initiatives that are held there to work together toward reducing the waste.

Unfortunately, UAE was considered the worst-performing country in the Food Sustainability Index that was studied by The Economist Intelligence Unit and the Barilla Center for Food & Nutrition Foundation on 34 countries. As its levels of food waste are very high beside the resource diminution and unhealthy lifestyle of the residents (McCarthy

2017). While bigger countries like France and US ranked better levels in this study. Therefore, after studying the impacts on the local area of Dubai in all aspects and its situation, the food wasted in UAE accounts for more than 3.5 million tonnes per year, costing around AED 15 billion. This research will continue on the suggested efforts and add to the theoretical part to find minimizing solutions for present causes and drivers as per figure (2), which shows the importance of the action plan to lower food waste. Where the most significant action must be focused on prevention and source reduction. (*Waste reduction movement gains traction in UAE hospitality industry - Arabian Business* 2018)

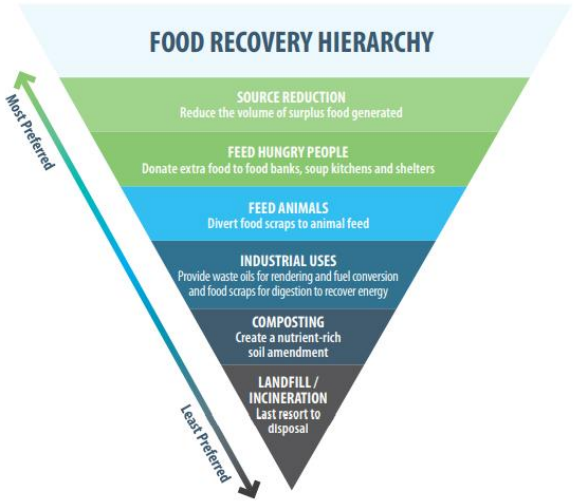


Figure 2 Food recovery hierarchy (Waste Not, Want Not: Reducing Food Loss and Waste in North America Through Life Cycle-Based Approaches | One Planet network n.d.)

1.3 Research Aim and Objectives

This research aims to investigate the causes of the food waste in the hospitality sector of the Emirate of Dubai by identifying the drivers for this waste and proposing strategies that could be applied to reduce this problem.

The aim of the research will be achieved through the following objectives:

- Finding the reasons behind wasting the vast quantity of food waste in the hospitality sector of Dubai from the view of the guests attending the food services and the employees working there.
- Investigating the factors that led the people in Dubai to cause the increase in food waste from salary, residency, type of level…etc. When attending the food services in the Emirate.

- Research the prevention strategies used in the Emirate of Dubai and the level of people's agreement with them.
- Discussing the other prevention strategies studied from the literature and checking the acceptance of applying such strategies in the food services from the viewpoint of the employees, managers and guests.
- Verifying the capability of implementing the accepted strategies in the Emirate of Dubai and extracting a road map for most food services to apply in the nearest future there.

1.4 Research Questions /Problem:

1- What is the people's level of education and awareness about the problem of food waste in Dubai?
2- What are the leading causes of food waste in Dubai from the point of view of the guests and the employees?
3- Are the guests' salary, residency status, and gender related to increases in food waste?
4- Does the type and level of food service, besides the employees' experience, relate to increased food waste?
5- Do the results of this research correspond to the results of the paper by Pirani & Arafat (2016) in the Emirate of Abu Dhabi?
6- What are the main strategies that could reduce food waste from the view of the experts? Furthermore, what are the ones most applicable to be implemented?

1.5 Research Map

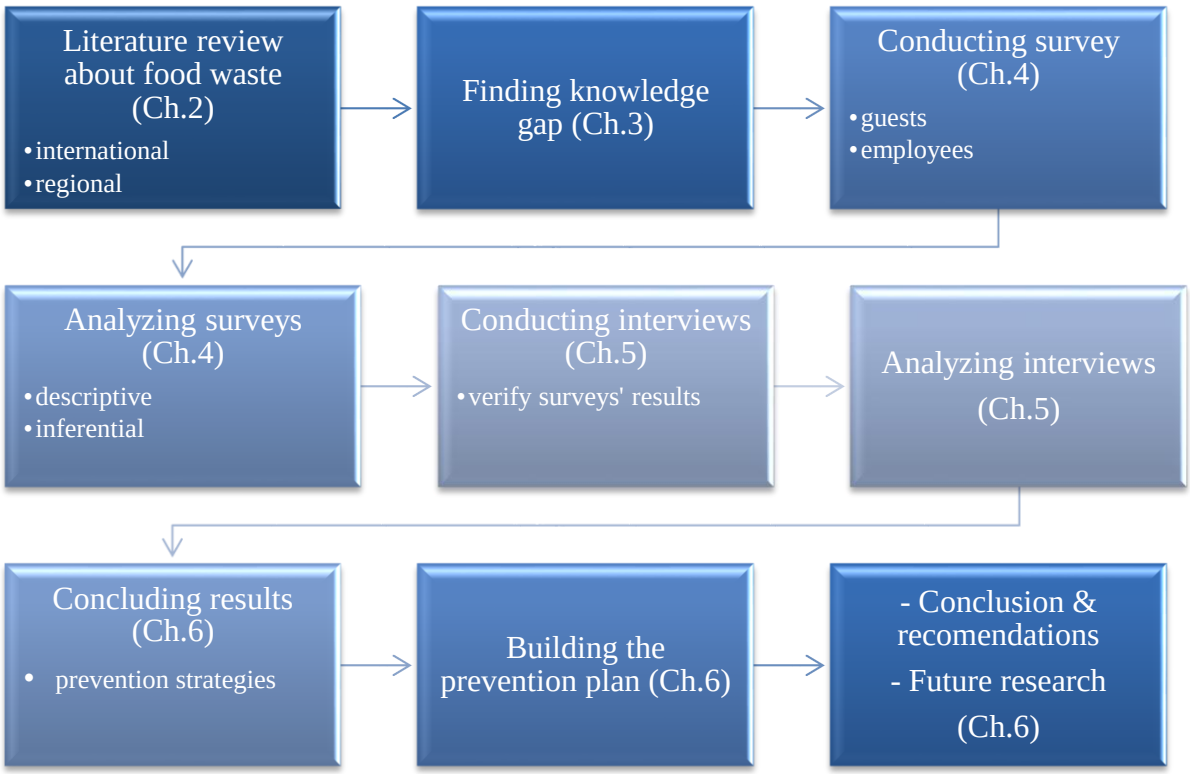


Figure 3 Research map - shows the steps taken to find the results of the study

CHAPTER 2: LITERATURE REVIEW

2.1 Food Waste Impacts

Food waste impacts cover all aspects of sustainability; environmental, social and economic. Environmentally, the decomposition of food as an organic substance releases methane gas, one of the dangerous greenhouse gases (GHG). It is considered harmful to the environment by around twenty-five times (25x) the carbon dioxide's effect (CO2), (Abiad & Meho 2018). Thus, disposing food in landfills would escalate the problem of global warming and lead to increased earth temperatures.

Food waste has one of the most significant carbon footprints, summed in around 3.3 billion tons of CO2eq yearly from the energy used through the supply chain (Jribi et al. 2020). It employs more than 70 Exajoules, as mentioned by Usubiaga-Liano et al. (2020a, cited in Coudard et al. 2021), distributed as 20% for production, 25% for food processing, and significant shares for transportation and consumption depending on the way of it. Looking at avoidable food waste (AFW), that represents the edible food left on purpose as plate waste and could be eaten by humans. AFW forms 75% of the total food waste in the hospitality sector, which is responsible for 4EJ of lost energy, comparable to Germany and France's electricity use (Jones 2017). Annual cumulative energy from food waste differs among countries depending on the type of food wasted, as meat and dairy foods use more energy through their supply chain. In UAE, the most kind of food waste, as reported by Ahmed, H.M.A (2014, cited in Essam, Gill & Alders 2022), was dairy foods, with 36.8% per cent. However, figure (4a) shows that energy is mainly wasted from vegetables as it is one of the most extensive wasted types globally. So food waste is considered the third largest contributor to GHG, with a rate of 26% (Martin-Rios, Hofmann & Mackenzie 2021).

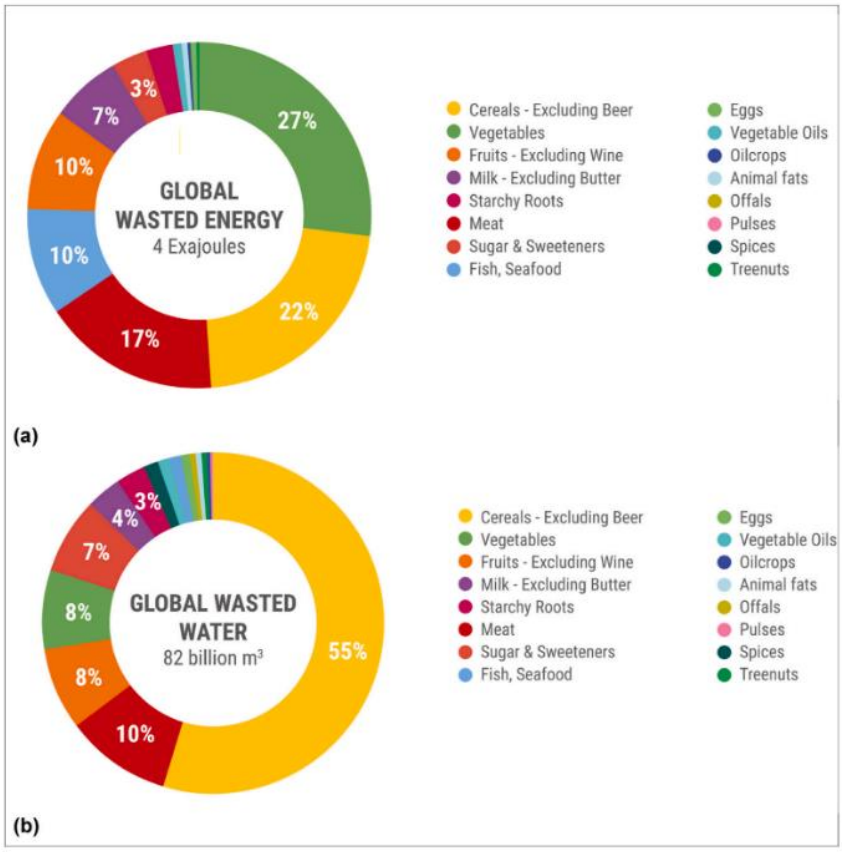


Figure 4a. Global wasted energy by food type, b. Global wasted water by food type (Coudard et al. 2021)

Moreover, the depletion of natural resources through the supply chain is hazardous if accumulated globally. Agriculture and farming, which is part of the production step in the food supply chain, use 70% of the world's freshwater. Water depleted from avoidable food waste globally is measured to be 82e9 m^3 in blue water footprint, defined as the amount of used fresh water from surface or subsurface resources that are put into a product or food through the supply chain. This is similar to water consumption in Mexico and Vietnam (FAO 2017, cited in Coudard et al. 2021). The UAE ranks second in wasting fresh water globally after the Kingdom of Saudi Arabia (KSA), using around 76.43 m^3 per capita (Skaf et al. 2021). Water is a scarce resource that populations must rationalize their consumption of it to prevent losing it. The most food type wasted that contributes to higher water depletion is cereals, including wheat and rice, figure (4b).

The land is the second depleted natural resource. The increased production of foods needs more land for farms which is considered a habitat for other creatures leading to loss of biodiversity, an unbalanced ecological system, and increased pollution levels.

Nevertheless, decreasing the use of FW by 38% will lower the loss of biodiversity by around 30% and other environmental impacts by 41%, such as the quantified ones in table (3), (Beretta & Hellweg 2019). The table proves that the highest impacts come from UAE, which ranges between second to fourth levels among the shown countries and when comparing Arab countries alone, UAE and KSA have thirty times worse impact on the environment than Lebanon, mainly due to differences in economics. However, according to Jones (2017), the environmental impacts do not supposedly wake people's consciousness to reduce food waste, where it could be the least as other reasons especially saving money, could be of more importance.

Table 3 The impacts quantified in countries per capita from food waste on the environment (Skaf et al. 2021)

Impact category	Agricultural Land Occupation (m2)	Climate Change (kg CO2 eq.)	Fossil Depletion (kg oil eq.)	Freshwater Eutrophication (kg P eq.)	Human Toxicity (kg 1,4 DCB eq.)	Natural Land Transformation (m2)	Particulate Matter Formation (kg PM 10 eq.)	Photochemical Oxidant Formation (kg NMVOC eq.)	Terrestrial Acidification (kg SO2 eq.)	Water Depletion (m3)
USA	606.63	527.36	66.51	0.51	334.85	0.03	1.3	1.59	6.56	33.95
Canada	519.16	447	58.38	0.41	271.94	0.03	1.11	1.35	5.56	30.19
Italy	275.8	227.13	31.47	0.18	117.96	0.01	0.54	0.71	2.66	22.19
Mexico	131.59	94.3	11.41	0.08	48.89	0.01	0.24	0.27	1.26	9.05
UK	280.46	230.91	32	0.18	119.91	0.01	0.55	0.72	2.71	22.59
France	252.56	207.98	28.82	0.16	108.03	0.01	0.5	0.65	2.44	20.34
Japan	179.44	140.93	21.41	0.08	55.83	0.01	0.32	0.46	1.46	19.31
Iraq	176.16	124.13	17.64	0.08	53.39	0	0.29	0.39	1.37	19.85
Germany	208.81	171.94	23.83	0.13	89.31	0.01	0.41	0.54	2.01	16.83
Sweden	183.62	151.33	20.98	0.12	78.61	0.01	0.36	0.47	1.77	14.8
UAE	678.28	477.78	67.87	0.31	205.4	0.03	1.11	1.48	5.28	76.43
KSA	794.55	559.75	79.53	0.36	240.64	0.04	1.31	1.73	6.19	89.55
Argentina	123.08	88.24	10.68	0.07	45.76	0	0.23	0.25	1.18	8.46
Lebanon	21.83	15.36	2.18	0.01	6.54	0	0.04	0.05	0.17	2.45
South Africa	10.62	11.23	1.9	0.01	3.82	0	0.02	0.04	0.09	0.99

Economically, producing more food is financially better for the consumers as its price will be lowered. Still, it will increase food waste and the related logistical, resources and energy costs. Every source loss consequently has a financial loss; thus, summing up the total prices is hard and forked; the water depletion contributes to a loss of USD 164 billion yearly worldwide (around 602 billion AED) (FAO 2014 cited in Jones 2017). The food wasted each year globally is estimated to be around 1.3-2 billion tons, costing around USD1 trillion (Jribi et al. 2020). In the UK, FW costs £2.5 billion (around 2.9 billion USD), (Jones 2017), where about 18% of it is the contribution of the hospitality sector (*Rise up against food waste • Guardians of Grub* n.d.). FW costs around 282 million dirhams (about 77 million US dollars) in Dubai alone yearly, while it costs approximately 6 billion dirhams yearly in UAE country (about 1.63 billion US dollars) (Sewatkar & Al Khayyat 2022). On a

smaller scale, hospitality businesses will increase their profit and lower their costs by 14% when reducing FW, especially when about 1kg of FW is assumed per guest in the sector.

Despite the vast quantities of wasted food, the rates of obesity and hunger are rising. The former is predicted by *World Obesity Federation* (2022) to be around 1 to 5 for women and 1 to 7 in men by the year 2030, while one-ninth of the world's population lives in hunger and suffers from malnutrition and deficiencies in all basic humanitarian requirements FOA (2019). According to Evans, Campbell & Murcott (2012), 70 million people in Europe (EU) suffer from hunger, and 16 million rely on food banks and charities, showing social inequality worldwide and unfavorable health situation. In UAE, the Food Bank distributed around 10 million meals in 2021, and many people rely on its support there (*UAE Food Bank distributes over 10 million meals in 2021* 2022). Thus national and international efforts are needed to act to return the balance in our lives leading to better social integrity, by increasing people's awareness and encouraging food security for everyone to lower the social, environmental and economic effects of FW.

2.2 Food Waste Recovery

Food waste could be recovered after being wasted or prevented before it happens. Recovering of FW is not the main aim of the research, but mentioning the acts that can be done for it is a must. Such actions include composting and using anaerobic digestion on vegetative waste to produce fertilizers. It is not preferable to use this type of waste for energy conversion, another recovery method, because it contains high moisture content and requires a lot of energy to remove. Another similar way is insect-based bioconversion which valorizes food waste and uses it in pharmaceuticals or fertilizers (Al-Obadi et al. 2022). Martin-Rios et al. (2018 cited in Al-Obadi et al. 2022) worked on treating food waste into beauty and hair products like what Marks & Spencer Stores are using in their produced hair dyes and using food waste to create luxurious clothing with high quality. Animal feed is a valuable way of recovering food waste used in the past but was banned a few decades ago in the United Kingdom as it caused the spread of viruses when it was not managed.

Other recovery methods may include using food waste as a new composite material, as chemical building blocks, as protein-based wood adhesives or transformed into quantum dots that are used in making LEDs and electricity (Sarswat & Free 2015) (Al-Obadi et al. 2022).

Food waste from hospitality services happens in many phases, generally summarised in planning, storing and handling, kitchen preparations, serving and consumption phases (Okumus 2019). Thus in hotels, incremental acts could be followed, like dealing with companies such as EssenceFood, which takes the food waste and generate new forms with high values through upcycling. This company proved to help reduce food waste in hotels by 5-15% (Food For future summit and expo 2022). A similar concept is suggested by (Al-Obadi et al. 2022), which uses excessive foods as food additives or as suggested by Okumus (2019) and Martin-Rios et al. (2018) that food service managers can use menu cycles to use leftovers in other types of food for next round of meal with paying attention to future forecasting. However, these could face hotels' owners' refusal caused by increased costs.

In UAE, solar pyrolysis is used to convert food waste into bio-fuel using concentrated solar rays; it is used for date palm waste and confirmed the reduction of environmental impacts by 38% (Abdelaal, McKay & Mackey 2019). Moreover, water recycling from food waste was tested in Abu Dhabi. Seguela, Littlewood & Karani (2017) suggested recovering this water and other sources of water for outdoor uses in irrigation or air conditioning units after being treated. Using anaerobic digestion to produce power (EnvironmentAgency - Abu Dhabi 2014). Besides, the pre-mentioned ways of sending untouched, edible food to the UAE Food Bank, composting and converting food waste to animal feed and fertilizers through a project called the Catalyst, which is done by Circa Biotech and supported by MOCCAE (Saleh, Ibrahim & WAM 2022). Figure (5) shows the percentages of used food recovery strategies in UAE.

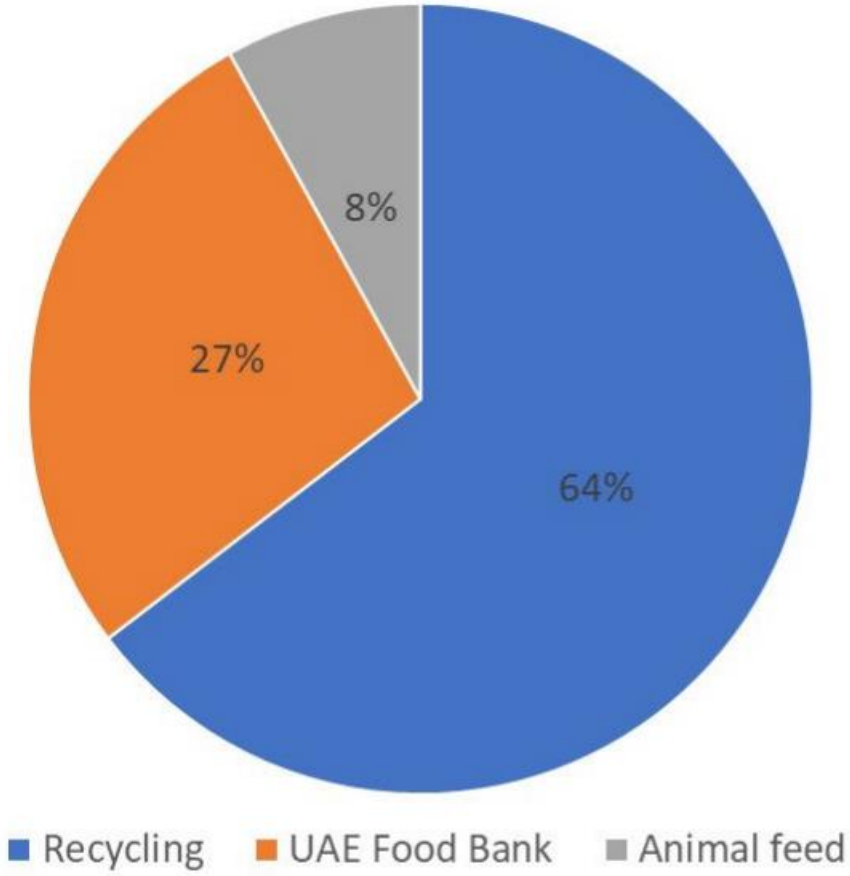


Figure 5 the management of food waste in UAE (Essam, Gill & Alders 2022)

2.3 Food Waste Prevention Papers/International Studies

Research done around the globe is improving to encounter the dangerous impacts of the food waste problem, measure its amounts and try to act accordingly by implementing strategies or campaigns such as Target, Measure and Act to help prevent FW or recover it. All countries are working hard to reduce this problem by forming national and international roadmaps to be implemented in the long term because of its complex nature and various causes. Generally, European countries are following the strategy of Farm to Fork, which is a plan started by the European Commision aiming to reach a sustainable food system and lower GHG emissions through performing changes to the whole supply chain (*What is Farm to Fork concept? | Farming Base* n.d.). However, according to Jones (2017), some food services are afraid of exposing their data about food waste because they fear being questioned, are nervous about customers' reactions, are unsure about the cost-benefit from this process, and find measuring food waste is labour-time consuming. However, new technologies are available to ease the measurement process but are still not cheap, especially for small to medium level outlets, which form most food services. This level of outlets can

participate in the initiative “buy today, eat today” suggested by Soma et al. (2021 cited in Al-Obadi et al. 2022) to lower their food waste from expired items.

France took the strictest decision and banned food waste; it called for action from all parts of the supply chain, especially banning supermarkets from throwing food. The action is done in two stages; first, preventing food wasting and second recovering it by donating, using as animal feed, as fertilizers, or energy like biogas but not throwing it away. This law started on the 11th of February 2016 as part of the environment code and national regulations (French and Italian Food Waste Legislation on JSTOR n.d.).

As for Russia, one of the largest population countries, the food waste from food services occupies 7% of total food waste, with fine dining restaurants taking the most share. These restaurants mainly focus on the customers’ happiness by offering perfect-looking meals, putting food waste as the second level of concern, and fearing losing customers. Food waste happens mostly at kitchen and post-kitchen levels, with meat being the most wasted type there. That is due to many reasons, as mentioned by (Filimonau & Ermolaev 2021); long menus and poor forecasting per season drove the increase in production and storage of extra food, which led to more disposing of it. At the same time, poor storing conditions add to the problem, as some improper temperatures or sanitization lead to food damage (Okumus 2019). In order to lower the problem there, an experiment was done on a few people. They were given a choice to fill their portion by offering different prices to reduce food waste. It was a successful one where people received a discount of 20-30% of the price with a portion reduction. While for recovering food, some restaurants were giving reduced-price meals at the end of the day without mentioning any donations.

18% of the food bought for food services in the UK is disposed of, almost double Russia, which contributes with all other sources of food waste to 30% of greenhouse gas emissions from the country. Thus, the efforts were started more than a decade and a half ago to find a roadmap and action plan for all food services to follow while tailoring and adapting its details with the different conditions as no “one plan fits all”, as mentioned in Courtauld Commitment 2025 Milestone Progress Report (n.d.). These efforts are mainly supported by The Waste and Resources Action Programme (WRAP), a British charity with the vision to teach people to use resources sustainably and offers a lot of research materials and initiatives to minimize and manage food waste to lower GHG emissions. One of these initiatives is The Guardian of the Grub, which teaches food services how to deal with food waste. Another

one is the First Stand Up For Food Month held in 2019 with the presence of many celebrities to support and distribute awareness about food waste. Moreover, the Courtauld Commitment supported by WRAP is implementing a target to halve food waste by 50% by 2030 for all sectors contributing to its increase. Another specialized commitment is the Hospitality and Food Service Group who are defining action plans and milestones to change. These targets are following the (SDGs) Champions 12.3, where both are calling for Target, Measure, and Act plans (*Food Waste Reduction Roadmap Progress Report 2021 | WRAP* 2021.). This plan is also being adopted by the United States of America (USA), which is the most contributing to food waste besides China. In the USA, food services contribute to more than 10M tons per year, figure (6), where the consumer businesses, which the food sector is part of, occupy 28% of total food waste (ReFED 2021). Thus using Target, Measure, Act plan is a beneficial way to start applying the roadmap to divert around 45M tons of food yearly by applying more than 40 solutions, figure (7). (Bajželj et al. 2020)

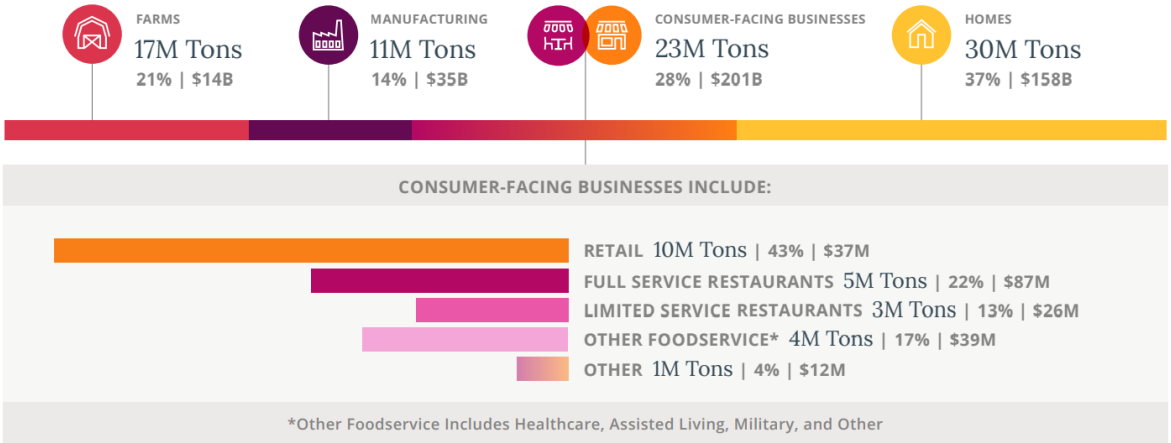


Figure 6 US food waste situation (ReFED 2021)

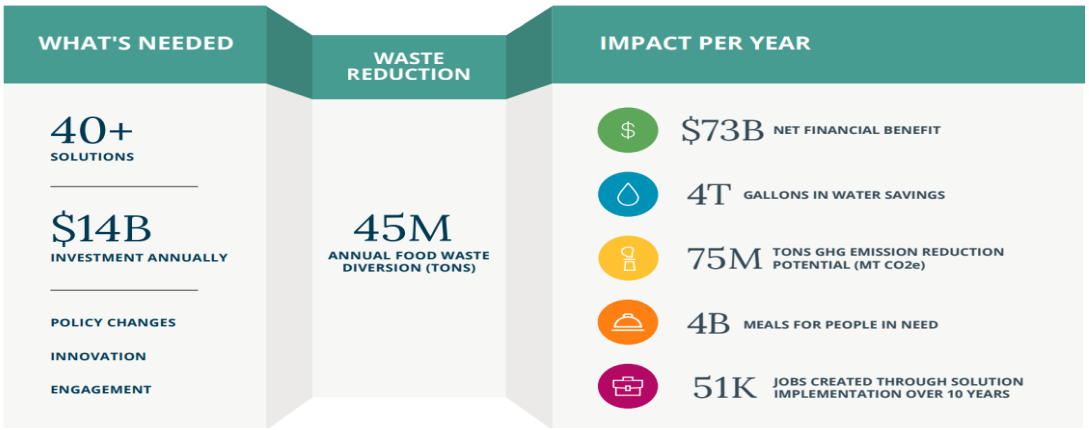


Figure 7 The roadmap needed to reduce food waste (ReFED 2021)

In China, food waste creates a substantial economic problem as the number of restaurants is enormous, and their gross domestic product (GDP) is low, as studied by Wang et al. (2017). This study showed that the main reason contributing to the waste was tourists, followed by low prices of food, shyness about taking doggy bags, and unfamiliarity with food taste and portion sizes which was also confirmed by Ravandi & Jovanovic (2019). They suggested in their studies an increase in workers' wages to encourage them to be more efficient inside the kitchen and lower the preparation's food waste.

In Pakistan, a country with sixth largest population in the world, where more than 60% of them faces food insecurity, are in hunger or malnutrition, 22% are poor and may reach alarming numbers of hunger by 2030. In contrast, more than 40% of their cooked food gets wasted per EPA reports which is a very alarming number compared to other countries. A study by Aamir et al. (2018) was done on three levels of restaurants in Pakistan. To sum up, in high-end and middle-end restaurants, the primary cause of food waste was overproduction, then plate waste and expiration date. On the other hand, low-end restaurants' waste was primarily from customer plates, followed by overproduction due to low quality of food with low prices. The survey respondents suggested demand forecasting as a major food waste reduction strategy, besides staff training, effectively storing and varied portion sizes.

Sometimes the food waste amounts differ according to the type of food service and not only the country it is studied in. Ethnic restaurants are a type of food service that needs special features, ingredients and techniques to present their food in a specific way and are usually for a particular group of people. Thus, if the type of people intended did not show or other groups tried it, food maybe wasted hugely. However, this type of restaurants will

increase in the UK by about 8% by 2025, as Filimonau, Nghiem & Wang (2021) mentioned. The wrong prediction is the main contributor to FW in these restaurants, as it may differ by days of the month, celebrations, and affordability. Moreover, they may deal with inflexible suppliers as it needs a specific type of food, so the long time it takes unique supplies to arrive make them more prone to lose their quality and be disposed of; other causes may be poor cooking skills, consumer taste and awareness. For example, Chinese restaurants in the UK waste up to 31% of food, mostly from sauces and preparation waste, to serve in the desired presentation. People attending these restaurants over-order to show their generosity, causing more food waste, especially when most people consider it as negligible or unimportant, such as business owners whose customers' happiness is their ultimate aim. The study suggested some strategies to reduce food waste, such as dealing with trustworthy suppliers, portion control, demand forecasting and most important the use of the 'pay-as-you-throw' method for business owners who will be scared of being fined for waste and will manage it accordingly (Filimonau, Nghiem & Wang 2021).

One of the most common types of hospitality food services is coffee shops. It has different types; branded or chain-affiliated, independent (not a chain), and non-specialized coffee shops which serve coffee, not as a main item like petrol stations. Some of these cafes have environmental awareness of items such as recovering coffee beans leftovers and solid waste. However, most are unaware of the food waste from other sources such as fruits, vegetables, bakery items…etc. The food waste problem in cafes must be resolved as consuming hot beverages outside the house is becoming a social habit, especially with the new blends and creations. Although they do not generate much as individuals, but are huge when calculated worldwide, much more than in other sectors, as their number is tremendous. Some of the causes of food waste in these types are irresponsible customer behavior and lack of awareness, and the size of the outlet, where more prominent outlets cause more waste in absolute terms. Moreover, in some seasons, people tend to go out more and cafes stock up more, while it is a busy business with no time to focus on preventing or managing food waste. Instead, you want to make money, and there are no incentives to donate the extra food as it could be more expensive to donate it than to dispose of it with the taxes and transportation fees. New policies and organisational engagement are needed to follow up with such sources of food waste besides incentivizing the owners to donate by giving facilities (Filimonau, Krivcova & Pettit 2019), especially lowering strict laws on chain-affiliated restaurants (Okumus 2019).

Policies of buffet restaurants like preparing food one day before the buffet time, cooking an extra 30% of food just in case of any missed, forecasted numbers, and discarding foods after 4 hours of display, contributes to vast amounts of food waste as Papargyropoulou et al. (2016) discussed. Moreover, some unpredicted problems may happen, such as technical problems in storage rooms, natural disasters, human errors in handling…etc., which adds a massive increase in waste (Gao et al. 2021). However, Canali et al. (2014) suggested delaying cooking till the last time possible, when the restaurant can know approximately how many guests are coming, and order on demand to save extra food waste (Okumus 2019). People of the study also suggested that buffet dishes not be refilled unless at least 70-80% finished. Leverenz et al. (2021) proposed lowering the displayed food quantities with frequent temperature checks. Several guests showed proportional correlations between number of guests with wasting food in some food services, such as in food-catered events in business, graduation or conferences (Leverenz et al. 2021). While on the other hand, breakfast buffets were generating massive amounts of waste regardless of the number of guests, which shows the dependence of FW on food service management and their booking strategy

Other papers discussed general drivers and causes of food waste in the hospitality sector, as mentioned in Jones (2017). Some employees are cautious about customers' reactions if they explain to them about food waste, as some do not see the problem as massive as it is because they only see their plate waste. Principato, Pratesi & Secondi (2018) noticed that kitchen waste depends on operating hours and the size of the outlet, while customer waste depends on price, type, taste…etc. Plate size as well plays an important psychological role, as people need to see the plate full no matter what is its size, thus reducing it will help in preventing food waste, mainly in buffet restaurants, as it could reduce about 20% of waste, as mentioned in (Al-Obadi et al. 2022). Moreover, portion size will do the same in A la carte restaurants, especially if sizes are not clear for the guests; it may cause customers to order more varieties if they think the portion is small, (Talwar et al. 2021). Portion size is a big problem in countries like the US, where they have two to eight times larger portions than the standard sizes suggested by the United States Department of Agriculture (Okumus 2019). Moreover, not declaring food allergies, cultural habits, low prices, or food availability adds to the over-ordering problem. Besides, when offering many menus choices, it increases item storage and preparation waste.

Some other general strategies could be added to lower the problem. Offering changes and options for sides to be sure that people do not waste them (WRAP n.d), figure (8). Accepting and encouraging the idea of using doggy bags' as not to feel guilty, especially in people who order a variety of food and the ones who study the menu before visiting the outlet, which shows their concern about food waste and how they try to deal with it (Okumus 2019). Some restaurants in the US encourage this idea by packing the leftovers in fun boxes such as tinfoil swans or colored ones (Talwar et al. 2021). Moreover, combining buffet and a la carte types as mixed restaurants types, where they serve main courses with specific portions, but allow for open sides buffet, which may reduce food waste. Encouraging messages, and using emotions to break the barrier of not asking about portions, ingredients, allergies, or options available to not get the wrong order and end up throwing it. Future visits' offers, and improve the kitchen's inefficient equipment are also good strategies (Okumus 2019). WRAP (n.d) suggested training the staff to inform the people about food portions, ingredients and techniques of cooking for them to take the right decision. An efficient initiative used in some outlets is Fruit-to-Root, which uses all parts of food, even unavoidable and encourages interaction with chefs to teach people how to use leftovers in new recipes similar to The Guardian and The Grub concept (Jones 2017).

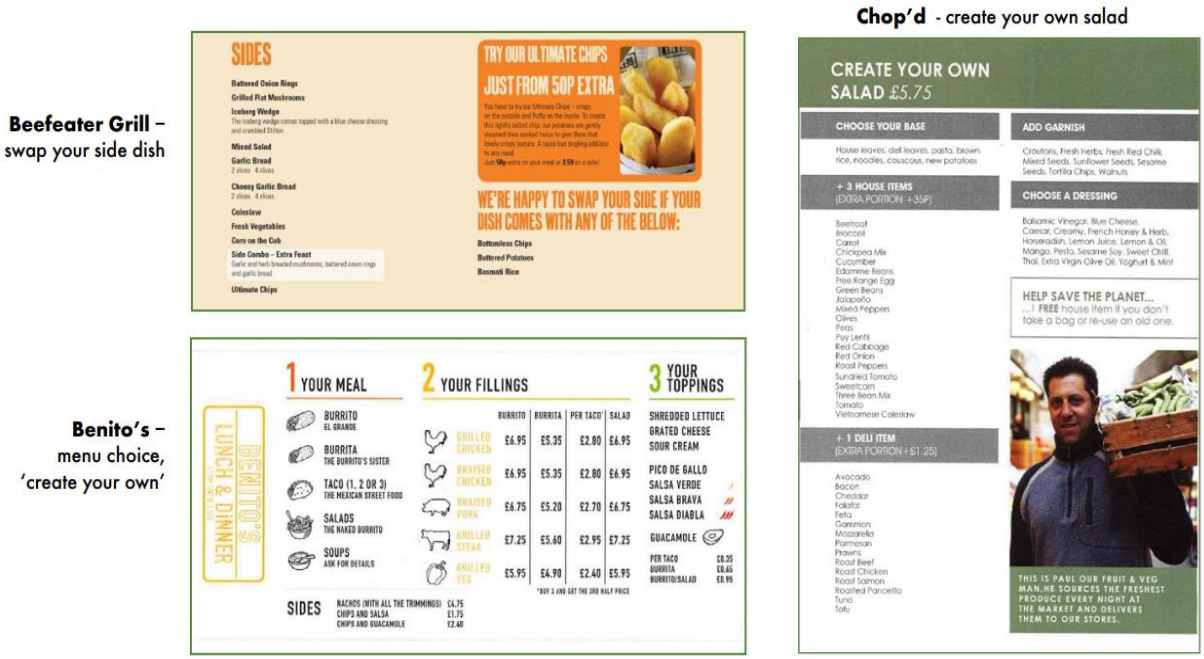


Figure 8 Options for sides as customer preference (Love Food Hate Waste Resource pack for the Hospitality and Food service sector | WRAP n.d.)

The motivation for food waste reduction, as Neff et al. (n.d. as cited in Jones 2017) confirmed, is saving money as it is the ultimate goal in businesses. Besides, achieving the customers' happiness and satisfaction through improved communication between customers and management. While national policies also have a significant share in encouraging guests and managers to prevent food waste by offering consent for restaurants to measure and manage FW without being questioned, offering training and free guidelines, besides facilitating donation processes, especially after the Food Act in 2014 (Jones 2017). Moreover, policies must put regulations on packaged food coming to the hospitality sector and force the use of some new technologies that may extend the products lifetime, such as SAVR PAK, which is a pack that could be added to food packages to remove moisture and keep it fresh or another technology studied by SUFRESCA company which uses an edible plant and water-based coating for fruits and vegetables to keep them fresh for longer time (Food For future summit and expo 2022).

Educating the people through awareness campaigns in all society parts; institutes, schools, and universities is a must, such as a campaign by Pinto et al.(2018 cited in Al-Obadi et al. 2022) with the name "clean dish, clean conscious". This campaign is needed in all countries as it is the best way to force people to do action, besides encouraging them to measure and reduce food waste, as its reduction results in lowering of up to 706–896 kg CO2-eq per ton of food waste (Al-Obadi et al. 2022). Awareness of people about labelling will save food waste for households, and hospitality stocking as 84% of foods are disposed of close to their packaging date caused by the confusion between "use by date", which concerns safety and "best before" date, which only concerns quality but can still be used. Labelling may encourage people to change their diets as labels with CO2 emissions of types of food may influence change (Okumus 2019), while changing diet to healthier ones, as Coudard et al. (2021) explained, may save up to 28% of vegetables in the hospitality sector where it is the second most wasted type of food after cereals globally, figure (9).

