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Saudi Zero Food Waste Certification: A Novel Approach for Food Waste Management in Saudi Arabia

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Abstract: Saudi Arabia (SA) is categorised as one of the nations with the highest food waste globally. However, this rate of food waste encompasses a high risk to the economy, society and environment. The government has prioritised food security and environmental sustainability in its Saudi Vision 2030; hence, the government has developed some initiatives for food waste reduction. However, these efforts have not achieved the desired outcomes, as there is no evidence that food waste was reduced after such initiatives. The current research reports the results of the first phase of a wider study on food waste management (FWM), which has undertaken a novel approach towards FWM in food service organisations in SA by integrating the perspectives of stakeholders: customers, managers and academics specialised in food management/service. The results of in-depth interviews with key stakeholders identified the main causes of food waste in food service organisations. The findings confirmed that causes of food waste are all associated with each other and linked to either the absence of strategic and legal frameworks, consumer behaviour or poor management of food chains in food service organisations. Solutions for effective FWM were discussed with key stakeholders. The research showed that there is a need for an integrated approach for FWM in each sector where food waste is apparent such as food service organisations. Hence, the Saudi Zero Food Waste Certification has been introduced as a novel approach for managing food waste in food service organisations.

Keywords: zero food waste; food loss; food waste; food chain; food waste management; food service organisations

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1. Introduction

According to recent reports [1–5], Saudi Arabia (SA) is categorised as one of the nations with the highest food waste globally. Surprisingly, food waste is the top waste in SA, which encompasses at least 50% of the overall waste in the kingdom, more than all other kinds of waste [1]. Food waste is also more than triple the food loss in SA [4]. A report by the Saudi Grains Organization [4] showed that over a third of food is wasted/lost. The Food and Agriculture Organization (FAO) confirmed that this proportion of food waste is slightly higher than the world's proportion, which is about 31% [2]. The average food waste in SA per individual is more than double the worldwide average, i.e., 250 kg compared to 115 kg. In addition, the average consumption of grains per individual in SA is 158 kg, which is also higher than the worldwide average of 145 kg. The proportion of food waste significantly increases during special days/months such as feast days and Ramadan [6,7]. Additionally, during the Hajj (pilgrimage) days 5000 tons of food waste are produced within a few days in the Holy City of Makkah alone [8]. This includes an additional challenge for the SA government to reduce food waste during this event, since the proportion of local pilgrims was 25% of 2,489,406 participants in the pilgrimage season of 2019 from around the world [9].

The proportion of food wasted/lost worldwide is a huge threat to food security as well as the international economy [10,11]. It costs nations USD 750 billion directly annually [12].

In SA, food waste costs the government about SR 41.00 billion (about USD 11 billion) every year [4]. The proportion of food wasted and lost is enough to feed 1.26 million hungry people every year [12]. Food waste is also a risk to environmental sustainability due to landfilling of untreated food waste and the carbon footprint of 3.3 billion tons of CO_2 for the overall food wasted [4]. Food loss and waste contribute to 10% of the greenhouse gas emission globally [13]. Hence, the leadership of SA, Crown Prince Mohamed Bin Salman, inaugurated the Saudi Green Initiative (SGI) in 2021, which aimed to champion climate action in SA by reducing carbon emission, achieving net zero emission by 2060 and protecting land and sea [14]. The SGI contributes to the Saudi Vision 2030, which prioritises green economy and ensures quality/sustainable life for Saudis and residents in SA [15]. It also contributes to several UN SDGs such as goals 11, 12 and 13. There is no doubt that food waste reduction contributes to this initiative and ultimately to the Saudi Vision 2030. Nonetheless, food waste remains a challenge to the progress of the SGI.

SA suffers from very high temperatures, a tough climate with limited opportunities for rainfall, inadequate arable land and scarce water resources for agriculture [6,16]. These characteristics of the country create several challenges for agriculture development. Additionally, the increasing standard of living and urbanisation are also affecting the demand for food among Saudis [17]. This also means SA relies heavily on imports to fulfil food requirements of the citizens and residents. Hence, SA imports 80% of its food [6]. Shockingly, more than 30% of the imported food is wasted [4], raising the need for understanding the reasons for this ongoing food waste, its consequences and effective approaches for managing it despite the efforts of the government and researchers to manage this issue.

Research has defined food waste as any type of food suitable for human consumption that is thrown away before or after it spoils [18]; whereas food loss is the proportion of food lost after harvest until its production for human consumption [19]. This study adopts the definition of food loss provided by the FAO that it "*occurs from post-harvest up to—but not including the retail level*" [20] and the UNEP definition of food waste, which "*occurs at retail, food service and consumer level*" [1]. The proportion of food waste was reported to be significantly higher than food loss mainly due to consumer behaviour [6,21,22]. The current research is more concerned with managing food waste in SA, especially in food service organisations.