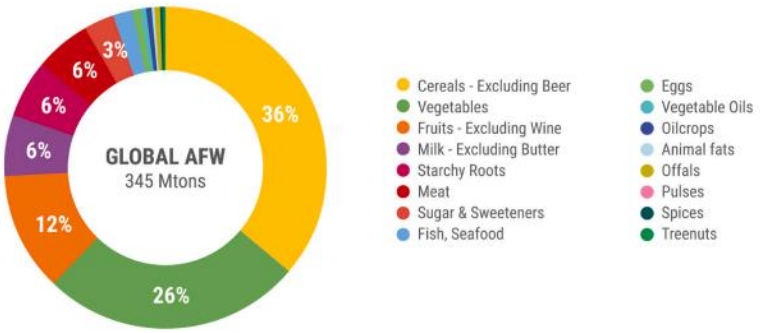


Figure 9 Avoidable food Waste (AFW) percentages per type globally (Coudard et al. (2021)

Some radical strategies depend on recent technologies and are anticipated to change and mitigate food waste in general. These strategies are like using new techniques or technologies for the production of food through the supply chain or using electrolysis of the wasted water and salt to produce hypochlorous, an acid best used for cleaning foods and keeping them fresh. While in the hospitality sector, using preventive technologies such as intelligent scales to quantify food waste and identify the most wasted types for future reference proved to significantly reduce FW in many hotels. Such scales are Winnow in UK and UAE, LeanPath in the U.S., LightBlue in Singapore, Kitro in Switzerland, and Orbisk in the Netherlands (Martin-Rios, Hofmann & Mackenzie 2021). Moreover, using smart kitchens with tracking systems to quantify the weekly use of items and predict precise future needs. Besides, the use of systems such as Tracer App, which gives a serial number for each item of food to track what happens to it, to check whether it was wasted or not, and the use of a forecasting software (Food For future summit and expo 2022). A new life-changing technology was introduced by Shiok Meats at the same summit, it offers cultivated seafood from healthy cells instead of killing animals or waiting for the time for them to grow up with all the food, water and energy they need for growing, figure (10). It is a great effort to do for meat as well as it is one of the types contributing hugely to CO2 through its supply chain. Other advanced technologies are like using 3d printing, which helps minimize food waste by using leftovers to invent new items (*Taste Tomorrow* 2021).

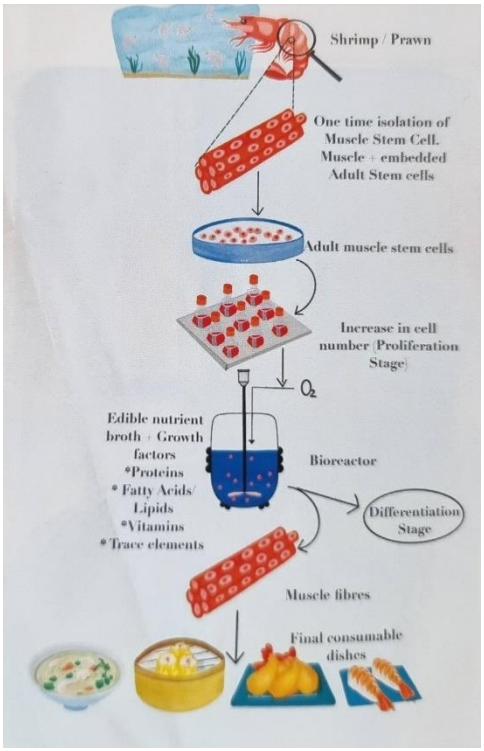


Figure 10 Seafood cultivating process introduced by Shiok Meats at (Food For future summit and expo 2022)

An experiment tried to use a tray-less system especially in University buffets to reduce FW. It revealed a reduction of 18% in it as people carried fewer items, (HLPE 2014). Another study by Eckert Matzembacher et al.(2020) used different tray colors for different portion sizes in buffets for customers to choose the suitable portion for them. The researcher also categorised customers' incentive to not waste food depending on food service type, with buffets having a low incentive for not wasting food because dishes are open to refill as preferred. A la carte restaurants got midst incentive as every dish is paid for, while weighted buffets took the highest incentive for not wasting as people can interact with food by smelling it and pay for what is chosen. The author suggested that the weighted buffet type be the new type of buffet to reduce waste, but without adding food stations containing types of food that need to be eaten directly as these will contribute to food waste because the quality will be damaged in a short time as discussed in Ravandi & Jovanovic (2019).

Another strategy suggested by Shao et al. (2020) was to use anthropomorphism, presenting objects as actual characters, in order to advertise ugly foods, which are used in supermarkets but could help in lowering food waste generally as hospitality also use supermarkets or help to advertise for them in their menus either as positive messages, explaining gained benefits or negative ones explaining losses. This method helps lowering

waste by building bonds between the people and the ugly foods leading to their purchase, such as the character Mr. potato head, figure (11).

Figure 11 Anthropomorphism method to promote ugly foods (Shao et al. (2020)

Recent efforts are developing rapidly worldwide as the progress reports show that many new food services are joining and implementing the Target-Measure-Act approach in the UK. Other countries are introducing laws and national plans, such as The Chinese Food Waste Law, which charges money for leftovers in hospitality. Food Summits and conferences are taking over periodically. Where the first-held United Nations Food Systems Summit was in September 2021, the Food for Future was in February 2022 in Expo 2020 Dubai, and The 27th session of the Conference of the Parties (COP 27) to The United Nations Framework Convention on Climate Change (UNFCCC) was held in Egypt in 2022. Besides assigning an international day for food loss and waste awareness will be on the 29th of September each year. (*SDG Target 12.3 on Food Loss and Waste: 2021 Progress Report | Champions 12.3* 2021), (*Event: International Day of Awareness of Food Loss and Waste 2022 | SDG Knowledge Hub | IISD* 2022).

Charities for food waste redistribution and donations are opening widely to reach needy people, such as Second Harvest in the US, FoodCycle or FareShare in the UK…etc. While other organisations, such as the Sustainable Restaurant Association (SRA, UK) and Love Food Hate Waste (New Zealand), are focusing their work on sustainable hospitality,

which must be the future trend. They started the 'too good to waste' campaign in London in 2011 to help spread awareness to prevent food waste (Evans, Campbell & Murcott 2012). Moreover, some public events were made in the past, such as 'feeding the five-thousand' events, offering people a safe meal from food waste to advise them about the problem and how leftovers are valuable.

2.3.1 International Papers Summary Tables

The tables (4-9) summarise the causes and strategies mentioned in the literature review section 2.3 by categorizing them into causes by customers, institutional and national ones, providing the reader with a different way to look at them.

Table 4 Causes of food waste from customers and papers mentioning it

Causes	Customer behavior	papers
1	Not big problem	(Jones 2017)
2	Wealth, luxury, generosity	(Jones 2017), (Baig et al. 2019)
3	Varieties for customer satisfaction	(Talwar et al. 2021), (Canali et al. 2014)
4	Cultural habits	(Talwar et al. 2021)
5	Not declare about allergies, religious restrictions…etc.	(Okumus 2019)
6	Personal preference	(Canali et al. 2014)
7	Vacation behavior/ tourists' unfamiliarity with the taste	(Papargyropoulou et al. 2016)/ (Wang et al. 2017)
8	Uncomfortable feeling using doggy bags	(Wang et al. 2017)
9	Customer behavior and lack of awareness	(Filimonau, Krivcova & Pettit 2019)

Table 5 Causes of food waste from institutions and papers mentioning it

Causes	Institutional	papers
1	Outlet concept/ ethnic restaurants	(Jones 2017)/ (Filimonau, Nghiem & Wang 2021)
2	Product development/presentation	(Jones 2017), (Filimonau, Nghiem & Wang 2021).
3	Cooking skills and errors/ low quality of food	(Jones 2017), (Okumus 2019)/ (Aamir et al. 2018)
4	Communication, cooperation & limited technology	(Jones 2017), (Okumus 2019)
5	Plate and portion size	(Jones 2017), (Al-Obadi et al. 2022), (Okumus 2019), (Leverenz et al. 2021), (Talwar et al. 2021)
6	Menu prices/ food availability	(Wang et al. 2017) , (Baig et al. 2019), (Talwar et al. 2021)
7	A lot of menu choices/long menus	(Okumus 2019), (Filimonau & Ermolaev 2021)
8	Staff confusion b/w 'use by' and 'best before' dates.	(Okumus 2019)
9	Poor planning and forecasting	(Okumus 2019), (Filimonau & Ermolaev 2021)
10	poor storing conditions	(Okumus 2019), (Gao et al. 2021).
11	Not honest suppliers (ethnic restaurants)	(Filimonau, Nghiem & Wang 2021).
12	overproduction	Aamir et al. (2018)
13	Busy business (cafes)	(Filimonau, Krivcova & Pettit 2019)
14	Lack of incentives	(Filimonau, Krivcova & Pettit 2019)
15	Discarding displayed food after 4 hours	(Papargyropoulou et al. 2016)
16	Natural disasters	(Gao et al. 2021).

Table 6 Causes of food waste on the country level and papers mentioned in

Causes	national	papers
1	Lack of legislations	Aramyan et al. (2020)
2	The vast number of restaurants	Wang et al. (2017)

Table 7 Strategies used internationally for customers and papers mentioning it

Strategies	Customer behavior	papers
1	Doggy bags acceptance & fun designs	(Jones 2017), (Talwar et al. 2021), (Al-Obadi et al. 2022)
2	Encouraging messages on screens or menus	(Talwar et al. 2021)
3	Incentives and next-visit offers	(Okumus 2019)
4	Changing to healthier diets	Coudard et al. (2021)

Table 8 Strategies used internationally for institutions and papers mentioning it

Strategies	Institutional	papers
1	End-of-day sale	(Sarswat & Free 2015), Martin-Rios et al. (2018)
2	Kitchen planning and demand forecasting	(Jones 2017), (Filimonau & De Coteau 2019), (Aamir et al. 2018), (Okumus 2019)
3	Training staff skills/better equipment	(Jones 2017), (Canali et al. 2014), (Aamir et al. 2018), (WRAP n.d.), (Okumus 2019)
4	Fruit to root	(Jones 2017)
5	Observing to study appropriate portion size	(Talwar et al. 2021), (Okumus 2019) & (Filimonau, Nghiem & Wang 2021)
6	Training and educational awareness	(Al-Obadi et al. 2022)
7	New prevention technologies; Apps, smart kitchens, leftover mobile apps, smart scales like winnow, 3D Printing	(Al-Obadi et al. 2022), (Canali et al. 2014), (Martin-Rios, Hofmann &

		Mackenzie 2021), (*Taste Tomorrow* 2021).
8	Incentives, offers & penalties for staff/ (pay as you throw) for owners	(Al-Obadi et al. 2022), (Wang et al. 2017), (Okumus 2019) / (Filimonau, Nghiem & Wang 2021).
9	Better storage &handling	(Al-Obadi et al. 2022), (Canali et al. 2014), (Aamir et al. 2018)
10	On-demand cooking and at the last time possible	(Okumus 2019), (Filimonau, Nghiem & Wang 2021)/ (Canali et al. 2014)
11	Menu design, emotional messages and	(Okumus 2019)
12	Different tray colors for different portion sizes	(Eckert Matzembacher et al.2020)
13	Using weighted buffets instead of fixed price	(Eckert Matzembacher et al.2020)
14	Dealing with trustworthy suppliers	(Filimonau, Nghiem & Wang 2021).
15	Less displayed food in buffets	(Leverenz et al. 2021)
16	Options for sides and prepare on your own	(WRAP n.d)
17	Anthropomorphism to promote ugly foods	Shao et al. (2020)

Table 9 Strategies used by national policies and papers mentioning it

strategies	National policy	papers
1	Easy donation facilities/Charities	(Jones 2017), (Filimonau & De Coteau 2019), (Evans, Campbell & Murcott 2012)
2	Provide free guidelines, assurance and frameworks, e.g. Target, Measure & Act.	(Jones 2017), (*SDG Target 12.3 on Food Loss and Waste: 2021 Progress Report | Champions 12.3* 2021)
3	Organisational training	(Jones 2017),
4	Organisational engagement	(Filimonau, Krivcova & Pettit 2019)
	Using new technologies, e.g. SAVR PAK, SUFRESCA coating	(Food For future summit and expo 2022).
5	Labelling all items with the addition of CO2 emissions numbers to make a change	(Okumus 2019)
6	Awareness campaigns (clean dish, clean conscious), Expiry date and Best before date explanation/ FWL international day	Pinto et al.(2018 cited in Al-Obadi et al. 2022),
7	Public events (Feeding the five thousand)	(Evans, Campbell & Murcott 2012)
8	Sustainable hospitality	(Evans, Campbell & Murcott 2012)

2.4 Food Waste Prevention/Regional Studies

Food loss and waste rise to 44% in Arab countries. Around 34% of it is from food waste at the consumption level. The composition of it may differ between countries due to their eating habits and diets; UAE and KSA cereals make up about 52% of the waste as their local cuisines involve the use of rice as a main item, figure (12).

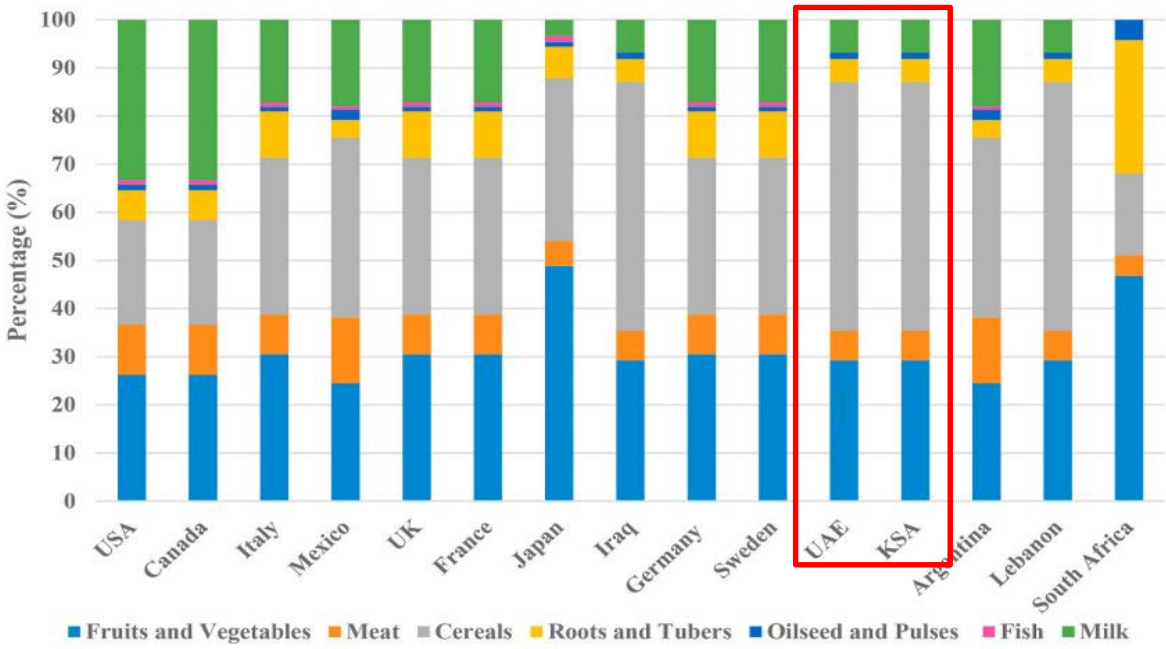


Figure 12 The composition of food waste in some countries such as UAE & KSA (Skaf et al. 2021)

Available data about wasted food in the hospitality sector of the UAE is deficient, regardless of the high number of food waste, which is around 224 kg per capita per year (Kohli 2021). The only direct paper about food waste in the hospitality sector was done by Pirani & Arafat (2016) in the Emirate of Abu Dhabi. It distributed surveys and measured waste amounts to discover the main reasons behind the increased waste were faults in forecasting, mainly from the extra 20% of food preparations, the food varieties and the serving style and times. More recent papers explained new technologies used to help lower FW, like Lamba (2021), who discussed using smart fridges in Carrefour supermarkets and social media to increase awareness. Besides, a paper checked the percentage of media interaction with the subject according to gender. Other international papers mentioned the environmental impacts of food waste, the lost water and carbon footprints internationally and in the UAE.

Table 10 The food waste in GCC – the researcher

GCC COUNTRY	FOOD WASTE KG CAPITA $^{-1}$ YEAR $^{-1}$	REFERENCE
UAE	224	(Kohli 2021)
KSA	338	(cited in Baig et al. 2019,Skaf et al. 2021)
QATAR	255-328	(Zhang & Marengo 2021).
BAHRAIN	132	(Khan 2021)
OMAN	95	(Muscat Daily 2021)
KUWAIT	95	(Arab Times 2021)

For that reason, regional, near countries such as some of The Gulf Cooperation Countries (GCC) were chosen to be studied. These have similar socio-cultural values and economic levels besides being import-based countries due to deficiencies in agriculture, resulting in higher amounts of food waste in the distribution and consumption parts of the supply chain. Moreover, they have the highest per capita waste per year, table (10). This paper focuses on KSA and Qatar, which have close per capita food waste numbers to UAE. KSA's food waste ranks among the top 25 countries globally (BCFN 2016 cited in Baig et al. 2019). This vast number is attributed to the cultural values of Arabs, where generosity is of enormous importance in celebrations and daily gatherings in houses or food services, without considering other consequences where 70% of this food is thrown away. Moreover, the norm for most Saudi people is to exchange all house groceries weekly with new ones regardless of their edibility, which adds to households' food waste. In the hospitality sector, people do not order doggy bags to collect leftovers as they see it unfavorable to eat the same food twofold or question its safety which shows lowered awareness levels.

Recently, awareness of the food waste harm led to the start of campaigns and moves toward lowering this issue by concentrating the focus on youth and women, which form the majority of the population there. They issued kids' movies by charities, increased the food prices and sent messages through media to target youth and encourage them to prevent wasting food.

Qatar, as a second close example to UAE, is also a significant contributor to food waste as its waste was doubling over the last decade, as investigated by Abdelaal, McKay & Mackey (2019). They conducted a study on students in one of the most extensive food services, a university cafeteria. It revealed that 78% of the food wasted was avoidable, untouched food that lasted on the buffet counters. This was caused by depending on the chefs' previous experience and not studying the actual needs of the students. This cafeteria included several food services; the lowest waste-generating service was an Arabic café and a burger restaurant. Unlike other services with open buffets, their orders' system was a la cart with a fixed menu and demand order. Other factors that increased FW were similar to causes mentioned in the international papers section 2.3.1, such as the wide variety of menu items, the quality of food and gender, as it was found that females generate more food waste than males. The students suggested some strategies to lower their food waste, summing in improving food quality, preordering food to minimize faulty forecasting, pre-tasting of buffet food, lowering the number of choices and portions, increasing awareness about the acceptance of a no-refill policy for some meals and using active rating systems to improve quality and choosing of top rated dishes.

On the other hand, UAE has many initiatives and companies that are concerned about food waste in hospitality or other sectors, because the quantities wasted per capita are very high, especially when we compare them to big countries like the USA, which consumes 59kg per capita per year and Sweden, which has similar population number but about half amount of FW, around 133kg per capita per year (Pressrelease 2020).

Institutions such as UAE Food Bank target getting food from supermarkets or ports that are not permitted by law to enter the market but are still safe to eat and distribute to people in need. Moreover, The Red Crescent, the Food and Agriculture Organisation (FAO) branch, and the Ministry of Climate Change and Environment (MOCCAE) are responsible for sponsoring campaigns such as the Food for Future Summit held in Expo 2020 in February 2022. Besides, Dubai Municipality is responsible for the food safety programs by forming the Food Safety Code and My Food Initiative, which digitalizes food safety and simplify the issuing of Food license for food services. In Dubai; there are more than 20,000 food establishments (DubaiMunicipality 2022). Other institutions are like Goumbook, an environmental enterprise that offers education and awareness about food waste, and

BonApp, which lists the extra foods from restaurants and offers them with discounts similar to an app used in Europe called “too Good to Go” (Al-Obadi et al. 2022).

UAE’s attempts to fight food waste are represented by leading by example. Thus additional initiatives are held in the country, which include signing a pledge (UAE Food Waste Pledge) by some of the leading hospitality sector institutes such as Armani Hotel Dubai, Fairmont The Palm, Hilton Dubai Jumeirah, and Rotana Hotel. They pledged to reduce food waste with the cooperation of Winnow Solutions, a technology that measures the amounts and types of food waste to help forecast food types that will not be wasted as much. It was expected to save about 3 billion meals by 2020 (Walla 2020). Hilton Dubai started using Winnow in its kitchens since 2016 to save more than $70,000 and 100,000 meals. The hotel’s Executive chef said that they had seen a reduction of 70% in waste, and their team accepted the technology well. Fairmont hotel also saved around $225,000 - and 170,000 tonnes of CO2e, with a reduction of 47% of FW. At the same time, Armani Hotel is saving around 117,000 meals yearly (winnow n.d. a).

“Ne’maa initiative” or “Blessing Pledge”, is a recent initiative structured by the Emirates Foundation with the participation of the Ministry of Climate Change and Environment (MOCCAE) in June 2022. It aims to encourage all sectors of the UAE community to be responsible and limit wasting food through all stages of the supply chain, (Sewatkar & Al Khayyat 2022). Besides, their initiative is in collaboration with Blue Planet Green People which is “I’mperfect initiative”, a national campaign. The campaign aims to support local food projects and educate the public about the importance of reducing the loss and waste of consumable food (H. AlMarashi 2022)

Dubai Sustainable Tourism is responsible for lowering food waste in hospitality sector through pressuring the food services and specially hotels to follow a plan of nineteen regulations to be more sustainable and have better classification, each regulation having its own documents to be completed. Two of these regulations are “Green Event” and “Waste Management Plan”. The former forces the rules of giving pre-plans for the event and post-event reports, this will lower the chances of extra food waste as everything is planned for. While the later regulation is the most important, where they aim to lower the disposal to landfills and food waste, using reducing, reusing and recycling (DTCM 2018).

UAE uses a policy of following by leadership in most of its recent initiatives, like when H.H Sheikh Mohamad Bin Zayed encouraged people to stop overspending and lower food waste to save the country's resources and food security in Ramadan Online Majlis in 2020 (Al Nowais 2020). Some restaurants offer lower prices for extra meals at the end of the day, as the managers of Best Kitchen in Dubai said (*Food wastage a growing concern for UAE* 2015). And others are specified in providing boxes of ugly foods (fruits and vegetables that were not meeting the specifications for supermarkets but are not unsafe to eat) with better prices to be consumed, not thrown out like EroeGo (reclaiming the grocery).

Food safety codes are applied to all sectors in UAE, including hospitality. Studying and training on these codes will help lower food waste as it will not be disposed of if managed well. Codes concerning storage, transportation, labelling, and consumption time affecting food waste, especially in buffets…etc. are included and obliged in food services (Khalid Saeed 2020).

2.4.1 Regional Papers Summary Tables

Tables (11-14) summarise the literature papers read about regional and local areas. They summarise the causes of food waste and prevention strategies to reduce it.

Table 11 Causes of food waste from customers and regional papers mentioning it

Causes	Customer behavior	papers
1	Gender → women waste more	Abdelaal, McKay & Mackey (2019)
2	Not accepting doggy bags	(Baig et al. 2019)
3	Generosity and cultural events	(Baig et al. 2019)

Table 12 Causes of food waste from institutions and regional papers mentioning it

Causes	Institutional behavior	papers
1	Wide menu options	Abdelaal, McKay & Mackey (2019)
2	Food quality	Abdelaal, McKay & Mackey (2019)

Table 13 Strategies of food waste prevention from customers and regional papers mentioning it

Strategies	Customer behavior	papers
1	Preordering of food→ better forecasting	Abdelaal, McKay & Mackey (2019)
2	Pre-tasting of food	Abdelaal, McKay & Mackey (2019)
3	No-refill policy acceptance	Abdelaal, McKay & Mackey (2019)

Table 14 Strategies of food waste prevention from institutes and regional papers mentioning it

Strategies	Institute behavior	papers
1	Improve food quality	Abdelaal, McKay & Mackey (2019)
2	Fewer choices and smaller portions	Abdelaal, McKay & Mackey (2019)
3	Active rating system / top-rated dishes chosen	Abdelaal, McKay & Mackey (2019)
4	Youth and women campaigns, e.g. kids' movies	(Baig et al. 2019)

2.5 Knowledge Gap

"Albert Einstein said: "If I had an hour to solve a problem, I would spend 55 minutes thinking about the problem and 5 minutes thinking about solutions." While Tony Robbins said the opposite: "Leaders spend 5% of their time on the problem and 95% of their time on the solution." (Harding 2019). That is the Emirate of Dubai's situation in UAE, there are many solutions to recover the food waste, redistribute it, compost it…etc. besides, having several organisations who are trying to find solutions, however, the studies on the root causes of the problem to try to prevent it are minimal. This research believes Einstein's words about spending much time to think about the problem before finding solutions because, in this way,

only your solutions will be directed precisely to the cause of the problem to lower it, which is not the situation in Dubai.

Moreover, it is clear from the recent study by Essam, Gill & Alders (2022), working in the Dubai Municipality, that the theoretical part of the food waste problem, especially in the hospitality sector in Dubai, is lacking and needs deep studying as wasted quantities are enormous in this sector as they mentioned.

CHAPTER 3: RESEARCH METHODOLOGY

In chapter two, many papers about food waste were studied with different research methodologies that led the authors to reach their goals depending on their focus. All the methods have other advantages that helped develop the research and achieve its aims and disadvantages that may stand behind delaying in getting the information. The most used method was the mixed-mode method, followed by using surveys or interviews separately. In contrast, other papers used different methods like literature review or systematic review for all the available documents. The least used were experiments and simulation, as the topic is sensitive for these methods to work as intended.

3.1 Mixed Mode/ Survey/Interviews

Eckert Matzembacher et al.(2020) conducted a mixed-mode method in their paper. They handed out surveys to measure the amounts of wasted food and used a life cycle analysis (LCA) aiming to test all environmental impacts produced from the studied waste. Moreover, they interviewed more than 320 people to ask about the guest's behavior toward food waste in a city in Brazil, where people are used to eating out of home as a social habit, increasing food waste there. The study showed that people are concerned about the significant portions of the meal and throw the responsibility for wasting it on the food service. They suggested changing the buffet system into a weighted buffet (paid by weight).

Another study by Gao et al. (2021) mixed between distributing more than 200 surveys and conducting focus group workshops to explore the causes of FW in Chinese restaurants. They found that more than 80% of respondents were familiar with the food waste policies, while others didn't find it a problem. Whereas the questionnaire done by Wang et al. (2017) on 195 restaurants in China tested the participants' knowledge about environmental problems and food waste issues. This paper used different programs for data analysis; Microsoft Excel and SPSS 18.0 using the independent sample t-test and One-way ANOVA, then used Tukey's honest significant difference (HSD) test to determine which variables affect the results. Moreover, linear regression analysis was used to test the effect of people's knowledge on different factors.

Additionally, Papargyropoulou et al. (2016) used semi-structured interviews with managerial staff to quantify food waste inside the kitchens and observe how it is wasted.

They confirmed in their study that buffet restaurants generate more waste than others, especially leftover waste. Martin-Rios et al. (2018) also used the same method in their research in Switzerland to study customers' behavior and suggest food waste reduction strategies. Data were analysed using ground theory (GT) to find a primary cause for food waste and relate it to the economy to show its importance.

Another paper used the survey method but with the addition of a new way of data analysis; the Generalized Maximum Entropy Estimation (GME) way which uses simple parametric assumptions for a small sample size to find out factors (clients and kitchen) contributing to food waste in the Italian hospitality sector (Principato, Pratesi & Secondi 2018). This exploratory study was done on 127 restaurants.

A survey done by Abdelaal, McKay & Mackey (2019) was distributed to 608 students, with a response of 9%. It used open questions to know the students' opinions toward food waste and why it is a problem while suggesting some prevention solutions.

This method helps the researcher to collect primary data sources, whether qualitative or quantitative, depending on the topic. It has, being combined or separated, several advantages and disadvantages. Advantages are summarised in the ease of its use, in constructing or distributing it to people through in-hand items like mobiles, emails, or social media. The technologies nowadays offer so much help to accelerate the spread of surveys, make online meetings from around the world and a lot more, especially in UAE, where almost all people have easy access to the internet. Moreover, the programs used to analyse the surveys data are straightforward. The same programs represent the statistical data from the surveys in graphs and charts to be used to explain the results automatically. They are used for trending subjects which need fast information collection about the behavior of people or their opinion toward it. Additionally, it gives people and respondents privacy if no personal demographic information is required, as they can fill it out online without the pressure of someone watching them.

On the other hand, it may have some disadvantages; if it was online, some class of people might not have the chance to fill it because either they don't have accessibility like poor people or people in remote areas, mostly not in UAE, or because they don't have the knowledge to access like older people. Other people may not want to waste time filling it out or understand its good intention, so they don't complete it. Moreover, if questions were

not carefully studied, they may be biased and lead the respondent to a precise answer and mislead the truth. Comprehending the questions could be a problem in a city like Dubai as more than 200 nationalities receive similar questions, meaning they may understand it differently depending on their background. Thus, it must be direct and straightforward.

3.2 Experiments

Other papers used different methods but were fewer in numbers, like Leverenz et al. (2021). Using their team, they used a tracking system in an experiment of self-reporting for the breakfast waste in four kitchens. They confirmed that measuring waste with few changes to kitchen habits helps reduce waste. While Dolnicar, Juvan & Grün (2020) used a different experiment in Slovenia's hotels; a quasi-experiment. This method also used surveys and interviews. They tested guests' environmental knowledge and distributed booklets for self-checking for waste that ended up with rewards for the least-wasting people. It helped reduce food waste because the problem was pointed out clearly to the guests but did not guarantee their continual efforts to reduce it after the study. Data analysis was done using violin plot graphs to check normal distributions and regression. Ravandi & Jovanovic (2019) didn't want to use actual experiments as it sometimes consumes more time but preferred using a computerized program, an Agent-Based Model (ABM). They simulated the food in some restaurants and the expected behavior of guests to study the effect of plate size and the relationship between the agents, the food stations and the guests with its sub-parameters. It was found after studying 480 combinations that decreasing plate size will lower plate waste but increase leftover waste, while increasing the number of food stations may reduce food waste.

The latter research methods may be suitable for other topics as food is sensitive, especially when studying the hospitality sector in a tourist hub such as Dubai. As live experiments need permission and consent from the guests and managers, they may fear legal questioning. In contrast, others will not be interested in breaking their leisure and satisfaction time and doing experiments. While the simulation method has a complicated nature besides the unreality of its results in this type of research, as studying customers' behavior is so forked when there is a high number of nationalities, where each one has his background and may act differently and unpredictably toward food waste. Besides, conducting an actual experiment may need much time to get better results, which the researcher may not have, and the food waste topic may change each month quickly.

3.3 Reviews

Different reviews were used on this topic, such as literature reviews and systematic ones. The difference is that for a systematic review, the researcher suggests some questions, and he reads all the literature available to answer these questions. At the same time, the literature review generally reads most of the literature and papers about a topic. The latter method was used by Filimonau & De Coteau (2019), who focused on food waste from a managerial view in the hospitality sector to come up with three generalized frameworks for future studies; explaining the causes and drivers of food waste, strategies and actions to reduce food waste and the third one concerns food businesses in hospitality.

A systematic review by Baig et al. (2019) discussed the problem of food waste in the Kingdom of Saudi Arabia (KSA) by going into all Arabic and English literature to study the society's behavior; the result was to make campaigns to educate women and youth about the problem as they make up the majority of the population there.

While Abiad & Meho (2018) mentioned in their paper that the percentage of articles on food waste is increasing more through the years than on other subjects, from the Arab world, the documents on the subject were the least, with a percentage of 2.5% from other countries, this is referred to as cultural difficulties. Iraq is considered the most Arabic country to publish papers about food waste.

This method is suitable because it helps the researcher find the gap in the research when looking into most of the papers and continue on the work of the others to come up usually with guidelines and roadblocks to building on it. However, it does not provide the researcher with recent information as other methods do because it is considered a secondary source of data; besides that, some resources are regarded as grey information, meaning that they are not a trusted source of information or a biased one where the surveys can be quick and ask about any trending subject. At the same time, reviews are mainly in the past literature and time consuming for a rapidly changing and improving issue like food waste.

3.4 Life Cycle Analysis (LCA)

Some papers used LCA as the primary research methodology or as a part of it. It is usually used to test the life cycle of a product with all its environmental effects that are produced from it and asses through which problem the researcher is mainly concerned about. Skaf et al. (2021) studied their paper-specific indicators of environmental impacts in fifteen Arab and non-Arab countries. They checked the hidden effects of food waste and compared them.

They find out that KSA, the US, and UAE have worse ones than other countries, which gives a deep analysis and guidelines for policymakers to take action.

Although this method is important, the truth is that it is complicated, needs special software that could be either outdated or expensive to afford, is time-consuming, and only focuses on the environmental impacts without focusing on other behaviors or context problems. It is inflexible unless the paper's main focus is one of these environmental indicators. Thus, it is not helpful in this paper as it mainly focuses on people's behaviors behind wasting food.

After searching the literature and reading through the papers, it was concluded that this study has different variables that may affect the increase or decrease of food waste in the hospitality sector. These variables include:

1- location of food outlet (independent, non-independent, indoor or outdoor)
2- Level of food service (high, mid &low)
3- Type of service (buffet, A la carte, café …etc.)
4- People's behavior (cultural and social)
5- Customers' type (tourist, expats or local)
6- Food-related (Type of cuisine)
7- Family income and wealth (high, medium)

3.5 Selected Methodology and Research Procedure

After studying these variables and assessing each research methodology with its cons and pros, it was concluded that a mixed-mode methodology is best to be used in this research as using different methods will give more comprehensive and inclusive data and image about the topic because each method will cover the faults and gaps of the other to provide better explanations for results. It will use surveys with helpful questions for a different group of people, followed by interviewing the responsible people to verify the results. This methodology will quickly help in searching for these variables and reaching goals, as it is the best practice to study the behavior and causes of food waste through qualitative and quantitative data. This type of data will help study a specific phenomenon (wasting food) and analyse it to explain why people do it. Thus, literature review and systematic reviews will only allow a little, as the literature in UAE about the subject is limited. Moreover, the LCA is complicated and focused on issues other than this paper's focus, as mentioned above, which will make it un-useful. Perhaps the experiment is an excellent method, especially

when suggesting strategies. Still, it could be inflexible in the context of Dubai, as any procedure which includes people must have permission because of the sensitivity of the guests of the hospitality sector.

Research Procedure:

1 researching the available papers in this field to find the research gap that is needed to be filled by looking into the literature presented locally and internationally,
2 Studying the methods of research to complete this aim and study its benefits and ease of use in Dubai's hospitality context,
3 Collecting the data needed from the sample about causes of food waste, then analyzing it. followed by comparing it with the international literature to come up with all the reasons behind food waste in the emirate of Dubai,
4 Checking the behavioral drivers of the guests and suggest strategies to incentivize them to change,
5 From the literature, offer strategies that fit the community and move along with national plans and regulations on food waste prevention,
6 Validate the implementation of the studied strategies by interviewing the people in charge, who can make a change in the country on the food services level or country level,
7 Check about the possibility of creating a framework for all food services to follow.

3.6 Survey Building

The survey method targeted two groups of people in the hospitality industry, the users and the workers. The users are the guests that attend the food outlets and benefit from their services. Their opinion is so important as they are the consumers of food and lead to leftover food waste, which is primarily avoidable, besides being the ones on which the FW prevention strategies will be applied. On the other hand, the workers have an essential point of view as well, as they live the different practices of the customers daily, besides the kitchen and food service practices that contribute to food waste.

The survey was built in two languages; English and Arabic. It was divided into four groups of questions for both targeted types of people, with the tailoring of some variables upon the need of each group. The surveys' questions were mainly inspired by a survey on food waste in Pakistan by Aamir et al. (2018). Some answers' choices were influenced by an Emirati survey about the effect of social media on food waste attitudes by Osaili et al. (2022), besides, some awareness questions were inspired from the survey by WRAP (2020)

.The first part included demographical questions about the person surveyed from his age, salary, gender and residency for the guests, age and experience of the employees with additional information about the food outlet from its type, level, and location. These questions help in finding a general trend, if any, on whether they affect food wasting behaviors or causes. The second group included awareness questions to check the participants' awareness about the environmental impacts of food waste and information related to the situation of FW in the emirate of Dubai. As the awareness of the people is important to start implementing any strategies as you cannot force people to change without making sure they understand why they do it. The third and fourth parts of the survey included questions answering the main aim of the research, where they asked about the causes behind wasting food and suggested prevention strategies for them to give their opinion about implementing them in the food services of the emirate. Both samples were asked about their opinion on each other's reasons for wasting food for higher accuracy of results. The total number of questions for guests was twenty-three, while for the employees, it was seventeen, Appendix (1&2).

The survey was built on a specialized website offered by the British University in Dubai (BUiD), Jisc.com. This website allows the researcher to design the survey, distribute it through links and analyse the results. It offers different questions that will benefit him in reaching his intended results. The paper's survey used different styles of questions; mainly, demographical questions used multiple choice questions with single answers. Other parts of the survey used various types, such as multiple choice with many answers, scale questions, and optional text comment boxes for different personalized opinions.

A pilot survey was sent to three people of the guests and checked for their comprehension of the questioned and verifying if the data were collected in the right way on the SPSS software, to show the need to remove a repeated question and a language check. The guests survey reached thousands of people; only 600 opened the link, and precisely 361 continued until the end and submitted it with a response rate of 60%. While the employees' survey was distributed to hundreds of people, 334 opened the link, but only 91 completed it, with a response rate as low as 27%. The hospitality sector guests were selected randomly through relatives, friends, friends of friends, social media groups in Dubai using Facebook, and two schools which are Amity Early Learning Center and Dubai British School Jumeirah Parks. While the employees survey participants were selected first, by contacting some of

Dubai's hotels managers who the researcher met in Food for Future Summit in Expo 2020. Second, data was collected using the iPad of the researcher through visiting each restaurant and asking kindly their managers to fill the survey link.

The time needed for both surveys to be completed was around one and a half months between sending them to different institutes and waiting for responses. Moreover, the time required for the analysis to be conducted was also one and a half months as the size of the collected data was very big, and it needed descriptive and inferential analysis.

3.7 Interviews

The interviews' main aim was to verify the data collected from the surveyed participants. Thus, the main direction was to interview expert people with high positions to verify the collected information covering the ideas of food waste awareness, causes, prevention strategies, laws and legislations. Federal-level ministry and local municipalities were targeted for questions about rules and legislation. At the same time, the social-environmental organisation "Goumbook" was mainly interviewed to ask about raising awareness and campaigns. Hotels and resorts employees were asked to verify reasons for food waste and prevention strategies to reduce it. Thus, the interviews concluded that people work on many sides of society; the governmental sector, the private (business) sector, and the nonprofit or social one, table (15).

The interviews were semi-structured with open-ended questions to allow the participants to share their opinion freely and personal points of view. The main idea of the questions directed for them was similar, with some focus on sub-subjects in each interview depending on the interviewee's position. The questions numbers ranged between nine to thirteen questions.

All the interviews were conducted within a month, starting 30th of September, 2022. They were recorded with confidentiality for the benefit of the researcher. All of them were conducted in English and Arabic, whichever was preferable for the interviewee. Most were face-to-face interviews, while few were virtual using Microsoft Teams. The data was transferred from the voice recorder to words on Microsoft word, then analysed and compared, as shown in section 5.1. Six of the interviewees signed a consent paper or oral consent for the researcher to use their name and record their voices, while the seventh interviewee refused and is shown by giving him a shortcut name and general company name (first interviewee).

Table 15 the personal information of the interviewed people

	Date of interview	Name of interviewee	Position of interviewee	Experience yrs. in Dubai/UAE	Name of institute
1	30th Sept 2022	Mr. D	Procurement manager of Food &Beverage	Over 20 yrs in hospitality middle east and Dubai	Major hotels company in Dubai and the middle east
2	7th Oct 2022	Ms. Tatiana Abella	Founder and managing director of Goumbook	Over 13 yrs. in Goumbook/ Dubai	Goumbook
3	10th Oct 2022	Dr. Sayed Essam Al-Hashmi	Head of the Food Trade Control Section at the Food Safety Department	Over 4 yrs. in Dubai	Dubai Municipality (DM)
4	14th Oct 2022	Mr. Kym Barter	Vice president of F&B at Atlantis	1.5 yrs in Dubai	Atlantis Resorts
5	19th Oct 2022	Ms. Amal Al-Ahmadi	Head of R&D in the ministry, Food security portfolio, and member of the general for the emirates food security council	Over 5 yrs. in federal government	Ministry of Climate Change and Environment
6	03rd Nov 2022	Ms. Maitha AlKaabi	Food safety and hygiene manager	6months DWTC and 7 yrs Food safety Dubai and Abu Dhabi	Dubai World Trade Center (DWTC)
7	03rd Nov 2022	Ms. Habiba AlMara'shi	Co-founder and Chairperson of EEG	-	Emirates Environmental Group (EEG)

CHAPTER 4: DATA COLLECTION AND ANALYSIS

The two surveys data were collected through the website built on it (jisc.com) and transferred to Microsoft Excel and SPSS to be analysed and represented as graphs and tables. In this chapter, the data of both surveys, the guests' survey (N=361) and the employees' survey (N=91), will be summarised and represented to ease the comprehension of the main results of the surveys. At the same time, detailed questions and answers will be provided in Appendix (1&2).

4.1 Survey 1 (S1)/ Hospitality Sector Guests

4.1.1 Demographics

Looking into the demographical results of the survey, it can be seen that the majority of the sample were aged between 20 years (yrs.) to 60 yrs. With few others being less than 20yrs and more than 60 yrs. While for the salaries, it shows various distributions among all categories ranging from 8-33% for each. When comparing the gender, it showed the contribution of the males was double that of the females, and the expats were the most category participating among residents, figure (13).

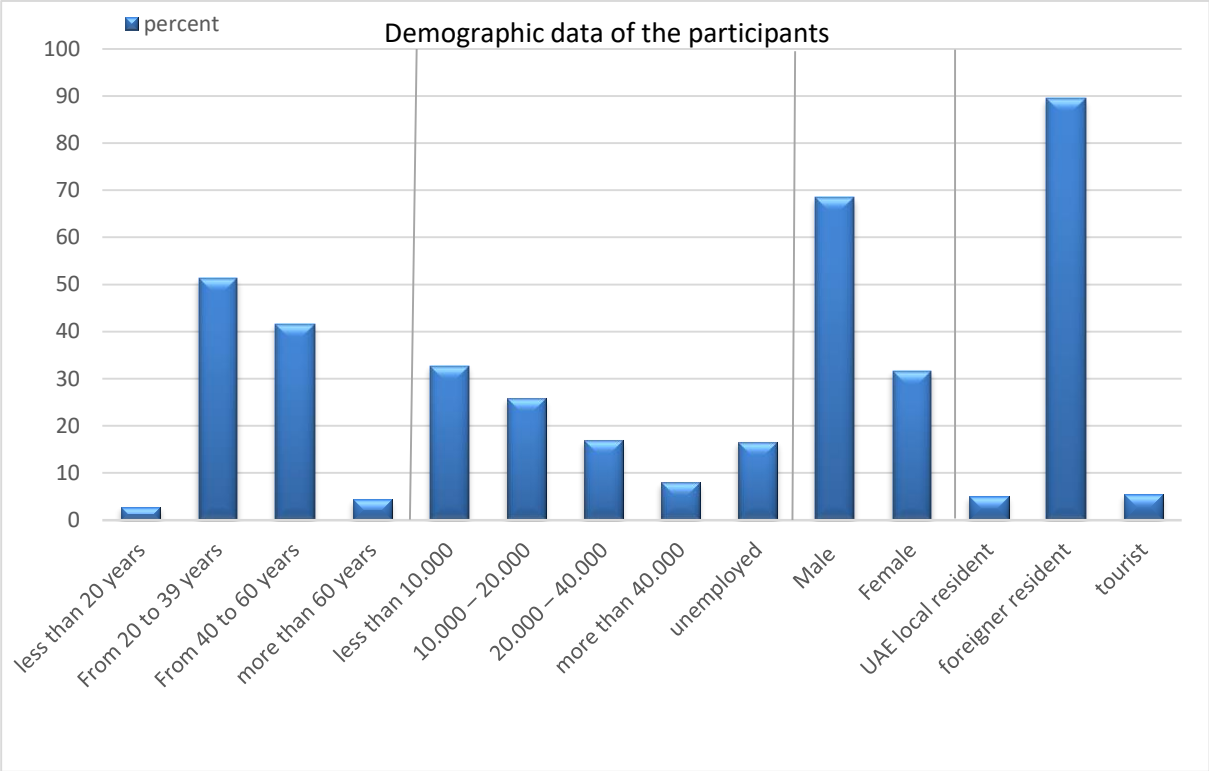


Figure 13 Demographics of the Guests' survey sample distribution across Age, Income, Gender, and Residency Status in Dubai

The type and level of the food services the sample liked to visit showed variety. The most visited type was the (a la carte) restaurants that offer a menu by order with a high percentage of 68.7%, followed by the buffet type offering fully prepared and displayed food dishes at 20%. Whereas for the restaurant level, the top-visited restaurants had a mid-level figure (14).

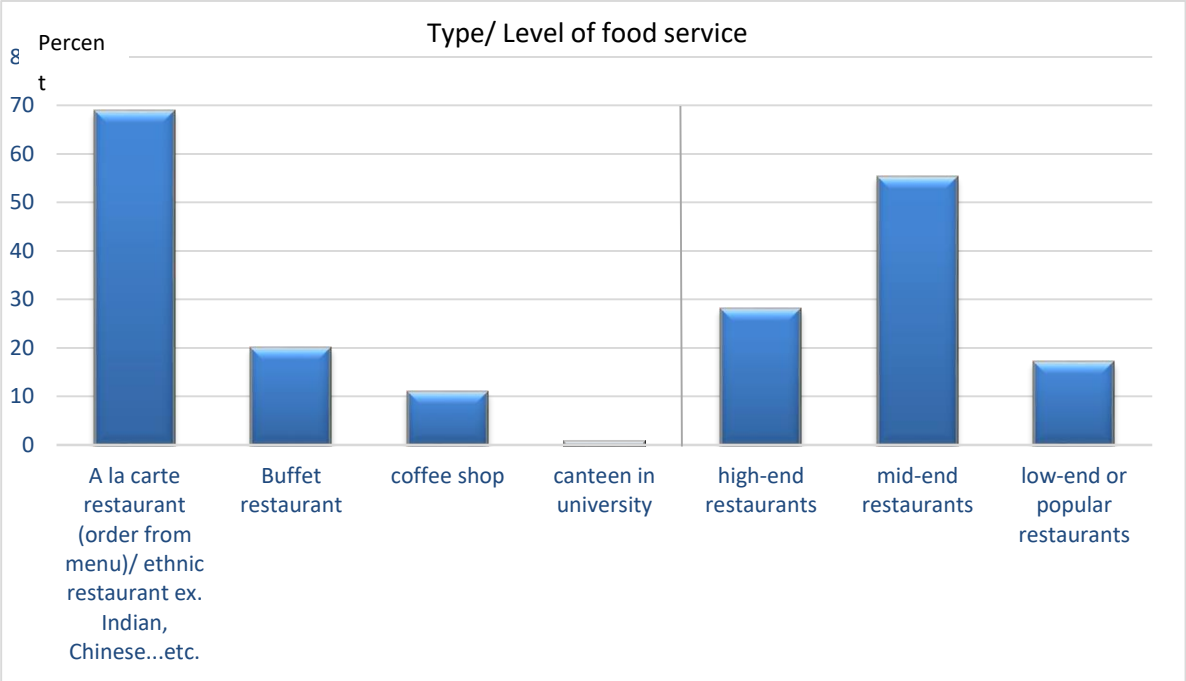


Figure 14 Percentages of guests' preferences according to the type and level of food service that they like to go to

4.1.2 Awareness of Food Waste

To start the change, the current level of awareness about the problem in participants needed to be investigated. Thus, three groups of questions were asked of the participants; to test general knowledge about FW, to test awareness of the Dubai/UAE situation in FW and to test their consciousness in taking their leftovers. The first group was accepted with a high agreement reached above 90% to all its questions which included question 1 (Q1), "Do you know that food waste contributes to major environmental, social, and economic problems such as natural resource loss, food insecurity, and methane gas emissions that contribute to global warming?", Q2 " Knowing the problem is the start of the solution?", Q3 "I care about the environment", and Q4 "I am willing to start a change if I get the knowledge ". This group showed a general awareness of the FW problem and the readiness of the people to make a change reflecting their high responsibility toward their planet, figure (15).

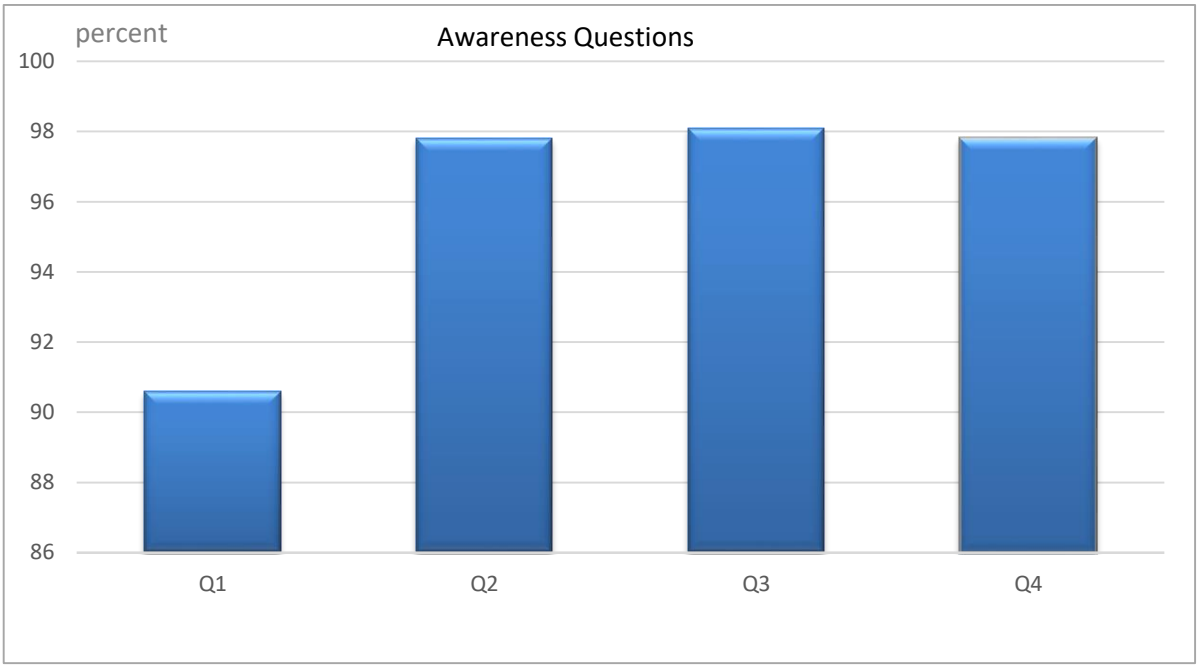


Figure 15 first group of awareness and change acceptability questions.

The second group of awareness questions tested the participants' awareness of the situation in the Emirate of Dubai; its FW quantity per capita, its available institutes that are concerned with this topic and the available methods of prevention or recovery of food waste found in the food services of the emirate. It revealed unfamiliarity with the quantity per capita of food waste in the emirate, which is found to be 224kg/ year/ per capita (Kohli 2021), as 78.4% of the participants were unaware of it. This is also apparent in another answer when they were asked to specify the exact amount of FW per capita; the majority chose around 59-133 kg/year/capita at 41.3%, less than half of the reality, so the awareness of that topic is low, figure (16).

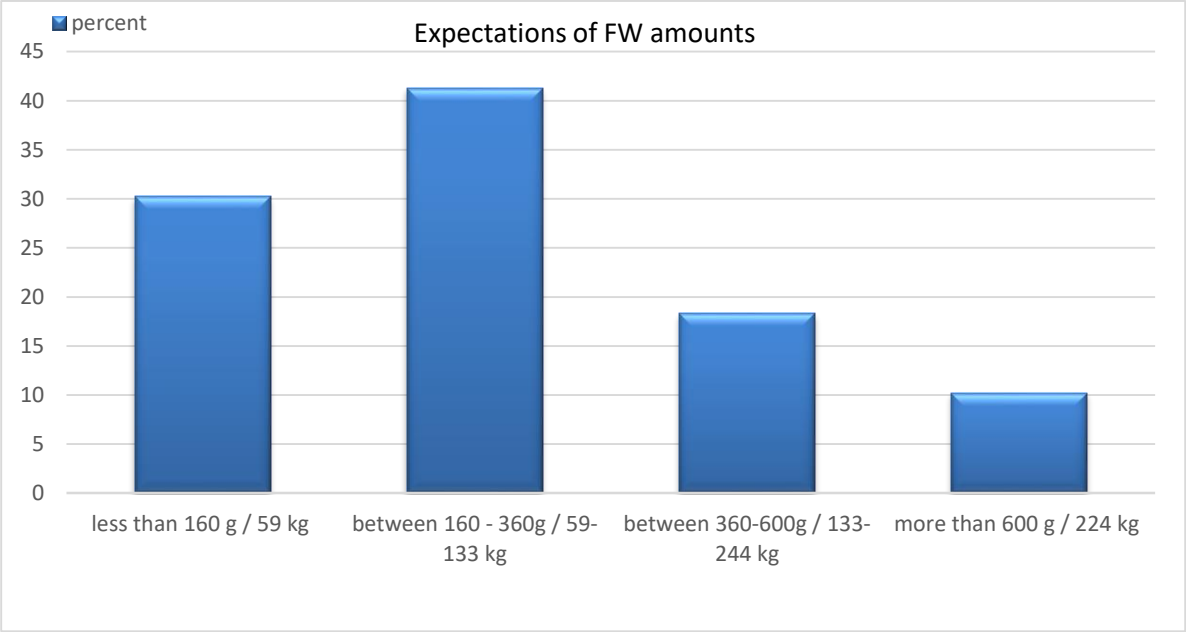


Figure 16 Percentages of guests' expectations to the amount of FW in the UAE per person daily (g)/annually (kg)

As for the available institutes, most participants (58.4%) showed awareness of at least one of the four presented institutes: BonApp, winnow solutions, UAE Food Bank and the Ministry of Climate Change & Environment (MOCCAE). These institutes were chosen after studying the companies and initiatives in UAE/Dubai concerned with food waste. It was found that MOCCAE has a department responsible for this issue and is behind most of the initiatives in the Emirates, such as "Food for Life", "Food Waste Pledge", and "Ne'maa initiative", making it the best platform to share FW issues and awareness. Winnow is a smart scale proven in UAE and worldwide to reduce food waste in hotels. Besides cooperating with MOCCAE to support the "Food Waste Pledge" for hotels. UAE Food Bank is a charitable organisation to help Dubai become the first city in the region to achieve zero waste (*About Us* n.d.). Moreover, BonApp is an app similar to the concept of the UAE Food Bank but on the level of the individuals, where they can offer or benefit from the extra foods of others. These four institutes /apps have platforms that are important to know, as prevention strategies and awareness campaigns are and will be through them. The participants gave the highest responses for knowing MOCCAE, at 26%, figure (17).

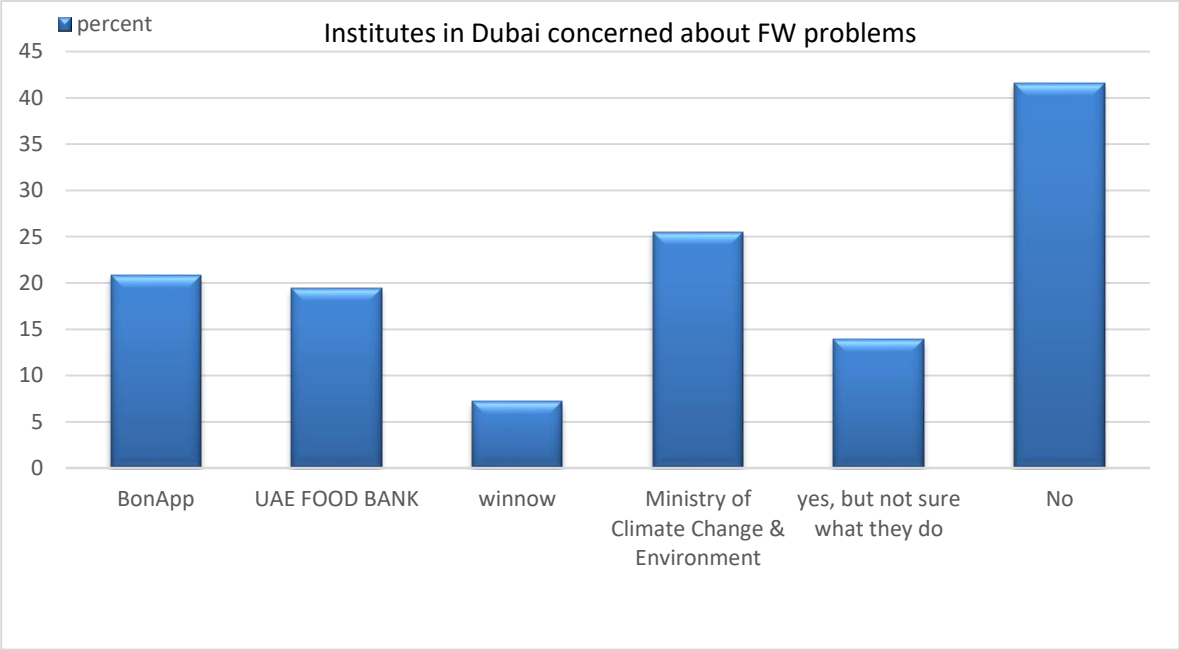


Figure 17 Percentages of guests' knowledge about the institutes concerned about FW in Dubai

Some food services in the emirate of Dubai have implemented some simple prevention strategies for food waste, and the guests were asked about nine of them to check their awareness of its existence. It showed that the highest percentage, 68.4%, of the guests were familiar with the strategy of "encouraging doggy bags/ takeaway bags", followed by similar percentages for the strategies "encouraging messages/menu design" and "better storage and handling", at 24.4%. However, one-fifth of the sample was unaware of any of these strategies, which confirms the importance of implementing FW prevention strategies in the Emirate and spreading awareness about it, figure (18). Moreover, the participants had the chance to add other strategies if they passed by some in the food services. They said being charged fines for wasting food and using fridges outside the food service to save leftovers for the needy.

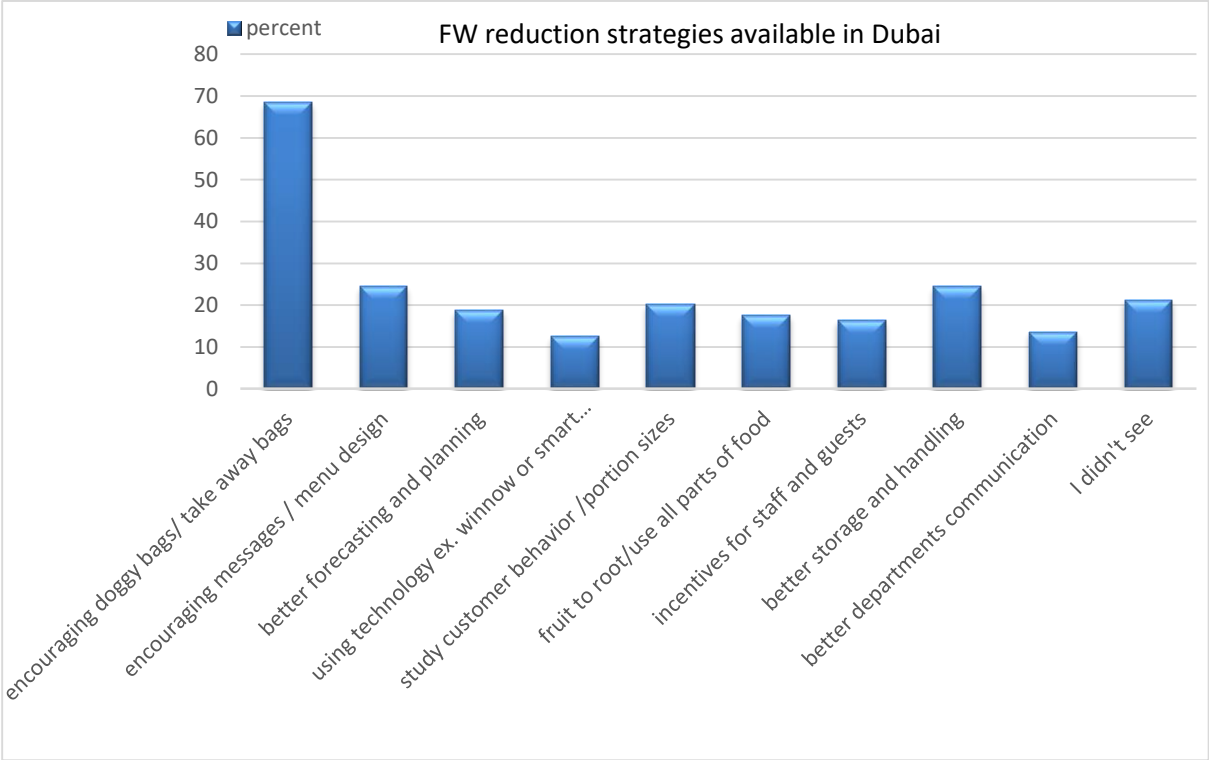


Figure 18 Percentages of guest's knowledge about the strategies to lower FW available in Dubai

A positive response was collected on the participants' amounts of food waste to show their high level of consciousness about the quantities of leftovers they keep on their plates in the food services. Around half of the sample (53.2%) admitted not leaving any of their food on their plates, and around 36% of them wasted less than one-third of the food they ordered, figure (19). However, this result does not correspond with the reports of UAE about FW percentages who consider UAE as one of the countries with the highest FW percentages, with around 38% of prepared food being thrown out annually (above one-third) and high per capita food waste (*dcce* 2019). However, this may be referred to as the increase in awareness and the vast effort about sustainable practices each month.

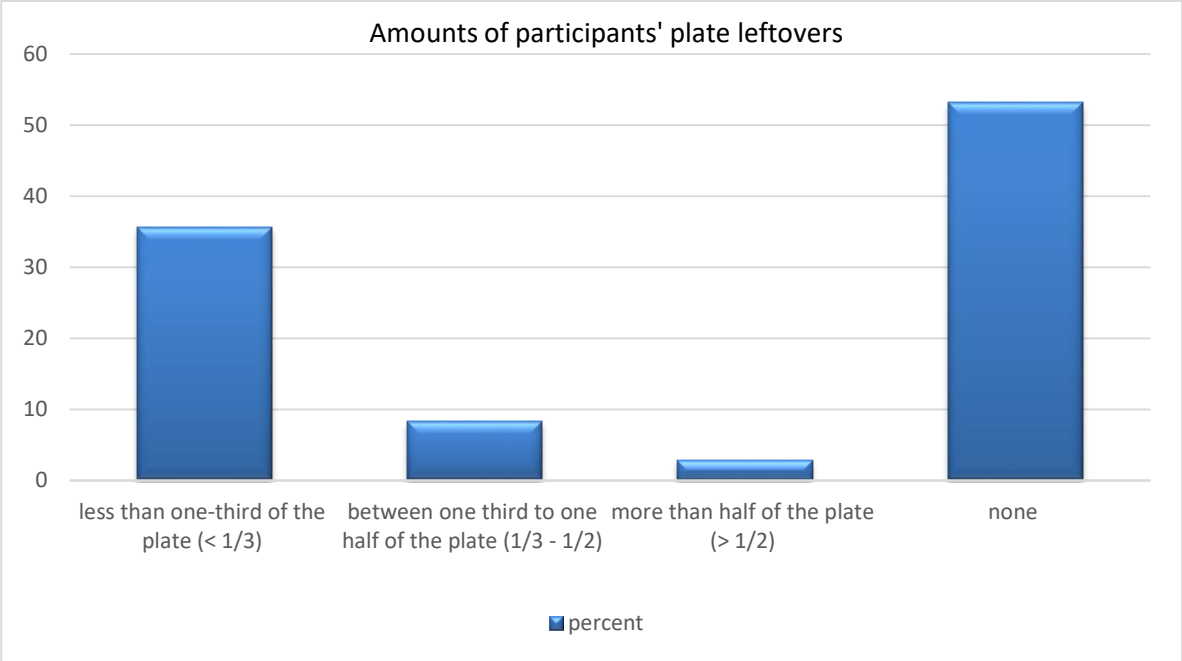


Figure 19 Percentages of guests' food leftovers on their plates.

Those who left food on their plates were asked if they agreed to take the leftovers home. The majority (around 87%) confirmed doing that. More than one-third of them chose to take their leftovers home because they knew the effects of wasting food, besides the religious and guilt-free feelings they have, figure (20). What they do with these leftovers is mainly eat them as it is, at 49%, gives them to other people or upcycle them into other forms of food, at around 25%, figure (21).

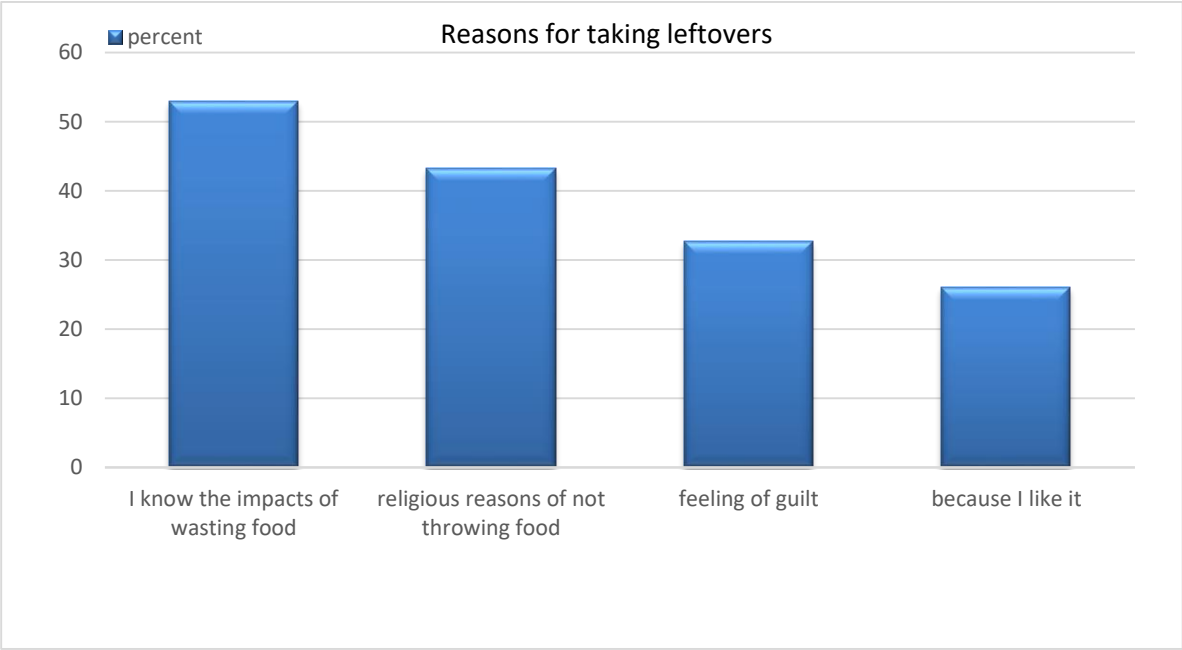


Figure 20 percentages of guests' reasons for taking leftovers to their homes

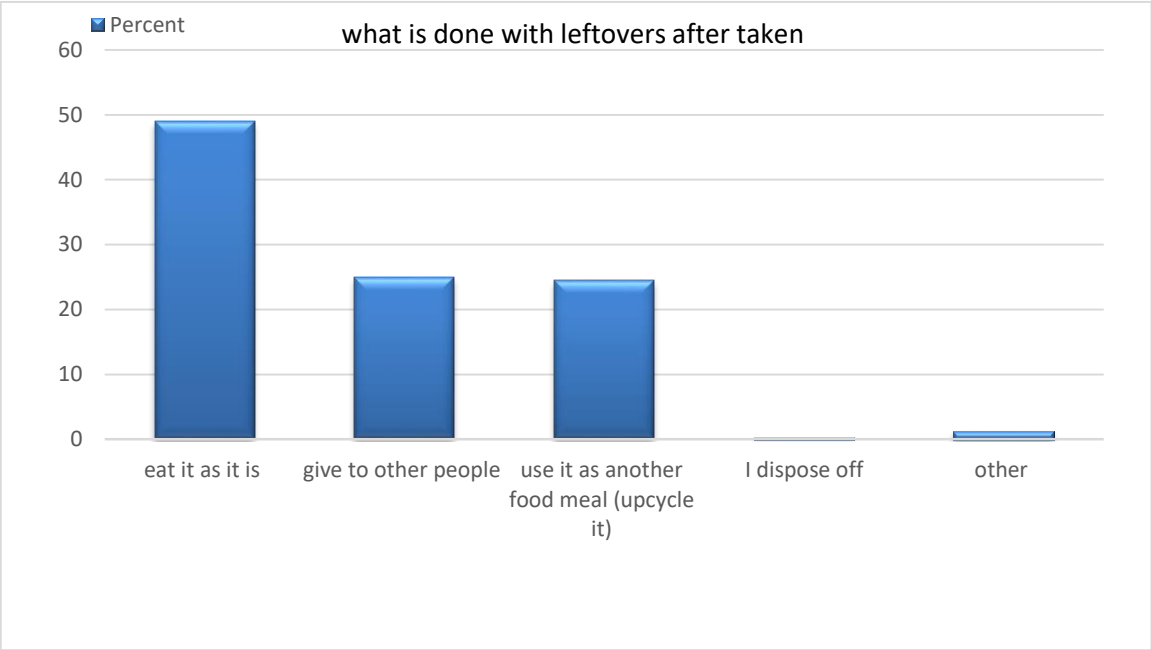


Figure 21 Percentages of guests' behaviour towards the food they take home

The three groups of awareness questions mentioned before resulted in high awareness in the first group, low awareness in the second group and increased awareness in the third group. The exact level of awareness needs to be investigated, and various questions and regular follow-ups, such as what WRAP (2020) is working on yearly to study awareness levels and attitudes of people toward FW. However, generally, it can be said that there is a good level of awareness about specific parts of the topic, and there is space for continuous improvement. This paper's awareness topics are comparable with the survey of Osaili et al. (2022). They asked about specific issues of awareness where their sample agreed on knowing: the impacts of food waste (95%), not leaving food on their plates (66.7%), eating leftovers (72.6%) and taking action to reduce FW regularly (48.8%).

4.1.3 Causes of Food Waste

After collecting the data about the causes of food waste, it was found that they can be categorised into different sections; causes from customers' behaviours, food services, and contributing factors. The factors that lead to food waste could be many, but the ones that were presented for the sample and asked about were the months, the days of the week, gender, the type of food service and a few special events. These factors are studied through the read papers of international studies and asked about in the survey by Aamir et al. (2018).

Winter months in Dubai which mark "December, January, and February", were agreed on as the most months contributing to food waste by 45.7% of the sample as almost 87% of them related this FW increase to the better weather in these months. Special events, such as the Dubai Winter Shopping Festival and the schools and religious holidays at that time, will increase the FW in hospitality services. The second quarter of wastage included the months of the summer marking "June, July, and August", which is related to events like the Dubai Summer Shopping Festival and schools' vacations. It was agreed on by around 31% of the sample to be the second most food-wasting quarter. Other quarters of the year were causing less wastage (13.3%, 9.7%) from the guests' point of view, but with agreement on the high wastage of food in the Holy month of Ramadan, which came in the spring season, the figure (22).

The second factor was the days of the week, where the sample agreed on the weekends as a significant contributor to FW by 93.1% agreement, as people mostly enjoy eating in food services at that time and less at their houses, figure (23).

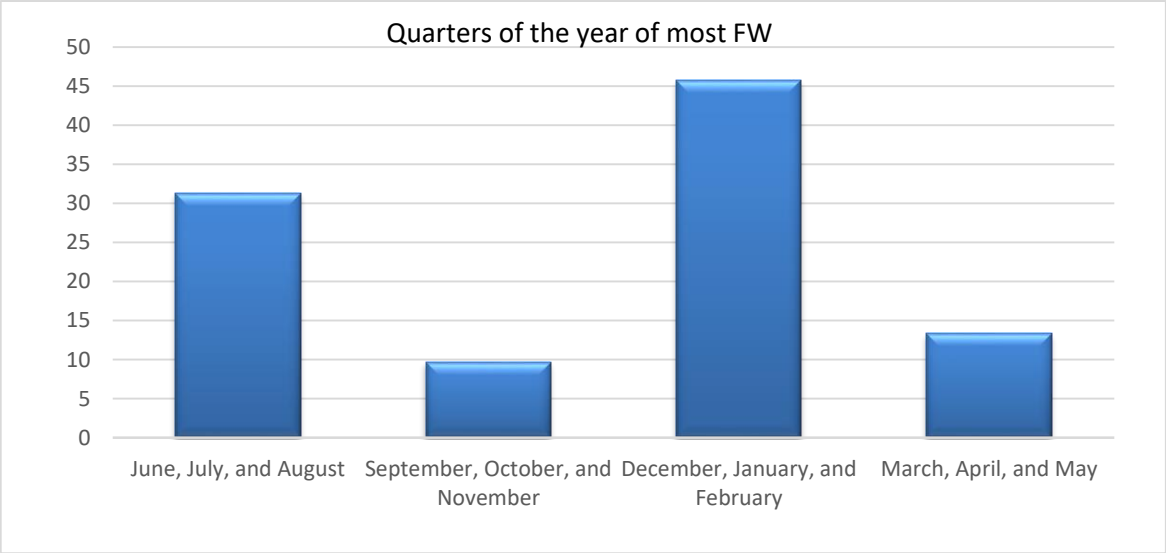


Figure 22 Percentages of guests' expectations of the months most contributing to FW in Dubai

Gender was studied by Abdelaal, McKay & Mackey (2019) to have some effect on wasting food. They related wasting more food to females than males. However, when the sample was asked about this, most rejected it as significant for food waste. Around 68% of them answered with a "no" when asked this question, figure (24). However, their study was focused only on a university in Qatar and not distributed to the public as this study did.

Besides, that their sample was around 55 surveys while this one is 361. Concluding that maybe this paper's result is more trusted.

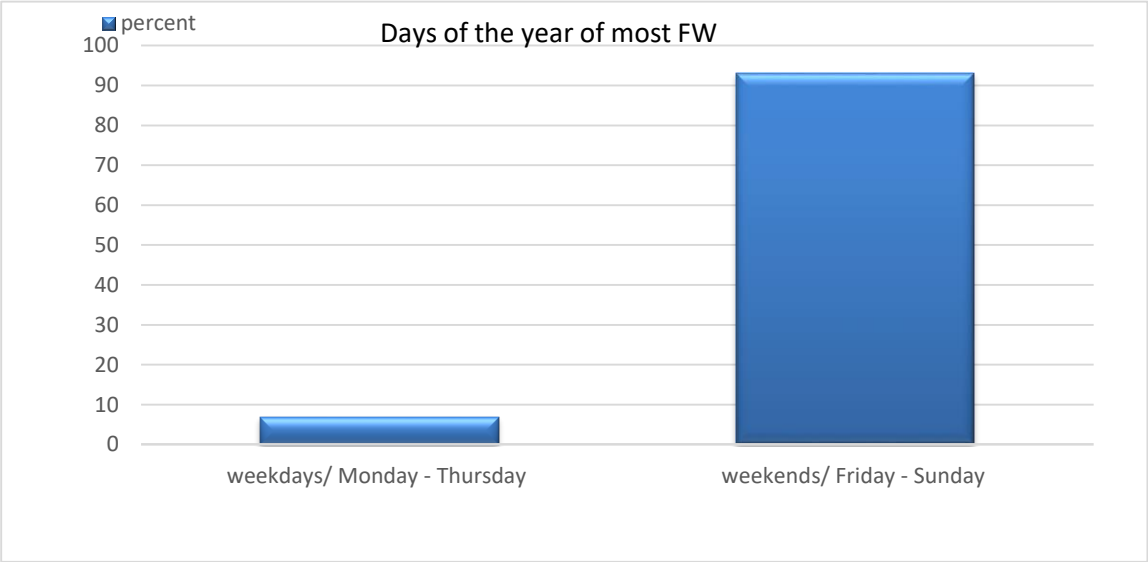


Figure 23 Percentages of guests' thoughts of the days of the week contributing to more FW

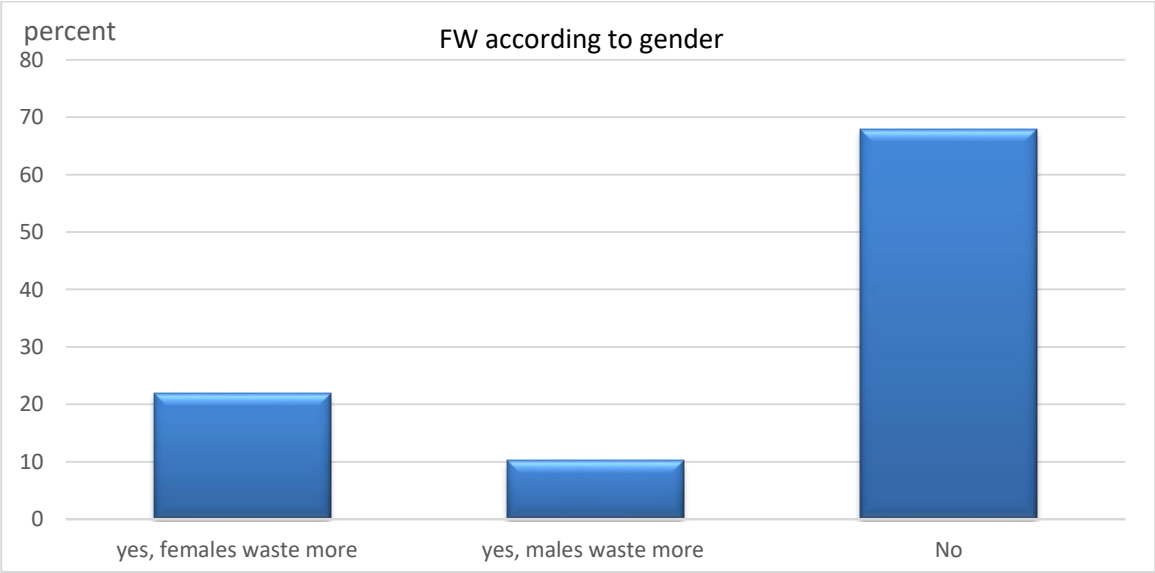


Figure 24 results of the sample's opinion about FW being related to gender

The type of food service is essential as some could offer you fully prepared, semi-prepared or unprepared dishes. Depending on that, the kitchen's and the customer's plate food waste are expected to change. The type they agreed on as most contributing to FW by

70.6% of the sample was the Buffet type, offering various dishes with unlimited quantities in the time of its service and contributing to both types of waste; kitchen and customer, figure (25). The guests suggested many specific reasons why buffet services wasted the most food and were recommended by the guests by adding them in the comment box presented to them in the survey. These include reasons related to customers and others related to food services. The former reasons were summarised in the lack of awareness and negligence the people have when taking more quantities than they need while destroying the other displayed dishes. They are greedy in trying most food types, despite not liking them to satisfy their eye craving, without paying attention to their health. Besides their feeling of having the right to waste it, as they paid for it or feeling that it will be destroyed anyway after the service is finished.

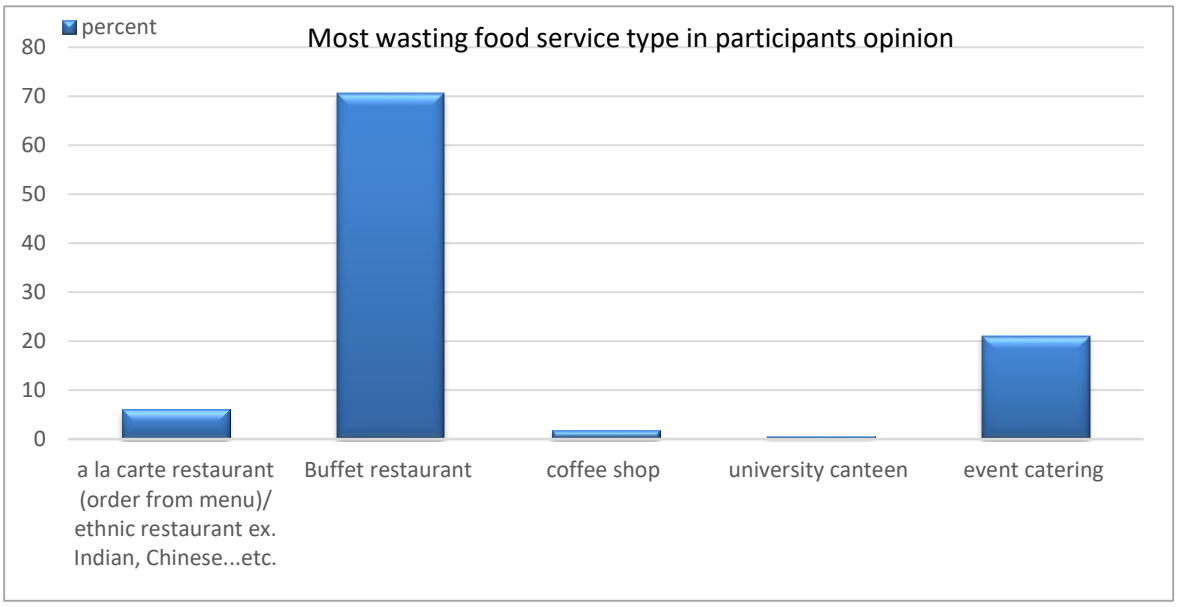


Figure 25 Percentages of guests by the type of food service they think is most wasting.

The other reasons were from the food service side. The customers blame them for serving huge quantities and options of food with a good presentation for advertising because they fear people's bad feedback if there is a shortage of amounts or types. Moreover, other reasons for FW from their side are the decreased quality of the food, offering undesirable options, having items with short display life, the inability to forecast the exact number of guests, prioritizing profit over waste, the customers' absence at some times of the week in some food services resulting in the throwing of fresh foods and the indifference of the workers to the amount of food wasted by customers. Other reasons suggested were specific to catering services, such as exaggeration in the quantities of food to show generosity, money

and social status of the owner of the occasion, especially in Arab Cultures, besides the cancellation of some guests without prior notification or the inability to know the exact numbers sometimes.

General causes of food waste from the customers were summarised from the international papers in section (2.3.1), then asked about in the guests' survey. It was found that the causes' mean scores of guests' agreement ranged between 2.44 and 3.89, with a medium agreement. For instance, guests reported the highest level of agreement on "taking big portions", "to show generosity and wealth", and "lack of awareness" as the most reasons contributing to food waste from their side. In contrast, they gave the lowest agreement on "I do not see it as a big problem", table (16).

Table 16 Means and standard deviations for participants' agreement with the reasons contributing to food waste

Causes from the customers	**Mean**	**Std**
Taking big portions	3.89	1.156
generosity and wealth in over ordering	3.86	1.118
I do not like the taste / unexpected quality	3.72	1.078
lack of awareness	3.79	1.093
tourist behaviour - try as many available options	3.49	1.033
more varieties of food and menu choices - I order more	3.46	1.134
un-wanted food sides like decoration items of vegetables and sauces/food type	3.30	1.239
not declare allergies/ religious restrictions	2.87	1.071
low prices of food	2.85	1.220
I do not see it as a big problem	2.44	1.389

On the other hand, the causes of food waste from food services were summarised in section 2.3.1 and shown in table (17) to be six main reasons. The guests evaluated these reasons based on their opinion to show their medium to a high agreement on them. They reported the highest level of agreement (Mean=3.75) on the reason of "poor planning or forecasting", followed by “food presentation and preparations” and “storage and expiration dates”. In contrast, they reported the lowest agreement (Mean=3.31) on the reason for “unqualified cooking skills/ staff errors" and “low meal prices & many choices” as they do not see them as much contributing to FW as others.

Table 17 Means and standard deviation of participant’s agreement with the reasons causing food waste by food services

Causes/ food services	**Mean**	**Std**
poor planning or forecasting	3.75	1.025
food presentation and preparations	3.62	1.034
storage and expiration dates	3.50	1.102
over-production	3.47	1.130
many menu choices	3.44	1.082
unqualified cooking skills/ staff errors	3.31	1.064

4.1.4 Food Waste Prevention Motivations and Strategies

Prevention strategies could also be divided into different categories depending on the side responsible for using them, food services or the guests. These strategies were concluded from the read international and local papers in sections 2.3.1 and 2.4.1 in tables (7-9) and (13,14), respectively. In order to reduce food waste, guests agreed on the need for motivation; 24% of them chose to “accept waiters’ advice on the ingredients and sizes of ordered meals”, then have a “nice design for doggy/leftover bags” and “being offered smaller

portions or plate sizes", without favoring the idea of "increasing the prices of food dishes", figure (26). Other guests added prizes and incentives for the people not leaving food waste on their plates when asked to add other motivations in the comment box. Moreover, they confirmed that the primary motivation must be built up in the humans' morality and humanitarian/religious conscious more than strategies that keep reminding the people to do so.

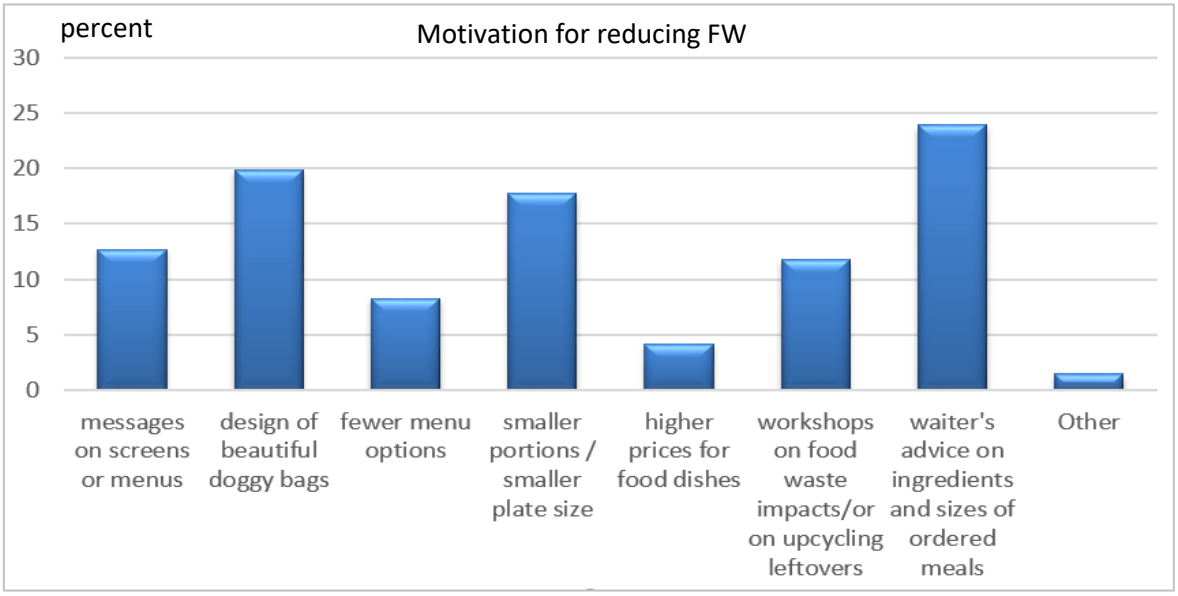


Figure 26 Percentages of guests' agreement to the motivations to reduce food waste

Confirming the top motivation mentioned before, the guests were asked different questions about the acceptance of servers' intervention in different aspects. These interferences were if they would accept "If the waiter told you the food you ordered is enough for you", "If the restaurant displayed pictures of food waste's social, environmental, and destructive economic impacts on screens or paper table mats" and "If the food service reduced the plate size as a food waste prevention strategy?". The guests showed high acceptance for the first two strategies (around 70%) while giving the third one a medium acceptance of around 47%.

Other strategies were tested using the mean scores of guests' agreement, resulting in medium to a high agreement with a range between 3.64 and 4.22. They reported the highest level of agreement (Mean=4.22) on the strategy "encouraging doggy bags/ takeaway bags", followed by "better storage and handling" and using "fruit to root/use all parts of food. In contrast, they reported the lowest agreement (Mean=3.64) on the strategy of "using smart technology, e.g. winnow or smart scales.", table (18).

Table 18 Means and standard deviations for participants' agreement on prevention strategies to lower food waste in food services

Strategy	**Mean**	**SD**
encouraging doggy bags/ takeaway bags	4.22	1.068
better storage and handling	3.97	0.917
fruit to root/use all parts of food	3.88	1.007
better departments communication	3.86	0.961
incentives for staff and guests	3.83	0.957
Encouraging messages/menu design	3.81	0.968
better forecasting and planning	3.81	0.969
study customer behaviour /portion sizes	3.69	1.036
using technology, e.g. winnow or smart scales	3.64	0.965

4.2 Survey 2 (S2)/ Hospitality Employees

4.2.1 Demographics

The demographical questions showed that the sample had covered most of the types, locations, and levels of food service in the Emirate of Dubai to be as representative as possible. The majority (72.5%) of the participants were aged from 20 to 39yrs, followed by a group aged from 40 to 60yrs, with experience levels ranging in almost equal frequencies of the three categories with years above one, figure (27).

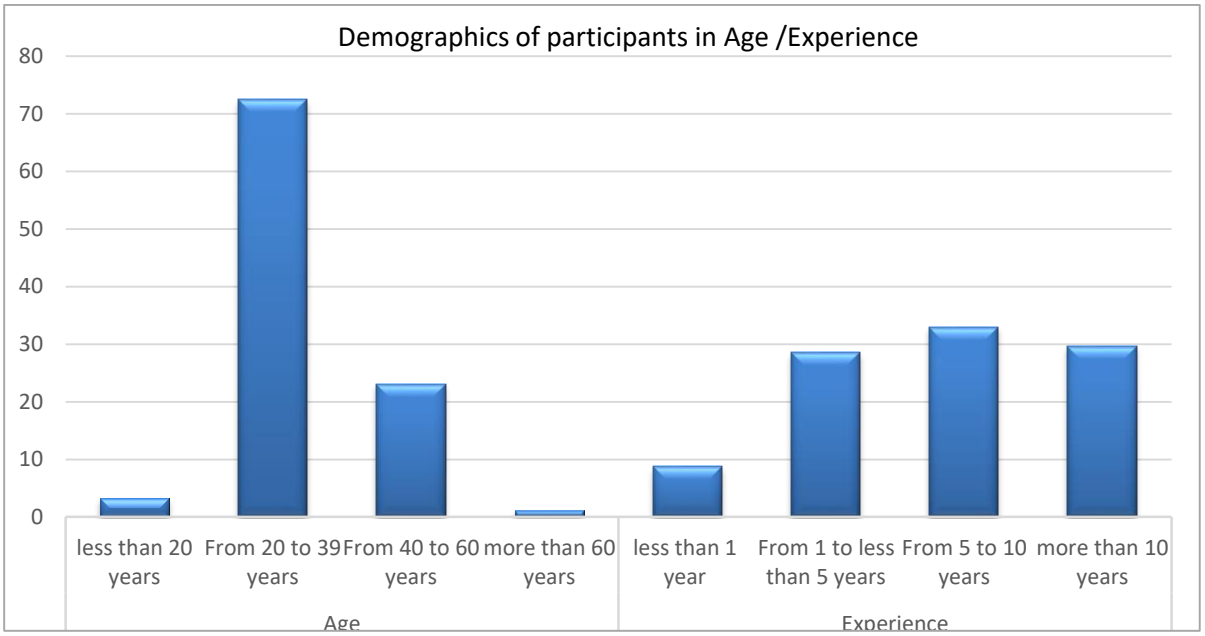


Figure 27 Sample distribution by age and experience

The sample mainly consisted of employees working in “A la carte” food services (50.5%) or mixed ones (28.6%), besides lower percentages for the other types of food services, figure (28a). The level of these outlets was investigated mainly between high and mid-levels (45.1% and 44%), respectively, besides some popular/low food services who agreed to fill out the survey, figure (28b). Their level of food preparation as fully prepared/ ready to serve, partly prepared/ half cooked or marinated, and unprepared/prepared from zero each time is evenly distributed, figure (29).

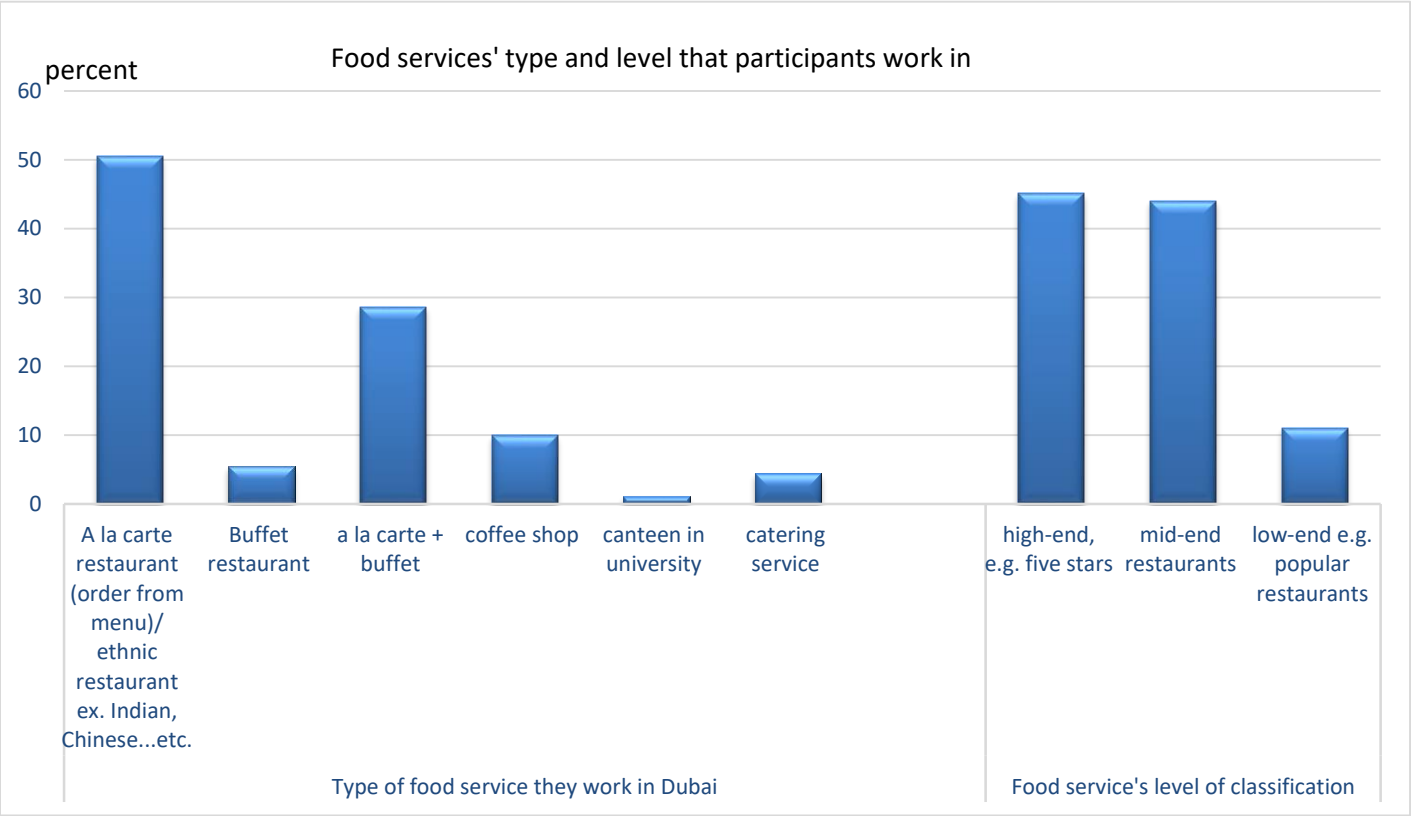


Figure 28 a. The types of food services that the sample work in and b. the food services' level of classification

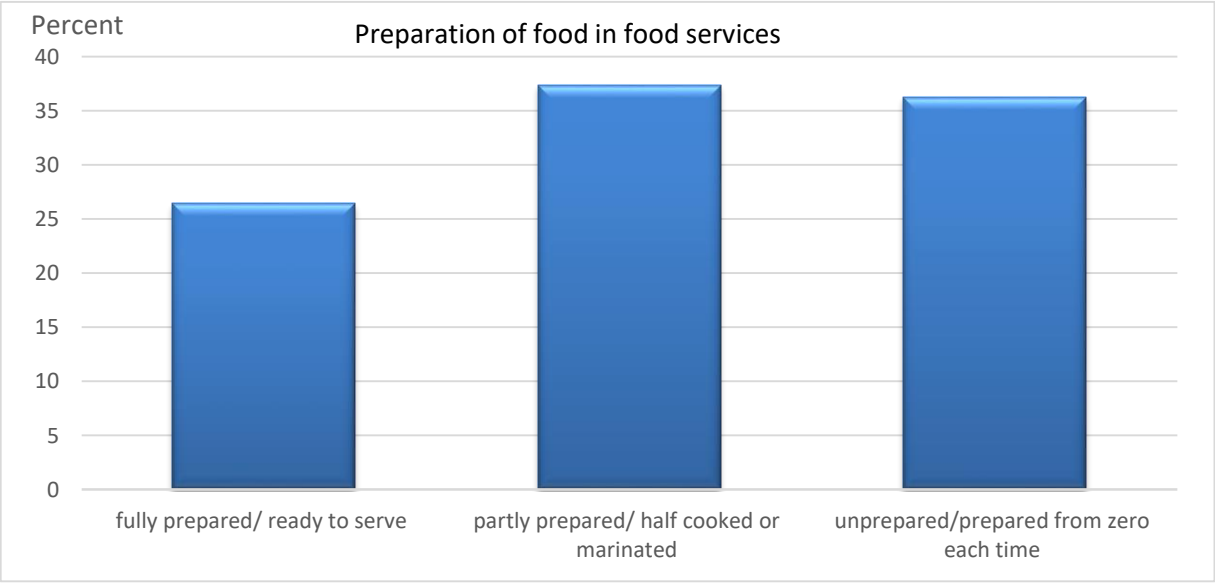


Figure 29 shows the readiness of food to be served among food services

The food services locations surveyed were distributed across many places, such as being attached or independent outlets, inside or outside the malls, hotels, commercial buildings or convention centers. However, they were mainly inside a mall or independent outlets (30.8% and 27.5%, respectively), figure (30).

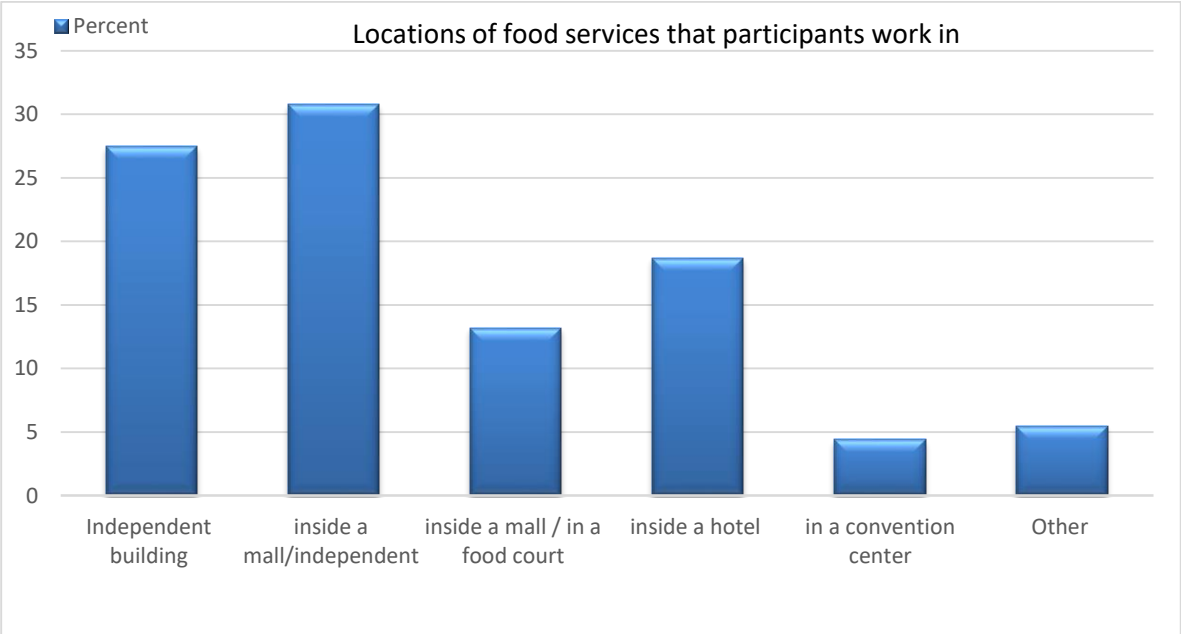


Figure 30 Locations of food services the sample is working in

4.2.2 Awareness of Food Waste

Similar to what was mentioned in section 4.1.2, different groups of questions were asked to assess the sample's awareness, including general and Dubai-related information. The general sample's awareness about food waste's impacts is very high; above 85% agreed on knowing them. Moreover, the results showed that they are highly caring for their environment and willing to make a change to reduce food waste if their companies help them, at more than 98% agreement. The questions they were asked included Q1, "Do you know that the UAE wastes around 224kg of food per person each year, one of the highest numbers globally?" Q2:" Do you know that food waste contributes to significant environmental, social, and economic problems such as natural resource loss, food insecurity, and methane gas emissions that contribute to global warming?" Q3 is "I care for the environment", and Q4 is "I am willing to make a change even if simple, starting with myself", figure (31).

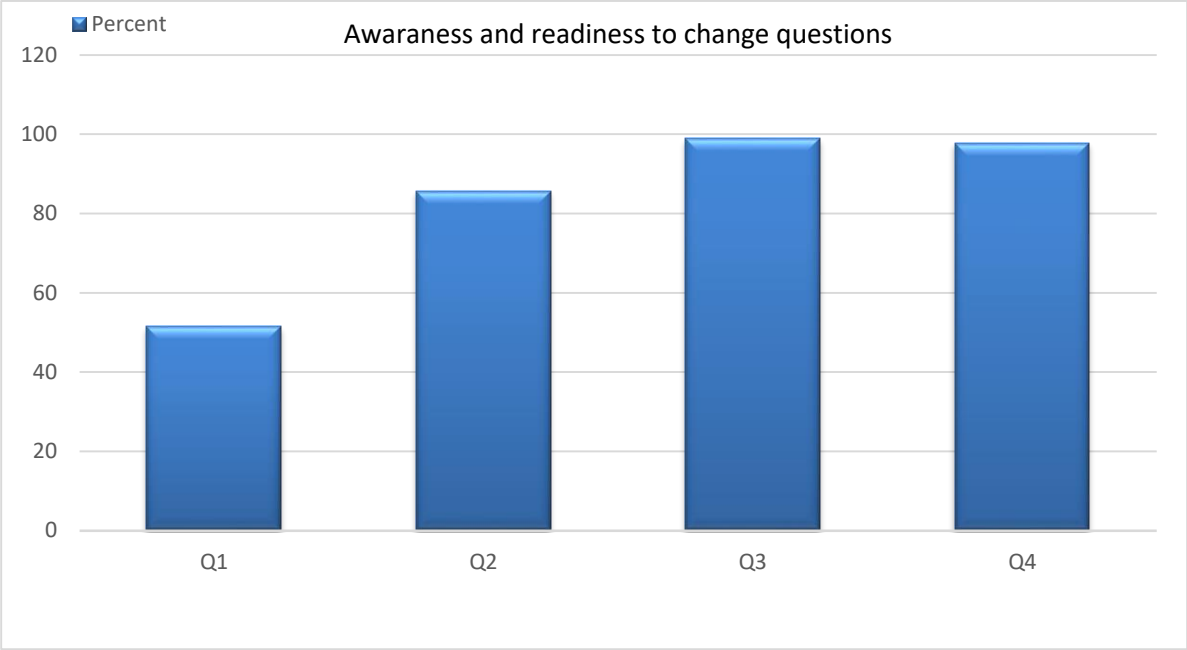


Figure 31 Percentages of participants' agreement to the awareness questions

However, the exact numbers of waste in the emirate of Dubai were unfamiliar to most, as less than half of them only confirmed their knowledge about wasting 224 kg/capita/ year (Kohli 2021), Q1. Besides, 33% only chose the exact numbers of waste quantities (between 360-600g / 133-244 kg and more than 600g / 224 kg). The results of the other options were distributed almost evenly, showing the uncertainty of their answers for the exact quantities, figure (32). The level of awareness on this group of questions was low in general.

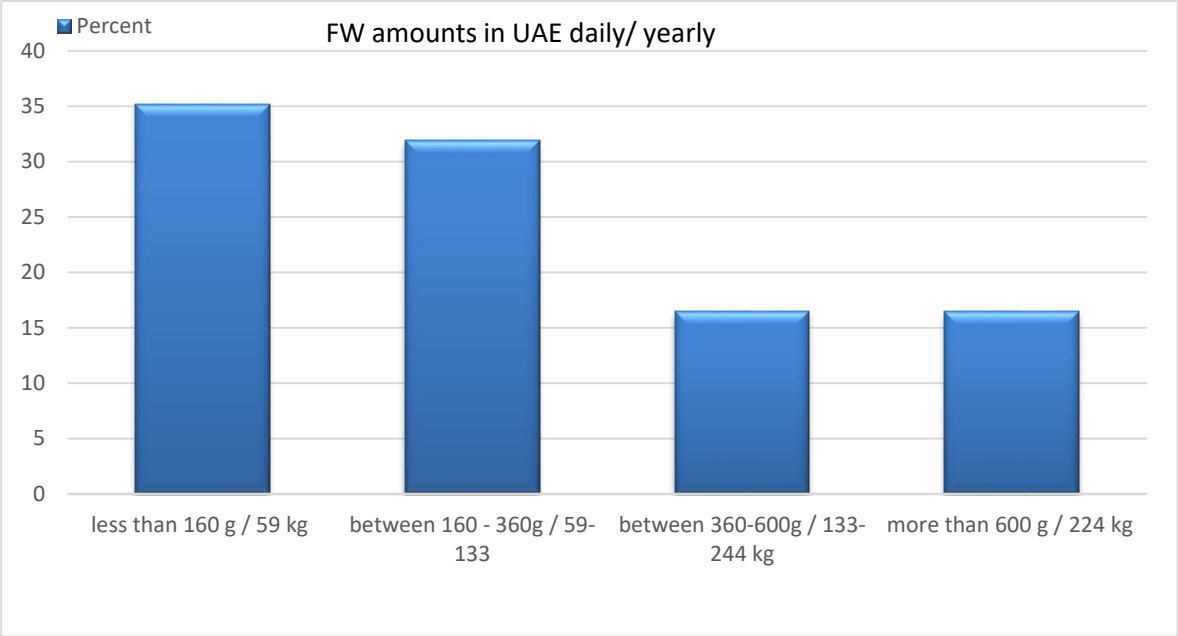


Figure 32 Amount of food wasted in UAE per person daily (g)/ yearly (kg)

This sample's awareness about the available institutes is better than the guests' awareness as they may be dealing with them already. This can be seen as the least percentage did not know about the institutes concerned about food waste in the emirate of Dubai, about 11.8%. At the same time, the others knew of at least one. The most famous one was the Ministry of Climate Change and Environment, figure (33).

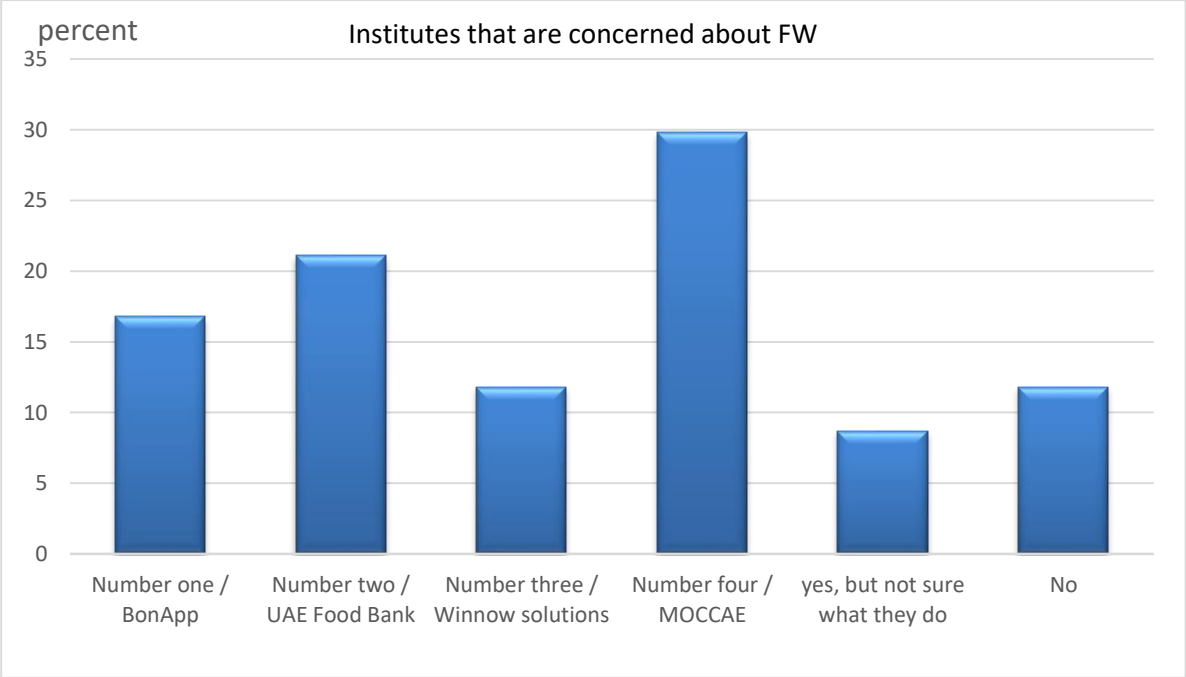


Figure 33 Percentages of participants who heard about the institutes that are concerned with FW

The three groups of awareness questions mentioned before resulted in high awareness of the general information about FW impacts and willingness to change, low awareness in the second group of quantities and increased awareness in the third group about available institutes, generally revealing a good level of awareness.

4.2.3 Causes of Food Waste

Similar to what was mentioned in survey one, the causes could be categorised as causes from the customers' side, from the food service side and other factors leading to food waste, including months, days of the week, events, and type of food service.

Starting with the factors, the agreement about the most wasting type of food service to be the "Buffet restaurants" was above half, at 63.7%, figure (34). The employees related the high wastage of food in buffet restaurants to some policies specialized to that type of service. The most policies they see contributing to food waste are the policy of "filling the food until 15 minutes before closing" and "refilling the dishes before fully consumed". The "Cooking of too many options and stations" policy was reported to have the lowest agreement to the most contributing reason to food waste, at a (Mean=3.11), table (19).

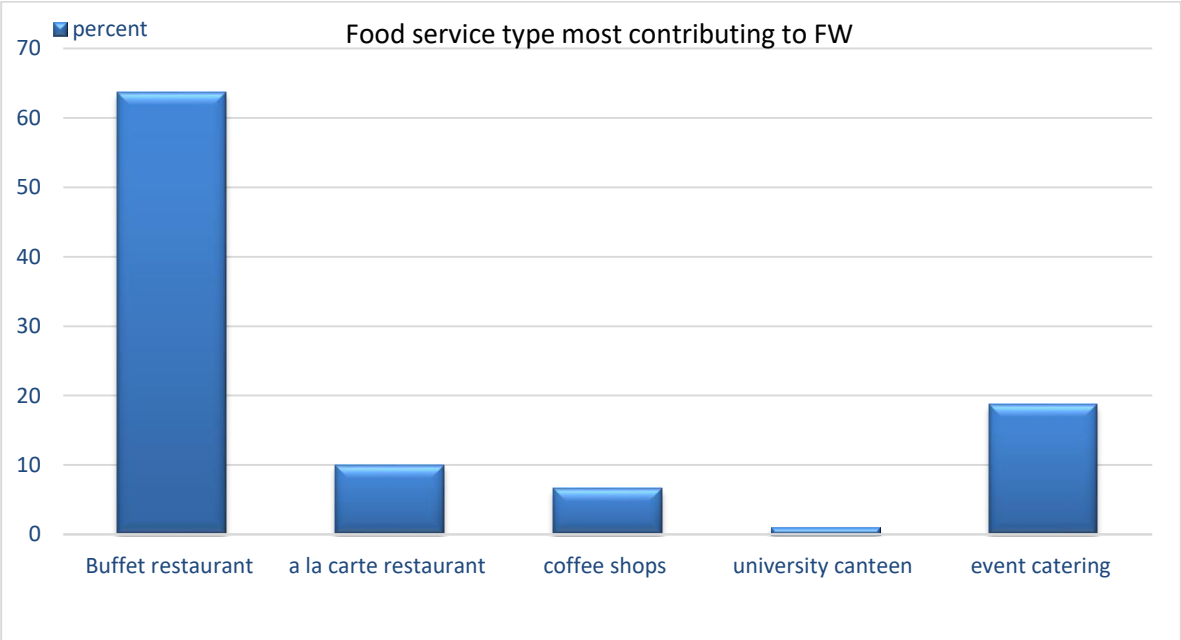


Figure 34 Type of food services the participants think to contribute the most to food waste.

Table 19 Means and standard deviations for participants' agreement of each policy's contribution to FW

Statement	Mean	Std.
Food is refilled until 15 minutes before closing	3.53	1.238
refilling the dishes before fully consumed	3.49	1.216
adding 30% extra food for the wrong forecast	3.37	1.325
disposing of all food after 4 hours	3.33	1.212
preparing some types of food one day before	3.20	1.200
cooking too many options and stations	3.11	1.271

Food waste could be affected by the days and months of the year as it may include some events and gatherings. The winter quarter of the year, including "December, January, and February", took the highest percentage of the sample's agreement on its effect on food waste increase. This is related to different events at that time, including the Dubai winter Shopping Festival, religious festivals and schools' vacations. The effect of the events' contribution to food waste increase was agreed on by 73.6% of the participants as the main effect besides better weather at that time.

The second chosen quarter to contribute to the most food waste was the summer season, including "June, July, and August"; it shares similar events as the first option, mainly the Dubai Shopping Festival and the school's vacation, figure (35). At the same time, most of the people who selected the other quarters agreed that the Holy month of Ramadan is a significant food waste contributor, at (80%).

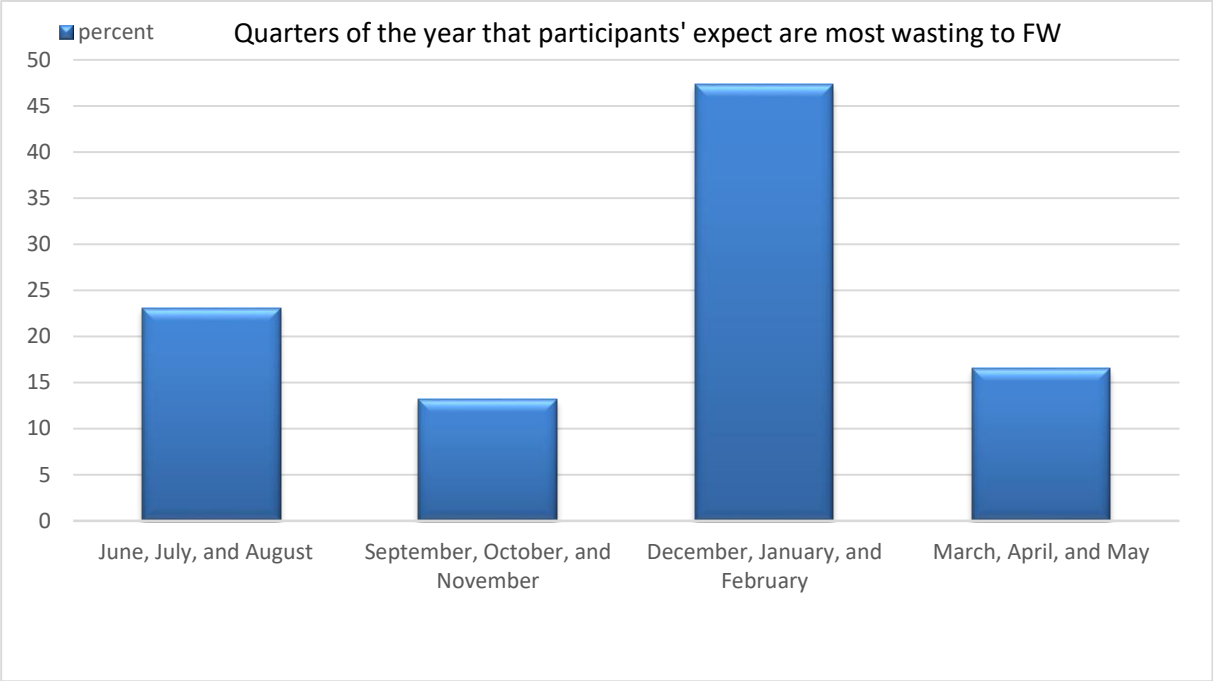


Figure 35 Percentage of employees' expectations for the most wasting months of the year

Days of the week also can be a contributory factor to food waste. Most participants (71.4%) agreed that the weekends are the central part of the week to cause FW as people may have more time to go out and experience different food services, figure (36).

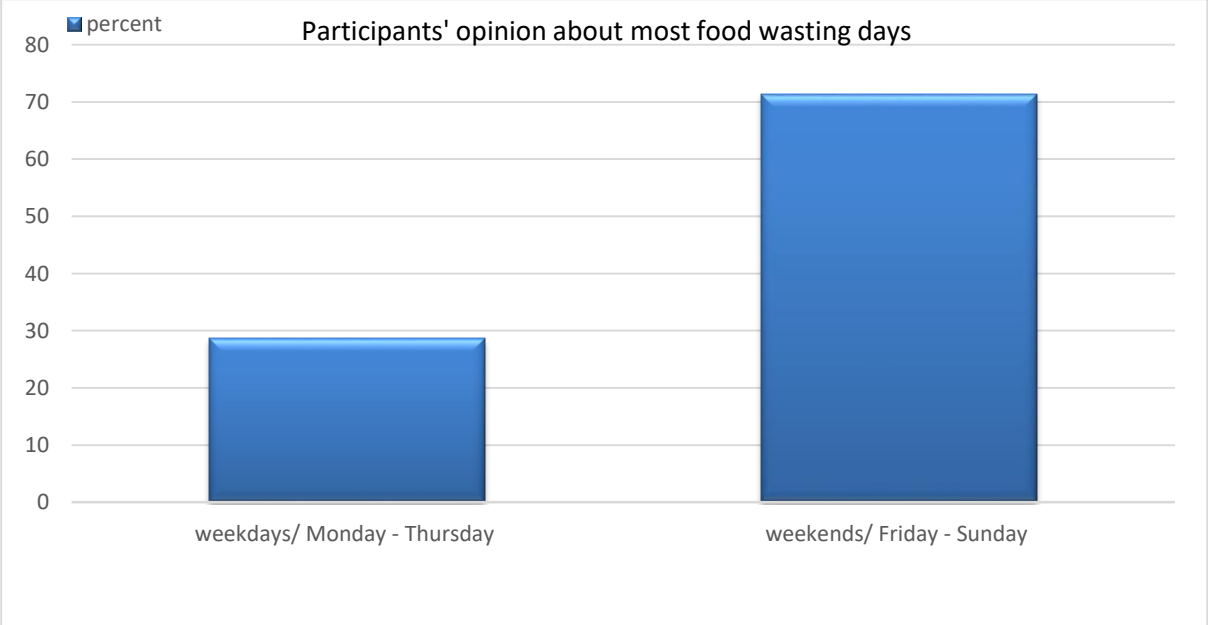


Figure 36 Percentage of employees' expectations of the most food-wasting days of the week

Reasons from the food services side had medium to a high agreement, with the mean scores ranging between 3.22 and 3.68 from the employees' point of view. The cause of "poor planning or forecasting" was at the top of the list, followed by "over-production" and

"customer plate waste". The latter cause is a significant part of the hotels' food waste study by Mabaso & Hewson (2018). However, they reported the lowest agreement to affect the increase in FW with (Mean=3.22) on the causes of "food presentation and preparations" and "low meal prices & many choices", table (20).

Table 20 Means and standard deviation of employees' agreement with the causes of food waste from food services

Causes from food services	**Mean**	**Std**
poor planning or forecasting	3.68	1.228
over-production	3.67	1.184
customer plate waste	3.67	1.250
depends on meal-time	3.53	0.877
storage and expiration dates	3.46	1.177
cooking skills/staff errors	3.45	1.241
low meals prices & many choices	3.22	1.120
food presentation and preparations in a special way	3.22	1.116

The participants were passionate about adding some other reasons they see increasing food waste from their opinions, such as food photo-shooting, offering significant portions, being late for delivery, having improper stocking rotation, suppliers' problems and specific staff errors such as not paying attention to customers' specific requests and giving wrong orders which lead to rejecting the food. Moreover, the season plays a role where some hours or days have a slow operation, resulting in wasting some food ingredients with a short shelf life.

On the other hand, eight causes of food waste from the guests' side were presented to the employees to choose their agreement with the most contributing to FW. They agreed

mainly on being offered a significant portion or plate to fill as 21.2% agreed on it, followed by having a variety of foods, so they ordered more, at 20%. While low prices and not declaring food allergies were the least contributing to FW, as 4.7% of the sample chose it, table (21). Moreover, the employees added some other causes they see as necessary from their opinion, such as the parents who allow their kids to spill or destroy the food eye craving and cultural habits, distinctive/unexpected taste, and changing their order or cancelling it at the last minute.

Table 21 Percentages of employees' agreement on reasons why customers (guests) leave food waste on their plates

Causes/ customers	**Frequency**	**Percentage**
big portions / big plate size	50	21.2
more varieties of food and menu choices - I order more	47	20
lack of awareness	31	13.1
generosity and wealth in over ordering	30	12.7
tourist behaviour - try most options	30	12.7
they do not like the taste	24	10.1
low prices of food	13	5.5
not declare about allergies/ religious restrictions	11	4.7

4.2.4 Food Waste Prevention Strategies

Prevention strategies that could be used in food services are divided into kitchen and serving area strategies. These strategies were concluded from the read international and local papers in sections 2.3.1 and 2.4.1 in tables (7-9) and (13,14), respectively. In the kitchen, chefs must be aware of expiration dates and the differences between "Best before" and "used by" dates to not through food items that are good to consume and must be trained to have good cutting skills and not waste food. Mabaso & Hewson (2018) insisted on the importance of using a FIFO (first-in-first-out) system in storing food items to prevent wasting them. This system

was confirmed to be used in 95.6% of the food services surveyed in this paper, showing a good level of awareness in their outlets. Moreover, having a monitoring system and maintenance for the storage's cooling and heating systems to prevent food damage is highly important, as over 93% of the sample agreed on using it. Another kitchen strategy was assigning one person to throw the unqualified or damaged foods as it could be misleading to have different people for that purpose and cause more waste, used by 62.5% of the sample. All the strategies were confirmed to be used in the outlets with a good percentage, adding to the good knowledge about the beneficial management practices in food outlets in Dubai. However, their agreement on having many team members cut the food may not help reduce food waste, at 65.9%, figure (37).

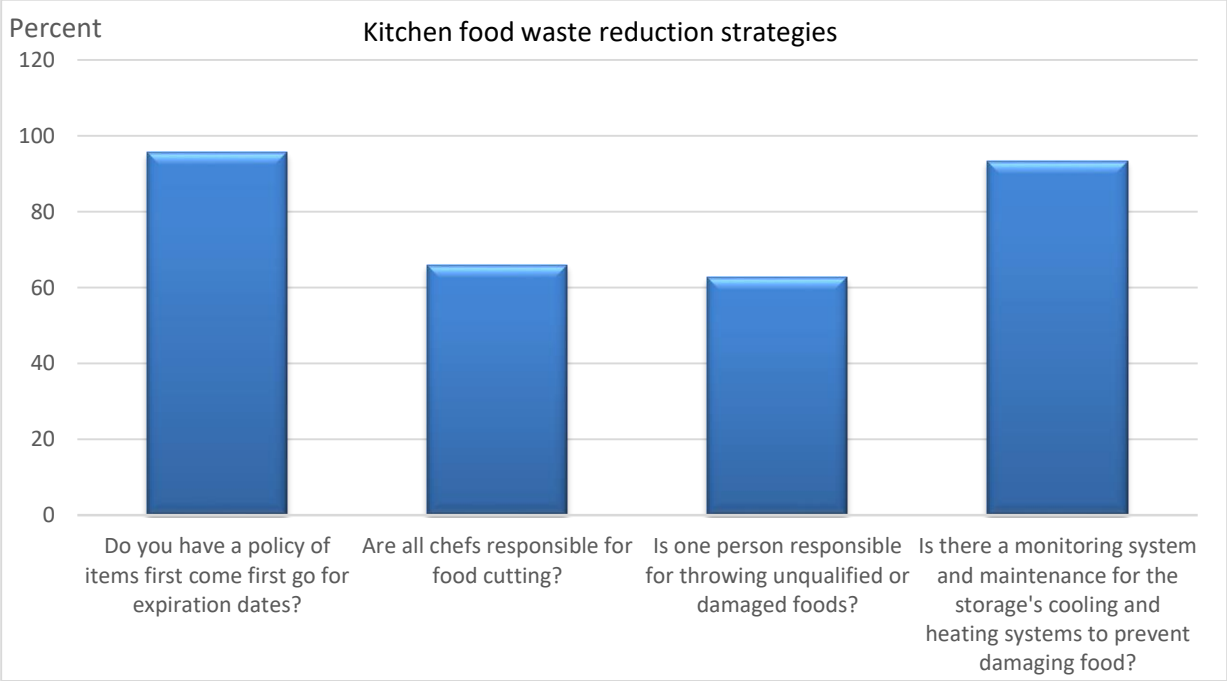


Figure 37 percentage of the participants who agreed on these kitchen strategies

The participants were asked whether they were implementing recovery strategies in their outlet; they were given supplementary questions depending on their answers. Half of them confirmed having food recovery strategies, mainly using food waste separation/ composting, followed by using it as staff meals and donating the untouched food to charities and food banks, figure (38). However, many great food and coffee chains with hundreds of branches in Dubai did not offer the latter strategies, and their employees resented that. Their management's policy was to throw the entirely edible, packaged food after two days in the

bin rather than giving it to their staff or needy people, per the informal meeting with the researcher.

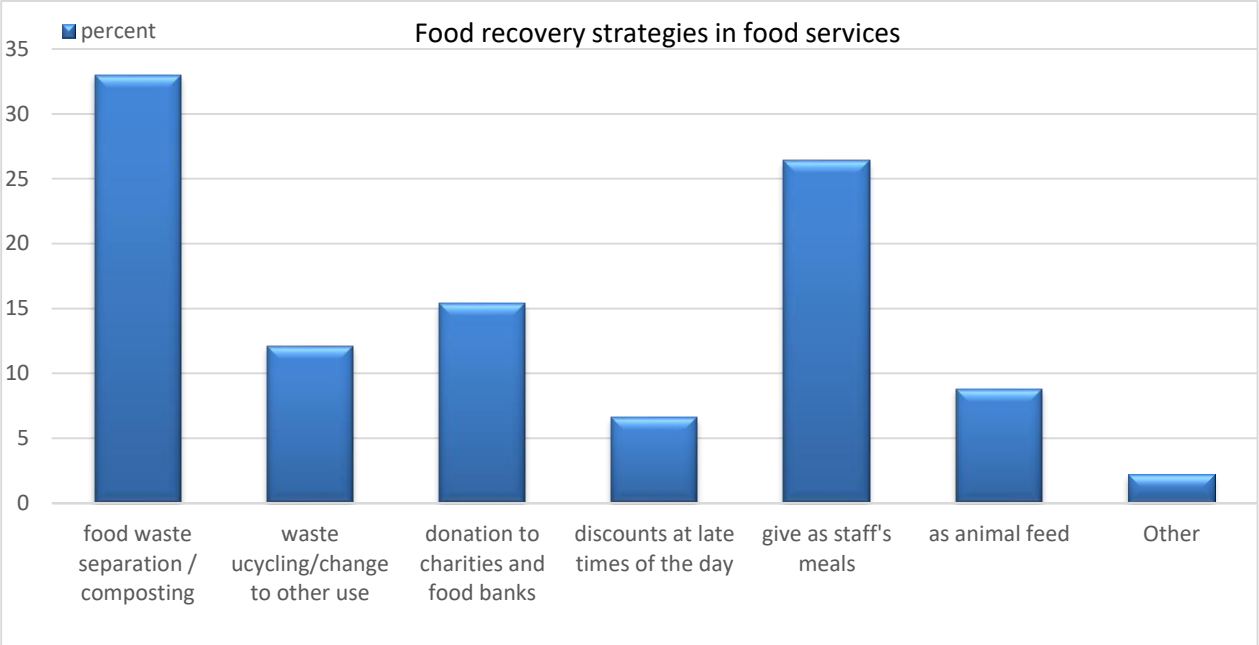


Figure 38 Percentages of used recovery strategies in the food services of Dubai

However, the food services that were not using recovery strategies were asked about the reason for not implementing such practices. It was found that lack of awareness, unavailable enough space, and unidentified available methods are the top barriers, besides adding other barriers from the participants like hygienic and safety purposes and the lack of official standards and laws, figure (39). However, they showed high interest in learning about the available strategies and using them if explained to them, at 70%.

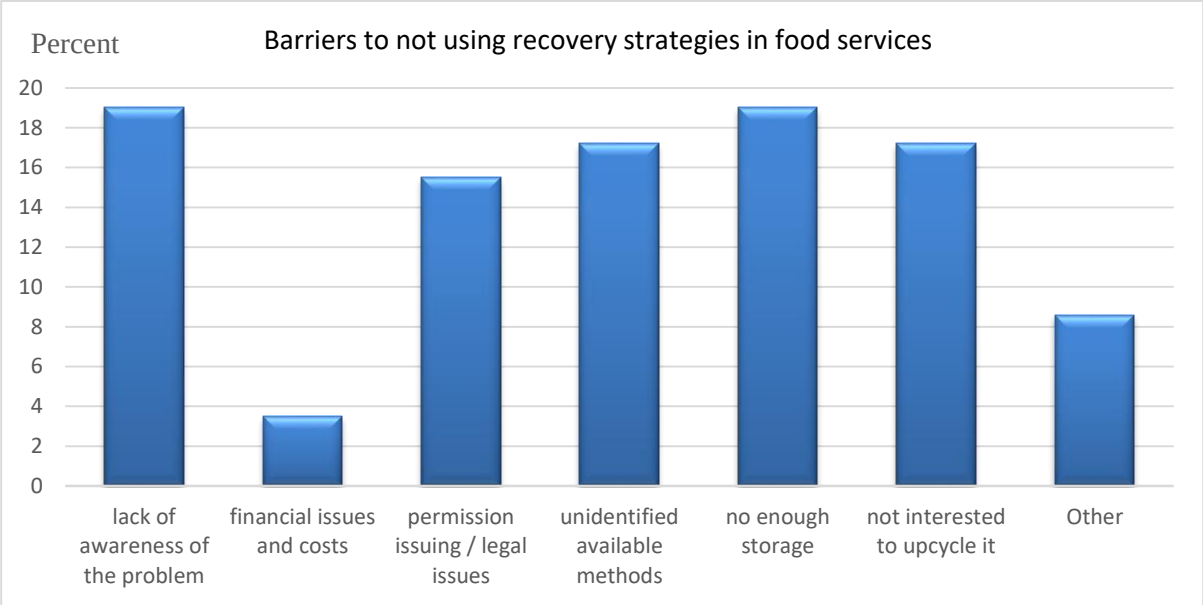


Figure 39 Percentages of an agreement to the barriers to not using strategy to recover food waste (after being wasted)

Most food services agreed on using prevention strategies and gave their medium to high agreement ranking on the prevention strategies presented to them that could be used in their outlets. The highest level of agreement (Mean=4.04) was to the strategy of offering "workshops for staff to improve skills". This is also clear as 84.6% of them emphasised their interest in taking such workshops. The second strategy was studying customers' behavior to lower portion and plate size, at (Mean= 3.91). At the same time, they reported the lowest agreement (Mean=3.38) on the strategy of " fruit to root/use all parts of food" and "low meal prices & many choices", table (22).

Table 22 Means and standard deviations of the participant's agreement with the efficiency of the strategies to prevent food waste

Strategy	**Mean**	**Std**
workshops for staff to improve skills	4.04	0.965
study customer behaviour /portion sizes	3.91	1.071
better storage for food items	3.91	1.170
exact forecasting and planning	3.85	1.053
Technology, ex. smart scales like Winnow	3.78	1.020
incentives for staff and guests to reduce food waste	3.74	1.124
Encouraging messages/menu design	3.67	1.076
encouraging doggy bags/ takeaway bags	3.56	1.240
fruit to root/use all parts of food	3.38	1.209

The waiters themselves can affect preventing food waste if they make some effort. They were asked if they would inform the customers about some things, such as if the ordered plates are enough for them as they know the portions better, and explain about its ingredients so no exchange or surprises may happen, if they may show the guests photos of the food waste impacts, and ask the guests to take their leftovers home to find out that almost half of them only agreed to these. All actions were agreed on by above 43% of the sample, figure (40). This is similar to what WRAP (n.d) suggested, as training the staff to inform people about food portions, ingredients and cooking techniques will lead them to take the right decision. In contrast, the majority refused to let them pay extra charges for waste, at 74.7%, similar to what was mentioned in Jones (2017), where few employees were cautious

about customers' reactions if they explained to them about food waste, as some did not see the problem as massive as it is because they only see their plate.

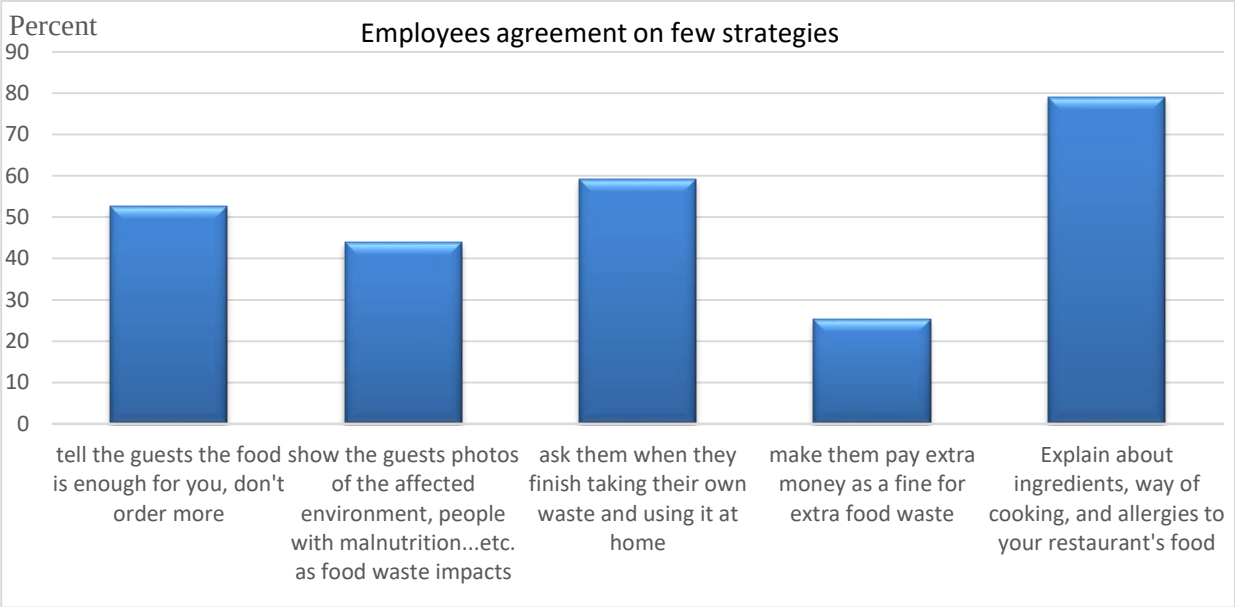


Figure 40 the agreement of the employees to offer the guests a few strategies.

Motivation strategies that the food services could offer are a lot. The most desirable and easy ones are: using messages on screens or table mats, at 21.1% and giving smaller portions and plates, at 17.6%, which the employees approved, table (23). While the least favored motivation was raising the prices as it could raise complaints about the outlet and lower guests' satisfaction, and it was refused in previous sections where raising the prices was the least favored one.

Table 23 Percentages of customers' agreement on the most efficient motivations that can be offered to reduce food waste

Motivation strategies	**Number**	**Percentage**
messages on screens or menus	43	21.1
smaller portions / smaller plate size	36	17.6
Incentives and cost offers on recent or next visit	33	16.1
less menu options	24	11.8
weighted buffets/pay for chosen food	20	9.8
design of beautiful doggy bags	19	9.3
mixed buffets /starters buffet and on-demand main dishes	19	9.3
I do not want to give motivations to lower food waste as it lowers my benefit	6	3.0
higher prices for food dishes	4	2.0

At last, the employees were optimistic about the possibility of change to prevent food waste and save the environment and society. However, the majority (55%) agreed on the importance of having governmental and strict policies to start a firm change, besides agreeing on the possibility of creating a general framework for all of Dubai's food services to follow, figure (41).

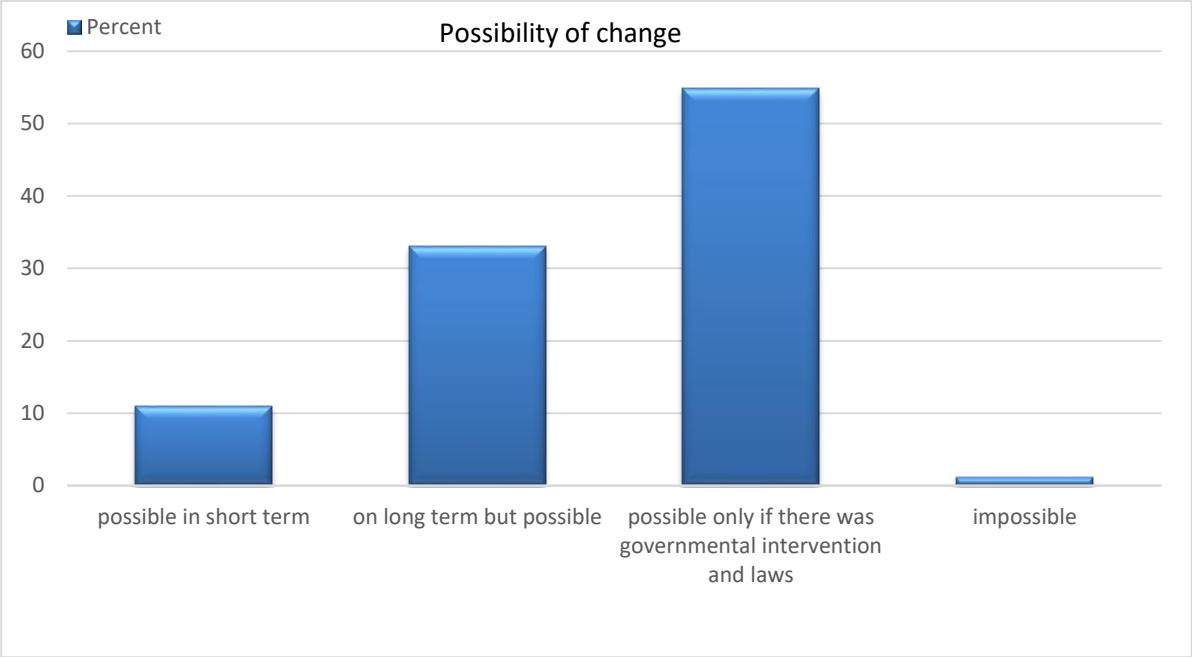


Figure 41 Possibility of change to prevent food waste from employees' point of view

4.3 Data Analysis and Discussion

4.3.1 Awareness on Food Waste Comparison

It was noticed that the levels of awareness of the whole sample (employees and guests) about the FW problem and their willingness to change are high, consenting tacitly to the implementation of the suggested prevention strategies of the research. However, according to Jones (2017), the environmental impacts do not supposedly wake people's consciousness to reduce food waste where it could be the least as other reasons, especially saving money, could be of more importance for them.

The knowledge of the sample about the amount of wasted food in UAE, around 600g / 224 kg per capita per year (Kohli 2021), was very low as only a third of them got close numbers, and around 70% confessed not knowing the exact quantities. This shows that some specific information is not available for the people and needs to be spread through accepted ways, such as the use of "messages on screens or menus, and workshops on food waste impacts/or on upcycling leftovers", which were accepted by the participants to work as motivators to reduce FW.

The awareness about the availability of institutes concerned about food waste was shown to be higher among employees than among guests, as the majority (around three quarters) confirmed knowing at least one of them. This goes back to the nature of their work as the employees deal more with such institutes. This will make it easier to implement and

encourage FW reduction strategies through the platforms of these institutes as it will touch the viewers easily and gain their trust to start the change.

One of the useful strategies to be implemented is the use of smart scales like winnow. This was proved to prevent high food waste in hotels like Hilton and Fairmont in UAE. Unfortunately, the knowledge about this scale was proven to be low between guests in different questions as it took one of the least efficient strategies to prevent FW. While between the employees', which is more important, the knowledge about it was better but with medium level. This needs to be improved significantly between employees and food services management as it is an easy, helpful prevention strategy.

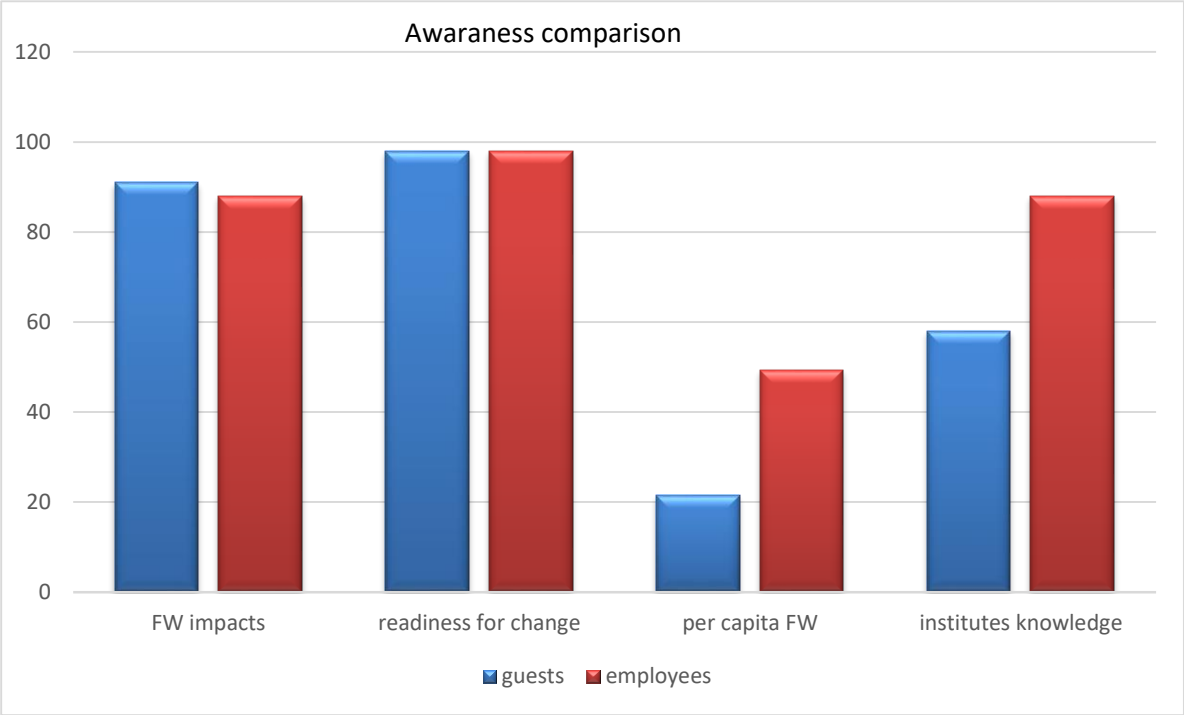


Figure 42 awareness percentages comparison between guests and employees

The overall employees' awareness seems to have higher levels, figure (42). This may be referred to as the work done through the institutes concerned about food waste and environmental problems, besides the work of the food services themselves in spreading awareness among its employees for the financial and environmental benefit.

4.3.2 Causes of Food Waste Comparison

All the samples highly agreed on the effect of buffet restaurants, as one of the food services' types, on the increase of FW. Mainly this is due to some of its policies, such as "refilling the dishes before fully consumed" and "refilling food until 15 minutes before closing", which most participants agreed on. This was confirmed by Papargyropoulou et al. (2016) in their

study that buffet restaurants generated more waste than others when they quantified the FW generated by it, especially leftover waste.

A way to solve this problem or reduce it is to use weighted buffet types or mixed buffets (Eckert Matzembacher et al.2020). When people pay for the exact amount they take from weighted buffets, they will be more careful and choose what they really might like and the amount they can eat. When they attend a mixed buffet which uses open one only for sides and a la cart for main courses, it will lower the food waste a lot; aside from applying the prevention strategies in reducing the size of the display dish, offering smaller plates and reducing the use of cut foods.

Moreover, more than half of the sample added some personal comments to show their concern about the subject. They related the FW in buffets to humans' feelings of greediness, lack of commitment, extravagance, lack of awareness of the FW problem or their health…etc. Besides, different problems from the management of the restaurants, including the decreased quality of the food while displaying huge, unstudied food quantities, prioritizing profit over everything, lack of control and punishment…etc.

Half of both participating samples selected the winter season of Dubai in the months of "December, January, and February" to be a reason for the increase in food waste. This is referred to as the increase in tourist numbers. According to GULFBUSINESS (2022), the number of foreign and domestic tourists this season increased tremendously (more than 25 million tourists). This increase caused a rise of about 50% in the hotels' revenue after the campaign "World's Coolest Winter" started in 2021, referring to better weather. Consequently, raising the food waste amounts as agreed by the majority of the guests and about half of the employees. However, the second quarter to be most wasting of food was "June, July, and August", which could be referred to as the schools' vacation season in the Emirate at that time, besides the "Dubai Shopping Festival", as mentioned previously.

While the Holy Month of Ramadan came as the reason why part of the participants chose the quarter of the year "March, April, May" as the third most food-wasting quarter; this is confirmed by the report of *dcce* (2019), where food waste reached around 60% during the Holy month of Ramadan that year. Moreover, both samples showed a high agreement on the effect of weekends on increased FW. Primarily due to vacations and people having time to go out more and use the food services.

The guests and the participants agreed that many different causes have similar levels of importance, from top to least. Four out of five reasons to have the utmost importance for them both, such as having “big portions/ big plate size”, “lack of awareness”, “generosity and wealth”, and “tourist behavior”, are highlighted in the table (24), yellow color to the causes at similar ranks and green color for similar causes but in different rankings. This raises the accuracy of the results as both sides agreed on the same most and least affecting the FW. Generosity in over-ordering is one of the main cultural habits in people, mainly in Arab countries. Baig et al. (2019) confirmed that this problem in KSA contributes to the massive amount of food waste, above 70% in the household.

Table 24 ranking of the causes of food waste from top wasting to least by the opinions of guests and employees

Causes/ customers	**Guest**	**Employees**
1	Taking big portions	Offering big portions / big plate size
2	generosity and wealth in over ordering	more varieties of food and menu choices - I order more
3	lack of awareness	lack of awareness
4	I do not like the taste / unexpected quality	generosity and wealth in over ordering
5	tourist behaviour - try as many available options	tourist behaviour - try most options
6	more varieties of food and menu choices - I order more	they do not like the taste
7	un-wanted food sides like decoration items of vegetables and sauces/food type	low prices of food
8	not declare about allergies/ religious restrictions	not declare about allergies/ religious restrictions
9	low prices of food	-
10	I do not see it as a big problem.	-

From the view of both guests and employees, the top reasons for food waste from the services are “the poor planning and forecasting” for the number of visitors, causing the extra preparation of food and extra waste. They also agreed that staff errors and skills are one of the least affecting reasons for increased food waste, table (25). Highlighted colors, such as yellow, show causes at similar ranks and green and blue colors for similar causes but in different rankings. This also can be seen in table (24) as the employees did not choose the “unexpected quality and taste” related to staff skills to be one of the most affecting FW, where it took the same level of none much importance (ranking #6) in both sides of the issue; customers and food services.

Table 25 ranking the causes of FW from food services from the point view of guests and employees

Causes/services	Guests	Employees
1	poor planning or forecasting	poor planning or forecasting
2	food presentation and preparations	over-production
3	storage and expiration dates	customer plate waste
4	over-production	depends on mealtime
5	menu's many choices	storage and expiration dates
6	unqualified cooking skills/ staff errors	cooking skills/staff errors
7	-	food presentation and preparations in a special
8	-	low meals prices & many choices

The top agreed cause of both the studies by Pirani & Arafat (2016) about the hospitality sector in the Emirate of Abu Dhabi/ UAE and this study was the faults in forecasting and planning that led to FW increase from both points of view of guests and employees about food services faults. Followed by the agreement with the guests’ sample that the serving

style of the food and presentation also led to undesirable FW increases and the time of meal with the employees. While they disagreed that the food varieties have a significant effect on it. The slight difference in the opinions of food services in both Emirates of the UAE may be referred to as a different perception of the participants of the surveys and the time of publishing of the paper; as for FW research, causes and strategies differ rapidly by time. Moreover, the disagreement could be referred as explained by Mr. D when interviewed, that the different varieties of food from the same cuisines not supposedly increase the food waste as people will choose what they want, while having different cuisines may let them want to try different dishes from each cuisine and contribute to food waste. Comparison summary is shown in figure (43).

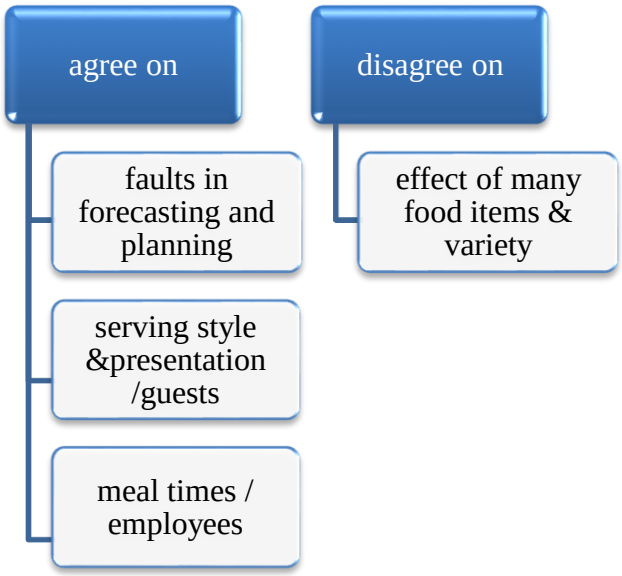


Figure 43 Comparison of top causes of FW by Pirani & Arafat paper in Abu Dhabi and this paper about Dubai

The faults in planning and forecasting were mentioned in most of the papers shown in sections 2.3.1 and 2.4.1. in contrast, the effect of food presentation and serving style was confirmed to have an effect, especially in ethnic restaurants such as Chinese ones, as mentioned in Filimonau, Nghiem & Wang (2021), as some cuisines need special presentations to attract guests.

It was also found that the employees considered a lack of awareness of the problem not only as a cause of food waste, as mentioned previously but also as a barrier to not implementing food waste prevention strategies in their services.

Besides having other barriers which are categorised as manageable and unmanageable. The former is like not having enough storage space and getting legal permissions, while the unmanageable one is that around one-fifth of the participants were not interested in doing it. This may be due to their limited, short-term thinking about the momentary costs other than saving the environment for a sustainable future for all and profit in the longer term, which also shows a lack of awareness and knowledge.

4.3.3 Food Waste Prevention Strategies Comparison

The employees of the sample agreed on the most critical strategy to prevent food waste that could be done from the food service side, which is to offer workshops for the staff to improve their skills and awareness, followed by better storage for food items and studying customer behaviour to reduce portion sizes depending on how much waste they leave in their plates. Workshops' importance is also supported when 84.6% of the employees agreed on their interest in taking these workshops when asked about it. At the same time, the other strategies had medium to a high agreement when their means were compared, which also shows their importance.

Mabaso & Hewson (2018) mentioned, in their research about employees' point of view of FW, that the best prevention strategies to be implemented in hotels start with building good relationships between the management and the staff. Loving the space forces the employees to take care of it and affects their behaviour in it in alignment with their cultural beliefs. They also agreed with the research's results about the efficiency of giving workshops for the staff to explain the ways for proper FW management, awareness increase and better storing and handling of food items. Developing the staff's awareness about this topic will come back as a financial benefit and reduce the impacts of FW. They added the strategy of encouraging guests to take leftovers which also was one of the critical mentioned strategies from the view of the guests in this research.

Comparing the opinions of both sides of participants about the best strategies to prevent food waste found that they agreed on three similar top essential strategies out of five but not in the same ranking. The strategies are having "better storage and handling", "studying customer behaviour to adjust portion sizes and "better forecasting and planning". Portion control is one of the most preferred strategies to implement in the hospitality sector as it is quickly done but needs studying the behavior and waste type. It was mentioned in Filimonau, Nghiem & Wang (2021), (Talwar et al. 2021) and in (Okumus 2019). Highlighted colors,

such as yellow color shows preferred prevention strategies at similar levels and green and blue colors for similar ones but in different rankings, table (26).

Table 26 the ranking of the most to least efficient FW prevention strategies from the guests' and employees' perception

Strategy	Guests	Employees
1	encouraging doggy bags/ takeaway bags	workshops for staff to improve skills
2	better storage and handling	better storage for food items
3	encouraging messages/menu design	study customer behaviour /portion sizes
4	study customer behaviour /portion sizes	exact forecasting and planning
5	better forecasting and planning	technology, ex. Smart scales like Winnow
6	fruit to root/use all parts of food	incentives for staff and guests to reduce food waste
7	incentives for staff and guests	Encouraging messages/menu design
8	better departments communication	encouraging doggy bags/takeaway bags
9	using technology ex. winnow or smart scales	fruit to root/use all parts of food

It was clear from the responses collected that the acceptance of some strategies from both views is high. More than 69% of the guests' participants accepted the idea of allowing the waiters to inform them whether the food was enough for them or not, to explain to them about food's ingredients, and the strategy of displaying some messages about food waste impacts besides choosing it also as a motivator to reduce FW. However, the strategy suggesting reducing the plate size of the food items did not get much acceptance from the guests' point of view as others did. However, it saves 20% of FW, mainly in buffet restaurants (Al-Obadi et al. 2022). This information must be educated to the people as this small strategy can help reduce FW with minimal effort.

On the other hand, the acceptance for the employees, as waiters or management, to tell the guests not to order food was shown, but not with a very high percentage as they are afraid to distress the guests' pleasure which is a priority in food services. However, the strategy of using FW impacts' pictures on the screens or menus was refused by 56.1% of them as they

knew the harshness of these impacts and imagined the unpleasant effect of displaying such pictures about famine, global warming...etc. on their guests.

The strategy that allows food services to encourage and promote the use of doggy bags/ takeaway bags was the top preference for the guests. This will make it easier for food services to implement besides confirming their readiness to ask the guests when they finish eating to take their waste (leftovers) home. Most of them accepted the idea, which means this strategy can easily be implemented in the food services of Dubai, as mentioned in (Jones 2017), (Talwar et al. 2021), (Al-Obadi et al. 2022) and others.

Moreover, more than 87% confirmed taking their leftovers home already, showing the good level of awareness discussed previously. Perhaps using doggy bags alone is not a prevention strategy, but encouraging it by food services may force some people who are shy to take leftovers home not to order extra food, which, if done, may put them in a disliked situation. Thus, offering well-designed doggy bags will work as a great motivator for the guests as they agreed to occupy the second level in the most efficient motivators to reduce food waste. This is also studied by Talwar et al. (2021), where some restaurants in the US encouraged this idea by packing the leftovers in fun boxes such as tinfoil swans or colored ones to encourage its usage.

The food services refused the idea of making the people pay fines for extra food waste because they are scared of losing their clients, even though it is used in some food services in countries like Jordan. On the other hand, it was studied by Filimonau, Nghiem & Wang (2021) that the same idea, which is called ‘pay-as-you-throw’ must be used for business owners, not only guests, to keep them aware and conscious of not being fined for wasting food and find alternative solutions accordingly.

Regarding the FW reduction motivator of using “encouraging messages and menu design”, it occupied the highest agreement among employees. It was confirmed by the guests to have a good effect that could be quickly done in an enjoyable way that will not hurt the feelings of the visitors and spread the message. This initiative is already started by Goumbook institute in the buffet restaurants of some hotels in Dubai, figures (44).

Figure 44 messages displayed by Goumbook organisation in a buffet restaurant in Dubai as a prevention strategy (Goumbook)

Table (27) summarises the sections before with top causes and prevention strategies agreed on by guests and employees. The researcher suggested the similarity range. A high similarity is given for typical answers, and a medium to high is given for answers with three similarities out of four. The medium similarity is for two similar answers out of four, and the low similarity is less than this.

Table 27 summary of the top leading causes of FW and strategies to reduce it from the point view of the whole sample

			guest	***employee***	***similarity***
causes	factors	Months	Winter months	Winter months	high
		Days	weekends	weekends	high
		events	Ramadan, DSF, Schools vacation	Ramadan, DSF, Schools vacation	high
		gender	No	-	N/A
		Type	buffet	buffet	high
	customers		portions erosity &wealth ɛ of awareness not like the taste	- Big portions - Variety of foods - Lack of awareness - Generosity/tourist	Medium to high
	Food services		planning l presentations age and expiration s rproduction	- Poor planning - Overproduction - Customer plates - Meal times	medium
strategies	customers		Accepting: ters' advice on the unt of ordered food cing plate size laying of impacts on ens	Employees acceptance: dvice on the amount of red food, ingredients leftover take.	medium
	Food services		ouraging leftover bag er storage & lling t to root ouraging sages/menu design	- staff workshops - portion size - better storage - better forecasting	low

4.4 Inferential Analysis of S1 and S2

4.4.1 Guests Survey 1 (S1)

In sections 4.1, 4.2 & 4.3, the level of agreement for some questions was tested without further analysis. In this section, the focus of the analysis will be mainly to test whether the causes and suggested strategies for food waste are related to one of the several demographical variables or not from the point of view of the employees and the guests using SPSS program. This analysis is essential to find a trend or pattern that could be generalized to the population if the small sample showed a difference in the tests. Thus, give explanations for this trend to suggest valuable solutions.

In order to complete this analysis, the Kruskal-Wallis H test was used to test if there is a significant difference between two or more dependent variables with one independent variable. Pair-wise comparison using the Bonferroni test was made after comparing each pair of means rank scores to check which is more likely to affect the result.

- **Customer's side**

As seen in table (16), the mean scores of guests' agreement, and the reasons causing food waste from the customers' side, ranged between 2.44 and 3.89, with the medium agreement. This agreement is tested with the important demographical values of the salary, residency, and type of food service to check if these contribute to a difference in results.

- Salary

When the Kruskal-Wallis H test was used, it was found that for the salary, the reasons highlighted in the table (28) differed by it. Therefore, there are statistically significant differences in the means rank scores of guests' agreement about those reasons.

Table 28 Results of Kruskal-Wallis H to test the differences in guests' agreement about the reasons for food waste based on salary

Reason (Dependent variables)	df	Chi-square	p-value
I do not like the taste / unexpected quality	4	5.99	0.200
Taking big portions	4	18.89	0.001
more varieties of food and menu choices - I order more	4	8.82	0.066
generosity and wealth in over ordering	4	11.52	0.021
tourist behaviour - try as many available options	4	14.11	0.007
not declare about allergies/ religious restrictions	4	9.61	0.047
lack of awareness	4	4.40	0.355
low prices of food	4	15.16	0.004
I do not see it as a big problem	4	5.87	0.209
un-wanted food sides like decoration items of vegetables and sauces/food type	4	16.56	0.002

Pair-wise comparisons were conducted to compare the five groups' salaries on their agreement with the reasons for food waste. The results revealed that:

- For the reason of "taking big portions", there is a statistically significant difference between the mean rank scores of the salary pairs ((less than 10,000) and (more than 40,000), (between 20,000-40,000) and (more than 40,000), (unemployed) and (more than 40,000)) groups in favor of the highest salary groups of each pair.
- For the reason "generosity and wealth in over-ordering", there is a statistically significant difference between the mean rank scores of the salary pairs ((less than 10,000) and (between 10,000-20.000), (less than 10,000) and (between (20,000-40,000), (less than 10,000) and (more than 40,000)), groups in favor of the highest salary groups of each pair.
- For the reason "tourist behaviour- try as many available options", there is a statistically significant difference between the mean rank scores of the salary pairs

((less than 10,000) and (between (20,000-40,000)), ((less than 10,000) and (more than 40,000)), groups in favor of the highest salary groups of each pair.

- For the reason "not declare about allergies/ religious restrictions", there is a statistically significant difference between the mean rank scores of the salary pairs ((less than 10,000) and (between (20,000- 40,000), (less than 10,000) and (between 10,000 -20,000)), ((less than 10,000) and (more than 40,000)) groups in favor of the highest salary groups of each pair.
- For the reason "un-wanted food sides like decoration items of vegetables and sauces/food type", there is a statistically significant difference between the mean rank scores of the salary pair ((less than 10,000) and (between 20,000-40.000)) group in favor of the highest salary groups of it.

Generally, these results showed the relationship between the level of guests' agreement on the reasons, which had a p-value of less than 5%, and the demographical variable (the salary) increased with the increase in the salary of the guests.

- Residency (UAE resident, expat & tourist)

Table (29) illustrates the results of Kruskal-Wallis to test the differences in the level of agreement of guests about reasons contributing to food waste based on their residency, p-value of more than 5%. The results revealed that there are no statistically significant differences in residency.

Table 29 Results of Kruskal-Wallis H to test the differences in guests' agreement about the reasons for food waste based on residency

Reason (Dependent variables)	df	Chi-square	p-value
I do not like the taste / unexpected quality	2	0.36	0.836
Taking big portions	2	0.48	0.787
more varieties of food and menu choices - I order more	2	0.06	0.973
generosity and wealth in over ordering	2	0.17	0.917
tourist behaviour - try as many available options	2	5.57	0.062
not declare about allergies/ religious restrictions	2	0.35	0.841
lack of awareness	2	1.17	0.557
low prices of food	2	1.00	0.607
I do not see it as a big problem	2	0.02	0.992
un-wanted food sides like decoration items of vegetables and sauces/food type	2	3.16	0.206

- Type of food service they attend (a la cart, buffet, coffee shop &canteen)

Kruskal-Wallis tested the differences in the level of agreement of guests about reasons contributing to food waste based on the type of food service. The results revealed statistically significant differences in the type of food service only for the reason "more varieties of food and menu choices - I order", table (30). However, Bonferroni correction for multiple tests revealed that there are non-significant differences between each pair-wise comparison.

Table 30 Results of Kruskal-Wallis H to test the differences in guests' agreement about the reasons for food waste based on the type of food service

Reason	df	Chi-square	p-value
I do not like the taste / unexpected quality	3	1.24	0.743
Taking big portions	3	4.63	0.201
more varieties of food and menu choices - I order	3	9.17	0.027
generosity and wealth in over ordering	3	4.21	0.240
tourist behaviour - try as many available options	3	6.67	0.083
not declare about allergies/ religious restrictions	3	5.33	0.149
lack of awareness	3	5.07	0.167
low prices of food	3	1.88	0.598
I do not see it as a big problem	3	5.36	0.148
un-wanted food sides like decoration items of vegetables and sauces/food type	3	6.18	0.103

- Level of the restaurant (high, mid & low)

Kruskal-Wallis test revealed that the guests' level of agreement about the reason "more varieties of food and menu choices - I order more" differ by restaurant level. As such, there is a statistically significant difference in the mean rank scores of guests' agreement only about the reasons "low prices of food" and "un-wanted food sides" of food waste across the level of restaurant categories, table (31).

Post hoc analysis revealed statistically significant differences between the mean rank scores of the two categories (High-end, Mid-end) for the two reasons in favor of the high-end restaurant, which means that the guests who choose to go to the high-end restaurants are choosing the mentioned reasons of FW to increase more so it can be generalized that the unwanted sides in the dishes at this level of restaurants is a big reason for food waste and must be reduced.

Table 31 Results of Kruskal-Wallis H to test the differences in guests' agreement about the reasons for food waste based on the level of the restaurant

Reason	df	Chi-square	p-value
I do not like the taste / unexpected quality	2	1.56	0.459
Taking big portions	2	0.73	0.694
more varieties of food and menu choices - I order more	2	0.26	0.877
generosity and wealth in over ordering	2	1.22	0.543
tourist behaviour - try as many available options	2	1.34	0.513
not declare about allergies/ religious restrictions	2	1.42	0.493
lack of awareness	2	0.67	0.717
low prices of food	2	6.56	0.037
I do not see it as a big problem	2	0.75	0.689
un-wanted food sides like decoration items of vegetables and sauces/food type	2	8.62	0.013

- **Food services' side**

It was clear from table (17) that the mean scores of guests' agreement along the reasons of FW from the food service side ranged between 3.31 and 3.75, with medium to a high agreement. Thus, the increase in food waste by food services (restaurants) had to be tested whether it differs by salary, residency, type of food service, and the restaurant's level.

- Salary

Kruskal-Wallis test revealed that the level of guests' agreement about the reason "food presentation and preparations" differs by salary, meaning that there is a statistically significant difference in the means rank scores, table (32). Post hoc analysis revealed statistically significant differences between the mean rank scores of the two categories, "less than 10,000 and more than 40,000," for that reason in favor of the highest salary. Thus, the guests who chose this reason are mostly those with a salary of more than

40,000AED, maybe because they go to higher-end food services who care about food presentations and may add food items that are only for this purpose, leading to its wasting, table 68.

Table 32 Results of Kruskal-Wallis H to test the differences in guests' agreement about the reasons contributing to the increase in food waste by food services (restaurants) based on the salary

Reasons	df	Chi-square	p-value
over-production	4	7.35	0.119
poor planning or forecasting	4	4.95	0.292
food presentation and preparations	4	10.65	0.031
unqualified cooking skills/ staff errors	4	4.15	0.387
menu's many choices	4	6.03	0.197
storage and expiration dates	4	3.94	0.415

- Residency (UAE resident, expat &tourist)

Kruskal-Wallis test revealed that the level of guests' agreement about the reason (poor planning or forecasting) has statistically significant differences in its means rank scores by residency, table (33). Post hoc analysis revealed statistically significant differences between the mean rank scores of the two categories (tourist, foreigner resident) for that reason in favor of tourists. Thus tourists mostly believe that this reason is the main one for the increasing food waste in food services which must be solved.

Table 33 Results of Kruskal-Wallis H to test the differences in guests' agreement about the reasons contributing to the increase in food waste by food services (restaurants) based on the residency

Reasons	df	Chi-square	p-value
over-production	2	2.08	0.354
poor planning or forecasting	2	6.77	0.034
food presentation and preparations	2	1.03	0.598
unqualified cooking skills/ staff errors	2	4.52	0.105
menu's many choices	2	0.24	0.886
storage and expiration dates	2	1.01	0.603

- Type of food service

Kruskal-Wallis test revealed that guests' level of agreement about the reasons do not differ by type of food service and has no statistically significant differences in the means rank scores, table (34).

Table 34 Results of Kruskal-Wallis H to test the differences in guests' agreement about the reasons contributing to the increase in FW by food services based on the type of it

Reasons	**df**	**Chi-square**	**p-value**
over-production	3	4.16	0.245
poor planning or forecasting	3	6.99	0.072
food presentation and preparations	3	3.26	0.354
unqualified cooking skills/ staff errors	3	3.10	0.376
menu's many choices	3	5.41	0.144
storage and expiration dates	3	1.92	0.589

- Level of the restaurant (high, mid &low)

Kruskal-Wallis test revealed that the level of guest's agreement about the reasons does not differ by the level of the restaurant and has no statistically significant differences in the means rank scores of it, table (35).

Table 35 Results of Kruskal-Wallis H to test the differences in guests' agreement about the reasons contributing to the increase in FW by food services based on the level of the restaurant

Reasons	**df**	**Chi-square**	**p-value**
over-production	2	0.26	0.877
poor planning or forecasting	2	0.07	0.967
food presentation and preparations	2	0.30	0.863
unqualified cooking skills/ staff errors	2	0.11	0.945
menu's many choices	2	0.65	0.723
storage and expiration dates	2	1.00	0.607

- **Prevention Strategies Tests**

Table (18) illustrates each strategy's means and standard deviations to lower FW in food services. The mean scores of guests' agreement along the strategies ranged between 3.64 and 4.22, with medium to a high agreement. Thus, these strategies will be tested to see if they differ by salary, residency, type of food service, and restaurant level.

- salary

Kruskal-Wallis test revealed that the level of guest's agreement about the efficiency of the strategies (encouraging doggy bags/ takeaway bags, better forecasting and planning, study customer behaviour /portion sizes, and incentives for staff and guests) differ by salary and has statistically significant differences in the means rank scores of guests' agreement about the efficiency of these strategies across the salary category, table (36).

For the strategy "encouraging doggy bags/ takeaway bags", post hoc analysis revealed statistically significant differences between the mean rank scores of the two categories (less than 10,000 and unemployed) in favor of less than 10,000 AED salary.

For the strategy "better forecasting and planning", post hoc analysis revealed statistically significant differences between the mean rank scores of the categories ((less than 10,000 and 20,000-40,000), (less than 10,000 and more than 40,000)) in favor of the highest salary.

For the two strategies, "study customer behavior /portion sizes" and "incentives for staff and guests", post hoc analysis revealed statistically non-significant differences between the mean rank scores of the salary categories.

Generally, the guests who earn more salary are the most likely ones to choose the reasons highlighted.

Table 36 Results of Kruskal-Wallis H to test the differences in guests' agreement about the efficiency of the strategies based on salary

Strategy	df	Chi-square	p-value
encouraging doggy bags/ takeaway bags	4	14.79	0.005
Encouraging messages/menu design	4	2.24	0.691
better forecasting and planning	4	13.36	0.010
using technology, e.g. winnow or smart scales	4	1.88	0.757
study customer behaviour /portion sizes	4	16.40	0.003

fruit to root/use all parts of food	4	8.84	0.065
incentives for staff and guests	4	11.93	0.018
better storage and handling	4	6.36	0.174
better departments communication	4	1.41	0.842

- Residency (UAE resident, expat & tourist)

Kruskal-Wallis test revealed that the level of guest's agreement about the efficiency of the strategy (better forecasting and planning) is the only one differing by residency and has statistically significant differences in the means rank scores of it, table (37).

Post hoc analysis revealed statistically significant differences between the mean rank scores of the two categories (tourists and expats) in favor of tourists.

Table 37 Results of Kruskal-Wallis H to test the differences in guests' agreement about the efficiency of the strategies based on residency

Strategy	**df**	**Chi-square**	**p-value**
encouraging doggy bags/ takeaway bags	2	2.48	0.241
Encouraging messages/menu design	2	0.76	0.684
better forecasting and planning	2	9.02	0.011
using technology, e.g. winnow or smart scales	2	2.99	0.225
study customer behaviour /portion sizes	2	3.31	0.191
fruit to root/use all parts of food	2	0.51	0.775
incentives for staff and guests	2	0.51	0.776
better storage and handling	2	3.16	0.206
better departments communication	2	3.08	0.214

- Type of food service:

Kruskal-Wallis test revealed that the level of guests' agreement about the efficiency of the strategies does not differ by the type of food service. As such, there are no statistically significant differences in the means rank scores of it, table (38).

Table 38 Results of Kruskal-Wallis H to test the differences in guests' agreement about the efficiency of the strategies based on the type of food service

Strategy	**df**	**Chi-square**	**p-value**
encouraging doggy bags/ takeaway bags	3	3.02	0.388
Encouraging messages/menu design	3	1.92	0.589
better forecasting and planning	3	6.60	0.086
using technology, e.g. winnow or smart scales	3	2.18	0.536
study customer behaviour /portion sizes	3	2.11	0.550
fruit to root/use all parts of food	3	1.61	0.657
incentives for staff and guests	3	0.46	0.928
better storage and handling	3	1.10	0.777
better departments communication	3	1.31	0.727

- Level of the restaurant (high, mid &low)

Kruskal-Wallis test revealed that the level of guests' agreement about the efficiency of the strategy (encouraging messages/menu design) is the only one differing by the restaurant level and has statistically significant differences in the means rank scores of guests' agreement about it, table (39).

Post hoc analysis revealed statistically significant differences between the mean rank scores of the two categories (low-end and mid-end) in favor of the mid-end category. Meaning that the guests who chose to go to mid-end restaurants mostly chose the strategy of (encouraging messages/menu design) to be more efficient in lowering FW, and that could be generalized about the benefit of encouraging messages and menu engineering to all mid-end restaurants' attending people.

Table 39 Results of Kruskal-Wallis H to test the differences in guests' agreement about the efficiency of the strategies based on the level of the restaurant

Strategy	**df**	**Chi-square**	**p-value**
encouraging doggy bags/ takeaway bags	2	2.20	0.333
Encouraging messages/menu design	2	6.23	0.044
better forecasting and planning	2	1.16	0.561
using technology, e.g. winnow or smart scales	2	3.57	0.168
study customer behaviour /portion sizes	2	2.92	0.232
fruit to root/use all parts of food	2	3.36	0.187
incentives for staff and guests	2	3.89	0.143
better storage and handling	2	0.11	0.948
better departments communication	2	1.09	0.580

4.4.2 Employees' Survey 2 (S2)

- Causes of food waste

Buffet Policies:

Table (19) shows that the mean scores of participants' agreement with the buffet's policies ranged between 3.11 and 3.53, with a medium agreement. Thus, the employees' perceptions about the effect of these policies on increasing FW in Dubai differ by the type of food service, employee experience, and food service's level of classification is studied.

Kruskal-Wallis test revealed that the distribution of each buffet's policy is the same across categories of the type of food service, employees' experience, and level of classification shown in tables (40), (41) & (42), respectively. In other words, employees' perceptions of buffet policies that increase food waste in Dubai do not differ by the food service type.

Table 40 Results of Kruskal-Wallis H to test the differences in the employees' perceptions of the effect of buffet's policies on increasing FW based on the type of service

Dependent variables (Policies)	**df**	**Chi-square**	**p-value**
Adding 30% extra food for the wrong forecast	5	8.44	0.134
Disposing of all food after 4 hours	5	7.46	0.189
Refilling the dishes before fully consumed	5	4.87	0.432
Cooking too many options and stations	5	2.97	0.705
Food is refilled until 15 minutes before closing	5	3.11	0.683
Preparing some types of food one day before	5	3.27	0.658

Table 41 Results of Kruskal-Wallis H to test the differences in the employees' perceptions of buffet's policies based on the experience

Dependent variables (Policies)	**df**	**Chi-square**	**p-value**
adding 30% extra food for the wrong forecast	3	5.81	0.121
disposing of all food after 4 hours	3	3.01	0.391
refilling the dishes before fully consumed	3	4.11	0.250
cooking too many options and stations	3	2.35	0.972
Food is refilled until 15 minutes before closing	3	1.51	0.680
preparing some types of food one day before	3	1.93	0.587

Table 42 Results of Kruskal-Wallis H to test the differences in the employees' perceptions of buffet's policies based on the food service's level of classification

Dependent variables (Policies)	**df**	**Chi-square**	**p-value**
adding 30% extra food for the wrong forecast	2	1.99	0.905
disposing of all food after 4 hours	2	1.30	0.523
refilling the dishes before fully consumed	2	1.13	0.570
cooking too many options and stations	2	3.04	0.218
Food is refilled until 15 minutes before closing	2	3.45	0.178
preparing some types of food one day before	2	2.71	0.258

- Causes from food services:

Table (20) showed that the mean scores of participants' agreement along the cause ranged between 3.22 and 3.68, with a medium to a high agreement. Thus, the employees' perceptions of the reasons (Causes) leading to increased food waste in their restaurants will be tested to see if it differs by the type of food service, employee's experience, and food service's level of classification.

Kruskal-Wallis H test revealed that the distribution of each cause is the same across categories of the type of food service and employees' experience, table (43) and (44), respectively. In other words, employees' perceptions of the reasons that lead to increased food waste in their restaurants do not differ by these variables. They have no statistically significant differences in the mean rank of it.

Table 43 Results of Kruskal-Wallis H to test the differences in the employees' perceptions of the Causes that lead to increased food waste based on the type of food service

Dependent variable (Causes)	**df**	**Chi-square**	**p-value**
over-production	5	8.94	0.111
poor planning or forecasting	5	8.36	0.138
food presentation and preparations in a special way	5	4.60	0.466
cooking skills/staff errors	5	3.01	0.698
low meals prices & many choices	5	2.62	0.758
customer plate waste	5	5.07	0.408
storage and expiration dates	5	7.04	0.218
depends on mealtime	5	4.86	0.434

Table 44 Results of Kruskal-Wallis H to test the differences in the employees' perceptions of the Causes that lead to increased food waste based on the experience

Dependent variable (Causes)	df	Chi-square	p-value
over-production	3	5.11	0.164
poor planning or forecasting	3	2.75	0.432
food presentation and preparations in a special way	3	5.79	0.123
cooking skills/staff errors	3	4.90	0.179
low meals prices & many choices	3	5.87	0.118
customer plate waste	3	3.22	0.359
storage and expiration dates	3	4.42	0.332
depends on mealtime	3	1.78	0.620

- Level of food service classification

Kruskal-Wallis test revealed that the distribution of each cause is the same across categories of the food service's level of classification, table (45). In other words, the employees' perceptions of the seven causes of increased food waste in their restaurants do not differ by the food service classification level. While only it differs about the cause “depends on meal time” by the food service's level of classification ($\chi^2(2) = 7.11$, $p = 0.029$).

Table 45 Results of Kruskal-Wallis H to test the differences in the employees' perceptions of the Causes that lead to increased food waste based on the food service's level of classification

Dependent variable (Causes)	df	Chi-square	p-value
over-production	2	2.81	0.246
poor planning or forecasting	2	1.40	0.497
food presentation and preparations in a special way	2	2.27	0.322
cooking skills/staff errors	2	0.75	0.689
low meals prices & many choices	2	1.12	0.571
customer plate waste	2	1.21	0.547
storage and expiration dates	2	1.57	0.457
depends on mealtime	2	7.11	0.029

To compare the three groups on the “depends on meal time” cause, pair-wise multiple comparisons were used. The results revealed a statistically significant difference between the mean rank of low-end and high-end groups in favor of the high-end group, which means that the employees working in the high-end food services mostly found that food waste increased depending on meal time. As Leverenz et al. (2021) mentioned on breakfast buffets, the FW generation is enormous, not depending on the number of guests.

- Prevention strategies

Table (22) showed that the mean scores of participants' agreement along the strategies ranged between 3.38 and 4.04 with medium to a high agreement. Thus, the employees’ agreement with the efficiency of the strategies to lower food waste was tested to check if it differs by the type of food service, food services level of classification, and employees' experience.

Kruskal-Wallis test revealed that the distribution of each strategy is the same across categories of the type of food service and level of classification, tables (46) and (47), respectively, where there were no statistically significant differences in the means rank of it.

Table 46 Results of Kruskal-Wallis to test the differences in the employees’ agreement with the efficiency of the strategies to lower food waste based on the type of food service

Dependent variable (Strategy)	**df**	**Chi-square**	**p-value**
Encouraging doggy bags/takeaway bags	5	6.16	0.291
Encouraging messages/menu design	5	9.72	0.084
Exact forecasting and planning	5	5.12	0.401
Workshops for staff to improve skills	5	4.02	0.546
Study customer behaviour /portion sizes	5	5.31	0.379
Fruit to root/use all parts of food	5	8.38	0.137
Incentives for staff and guests to reduce food waste	5	2.33	0.801
Better storage for food items	5	9.18	0.102
Technology, ex. smart scales like Winnow	5	9.22	0.101

Table 47 Results of Kruskal-Wallis to test the differences in the employees' agreement with the efficiency of the strategies to lower food waste based on the food service's level of classification

Dependent variable (Strategy)	**df**	**Chi-square**	**p-value**
Encouraging doggy bags/takeaway bags	2	0.51	0.774
Encouraging messages/menu design	2	0.92	0.629
Exact forecasting and planning	2	1.59	0.453
Workshops for staff to improve skills	2	0.16	0.923
Study customer behaviour /portion sizes	2	4.47	0.107
Fruit to root/use all parts of food	2	3.82	0.148
Incentives for staff and guests to reduce food waste	2	0.32	0.853
Better storage for food items	2	1.24	0.539
Technology, ex. smart scales like Winnow	2	1.42	0.491

- Experience

Kruskal-Wallis test revealed that the employees' agreement with the efficiency of the strategies highlighted in table (48) to lower food waste differed by the employees' experience.

Table 48 Results of Kruskal-Wallis to test the differences in the employees' agreement with the efficiency of the strategies to lower food waste based on the employees' experience

Dependent variable (Strategy)	**df**	**Chi-square**	**P-value**
Encouraging doggy bags/takeaway bags	3	6.86	0.076
Encouraging messages/menu design	3	8.23	0.042
Exact forecasting and planning	3	7.99	0.046
Workshops for staff to improve skills	3	8.76	0.033
Study customer behaviour /portion sizes	3	13.20	0.004
Fruit to root/use all parts of food	3	8.84	0.031
Incentives for staff and guests to reduce food waste	3	5.58	0.134
Better storage for food items	3	8.14	0.043
Technology, ex. smart scales like Winnow	3	6.01	0.111

Pair-wise comparisons were conducted to compare the four groups' experiences in their agreement with the food waste strategies. The results revealed that:

- There is a statistical difference between the mean rank of (between 1-5 years) and (more than 10 years) group and (between 1-5 years) and (between 5-10 years) group in the "encouraging messages/menu design" strategy in favor of the longer experienced group.
- There is a statistical difference between the mean rank of (between 1-5 years) and (more than 10 years) group and the (between 1-5 years) and (between 5-10 years) group in the "exact forecasting and planning" strategy in favor of the longer experienced group.
- There is a statistical difference between the mean rank of (between 1-5 years) and (more than 10 years) group and the (between 1-5 years) and (between 5-10 years) group in the "workshops for staff to improve skills" strategy in favor of the longer experienced group.
- There is a statistical difference between the mean rank of (between 1-5 years) and (more than 10 years) group and the (between 1-5 years) and (between 5-10 years) group in the "study customer behaviour /portion sizes" strategy in favor of the longer experienced group.
- There is a statistical difference between the mean rank of (between 1-5 years) and (between 5-10 years) groups in the "fruit to root/use all parts of food" strategy in favor of the (between 5- 10 years) group.
- There is a statistical difference between the mean rank of (between 1-5 years) and (between 5-10 years) groups in the "better storage for food items" strategy in favor of the (between 5- 10 years) group.

Generally, it is clear from the results that the more experienced the employees are, the more they choose the pre-mentioned strategies, which could be chosen as a trend and generalize to the population with higher experience. The more experienced the employees, the more they see that studying customer behaviour to reduce portion sizes is important, followed by the importance of using all parts of the food and giving workshops for the staff as main strategies besides the others. Tables (49&50) summarise the inferential analysis part of data that had a significant difference upon some demographics.

Table 49 summary of the guest agreement on some reasons and strategies of FW depending on the demographics of the participants

FW		*salary*	*residency*	*Type of food service*	*Level of food service*
Guests agreement	Customer causes	increase with a salary increase	No difference	No difference	high-end restaurant agreements are highest among the reasons
	Food services causes	increase with a salary increase	Tourist	No difference	No difference
	Strategies	increase with a salary increase	Tourist	No difference	mid-end restaurant agreement highest among the reasons

Table 50 summary of the employees' agreement on some reasons and strategies of FW depending on the demographics of the participants

		Type of food service	*Employee's experience*	*Level of classification*
Employees agreement	Buffet policies	No difference	No difference	No difference
	Food services causes	No difference	No difference	high-end restaurant agreement is the highest among the reason
	strategies	No difference	Higher experience, higher agreement on reasons	No difference

CHAPTER 5: INTERVIEWS DATA COLLECTION &ANALYSIS

5.1 Interviews – Data Analysis and Verification of Results

The data collected previously needed to be verified by professionals with different roles in society to confirm the main results to summarize a plan for strategies to be implemented. The questions asked for them focused on the research's main aim. They included questions about awareness, causes for food waste in the hospitality sector of Dubai and prevention strategies to lower the amounts of the problem. Besides, other prospective expectations for the situation. The interviews were from credible sources such as EEG, MOCCAE, DM, DWTC, Goumbook, and two hotels company such as, Atlantis. The reliability of the information is the most important to work as a base for future research. Some tables

Table 51 answers of the participants about the size of the food waste problem in the hospitality sector of Dubai

Q1.a	**Question**	**What is the size of the FW problem in the hospitality sector in Dubai?**
1	Mr D (Major hotel Group)	Higher than other global averages because of lifestyle and luxury expectations
2	Mr Kym (Atlantis)	Food waste in hospitality is becoming more prominent.
3	Ms Tatiana (Goumbook)	FW in major hospitality companies is considerable as they are expected to give abundance and food gifts, but they prioritise reducing it because of their sustainable policies and financial benefit. In smaller companies, it's less as they don't have to give the same luxury.
4	Dr Essam (DM)	The size is significant and needs to be measured in all food services, major and minor, to come up with a baseline. FW in shopping malls is huge and needs addressing.
5	Ms Amal (MOCCAE)	Hospitality is one of the significant contributors to FW as Dubai is a tourist hub, thus burdening the situation. Still, it is improving as they are concerned with sustainability and economics.

6	Ms Habiba (EEG)	UAE ranks amongst the world's highest per capita waste generation as 38% of FW is directed to landfills. UAE and worldwide have alarming figures that must be tackled. However, there are reasonable efforts to do so, such as the "Ne'ma Initiative", UAE Food Bank, and the "I'mperfect initiative",
7	Ms Maitha (DWTC)	DWTC has food waste but much reduced in amounts than in previous years. Dealing with FW is easier when it is reduced.

It is noticed from table (51) that all interviewees agreed that the food waste problem is a prominent burden in Dubai, especially in the hospitality sector. It is a significant one as Dubai is a tourist hub. Thus, it needs to be measured and managed. However, they all confirmed that UAE and Dubai are allocating considerable efforts to reduce this problem through many different initiatives such as the "Ne'ma Initiative", UAE Food Bank, and the "I'mperfect initiative". These efforts are mainly made to follow up with the international and local agendas and targets about sustainability, besides enhancing the society's environmental, social and economic sides.

This opinion is confirmed by the country's huge statistics on food waste. The food waste average is 38% annually is being wasted off the daily prepared food in UAE and reaches around 60% during the Holy month of Ramadan (*dcce* 2019). At the same time, it has one of the highest per capita food waste per year globally at 224 kg (Kohli 2021).

Table 52 answers of the participants about the knowledge of the food waste problem in the hospitality sector of Dubai

Q1.b	Question	What is the awareness situation about the FW in the hospitality sector in Dubai?
1	Mr D (Major hotel Group)	Major hotels have good awareness (coming from their sustainable practices, either their company origins or local) Smaller-unbranded hotels have a lack of awareness /almost zero action.
2	Mr Kym (Atlantis)	Hotels are more aware of the impacts and costs of FW and sustainability, and many pioneers are leading the awareness. People also are aware of and trying to change their diets.
3	Ms. Tatiana (Goumbook)	Hospitality knowledge is good. Many efforts are made because of sustainability and profit (reducing procurements and waste fees). Generally, in smaller hotels, awareness is there, but the quantity of waste is less as no abundance is expected, and there is a lower budget to waste.
4	Dr Essam (DM)	The government - there is awareness and reasonable efforts to implement legislation like a fining system on waste per ton has started in 2022, but still needs to be added to more minor food services levels. But challenges in food waste separation are still there. Individual – awareness is growing, but the law of waste fining needs to be applied to them. The youth have more awareness these days than the adults about it.
5	Ms Amal (MOCCAE)	Awareness is improving as we work on it through campaigns; Dubai Tourism is doing the same. At the same time, major private companies like Emaar and Majid Al-Futtaim have their own Corporate Social Responsibility (CSR) departments and doing lots of initiatives.
6	Ms. Maitha (DWTC)	In Dubai and globally, there is a big wake for the FW problem; the exhibitors now request reports about food waste management for events and the amounts of carbon emissions produced. The awareness of the customers is raised aligning with the initiatives that emerged in the country like “The one million meals” and “UAE Food Bank” besides “Hifth AlNi’ma” in Abu Dhabi and especially after covid19. People are more advertising to healthy style living rather than over wasting food.

It was generally noticed from table (52) that the interviewees agreed that the awareness in the hospitality sector is developing as many of them have their sustainable practices mainly coming from the company's origins. Besides, the aim to enhance their financial status and lower their costs forms a big motivation for FW reduction; as Neff et al. (n.d. as cited in Jones 2017) confirmed, saving money is the ultimate goal in businesses.

This awareness improvement is confirmed based on the efforts of MOCCAE, Goumbook and EEG, where they do campaigns and workshops to improve awareness among individuals and companies. Dr. Essam confirmed the governmental awareness to be improving as well. However, policies still must be considered and mainly applied to smaller food services and individuals. Mr. Kym and Ms Maitha shared the same idea about the importance of awareness in some people's habits, where they change their eating habits to a healthy lifestyle which contributes to less FW as portions are calculated and as Coudard et al. (2021) explained, may save up to 28% of vegetables in the hospitality sector where it is the second most wasted type of food after cereals, globally. All interviewees confirmed that a higher level of awareness is found in the youth and their passion for making a change.

The interviewees' opinion about smaller hotels' awareness is not consistent. Mr. D says they don't have awareness and are doing zero action, while Ms Tatiana confirmed having it. Still, their level of luxury expectance is lower, so less waste is produced, not as in five-star hotels, besides having less budget to waste. One of the interviewees opinion was excluded from the table as it is general about the initiatives and efforts of the UAE more than the opinion on the awareness situation.

Table 53 answers of the participants about the causes of food waste from the customer side in the hospitality sector of Dubai

Q2	Question	What are the leading causes of FW in the hospitality sector from customers?
1	Mr D (Major hotel Group)	Their habit of taking more than they need, lack of consciousness and awareness, having various cuisines which make guests, especially tourists, try different plates, and last minute bookings or cancelling.
2	Mr Kym (Atlantis)	Awareness problem is the base; they get the most value out of the price they pay, love to see abundance, and take more than they can physically eat, tourist behaviour may show in buffets as they like to try as much, or people cancel or change their minds.
3	Ms. Tatiana (Goumbook)	Cultural thoughts and expecting abundance, over-ordering, filling more than you can, and no value of food because of a lack of awareness
4	Dr Essam (DM)	Hygienic problems include labour camps areas and lack of awareness among individuals.
5	Ms Amal (MOCCAE)	People love to be spoiled and see a variety without limits.
6	Ms Maitha (DWTC)	Arab cultural habits of generosity, competence to show social status and over-ordering in weddings, especially before covid-19, customers' preference as catering services need to follow customers' inquiries. The guests' pleasure to see extravagance in food quantities and types.

It was noticed from table (53) that the top leading cause of food waste from customers from the point view of the interviewees was the lack of awareness as it can be seen in their greed to take more significant portions than they can consume and try various cuisines; the second was the love to see extravagance in amounts as this will satisfy them as they go to food services seeking to fulfil their satisfaction. Following is the cultural habits they have, causing them to be more generous in ordering and competing in additional ordering for food to show their social status. Moreover, some other causes were mentioned in single opinions, such as hygiene problems in some labour areas, as Dr Essam said. The hotel services managers, Mr D and Mr Kym, also added that customers' cancelling their orders or changing their minds about the dishes is one of the reasons for food waste.

Tourists' behaviour is affecting the increase in FW, as Mr D and Mr Kym confirmed, especially if they want to try different cuisines in buffets or from menus. At the same time, it causes the catering services to produce more waste as in DWTC; as they have to offer meals suitable for all tourists worldwide with particular eating habits such as vegan, Jewish...etc. Wang et al. (2017) also confirmed in their study about Chinese food services that tourists mainly contributed to food waste in their country. On the other hand, Mr Essam disagreed with that, as food-wasting behaviour depends on the person's background and habits, which do not change wherever they go.

One of the interviewees' answer was general and not specific to hospitality causes, as she mentioned having a problem in mismanagement at various levels in the food supply chain from production to processing, retailing and consumption. Thus, this one was excluded from the table's answers.

Table 54 answers of the participants about the causes of the food waste from the food services side in the hospitality sector of Dubai

Q3	Question	What are the causes of the FW in the hospitality sector from food services?
1	Mr D (Major hotel Group)	The generosity of businesses to impress the guests, chefs decide on portions according to previous trends, unavoidable waste from kitchens, forecasting and planning is sometimes unpredictable, and improper maintenance.
2	Mr Kym (Atlantis)	If chefs do not feel the responsibility, they cannot manage it well and not plan for actual trends of numbers.
3	Ms Tatiana (Goumbook)	Not giving extra food as staff meals and not measuring FW quantities make it hard to manage, and low awareness of the chefs about waste and sustainable practices.
4	Dr Essam (DM)	Over-production/ thinking about finance, wrong planning, lack of punishments and laws, lack of awareness (in refusing edible food items on shape or colour), and fear of giving untouched food to Banks because of legal responsibility.
5	Ms Amal (MOCCAE)	They give abundance to satisfy guests/ significant portions and are afraid to donate untouched food.
6	Ms Habiba (EEG)	Purchase of excess food when not required, improper planning, and not adhering to health and safety policies can all lead to increased food waste.
7	Ms Maitha (DWTC)	DWTC's main waste is from catering for weddings, followed by events and finally, Ramadan Buffet (each type of food needs 2-3 refills). Over-producing to stay safe from unpredicted numbers (20-30% more), as more significant amounts are easier to produce in efforts and equipment. Having tourist always increases FW as you have to offer different cuisines to suit them; vegan, allergens, Jewish…etc.

Overproduction and generosity of food services are agreed to be the top leading cause of food waste from food services by the interviewees' opinions in table (54) as Mr Essam and Ms Maitha said that producing larger quantities is easier and more financially feasible for food services in addition to staying safe of unpredicted extra guests. Followed by wrong planning from the chefs or the management of the services as they follow the previous trends and not have strict policies for reservations. Four interviewees agreed that the awareness of

the chefs was a significant problem. Suppose they do not feel the responsibility of reducing waste, measuring it and managing it within their sustainable practices. In that case, the problem will be out of their hands, and no actions can be effective by then. This complies with the importance of following the global trend of "Target, Measure & Act" (*SDG Target 12.3 on Food Loss and Waste: 2021 Progress Report | Champions 12.3* 2021).

The governmental institutes of the interviewees mentioned another cause: some food services fear donating untouched food to food charities and banks. This may be referred to as not adhering to health and safety policies, as Ms. Habiba from EEG mentioned. This food recovery strategy is highly used in DWTC, as Ms Maitha confirmed. They communicate with UAE Food Bank before events to prepare them for collecting the extra food and distributing it to the needy, which helps enhance the social conditions of the society. Besides, it helps lower waste costs for the company, as Dubai Municipality started the law in 2022 to fine food services on waste per ton. Ms. Tatiana expected that by forcing the new law, companies would begin counting their extra expenses and suggest some alternatives and strategies to reduce waste. Her opinion was confirmed by Mr. Kym, who said that this law made them more conscious and pushed them to start using new technologies in their restaurants, such as winnow, where they noticed around 47% reduction in food waste in the past four months and will be implementing it in other buffet restaurant and the employees' dining room. In the meanwhile, it was studied by Filimonau, Nghiem & Wang (2021) that the idea, which is called the 'pay-as-you-throw' method, must be used by business owners to scare them of being fined for waste and will manage accordingly.

However, Mr Essam suggested this law be applied to smaller businesses and individuals as well, as he sees that the big problem is from these services and sees that lack of punishments is a major cause of FW from food services. Although their leftovers are extra tens of meals, the number of them in the Emirate (thousands) is much larger than the hotel numbers in it (a few hundred around 570) (*Dubai In Figures* 2022). A comparison can be estimated with the UK food waste generation, where hotels generate 79,000 tonnes yearly, while restaurants generate around 199,100 tonnes yearly (*Open Access Government* 2018).

Table 55 answers of the participants about what they can offer to minimise the lack of awareness problem

Q8	Question	What do you do in your organisation/company to increase awareness?
1	Mr D (Major hotel Group)	We have training workshops and started a sustainability program recently.
2	Mr Kym (Atlantis)	We are open to sharing our experience with others; we do workshops for buffet chefs specifically and talk about food waste awareness.
3	Ms. Tatiana (Goumbook)	Recipe of Change campaign with lots of awareness downloadable materials, training with the chefs, servers and employees to let them understand how to communicate with guests to lower mistakes and guide on FW solutions for hotels. Schools and youth are involved in our campaigns, although they are more aware than adults.
4	Dr Essam (DM)	We are increasing awareness through governmental social media, trending TV or radio shows…etc. Especially the smaller food outlets and labourers in their camps or companies, as the awareness and hygiene levels are lower. Youth awareness and education in their curricula (with the support of the ministry of education)
5	Ms Amal (MOCCAE)	Share tips and practices to increase awareness on social media, regular campaigns, especially in Ramadan, youth awareness campaigns and curricula (with the support of the ministry of education). Ne'ma initiative is for a broader purpose and encourages retailers to use local sources.
6	Ms. Habiba (EEG)	EEG has various workshops, seminars, and public speaking competitions at national and international levels specifically designed for the student community and beyond, aiming to arm young minds. We further provide platforms that can be tailor-made per the entity's preference in wanting to take a step forward and contribute to the sustainability and well-being of society.
7	Ms. Maitha (DWTC)	We do workshops for general waste but not specific to FW as there is still no specialised department for the problem. We do reports for food waste and carbon emissions for external exhibitors. We will help by using messages on menus to increase customers' awareness.

It was noticed in table (55), that all interviewees are offering workshops in their companies or organisations. These workshops are mainly to enhance the awareness of the workers (chefs, servers…etc.) and wake their consciousness up, as a significant share of waste is generated in the kitchen and display areas. Governmental institutes confirmed using their platforms to raise people's awareness and support awareness campaigns such as the "Ne'ma initiative". Ms. Tatiana, Ms Amal, Ms. Habiba and Dr Essam explained how the work on their awareness is intense; in school campaigns, workshops and curriculum as they are the future leaders in the long term, as was confirmed in much importance in the study of Pinto et al.(2018 cited in Al-Obadi et al. 2022) when they insisted on the significance of educating people through awareness campaigns in all society parts; institutes, school, and universities. This work on youth is also confirmed in the papers of (Baig et al. 2019), where the youth form the majority of Saudi society. Thus, the efforts are focused on changing their behaviour toward FW. While in a paper in the UAE done on university students by Yagoub et al. (2022) confirmed that most of their respondents (57%) agreed that young people waste more food than older ones, showing the importance of focusing the work on this group of age.

Social and environmental organisations like Goumbook and EEG offer educational workshops and training for all ages of society. Combining awareness campaigns with training, as the social institutes are doing, is the best practice to increase awareness, as more than one is needed to do the job. This was confirmed by Quested et al. (2013 cited in Alsuwaidi, Eid & Agag 2022). They suggested using the "cascade training effect", where they train a group of people in the most affecting positions who will train other people and so forth.

Other interviewees expressed their interest in sharing their experience in food waste reduction to be role models. Ms Tatiana mentioned having the "Recipe of Change" campaign implemented with the United Nations Environment Program (UNEP), which started its second phase after households targeted HO.RE.CA (Hotels, restaurants, cafes). It offers free downloadable materials to change simple behaviours to reduce food waste. Ms Habiba added having the ability to provide tailor-made platforms upon entities' preference.

Table 56 answers of the participants about the prevention strategies to reduce food waste in the hospitality sector of Dubai

Q4	Question	What are the primary prevention strategies to reduce FW in the hospitality sector?
1	Mr D (Major Group)	The use of technological tools like winnow or others, menu engineering (choices and portion sizes), sourcing locally, planning for amounts, not introducing cut fruits, using messages to offer gifts until they order it, giving workshops for the chefs to increase their awareness and the help of a waste controller.
2	Mr Kym (Atlantis)	Menu engineering (choices number, menu size and upcycling for sauces), making special days' meals, using smart scales as winnow, studying guest behaviour to check portion sizes, sourcing locally, encouraging pre-booking and checking guests' satisfaction in daily reports and scoring.
3	Ms. Tatiana (Goumbook)	Measuring and reporting using scales like winnow, using smaller plates, writing messages and signs in buffets to increase guests' awareness and encourage returning to buffets when needed, having various cook-on-spot sections in buffets, and giving training to chefs
4	Dr Essam (DM)	Measure quantities in Dubai and most wasted types, lowering food safety policies, building local intelligent systems like winnow, and governmental ranking (scoring) systems.
5	Ms Amal (MOCCAE)	Reduce portion sizes, reuse items (upcycle), servers encourage using leftover bags, give creative chefs the space to challenge and repurpose FW, get involved in private sector initiatives, lower food safety policies and extend expiry dates, sourcing locally.
6	Ms. Habiba (EEG)	implementing intelligent strategies and technologies such as Winnow. Consumers and food services must monitor their purchased food for production and consumption needs. Besides helping the governmental efforts to achieve the transition to a more circular economy in alignment with the UN 2030 Agenda and UAE's Green Agenda 2030. Offer educational programmes that aim to educate and install sustainable practices within all sectors of society; hospitality is one of them.
7	Ms. Maitha (DWTC)	Some customers are lowering their offering in their weddings (quarter a lamb/table, not as before one full lamb/table), reducing the number of

		guests, using simplified menus with fewer types and using individual sizes rather than buffets. We help quantify the needed amounts of food when the customers are still determining. Buffet workers mostly scoop for the people to keep food untouched and donate it to charities or as staff meals. DWTC offers different types of menus to suit each customer's needs (silver, gold…etc.), ensuring that the number of guests arriving at the wedding is similar to what was decided on. In "Pass around" systems, we arrange for people to sit together, and waiters ask if food is enough or need to add more. DWTC uses stand-up tables to keep customers uncomfortable in staying a long time and wasting more food. We use international cuisines, not local, to suit all tastes unless specified. We offer the foods and remove them simultaneously for all guests to save the quality and donate extras in good condition. We use Food Waste Compactor to eliminate touched waste and protect the kitchen from insects, odours and bad appearance. We will use messages in the menus for customers.

All the interviewees confirmed in table (56), the importance of technology use as a major prevention strategy to reduce food waste in food services. The main mentioned technology was the Winnow smart scale system, which was proven to lower food waste in major hotels, as mentioned in section 2.4. This technology is used mainly in key hotel restaurants as it could be costly for smaller ones as it costs around 300-600 every month depending on the model (Mills 2019). The main idea of its work is to measure the quantity of wasted food and categorise it by type using a camera to avoid using cooking it in the upcoming meals. Dr Essam confirmed this; he believed that measuring and knowing the most wasted types is the first step to make change and reduce the problem. Other technologies, like, Food Waste Compactor systems, are used in some catering services in UAE, like DWTC. This operates as a built-in system to eliminate touched foods, and forbid the generation of odours, insect invasion and lousy appearance. The second prevention strategy agreed on by interviewees was the importance of reducing portion/plate sizes in the services and promoting individual sizes in catering services. This strategy was proven to reduce about 20% of food waste, as mentioned in (Al-Obadi et al. 2022).

The majority of the interviewees agreed on the strategy of sourcing locally. This strategy extends the shelf life of food items as it skips the wasted days in importing, transportation, getting certifications at ports…etc. So these lost days are added to the shelf

life if contracted with local suppliers of foods, especially dairy and veggies. Reasonable efforts from the Food Safety departments are trying to reduce strict safety policies on imported food items and changing their expiration days within safe limits, as confirmed by Ms Amal and Dr. Essam. Ms. Amal also mentioned that she had a meeting in October with a Danish company that provides a kind of Microbe to extend the shelf life of dairy products, as shelf life is the reason for 80% of waste from dairy items mentioned in a European study. This is great to be considered as the most wasted item in UAE is dairy foods (36.8%) as mentioned in Essam, Gill & Alders (2022). Ms Habiba added that in their 4th-panel discussion of 2022, they aimed primarily to address the effective use of packaging to eliminate food waste and support a more circular economy.

The three food-related services managers, Mr D, Mr Kym and Ms Maitha, confirmed the importance of using menu engineering, each with what suits their service. Mr D uses it to control portion size and favoured choices of people. Mr Kym also uses it for the same purpose besides upcycling some items like sauces to be used for different options in the menu to reduce waste. His opinion was confirmed by Okumus (2019) and Martin-Rios et al. (2018), who agreed that chefs could use menu cycles to use leftovers in other types of food for the next round of meals with paying attention to future forecasting. At the same time, Ms Maitha mentioned having different menus to suit customers' diverse tastes.

Three interviewees discussed the importance of raising the education of the chefs by offering them workshops and training to increase their skills and awareness to prevent wasting food. This was aligned with the study of Aamir et al. (2018) in Pakistan and WRAP (n.d), who confirmed the importance of training the staff to reduce FW.

Three interviewees agreed that adding encouraging messages on menus, screens, and between buffet items is an efficient prevention strategy that may touch the guests' feelings. This strategy was started to be used by Goumbook in some buffets in Dubai. Another helpful strategy in the buffets is being used widely in Hilton Hotels and other services is cooking more live sections, which lowers the waste as only on-demand is being cooked, keeping it as fresh as possible and enhancing its quality (as mentioned on the 29th September, 2022 in Atlantis Hotels which represents the International Day of Awareness of Food Loss and Waste.

Other strategies mentioned by some are like: not introducing cut fruits and using a governmental ranking (scoring) system to encourage food services to enhance their business to get higher scores and get higher trust from guests. Getting involved in private sector initiatives as the private sector forms a high percentage of the companies and helping them will cause a difference. A simple strategy in DWTC is using stand-up tables so people will only be comfortable staying a short time and waste less food. Ms Amal in MOCCAE discussed the idea of servers encouraging the use of leftover bags to reduce food waste. Meaning that they accept being told to get their food home. On the other hand, Mr. D did not show interest in this advice; as according to him, it may increase container/paper waste.

Pirani &Arafat (2016) suggested that the main strategy for food waste prevention is to have better department communication and cooperation between the hotel/restaurant staff and the guests in their study in Abu Dhabi. This was felt lacking in the major hotel company interviewed, as planning for the number of guests depends on the chefs' experience rather than communicating with the reservation department daily. On the other hand, encouraging booking in Atlantis was an implemented strategy to improve communications and planning.

Table 57 answers of the participants about the possibility of removing or changing the buffet service type

Q5	**Question**	**Could you consider removing the buffet food type? Or changing it? Or do any changes in the Holy Month of Ramadan?**
1	Mr D (Major hotel Group)	Not feasible to remove it as numbers in big hotels or resorts cannot handle another type of restaurant, especially breakfast. Only we can reduce portion size and cook to people's personal preferences. Increasing awareness in Ramadan and using messages
2	Mr Kym (Atlantis)	It is pretty challenging to remove the buffets, but instead, be more conscious of portion sizes, having a preferable meal selection, and on-spot cooking sections.
3	Dr Essam (DM)	Impossible to eliminate and have no particular policy for Ramadan; instead, reduce portion sizes in dishes and recover food.
4	Ms Amal (MOCCAE)	Not eliminating, but better number estimation, using messages, eliminating un-favoured plates, and on-spot cooking.
5	Ms Maitha (DWTC)	We try to promote individual-size foods and single shots, although the buffets are easier for caterers to do.

All interviewees insisted in table (57) that it is impossible to eliminate buffet-type restaurants while applying reduction strategies is the better alternative idea, such as reducing portion/plate sizes, increasing live sections, using messages, removing unfavourable meals, and promoting for individual sizes in catering services which are summarised in the previous question. This refusal is referred to the type of luxury that the buffets give and guests are waiting for. Besides, having buffets especially in breakfast time and Ramadan Month is essential, as all the guests are expected to eat at the same time making it impossible to follow up with the huge numbers of guests that a hotel or resort could get. The researcher suggested alternative options for buffet service for the interviewees, such as weighted buffets. Ravandi & Jovanovic (2019) confirmed the ease of this type as people can interact with food by smelling it and paying for what is chosen, which may reduce the leftover waste as they will not overfill it with extras. However, no interest was felt to apply this type from the interviewees as people have expectations of luxury level in Dubai that is hard to change in the coming future, but prevention strategies are used as mentioned.

Two of the interviewees were not asked this question as they are social/environmental organisations that do not have the capability of applying a law. Thus, this question was not related to their work.

Table 58 answers of the participants about the possibility of changing the food waste problem

Q6	Question	Is the possibility of change related to forcing laws and legislation?
1	Mr D (Major hotel Group)	It doesn't need it if the company is highly aware of food waste's impacts and losses.
2	Mr Kym (Atlantis)	Awareness is the best motive to change, but governmental laws and rules are the best support and leader of change.
3	Ms. Tatiana (Goumbook)	Government policies are fundamental, but change happens gradually. Governments need to give suggestions and increase awareness. Change is easy, but it requires the will and the budget.
4	Dr Essam (DM)	Laws are needed, especially in the first point of wasting; punishment can be financial, in the ranking system, or not participating in social events.
5	Ms Amal (MOCCAE)	We do not need it; many countries have excellent sustainable practices without governmental legislation or recently implemented. Raising awareness is the most motivation, then segregating waste and checking the capacity of food banks before reaching the regulatory stage.
6	Ms. Habiba (EEG)	Change is only achievable under collective efforts. At the same time, the government is very active in implementing these policies and has achieved noticeable progress, while EEG always supports them with educational programmes and action campaigns.
7	Ms. Maitha (DWTC)	Yes, governmental support is indeed needed, although awareness is raised. Both governmental support and technology use will help do a change, such as the "Food Waste Compacter System" that we use.

All interviewees confirmed the importance of the involvement of the government, table (58). Their efforts are most needed to raise awareness, implement policies and suggest prevention strategies. Especially the government of UAE is always a leader in new technologies or in implementing measures to become the most sustainable city. Raising awareness is confirmed by all interviewees as being the best and first motive to change. However, half of the interviewees confirmed that laws and legislations are fundamental. In contrast, others expressed that it must start from inside the person or the company's sustainable policies with the governmental legislation as support only. Heinrich (2022), a waste specialist from the Beyond Food Waste initiative, commented on this topic by writing

that, to implement food waste legislation, it needs a long time to introduce the community and business owners to the problem on how it will affect them, what and when it will happen. This can be done by offering awareness campaigns from the governments aligned with training for them on how to meet their new commitments. Before that, the country must study how it will start separating its food waste before reaching landfills, how it will be collected and what will happen to it to convince food services to commit to the change. However, she confirmed that it needs a long time to make such a change.

Dr Essam confirmed the importance of being fined at the first spot of wasting; if it didn't start there, no one would care to waste after. He mentioned that punishment could have different shapes; it could be financial, lowering governmental scoring or prohibiting them from social events' involvement. Ms Tatiana concluded by ensuring that the most important thing to change is willing to make the change and having the budget for it.

Table 59 answers of the participants about the possibility of building a framework for food services to follow

Q7	**Question**	**Can we make a road map for all the food services to follow?**
1	Mr D (Major hotel Group)	Not possible to put one policy for all, just a general framework, and food services adapt it to their outlets. Highly experienced chefs will refrain from following detailed rules.
2	Mr Kym (Atlantis)	A bit challenging as each type differs, but it could start with a general framework.
3	Ms. Tatiana (Goumbook)	A general universal outline is possible with each food service type to adapt to it.
4	Dr Essam (DM)	Yes, we can, only if we measure and make a baseline upon different factors for food waste, such as the type, area, nationality…etc.
5	Ms Amal (MOCCAE)	Yes, that is what we are doing, offering tips on what is doable. And we are cooperating with the private sector in a significant way.
6	Ms. Habiba (EEG)	A general framework is required to formulate strategies in alignment with government policies. Still, it needs to be tailored to help address the challenges and discover the opportunities within food services.
7	Ms. Maitha (DWTC)	We can force some policies by the municipality, such as fines on waste and dealing with contractors to take waste. We can also suggest using a "Food waste compactor" for big catering services.

Forcing a plan for all food services to follow to reduce their food waste was agreed by all to be a bit challenging; the only thing that can be done and the governments are trying to do is give a general framework and tips for what is doable for food services. Then, they will tailor it to their needs as each service has challenges that no one-plan-fits-all may work as agreed in *(SDG Target 12.3 on Food Loss and Waste: 2021 Progress Report | Champions 12.3 2021) and in (Courtauld Commitment 2025 Milestone Progress Report n.d.).* A general framework and forecasting system was agreed on, as well, by 79.1% of the surveyed employees.

Generally, Dr Essam discussed the available food recovery strategies in Dubai, which are 1- UAE Food Bank, 2-Animal feed, and 3- recycling. At the same time, touched food from food services must all get to composting for safety and benefit. Moreover, Ms Amal confirmed the significant progress of the UAE Food Bank. She encouraged the work of the Red Crescent, Retailers, the Private sector and community practices like in some supermarkets. Ms. Maitha said that awareness of DWTC is still in the early stages. Still, efforts are focused on dealing with food waste, especially in donating to UAE Food Bank and charities extra food and samples from the events such as Gulf Food. They will be dealing with the composting company soon. These efforts enhance the sustainable image of the city, help society and reduce food waste treatment fees.

5.2 Summary Table

Table 60 summary of the opinions collected from the seven interviewees on the main research questions

3	2	1	
Ms. Tatiana (Goumbook)	**Mr Kym (Atlantis)**	**Mr D (Major hotel Group)**	
considerable	prominent	Higher than global averages	**Situation/size**
Good. Less-star hotels do not have luxury standards	improving	good in major hotels /lacking in small ones	**Situation/ awareness**
-over-ordering/take big portions - cultural habits -love abundance -lack of awareness	-lack of awareness -love abundance -taking big portions -late cancel -tourists	-lack of awareness - cultural habits -taking big portions -late cancel -tourists	**Causes/ customers**
-no FW measuring - chefs' low awareness -no food recovery (staff meal)	-chefs' low awareness and responsibility -wrong planning	-impress guests -quantities on previous trends /wrong planning	**Causes/ food services**
-quantity measuring - technological tools -portions control -using messages -awareness workshops &training -live buffet sections	- technological tools -menu engineering - local Sources -planning (portions) -encourage pre-booking -live buffet sections	- technological tools -menu engineering - local Sources -planning (portions) -no cut fruits -using messages -awareness workshops	**Prevention strategies**

7	6	5	4
Ms. Maitha (DWTC)	**Ms. Habiba (EEG)**	**Ms Amal (MOCCAE)**	**Dr Essam (DM)**
high, improving in DWTC	highest per capita in UAE	significant	significant
It is raising and globally awakened	-	Improving	Governmental and individual are aware but need improving
-generosity /cultural habits -love abundance -over-ordering	-	-love abundance -satisfaction	-lack of awareness - hygienic problem in some areas
-over-production/financial thinking -weddings catering -satisfying tourists	-extra food purchasing -wrong planning -not following food safety	- over-production /big portions - fear of food	- over-production/financial thinking - lack of awareness
-lower generosity in weddings -simpler &various menus -advice on amounts -food recovery (donations and staff meal) -pass around system -standup tables -attendance check	- technological tools -monitor purchases - offer educational program	-encourage leftover bags -upcycle food -portion control - less food safety policies -involved in private sector - local	-quantity measuring - technological tools -governmental scoring - less food safety policies

CHAPTER 6: CONCLUSION

6.1 Concluded Results

6.1.1 Main results

This section summarizes the verified results about the main objectives of the research only. Figure (42) from Section 4.3.1 shows that employees of the food services have better awareness about food waste-related subjects than the public. This verifies the specific efforts that are being done on them by the interviewed experts in their companies or organisations mentioned in section 5.1, where they explained offering awareness campaigns and that awareness level is improving.

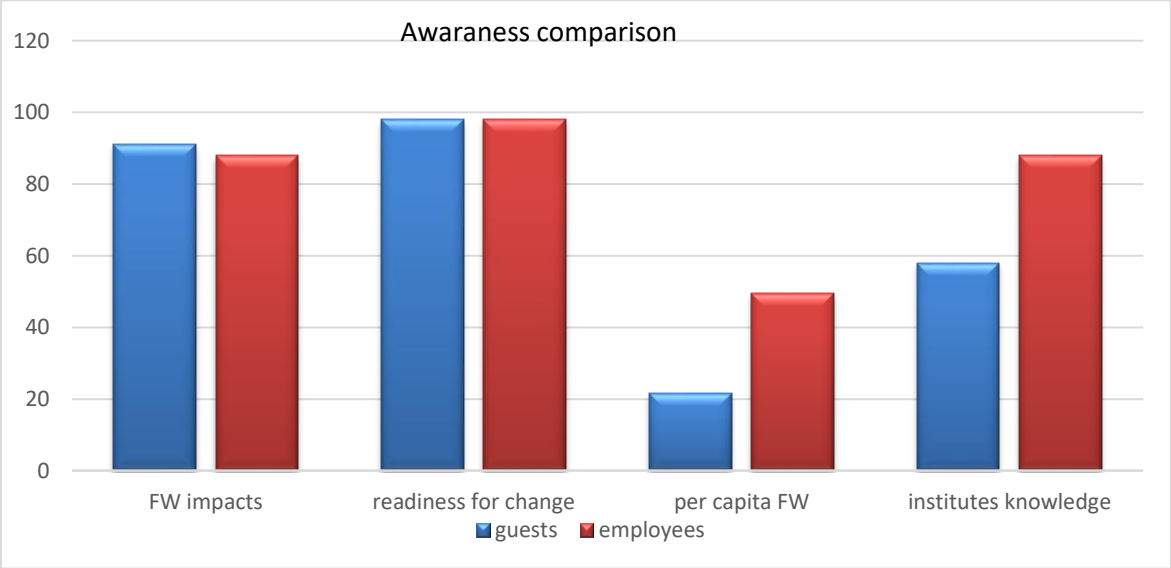


Figure 42 (section 4.3.1) awareness percentages comparison between guests and employees

The interviewees opinion came to verify the surveyed sample's opinion about the top three causes of food waste from customers in the hospitality sector in Dubai, table (24) in section 4.3.2 which are lack of awareness, big portions and love to see abundance, and generosity (cultural-social habits). The food-related managers of the interviewees confirmed that the tourists' behavior is a leading cause as well but it was refused by Dr Essam from DM; which keep questions about its credibility.

The interviewees' opinion came to verify the opinion of the surveyed samples in table (25) as well, where they also agreed on over-production and planning to be significant contributors of food waste from food services in Dubai. It is also similar to the results of the study by Pirani & Arafat (2016) about the hospitality sector in the Emirate of Abu Dhabi/ UAE done a few years ago, as their leading cause was poor planning and forecasting as well.

The opinion of the surveyed employees who agreed that Winnow technology is a good prevention strategy, as food services are familiar with it has been verified by the interviewees. Besides verifying the importance of using smaller portions and plate sizes who all the surveyed sample agreed on as being a top prevention strategy. Three food-related services managers, Mr D, Mr Kym and Ms Maitha, confirmed the importance of using menu engineering which was also one of the top chosen strategies in the surveyed guests' opinion, table (26) in section 4.3.3. Moreover, three interviewees discussed the importance of raising the education of the chefs by offering them workshops and training to increase their skills and awareness to prevent wasting food. This was aligned with the top-chosen strategy from the employees' point of view as well.

The strategy of using encouraging messages was chosen by the surveyed guests as one of the top prevention strategies, besides, obtaining a 70% agreement when asked about it in another specific question. This was verified by the opinion of the interviewees on top prevention strategies.

Ms Amal in MOCCAE discussed the idea of servers encouraging the use of leftover bags to reduce food waste. Her opinion verifies the top selected strategy by the surveyed guests. On the contrary, Mr D did not interest in it; as according to him, it may increase container/paper waste.

It was confirmed in this study that the buffet type contributes to food waste from the view of employees and guests. Besides, it was also confirmed by Papargyropoulou et al. (2016) in their study that buffet restaurants generated more waste than others when they quantified the FW generated by it, especially leftover waste. That was the reason for verifying the possibility of removing it from the interviewees. To result in refusal as it is impossible to remove it especially in hotels and resorts which have hundreds of sleep-in guests that cannot be served all together in a short time especially in breakfast or in Ramadan buffets without pre-preparing for the meals. Moreover, buffets satisfy the luxury standards that people attended the food services to have.

Dr Essam, Ms Tatiana and Ms Maitha's opinions to have laws and legislation are aligned with the point view of the surveyed employees, where they all agreed that change is possible. At the same time, 55% of them confirmed that laws and regulations are needed for this change to happen.

This section is needed to summarize the study and come up with a plan (framework) to be implemented by the food services, mainly based on the suggested strategies by the interviewees. It includes the food waste prevention strategies that the interviewed experts verified, and which were tested for acceptance by the surveyed participants, who will be affected by applying them.

6.1.2 Literature review comparison for strategies

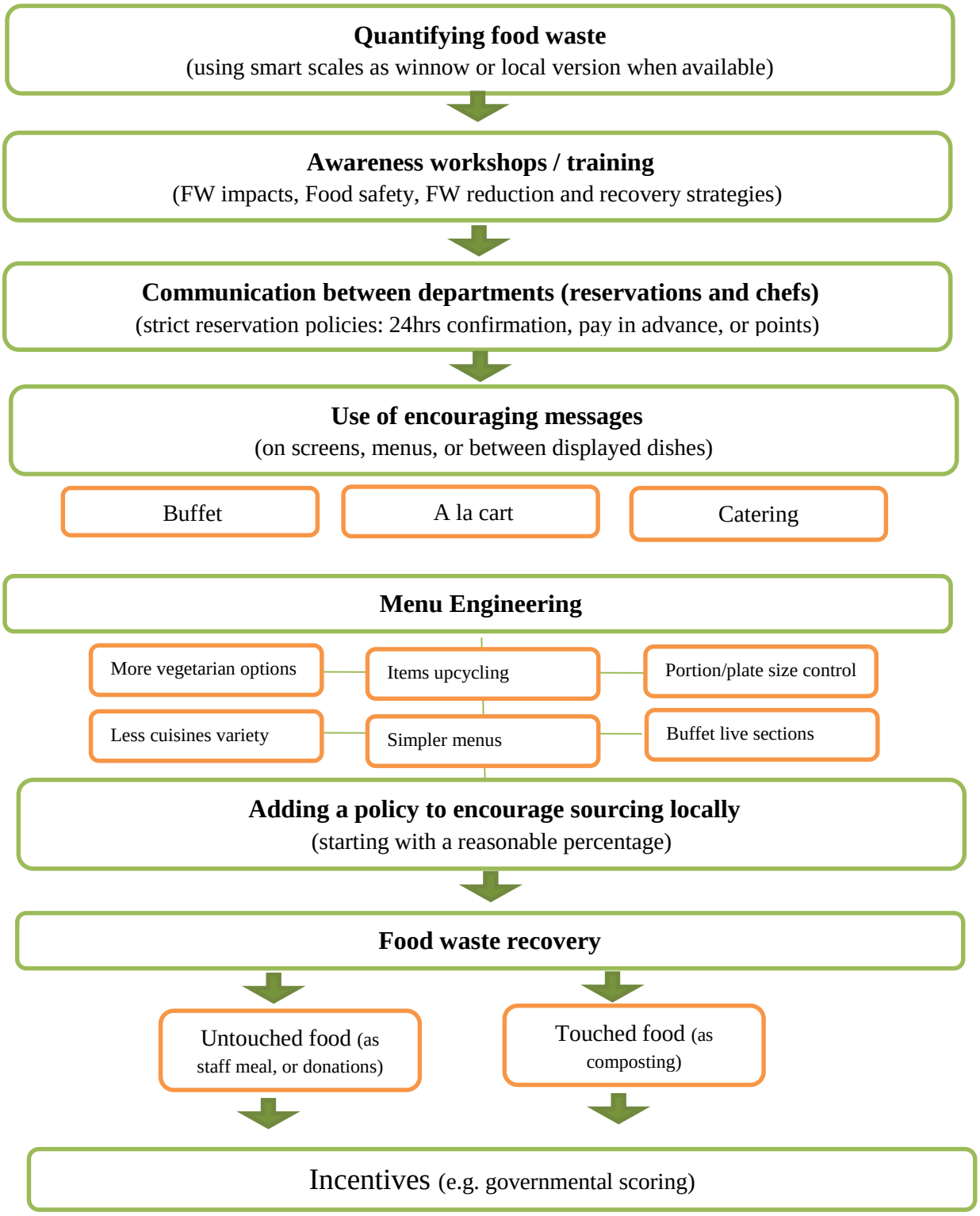
Table 61 comparison between the investigated food waste prevention strategies and the studied ones.

Prevention strategies/difference	**This paper's strategies**	**Literature review's strategies**
1	Local Sources	End-of-day sale
2	Encourage pre-booking	Kitchen planning and demand forecasting
3	Governmental scoring	Fruit to root
4	Upcycle food	Better storage &handling
5	Monitor purchases	On-demand cooking and at the last time possible
6	Lower generosity in weddings	Dealing with trustworthy suppliers
7	No cut fruits in buffets	Options for sides and prepare on your own
8	More live buffet sections	Anthropomorphism to promote ugly foods
9	Less food safety policies	Labelling all items with the addition of CO2 emissions numbers to make a change
10	Simpler &various menus	Public events (Feeding the five thousand)
11	Advice on amounts to order	Preordering of food→ better forecasting
12	Standup tables- stay less time	Pre-tasting of food
13	Attendance check	No-refill policy acceptance
14	Food Waste Compactor	Active rating system / top-rated dishes chosen
15	Pass around system	-

Table (61) shows the comparison between the literature review prevention strategies, and the strategies investigated about in this paper. It only shows the ones that were not repeated in both areas, as others were eliminated. Most important additions that was not mentioned in the read papers are the strategy of sourcing locally especially for import-based countries such as UAE and GCC, as around 90% of UAE food is imported which increase the possibility of wasting food, besides using governmental scoring to encourage food services and lowering food safety policies as they also add to the problem while safe measures can still be taken with less policies. Simpler strategies for buffets such as more live-buffet sections and not introducing cut fruits may help in reducing FW, besides catering services strategies such as offering advice on amounts, enhance the importance of less generosity in events, and attendance checking. On the other hand, some strategies from the literature review is viewed as important to be added in UAE, especially the active rating system for dishes in food services, pre-tasting for few options of buffets, environmental labelling for food items and adding public events such as (feeding the five thousand) which prepared 5000 meals from safe food waste and leftovers to promote for their use which could also inspire other types of similar events.

6.1.3 The plan

In alignment with the world trend of “Target, Measure, and Act” this plan is suggested to be started with by food services with tailoring to what suits their service and problem size.


Quantifying food waste
(using smart scales as winnow or local version when available)
Awareness workshops / training
(FW impacts, Food safety, FW reduction and recovery strategies)
Communication between departments (reservations and chefs)
(strict reservation policies: 24hrs confirmation, pay in advance, or points)
Use of encouraging messages
(on screens, menus, or between displayed dishes)
Buffet
A la cart
Catering
Menu Engineering
More vegetarian options
Items upcycling
Portion/plate size control
Less cuisines variety
Simpler menus
Buffet live sections
Adding a policy to encourage sourcing locally
(starting with a reasonable percentage)
Food waste recovery
Untouched food (as staff meal, or donations)
Touched food (as composting)
Incentives (e.g. governmental scoring)

6.2 Study Conclusion

Food waste is an alarming, global problem that touches all sectors within all societies. As easy as some people see it, as hard it is to eliminate its huge effects and the many factors that contribute to it. Different than Other environmental problems, food waste damages the three pilars of sustainability; environmental, social and economic. The decomposition of the organic substance into methane gas, high carbon footprint through the supply chain and the loss of natural resources such as land and water add to the environmental problems' spread on the earth, especially global warming and water scarcity. It also contributes to social inequality, where millions of people are hungry while wasting food is in billions of tons. This wasted food also costs money to produce, transport, distribute and dispose of through the whole supply chain, thus, affecting the individuals and the countries' economies. UAE is one of these highly affected countries by this problem, as it has one of the highest per capita number of food waste per year, 224kg (Kohli 2021), and ranks second in wasting fresh water globally from food waste by using around 76.43 m^3 per capita (Skaf et al. 2021), while it lacks the availability of enough fresh water resources. Efforts are started to control this problem in the country, especially in the hospitality sector, which is a huge contributor to FW, as the Emirate of Dubai is a tourist hub.

This research has been dedicated mainly to finding the roots of this problem. It focused on finding the causes of food waste in the hospitality sector in the Emirate of Dubai, aiming to reach a level of knowledge about the situation and to suggest prevention strategies to reduce it, as source reduction is the most preferred problem solution. It used a mixed-mode methodology to collect all the needed data. After surveying both the people attending the food services (the guests, N=361) and the services providers (the employees, N=91)), the results showed that the main causes of FW from customers from the top affecting are taking big portions and seeing abundance in types and amounts, the lack of awareness, the cultural habits shown in generosity in over-ordering. While causes of FW from food services are summarized mainly in their over-production and wrong planning and forecasting for numbers. Other factors were checked for their effect on food waste according to the opinion of the (guests, employers), to find that (45%, 47%) chose winter season, (93%, 71%) chose weekend days, and (71%, 64%) chose buffet type. Results were checked by SPSS program for a general trend with some demographics such as (guests' salary, residency, and type of preferred food service) to show that guests with higher salary and going to high-end services mainly chose "food presentation" as a major cause of FW. While it was tested also for

employees' demographics of (the type of food service, employee experience, and food service's level of classification), to find out mainly that employees of the high-end services find "meal time" as being a cause of FW. Prevention strategies were checked for the samples' acceptance to implement them in the food services of Dubai.

The surveys' results were followed by verifying their answers and suggesting prevention strategies by seven of the highly-positioned experts whose work is related to food, environment or policy-making. It was found that the main reasons contributing to food waste caused by both customers and food services were similar to the interviewees' opinion. Moreover, some interviewees saw that hygiene problems in some labour areas and customers' cancelling their orders add to the problem. Tourists' behaviour was one of the leading causes in the view of all, except Dr Essam from DM, as he sees wasting food depends on the person's background.

The experts explained that the current hospitality sector size is huge and the awareness levels to be there but still improving as taking meaningful actions needs higher levels of it. They agreed on the main food waste prevention strategy to be using smart scale technology like Winnow Solutions in food service. The second prevention strategy was the importance of reducing portion/plate sizes in the services and promoting individual sizes in catering services. Followed by sourcing locally, using menu engineering to upcycle and reduce FW, raising the chefs' education, using encouraging messages on menus, screens, and between buffet items and encouraging the use of leftover bags to reduce food waste. The study used these strategies along with the accepted ones from the surveys to conclude up with a base plan for food services to follow in order to reduce their food waste, summarised in section 6.1.

The plan suggests multiple steps be followed to reduce food waste. Each step is estimated to lower an approximate percentage of food waste but may be varied. It starts with quantifying the food waste using the technology of Winnow or others. Winnow was proven to save about 47% of FW in the first months (as in Fairmont and Atlantis Hotels) and may reach higher savings over time as in Hilton (70%), (winnow n.d. a). The second and fourth steps suggested offering workshops and spreading encouraging messages. These steps were tested in a university canteen in Portugal, in a campaign name "Clean dish, clean conscience" which used only simple posters and messages to wake up the student consciousness. It revealed a reduction of about 15% in the consumption index that they calculated by

quantifying the FW in the first 10 days, (Pinto et al. 2018). Department communications, especially between reservations and chefs, must be always updated so as to not allow the chefs to estimate amounts built on previous trends. Menu engineering is verified by all types of services providers in the interviews to be so important, it includes different strategies. Using vegetarian options may reduce up to 28% of vegetables in the hospitality sector, (Coudard et al. 2021). Reducing the plate size results in a 20% reduction of food waste, (Al-Obadi et al. 2022). The strategy of sourcing locally will definitely reduce the food loss and waste as it is estimated that 14% of food is lost between the harvesting to retail and that is locally (*Globalagriculture* 2019), if imported more waste can be added up caused by the missed days of expiration (especially for the dairy and fresh items) beside losing the quality of them. Moreover, in the final suggested step of the plan, it suggests offering incentives for the food service that committed to reduce its food waste. Incentives could be financial discounts, taxes reduction, higher government scoring, involvement in social events. This strategy was studied in a (all-you-can-eat) restaurant in a university in USA, to find that when students were given a financial incentive of paying them 2 dollars, they reduced their plate waste by around 22% (Katare, Wetzstein & Jovanovic 2019). Chalak, Abou-Daher & Abiad (2018) found out in their study on 33 countries that suggest that using a verified legislative framework, awareness campaigns and financial incentives will considerably lower food waste by about 17.6, 21.3 and 14.3%; respectively. In general, it was studied by Champions 12.3 that hotels are estimated to save $7 for every $1 they pay for reducing food waste investment (Lim 2019).

Some food services fear donating untouched food to food charities and banks. Awareness camps must encourage removing this idea and simplifying the ways to do it, as recovering food waste is also important. Initiatives and organisations dealing with food waste in UAE/Dubai are plenty; their work is mainly to raise awareness and recover food waste (donations, composting, animal feeds). Some of these initiatives/ organisations are the "N'ema Initiative", "Recipe of Change Campaign", EEG, MOCCAE, Goumbook, Dubai Sustainable Tourism, UNEP, UAE Food Bank, DM…etc. Besides, the private sector's initiatives are within their food services or retail stores. These extensive efforts must be united to apply the "Target, Measure and Act" food waste plan according to what benefits the community.

The surveyed sample and the studied papers confirmed that the buffet type as the most contributing one to FW. Thus, a conceptual change of the operations of the services to reduce food waste was refused by the interviewees. Two proposals were presented to them, using weighted buffets to lower leftover waste and mixed buffets (sides as buffets and main dishes as on-demand). They explained their refusal by saying that no other option of services can follow up with the huge numbers of guests coming in a short period of time especially for breakfast in hotels or resorts, or in Ramadan Month, when the time is limited, besides, the feeling of luxury that the buffets give is essential for guests satisfaction. However, the possibility of long-term change in the beliefs and policies of the individuals and country was felt possible. A general framework was agreed on to be essential and beneficial to be implemented in food services with tailoring to suit each one by their management. Applying doable tips and strategies will help reach the targeted, national and international goals for the upcoming years, as the researcher felt good intentions and care from all the contacted participants.

The research answered all its questions from the data collected through surveys and interviews. This data could be the basis for further studies, each in testing exact awareness levels or redoing it for other sectors such as retail and households, besides the importance of quantifying the food waste in each industry, especially hospitality, to widespread the knowledge about the causes and come up with a base plan to start implementing the needed strategies to prevent food waste.

6.3 Study Recommendations

Part of the food services' employees sample, who were not using prevention strategies in their outlets, were asked about their interest in using them; 70% of them extremely agreed on that if they were explained to them. Thus, public or specific workshops are recommended for such sectors to spread knowledge about preventing strategies for food waste. Besides, the food services that didn't use prevention strategies in buffet restaurants, such as portion sizes, more on-spot cooking sections…etc. must start to promote alternatives as buffets are emphasised by all interviewees, survey participants and literature to have the highest waste among types. Options could include using weighted buffets and family-style sharing, which is proven to lower plate waste (Ravandi & Jovanovic 2019).

Emphasis on promoting the mentality change in the hospitality sector as not to treat the "guest as a king", but rather convince the visitors to act as "responsible guests" toward their environment and planet, as also mentioned in Mabaso & Hewson (2018). This could be done by simple strategies like using messages and graphics in all food-related areas in the service and not worrying about guests' reactions as they may be touched by it not. These messages should also focus on the idea of lowering the extreme generosity in ordering which was one of the main causes of FW in the opinion of both samples. Moreover, the study noticed that faults in planning and forecasting of number of guests are agreed on by food services and guests beside understanding from some of the interviewees that they don't have strict policies for reservations and prepare food upon their expectations and days' trends. Thus, recommendations for a strict reservation system maybe through contacting people to confirm prior to the food preparations and also distributing messages in the food services.

The study confirmed that having special events like DSF and months such as Ramadan besides weekend days leads to more food waste. It is highly beneficial if these seasons are started with awareness campaigns through social media, videos on screens, flyers…etc. to remind people to have responsible consumption and show them positive environmental impacts if they do it. Educationally, efforts to add food waste awareness in the school's curriculum are outstanding, but measures for further introduction of this education in universities and other grade levels as well are recommended.

Recommendations for governmental organisations concerned about food safety's strict policies and the possibility of lowering it and increasing shelf life expiry dates were asked about and confirmed to be understudies and work. Moreover, aligning with the suggestion of Dr Essam in DM to measure food waste in all food services and check the type of most wasted items. The study suggests creating a governmental mobile/tablet application for food services to self-report their waste and get daily data while offering them incentives and assuring no legal liabilities. Creating this application and supporting more comprehensive studies needs providing funds, but is a start for change. Moreover, incentivizing the small food services to donate their extra food such as offering transportation with nominal fees, outdoor fridges…etc. as the cost of donations is more than the cost of wasting for these services.

The study recommends applying a policy of forcing coffee shops which offer packaged foods and have tens and hundreds of branches in Dubai to donate this food to charities or

labour camps. As experienced by the researcher that these services have a strategy to throw leftover foods in the bins regardless of being packaged, untouched foods that have been saved in fridges and good conditions.

6.4 Limitations of the Research

The research has a few limitations, especially in collecting data at the two stages of it; surveys and interviews. The number of people that received the survey was huge as the efforts of distributing it were very high from the researcher and her family, friends, school, university…etc. but the responses were not as high. Although the number meets the calculated sample upon the population of Dubai, to be more representative, surveys about these subjects must be inclusive to a larger sample that covers a larger geographical area.

The survey was long compared to the time people can give for such things; it took the people around ten (10) minutes at a minimum to answer it entirely, which may be one of the reasons for others not to complete it as they either don't have tolerance, or busy doing their work. Besides, the employees didn't fancy filling out the survey online, forcing the researcher to go to their outlets one by one to fill out a survey from each at a time; this was time-consuming as it took much time and effort to convince them that it is only for research purpose, yet not all were welcoming to do it. Thus, extra help for the researcher was needed to expand the areas of study within a limited time. Besides, a big shopping mall refused to allow the researcher to survey the food services, fearing tenants' complaints. Distributing all the samples in a short time may not let the results be generalized, as opinions and behavior may change over time.

As for the information, when surveying by hand, the researcher felt some managers to be explaining perfectly about food waste and strategies as their outlets almost have zero waste which may not be accurate in some cases. Thus, some information may be misleading to reality as employees feared blame or a lousy image. This is because this study uses a cross-sectional approach, which may cause results to be biased. This puts questions on the idea of generalizing a trend upon the answers of the sample and may be limited to exploring and investigating, not concluding results. The tourist sample was the lowest among residents, while there was a paper accusing them of being a cause of food waste. Thus, this could not be accurately compared as their participation must be increased.

The language was a limitation in some types of low-level restaurants as the employees didn't understand both offered languages of the survey. Interviewing these

employees by someone who understands the language was a better idea to reach all levels of food services.

Interviewing policy-makers was a challenge sometimes. Although they support the research and the topic of food waste and are doing initiatives themselves, their time was limited to give some of it to the researcher, unfortunately. The researcher expected to cover ten as a minimum number of the Emirate's critical environmental/hospitality organisations, but it turned out hard to achieve.

6.5 Future Research

As food waste studies differ by customers' behaviors, similar types of analysis and surveys are recommended to take place in other parts of the country of UAE to cover the other six Emirates, reach a country-level awareness and suggest a framework that may allow food services to follow. As mentioned previously, this is important to achieve the sustainable vision of the country aligned with SDGs 12.3 of halving food waste by 2030 and SDGs 2 of achieving zero hunger. Moreover, this study is recommended to include other aspects of society, education, health, households…etc. and in all sections of the supply chain to help in circular economic studies, as this study focused on one of the most contributing sectors to FW; the hospitality sector. Especially studies on food loss in ports, as there is a massive loss in these areas, as was recommended for the researcher by one of the UAE Food Bank employees.

Although the study used mixed methodology to collect data and reached high-level positioned people, it can be categorised as theoretical, not practical. However, future food waste studies should be accompanied by quantitative, observational ones to quantify them. Observing customers' behavioural attitudes could be more accurate than letting them select choices in a survey to give ideal answers sometimes. That will be aligned with the global trend "Target, Measure and Act". However, this can be achieved only if a big team works simultaneously with the food services' efforts to achieve the desired results and for longer time from what was done to be sure of the results.

As emphasised in the interviews and surveys, the lack of awareness is the biggest problem affecting food waste and where most of the efforts in Dubai are targeted. It is believed that more focus on awareness in the surveys is best practice in future studies, as it is essential to measure the level of awareness of the community and find the ways and areas

that are useful for spreading the information to reach everybody. Thus, awareness survey to study the behavior of the people and testing it through psychological analysis is suggested.

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Appendices

Appendix 1 (Survey 1 (the guests))

1. What age group are you in? ما هي فئتك العمرية

- less than 20 yrs
- 21 - 39 yrs
- 40 - 59 yrs
- more than 60 yrs

2. What is the range of your salary per month? (الراتب الشهري شهريا) ما هو نطاق دخلك

- less than 10,000 aed / أقل من
- 10,000 - 20,000 aed / بين
- 20,000 - 40,000 aed / بين
- more than 40,000 aed / اكثر من
- unemployed

3. What is your gender? ما هو جنسك

- female / أنثى
- male / ذكر

4. What is your status in Dubai? ما هو وضعك في دبي

- UAE local resident / مواطن اماراتي
- foreigner resident / مقيم
- tourist / سائح

5. Which type of food service do you like to go to? ما نوع خدمة الطعام التي تفضل الذهاب اليها

- ○ a la carte restaurant (order from menu)/ ethnic restaurant ex. Indian, Chinese...etc / مطعم بقائمة حسب الطلب
- ○ Buffet restaurant / مطعم بوفيه
- ○ coffee shop / مقهى
- ○ canteen in university / مقصف بالجامعة

6. Which level of restaurant do you mostly prefer to go to? ما مستوى خدمة المطعم التي تفضل الذهاب اليه عادة؟

- ☐ high-end restaurants / مطاعم راقية
- ☐ mid-end restaurants / مطاعم متوسطة
- ☐ low-end or popular restaurants / المطاعم الشعبية

7. Answer with yes or no for the following statements :اجب على الجمل التالية بنعم او لا

	yes	no
Do you know that food waste contributes to major environmental, economic and social problems such as natural resources loss, food insecurity, methane gas emissions that contribute to global warming? هل تعلم ان هدر الطعام يساهم في مشاكل بيئية واقتصادية واجتماعية كبيرة مثل فقدان الموارد الطبيعية وانعدام الأمن الغذائي وانبعاثات غاز الميثان التي تساهم في الاحتباس الحراري؟	☐	☐
Knowing the problem is the start of the solution? /معرفة المشكلة هي بداية الحل؟	☐	☐
I care about the environment / انا اهتم بالبيئة	☐	☐
I am willing to start a change if I get the knowledge / أنا على استعداد لبدء التغيير اذا حصلت على المعرفة	☐	☐

8. How much food do you waste when you eat in the restaurants of Dubai? كم من الطعام تهدر عندما تأكل في مطاعم امارة دبي؟

- less than one third of the plate (< 1/3) / أقل من ثلث الصحن
- between one third to one half of the plate (1/3 - 1/2) / بين ثلث إلى نصف الصحن
- more than half of the plate (> 1/2) / اكثر من نصف الصحن
- none / لا شيء

9. How much amounts of food do you think is wasted daily (g) / yearly (kg)? ما مقدار الطعام الذي تعتقد انه يهدر يوميا للفرد يوميا (جم) / سنويا (كجم)؟

- less than 160 g / 59 kg / أقل من
- between 160 - 360g / 59-133 kg / بين
- between 360-600g / 133-244 kg / بين
- more than 600 g / 224 kg / اكثر من

10. Do you know that UAE wastes around 224 kg yearly per person, which is one of the top wasting nations per person? هل تعلم ان الامارات العربية المتحدة تهدر حوالي 224 كجم من الطعام سنويا للفرد، وهي واحدة من اكثر الدول هدرا للطعام للفرد؟

- yes / نعم
- no / لا

11. Did you ever hear of these institutes/apps? Which one? هل سمعت من قبل عن اي من هذه المؤسسات او التطبيقات؟ اي منها؟

1- BonApp 2- UAE FOOD BANK بنك الإمارات للطعام 3- winnow 4- وزارة التغير المناخي والبيئة MINISTRY OF CLIMATE CHANGE & ENVIRONMENT

- [ ] yes, # 1
- [ ] yes, # 2
- [ ] yes, # 3
- [ ] yes, # 4
- [ ] yes, but not sure what
- [ ] they do
- [ ] no

12. Which type of food service do you think is the most contributing to food waste? ما نوع خدمة الطعام التي تعتقد انها الاكثر مساهمة في هدر الطعام؟

- ○ a la carte restaurant (order from menu)/ ethnic restaurant ex. Indian, Chinese...etc / مطعم بقائمة حسب الطلب
- ○ Buffet restaurant / مطعم بوفيه
- ○ coffee shop / مقهى
- ○ university canteen / مقصف الجامعة
- ○ event catering / شركات تقديم الطعام بالمناسبات

13. Which months do you think people waste more food in Dubai? ما هي الأشهر التي تعتقد انه يتم اهدار المزيد من الطعام فيها في دبي؟

- [ ] June, July and August / يونيو ويوليو وأغسطس
- [ ] September, October and November / سبتمبر واكتوبر ونوفمبر
- [ ] December, January and February / ديسمبر ويناير وفبراير
- [ ] March, April and May / مارس وابريل ومايو

a. Do you think food waste is related to better weather, so people tend to go out more? هل تعتقد أن زيادة هدر الطعام مرتبطة بتحسن الطقس والخروج من المنزل؟

- yes / نعم
- no / لا

b. Do you think that food waste increases during the holy month of Ramadan? هل تعتقد ان هدر الطعام يزداد خلال شهر رمضان المبارك؟

- yes / نعم
- no / لا

i. Is food waste related to any other event or celebration? If yes, what is it? هل تعتقد ان هدر الطعام مرتبط بأي احداث او مناسبات اخرى؟اذا كانت الاجابة نعم فما هي؟

14. Which days of the week the food waste at its highest? اي ايام من الاسبوع يكون فيها هدر الطعام بأعلى مستوى؟

- weekdays/ Monday - Thursday / ايام اسبوع / الاثنين - الخميس

- weekends/ Friday - Sunday / عطلة نهاية الاسبوع / الجمعة - الاحد

15. To what extent do you agree that these reasons contribute to food waste? الى اي حد توافق ان هذه الاسباب تؤدي للزيادة في هدر الطعام؟

	strongly disagree / لا اوافق بشدة	disagree / لا اوافق	neutral / محايد	agree / موافق	strongly / موافق agree بشدة
I don't like the taste/ unexpected quality – لم احب الطعم، جودة الطعام رديئة					
Big portions- حصص كبيرة					
More variety of menu choices- I order more food/ خيارات القائمة متعددة فاختار المزيد					
Generosity and wealth in over-ordering / الكرم والثروة في الافراط في الطلب.					
Tourist behavior-try as much available options / السلوك السياحي-تجربة أكبر قدر ممكن من الخيارات المتاحة					
Not declare about religious allergies or restrictions / عدم الاعلان عن الحساسية او القيود الدينية					
Lack of awareness / قلة الوعي بالمشكلة					
Cheap prices of food / اسعار اصناف الطعام قليلة					
I don't see it as a big problem / لا أرى أنها مشكلة كبيرة					
Un-wanted food sides like decoration items and vegetables/sauces – جوانب الطعام غير المرغوب فيها مثل عناصر الديكور والخضار.					

16. Do you think that wasting food is related to gender? هل تعتقد أن هدر الطعام مرتبط بالجنس؟

- ○ Yes, females waste more / نعم النساء تهدر المزيد
- ○ Yes, males waste more / نعم الذكور يهدرون المزيد
- ○ No/لا

17. To what extent do you agree that these reasons cause an increase in food waste by food services (restaurants) / الى اي مدى توافق على ان هذه الأسباب تؤدي الى الزيادة في هدر الطعام من قبل مؤسسات خدمات الطعام؟

	strongly disagree / لا اوافق بشدة	disagree / لا اوافق	neutral / محايد	agree / موافق	agree / strongly موافق بشدة
Over-production/ الافراط في الانتاج	☐	☐	☐	☐	☐
Poor planning or forecasting / سوء التخطيط أو التنبؤ	☐	☐	☐	☐	☐
Food presentation and preparations عرض وتحضير الطعام /	☐	☐	☐	☐	☐
Unqualified cooking skills/ staff errors / مهارات طبخ غير المؤهلة للطهاة / اخطاء من الموظفين	☐	☐	☐	☐	☐
Menus' many choices / الخيارات المتعددة لقائمة الطعام	☐	☐	☐	☐	☐
Storage and expiration dates/ التخزين وتواريخ انتهاء الصلاحية	☐	☐	☐	☐	☐

18. How would you react if the waiter told you the food you ordered is enough for you? كيف سيكون رد فعلك اذا اخبرك النادل ان الطعام الذي طلبته كاف لك؟

- I appreciate him / Happy / أقدره واكون سعيدا /
- no reaction / لا أعطي ردة فعل
- stop him and not listen / أوقفه ولا استمع اليه
- not come again / لا اتي مرة اخرى

19. how would you react if the food service reduced the plate size as a food waste prevention strategy? ماذا سيكون رد فعلك اذا انقص المطعم من حجم صحن التقديم كاستراتيجية للحد من هدر الطعام؟

- I appreciate him / Happy / أقدره واكون سعيدا /
- no reaction / لا أعطي ردة فعل
- not come again / لا اتي مرة اخرى

20. how would you react if the restaurant displayed pictures of food waste social, environmental, and economic bad impacts on screens or on paper mats? كيف سيكون رد فعلك اذا عرض المطعم صورا للتأثيرات الاجتماعية والبيئية والاقتصادية السيئة لهدر الطعام على الشاشات او الحصائر الورقية للطاولة؟

- I appreciate him / Happy / أقدره واكون سعيدا /
- no reaction / لا أعطي ردة فعل
- not look at it / لا انظر اليه
- not come again / لا اتي مرة اخرى

21. Which strategies help in lowering food waste have you seen in restaurants of the Emirate of Dubai? (select multiple) ما هي استراتيجيات تقليل من هدر الطعام التي رأيتها في مطاعم امارة دبي؟

- ☐ encouraging doggy bags/ take away bags / أكياس لتشجيع اخذ بقايا الطعام
- ☐ encouraging messages / menu design / رسائل تشجيعية / تصميم أفضل للقائمة
- ☐ better forecasting and planning / تنبو وتخطيط افضل
- ☐ using technology ex. winnow or smart scales / استخدام التكنولوجيا مثل الموازين الذكية
- ☐ study customer behavior /portion sizes / دراسة سلوك العميل لتغيير احجام الحصص بناءا عليه
- ☐ fruit to root/use all parts of food / استخدام جميع لجزاء الطعام
- ☐ incentives for staff and guests / حوافز للموظفين والضيوف
- ☐ better storage and handling / التخزين الجيد للطعام
- ☐ better departments communication / التواصل الجيد بين الاقسام

- ☐ I didn't see / لم ارى
- ☐ Other / آخر

21. a If you selected Other, please specify:

☐

21.b To what extent do you agree that these strategies are effective to lower food waste in food services?الى أي مدى توافق على أن هذه الاستراتيجيات ناجعة في التقليل من هدر الطعام في مؤسسات خدمات الطعام؟

	strongly disagree / لا اوافق بشدة	disagree / لا اوافق	neutral / محايد	agree / موافق	/ strongly agree موافق بشدة
Encouraging take away bags / doggy bags- تشجيع أخذ اكياس باقي الطعام للمنزل	☐	☐	☐	☐	☐
Encouraging messages/ menu design رسائل تشجيعية والتصميم الافضل للقائمة	☐	☐	☐	☐	☐
Better forecasting and planning / التنبؤ والتخطيط الأفضل للكميات	☐	☐	☐	☐	☐
Technology use like using smart scales, e.g. winnow/ استخدام التكنولوجيا الحديثة مثل الموازين الذكية	☐	☐	☐	☐	☐
Study customer behavior to know portion sizes/ دراسة سلوك العميل لتغيير احجام الحصص					
Fruit to root/ use of all parts of food/ استخدام جميع اجزاء الطعام					

Incentives for staff and guests/ حوافز للموظفين والضيوف					
Better handling and storage/ التخزين الجيد للطعام					

22. Do you usually take food leftovers with you home? هل عادة ما تأخذ بقايا الطعام معك الى المنزل؟

- ○ yes / نعم
- ○ no / لا

22.a Why do you take leftover home? لماذا تأخذ بقايا الطعام للمنزل؟

- ☐ I know the impacts of wasting food / اعرف اثار هدر الطعام
- ☐ reasons of not throwing food / أسباب دينية تمنع ذلك
- ☐ religious
- ☐ feeling of guilt / الشعور بالذنب
- because I like it / لأنها تعجبني

22.b what do you do with the leftover home? ماذا تفعل ببقايا الطعام بالمنزل؟

- eat it as it is / اكله كما هو
- give to other people /اعطيه للاخرين
- use it as another food meal (upcycle it) / استخدمه كوجبة طعام اخرى (اعد استخدامه)
- I dispose it / أتخلص منه
- other / آخر

22.b.i if you selected other, please specify:

23. What will motivate you to reduce food waste (select multiple) ? ما الذي سوف يحفزك لتقليل هدر الطعام؟

- incentives and cost offers / عروض وحوافز
- messages on screens or menus / الرسائل على الشاشات او القوائم
- design of beautiful doggy bags /تصميم اكياس جميلة لبقايا الطعام
- less menu options / خيارات قائمة اقل
- smaller portions / smaller plate size / حصص أصغر / حجم الصحن أصغر
- higher prices for food dishes / ارتفاع اسعار اطباق الطعام
- workshops on food waste impacts/or on upcycling leftovers/ ورش عمل حول تأثيرات نفايات الطعام او على كيفية اعادة تدوير الطعام/
- waiter's advise on ingredients and sizes of ordered meals / نصيحة النادل بشأن مكونات واحجام الوجبات المطلوبة
- Other / آخر

Appendix 2 (Survey 2 (the employees))

1. What age group are you in? ما هي فئتك العمرية؟

- less than 20 yrs / أقل من
- 21 - 39 yrs/ بين
- 40 - 59 yrs / بين
- more than 60 yrs / اكثر من

2. How long are you working in the hospitality sector in Dubai? ما هي مدة عملك في قطاع الضيافة (المطاعم) في دبي؟

- less than 1 year / أقل من
- between 1-5 yrs / بين
- between 5 -10 yrs / بين
- more than 10 yrs / من اكثر

3. What is the type of food service you work in Dubai? ما هو نوع خدمة الطعام التي تعمل فيها في دبي؟

- a la carte restaurant (order from menu)/ ethnic restaurant ex. Indian, Chinese...etc / مطعم حسب الطلب من القائمة
- Buffet restaurant / مطعم بوفيه
- a la carte + buffet / مطعم متنوع من بوفيه والطلب من القائمة
- coffee shop / مقهى
- canteen in university / مقصف في الجامعة
- catering service / خدمات تقديم الطعام بالمناسبات

3.a what is your food service level of classification? ما هو مستوى تصنيف خدمة الطعام التي تعمل بها؟

- high-end, e.g. five stars / الراقية ،مثل مطاعم خمس نجوم
- mid-end restaurants / مطاعم متوسطة
- low-end e.g. popular restaurants / مطاعم شعبية

3.b Where is your food service located? اين تقع خدمة الطعام التي تعمل بها؟

- Independent building / مبنى مستقل
- inside a mall/independent / داخل مركز تجاري / مستقل
- inside a mall / in a food court / في قاعة طعام / داخل مول
- inside a hotel / داخل فندق
- in a convention center/catering events / في مركز المؤتمرات / خدمات تقديم الطعام للمناسبات
- Other / آخر

3.b.i if you selected other, please specify:

3.c How is the food prepared for serving in your restaurant? كيف يتم تحضير الطعام للتقديم في مطعمكم؟

- fully prepared/ ready to serve / على استعداد تام / جاهز للتقديم
- partly prepared/ half cooked or marinated / محضر جزئيا / نصف مطبوخ او متبل
- unprepared/ prepare from zero each time / غير مستعدين / نحضر من الصفر في كل مرة

4. About how much amount of food do you think is wasted in UAE per person daily (g)/ yearly (kg)? / تقريبا ما مقدار الطعام الذي تعتقد أنه يهدر في دولة الامارات العربية المتحدة للشخص يوميا (جم)

- less than 160 g / 59 kg / أقل من
- between 160 - 360g / 59-133 kg / بين سنويا (كجم)
- between 360-600g / 133-244 kg / بين
- more than 600 g / 224 kg / اكثر من

5. Comment on the following statements with yes or no: علق على الجمل التالية بنعم أو لا

	yes / نعم	no / لا
Do you know that the UAE wastes around 224kg of food per person each year, one of the highest numbers globally / هل تعلم ان الامارات تهدر حوالي 224 كيلوجراما من الطعام للفرد كل عام، وهو من أعلى الأرقام عالميا؟	☐	☐
Do you agree that pre-planning food wastes more? هل توافق أن التحضير المسبق للطعام يهدر الطعاك أكثر؟	☐	☐
Do you know that food waste contributes to major environmental, social and economic problems such as resource loss, food insecurity, and methane gas emissions that contribute to global warming? هل تعلم أن هدر الطعام يساهم في زيادة المشاكل البيئية والاجتماعية والاقتصادية مثل فقدان الموارد الطبيعية وانعدام الأمن الغذائي وانبعاثات غاز الميثان التي تساهم في الاحتباس الحراري؟	☐	☐
I care for the environment / أنا أهتم للبيئة	☐	☐
I am willing to do a change even if simple, starting with myself / أنا أريد التغيير حتى لو بأشياء بسيطة وابدأ بنفسي	☐	☐

6. Did you ever hear of these institutes/apps? Which one? هل سمعت من قبل عن اي من هذه المؤسسات او التطبيقات؟ اي منها؟

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- ☐ yes, # 1
- ☐ yes, # 2
- ☐ yes, # 3
- ☐ yes, # 4
- ☐ yes, but not sure what they do
- ☐ no

7. Which type of food service do you think is the most contributing to food waste? ما نوع خدمة الطعام التي تعتقد انها الاكثر مساهمة في هدر الطعام؟

- ○ a la carte restaurant (order from menu)/ ethnic restaurant ex. Indian, Chinese...etc / مطعم بقائمة حسب الطلب
- ○ Buffet restaurant / مطعم بوفيه
- ○ coffee shop / مقهى
- ○ university canteen / مقصف الجامعة
- ○ event catering / شركات تقديم الطعام بالمناسبات

7.a to what extent do you agree that these buffet service policies affect increasing food waste? إلى اي مدى توافق أن سياسات البوفيه هذه تزيد من هدر الطعام؟

	strongly disagree / لا اوافق بشدة	disagree / لا اوافق	neutral / محايد	agree / اوافق	strongly agree / اوافق بشدة
Adding extra 30% of food for the wrong forecast اضافة 30% من الطعام للحد من التنبؤ الخاطئ	☐	☐	☐	☐	☐
Disposing of all food after 4 hours of displaying/ التخلص من جميع الأطعمه بعد 4 ساعات من وضعها للعرض	☐	☐	☐	☐	☐

Refilling the dishes before fully consumed/ اعادة تعبئة الأطباق قبل استهلاكها بالكامل	☐	☐	☐	☐	☐
Having too many stations and cooking many options/ طهي العديد من الخيارات وتوفر العديد من المحطات	☐	☐	☐	☐	☐
Food is refilled until 15 min before closing / تعبئة الطعام حتى 15 دقيقة قبل الاغلاق	☐	☐	☐	☐	☐
Some types of food are prepared one-day before/ بعض أنواع الطعام تحضر قبل بيوم من التقديم	☐	☐	☐	☐	☐

8. Which months do you think people waste more food in Dubai? ما هي الأشهر التي تعتقد انه يتم اهدار المزيد من الطعام فيها في دبي؟

- ☐ June, July and August / يونيو ويوليو وأغسطس
- ☐ September, October and November / سبتمبر واكتوبر ونوفمبر
- ☐ December, January and February / ديسمبر ويناير وفبراير
- ☐ March, April and May / مارس وابريل ومايو

a. Do you think that food waste increases during the holy month of Ramadan? هل تعتقد ان هدر الطعام يزداد خلال شهر رمضان المبارك؟

- ○ yes / نعم
- ○ no / لا

b. Is food waste related to any other event or celebration? هل تعتقد ان هدر الطعام مرتبط بأي احداث او مناسبات اخرى؟

- yes / نعم
- no / لا

c. Do you think food waste is related to better weather, so people tend to go out more? هل تعتقد أن زيادة هدر الطعام مرتبطة بتحسن الطقس والخروج من المنزل؟

- yes / نعم
- no / لا

9. Which days of the week the food waste at its highest? اي ايام من الاسبوع يكون فيها هدر الطعام بأعلى مستوى؟

- weekdays/ Monday - Thursday / ايام اسبوع / الاثنين - الخميس
- weekends/ Friday - Sunday / عطلة نهاية الاسبوع / الجمعة - الاحد

10. To what extent do you agree that these causes increase food waste in your restaurant: الى أي مدى توافق على أن الأسباب التالية تزيد من هدر الطعام في مطعمكم؟

	strongly disagree / لا اوافق بشدة	disagree / لا اوافق	neutral / محايد	agree / موافق	strongly agree / موافق بشدة
over-production / الافراط في الانتاج	☐	☐	☐	☐	☐
Poor planning or forecasting/ سوء التخطيط والتنبؤ	☐	☐	☐	☐	☐
Food presentation in special ways' preparations/ عرض وتحضير الطعام بطريقة مميزة	☐	☐	☐	☐	☐
Cooking skills and staff errors/ مهارات الطبخ الضعيفة واخطاء الموظفين	☐	☐	☐	☐	☐

Low prices and meals' many choices / أسعار منخفضة للأطباق وتعدد الخيارات	☐	☐	☐	☐	☐
Customers' plate waste/ بقايا الطعام للزبائن	☐	☐	☐	☐	☐
Expiration dates and storage/ عدم التأكد من تواريخ الانتهاء والتخزين الصحيح	☐	☐	☐	☐	☐
Meals depend on time/ يعتمد على موعد الوجبة	☐	☐	☐	☐	☐

10.a Do you see any other reasons for food waste in your restaurant? هل ترى أي اسباب اخرى لهدر الطعام في مطعمك؟

11. Comment on these statements with yes or no: علق على هذه الجمل بنعم أو لا

	yes / نعم	no / لا
Do you have a policy of items first come first go depending on expiration dates? هل لديك سياسة الاطعمة التي تأتي أولا تذهب أولا لتواريخ انتهاء الصلاحية؟	☐	☐
Are all chefs responsible for food cutting? هل جميع الطهاة مسؤولين عن تقطيع الطعام؟	☐	☐
Is one person responsible for throwing the unqualified or damaged foods? هل هناك شخص واحد مسؤول عن رمي الأطعمة غير المؤهلة أو التالفة؟	☐	☐
Is there a monitoring system and maintenance for storage's cooling and heating system to prevent damaging the food? هل يوجد نظام مراقبة وصيانة لانظمة التبريد والتدفئة بالمخزن لمنع تلف الأطعمة؟	☐	☐

12. Why do you think customers (guests) leave food waste in their plates? لماذا تعتقد أن العملاء (الضيوف) يتركون بقايا الطعام على أطباقهم؟

- [ ] they don't like the taste / لا يحبون الطعم
- [ ] big portions / big plate size / كميات كبيرة / اطباق كبيرة الحجم
- [ ] more varieties of food and menu choices - I order more / خيارات القائمة متعددة فيختارون ألمزيد
- [ ] generosity and wealth in over ordering / الكرم والثروة في الافراط في الطلب
- [ ] tourist behavior - try most options / سلوك السائح - جرب معظم الخيارات
- [ ] not declare about allergies/ religious restrictions / لا تعلن عن الحساسية / القيود الدينية
- [ ] lack of awareness / قلة الوعي بالمشكلة
- [ ] cheap prices of food / اسعار الاصناف رخيصة

13. Does your food service use a strategy to recover food waste (after being wasted)?
هل يستخدم مطعمكم أي استراتيجية لاستعادة بقايا الطعام (بعد هدرها)؟

- ( ) yes / نعم
- ( ) no / لا

13.a Why not? Is there a barrier to not use a recovering strategy? لما لا؟ هل هناك عائق يحول دون استخدام احدى هذه الاستراتيجيات؟

- [ ] lack of awareness of the problem / قلة الوعي بالمشكلة
- [ ] financial issues and costs / القضايا المالية والتكاليف
- [ ] permission issuing / legal issues / اصدار الاذن / المسائل القانونية
- [ ] unidentified available methods / عدم المعرفة بالطرق المتاحة
- [ ] no enough storage / لا توجد مساحة تخزين كافية
- [ ] not interested to upcycle it / غير مهتم لاعادة استخدامه
- [ ] Other / آخر

13.a.i If you selected others, please specify اذا اخترت اخر، ارجو كتابة ما هو

[ ]

13.a.ii How much are you interested to use these strategies if explained to you? ما مدى اهتمامك باستخدام هذه الاستراتيجيات اذا تم شرحهم لك؟

- low- / قليل الاهتمام interest
- mid- / متوسط الاهتمام interest
- high- / عالي الاهتمام interest

13.b What are these strategies to recover food waste (after it is wasted) that your restaurant use? ما هي هذه الاستراتيجيات المستخدمة لاعادة استخدام الطعام المهدر في مطعمك؟

- ☐ food waste separation / composting / فصل بقايا الطعام / تحويلها الى سماد
- ☐ waste upcycling / change to other use / اعادة تدوير بقايا الطعام/ التغيير الى استخدامات لخرى
- ☐ donation to charities and food banks / التبرع للجمعيات الخيرية المعنية
- ☐ discounts at late times of the day / الخصومات في الاوقات المتاخرة من النهار
- ☐ give as staff's meals / تقديمه كوجبات للموظفين
- ☐ as animal feed / تقديمه كأعلاف حيوانية
- ☐ Other / آخر

13.b.i If you selected others, please specify اذا اخترت اخر، ارجو كتابة ما هو

14. Does your food service use any strategy to prevent food waste (before it happens)? هل يستخدم مطعمكم اي من الاستراتيجيات التي تحد من هدر الطعام (قبل هدره)؟

- yes / نعم
- no / لا

14.a to what extent do you agree with the efficiency of these strategies to lower food waste before it happens: الى أي مدى توافق على كفاءة هذه الاستراتيجيات للتقليل من هدر الطعام قبل حدوثه

	strongly disagree / اوافق بشدة لا	disagree / لا اوافق	neutral / محايد	agree / موافق	strongly agree / موافق بشدة
encouraging doggy bags/take away bags / التشجيع على استخدام اكياس اخذ بقايا الطعام	☐	☐	☐	☐	☐
encouraging messages/menu design رسائل تشجيعية/ وتصميم أفضل لقائمة الطعام	☐	☐	☐	☐	☐
Exact forecasting and planning / التنبؤ والتخطيط الدقيقين للاعداد	☐	☐	☐	☐	☐
Workshops for staff to improve their skills/ ورش عمل للموظفين لتحسين مهارات الطبخ والتقطيع لديهم	☐	☐	☐	☐	☐
Study customer behavior to know portion sizes/ دراسة سلوك العميل لاقتراح احجام مناسبة للحصص	☐	☐	☐	☐	☐
Use all parts of the food/ Fruit to root/ استخدام جميع اجزاء الطعام بما فيها التي لا تؤكل	☐	☐	☐	☐	☐

incentives for staff and guests to reduce food waste / حوافز للموظفين والضيوف لتقليل هدر الطعام	☐	☐	☐	☐	☐
Better storage for food items/ تخزين أفضل للطعام	☐	☐	☐	☐	☐
Using technology like smart scales, ex. Winnow/ استخدام التكنولوجيا مثل الموازين الذكية	☐	☐	☐	☐	☐

15. What can you offer and apply as a restaurant to motivate guests to lower their plate waste?
ما الذي يمكن أن تقدمه وتطبقه كمطعم لتحفيز الضيوف على تقليل ترك بقايا الطعام في أطباقهم؟

- ☐ incentives and cost offers on recent or next visit/ عروض وحوافز للزيارات القادمة او الحالية
- ☐ messages on screens or menus / الرسائل المشجعة على الشاشات او القوائم
- ☐ design of beautiful doggy bags /تصميم اكياس جميلة لبقايا الطعام
- ☐ less menu options / خيارات قائمة اقل
- ☐ smaller portions / smaller plate size / حصص أصغر / حجم الصحن أصغر
- ☐ higher prices for food dishes / ارتفاع اسعار اطباق الطعام
- ☐ weighted buffets / pay for chosen food / استخدام نظام البوفيه المدفوع (دفع المال حسب الكمية المأخوذة
- ☐ Mixed buffets/ starters buffet and on demand main dishes بوفيه مختلط/ نظام البوفيه للمقبلات والطلب من القائمة للوجبات الرئيسية/
- ☐ I don't want to give motivations to lower food waste as it lowers my benefit / اريد اعطاء لا دوافع للتقليل من هدر الطعام لأنه يؤثر على مصلحتي

16. Please comment on the below statements and choose between yes or no, could you : علق على الجمل التالية بنعم أو لا، هل ممكن أن

	yes / نعم	no / لا
Tell the guests that the food is enough for them and don't order more / تخبر الضيوف أن الطعام كاف لهم ويجب ان لا يطلبوا المزيد	☐	☐
Show the guests photos of the affected environment, people with malnutrition…etc. as food waste impacts / تعرض على الضيوف صور للبيئة المتضررة والأشخاص المصابين بسوء تغذية وغيرها من مضار هدر الطعام		☐
Ask the customers to take home their leftovers when they finish/ تطلب من الزائرين أخذ بقايا الطعام الخاصة بهم الى المنزل لاستخدامها	☐	☐
Make them pay extra money as a fine for extra food waste/ تجعلهم يدفعون نقودا اضافية كغرامة لهدر الطعام الاضافي	☐	☐
Explain about ingredients, way of cooking and allergies that could be caused by the food / تشرح لهم عن مكونات وطريقة طهي الطعام والحساسية التي يمكن أن يصاب بها الشخص منه	☐	☐
Be involved in workshops that teach how to prevent food waste / المشاركة في ورش عمل للتعلم كيفية منع هدر الطعام	☐	☐
Can we make a general forecasting system for all types of food services? (e.g. low-end or high-end)/ هل يمكننا عمل نظام تنبؤ عام وموحد لجميع أنواع الخدمات الغذائية؟ (على سبيل المثال مطاعم فاخرة أو منخفضة المستوى)؟	☐	☐

17. What do you think about the possibility of change to prevent food waste? ما رأيك في امكانية التغيير للتقليل من هدر الطعام؟

- possible in short term / ممكنه على المدى القصير
- on long term but possible / ممكنه على المدى الطويل ولكن ممكن
- possible only if there was governmental laws and intervention ممكنه فقط اذا تواجد تدخل من الحكومة وفرض القوانين
- impossible / غير ممكن