Although a plethora of studies have been undertaken on food waste internationally, e.g., [23,24], or in the SA context, see, for example, [8,18], research has often focused on addressing the current state of food waste and understanding the main reasons or determinants of waste food or the consequences of food waste. Few research studies, if any, have addressed how food waste could be properly managed, especially in countries such as SA, where food waste is apparent since social and cultural issues play a key role in food waste behaviours [6]. Additionally, earlier studies focused on food waste from consumer perspectives. No studies to date, in English or even Arabic languages, have undertaken an intensive approach for managing food waste from the perspective of different stakeholders, e.g., customers, managers, government officials and food waste management experts. Earlier studies provided general advice and practical implications; however, none of them has provided an integrated approach for managing food waste in food service organisations, although they encompass the majority of food waste in SA [7].

This research explores the perspective of various stakeholders, e.g., customers, managers and food waste experts, about food waste management (FWM) in food service organisations in SA. The current research investigates the reasons for food waste in food service organisations, such as restaurants and banquet halls, and discusses approaches undertaken or that should be undertaken to reduce food waste in food service organisations. The research is an attempt to recognise the drivers of food waste problems in food service organisations and the approach for properly managing this phenomenon. The research provides an integrated model for managing food waste in food service organisations based on the perspectives of various stakeholders. The research adopted a qualitative research approach to deeply delve into FWM in food service organisations for food security and a

more sustainable society. The study answers the following research questions: what are the reasons for food waste in food service organisations? How can food waste in food service organisations be properly managed? The next part of the paper critically reviews the reasons for food waste in SA. It then explores the approaches raised by researchers or taken by governments/organisations for FWM. The paper then presents the research methods adopted in the study for collecting and analysing the data. The key findings are presented and discussed. Implications of the research are then discussed. Finally, the conclusion and opportunities for further studies are suggested.

2. Conceptual Framework

2.1. Understanding the Reasons for Food Waste in SA

A review of the growing research to date on the reasons for food waste in SA, e.g., [6,7,10,18,25], has shown several factors that drive consumers' behaviour towards food waste in SA. The factors include economic prosperity [6], lack of awareness among consumers [6,7], food consumption culture [7], absence of legal frameworks [6], food offers and promotions [6], personal attitude towards food waste, social influence and perceived behavioural control [7], special events and seasons [6], social media [23] and demographic factors [26]. These factors are discussed in some detail in the following subsections.

2.1.1. Economic Prosperity

Economic condition was identified as one of the main constructs that drive the behaviour of customers towards food waste in SA [6]. SA is categorised as a country with a prosperous economy because of high oil reserves, which made the country among the top countries worldwide in oil production. The government of SA through its 2030 Vision is keen to ensure that its citizens live prosperous and quality lives [16]. Hence, the government is controlling the prices of products and services for the sake of its citizens, which include prices caps as well as offering subsidies to food producers for providing food with reasonable prices [26]. The high level of income encourages consumers in SA to engage in excessive food purchasing and buy more than they need, which ultimately means much of the bought food is unconsumed, causing a high rate of food waste [27]. Hence, it was argued that the economic prosperity in SA stimulates food waste.

2.1.2. Lack of Awareness

Recent research [6,7,26] on food waste in the SA context confirmed an absence of awareness among the Saudi Arabian consumers concerning its undesirable outcomes. Although the SA government has undertaken some initiatives to nurture the responsiveness of Saudis regarding the undesirable impacts of food waste [7], it seems that these efforts do not achieve the expected outcomes and positive impacts as there is no evidence that consumers' attitudes towards food waste have been changed [7]. This reflects that the role of the government in raising consumers' awareness regarding food waste is still limited. Food service organisations' role in raising the awareness of customers mostly lacking [6]. Therefore, some research studies [6,7] have invited both the government and food service organisations to undertake media campaigns to raise the consciousness of consumers regarding food waste. Recent research [6] has highlighted the vital role of food service organisations in controlling food waste by raising the awareness of their employees as well as their consumers. The behaviours of both employees and consumers are important in managing food waste. Although Saudi Arabian people are classified as Muslims, who believe in God and undertake their actions based on the guidance of the God, they engage in food wastage, which is against their religious guidelines. This encouraged some scholars [7,21] to test the influence of religiosity on food waste among Saudis; however, they found that either religiosity has no effect on food waste [7] or it positively affects Saudis' food waste behaviour [21]. This unexpected result was justified by a lack of understanding of Islamic principles among some Saudis that guided them to engage in excessive food buying and, hence, engaging in a high rate of food waste.

2.1.3. Food Consumption Culture

The relationship between Saudi Arabian consumers' food consumption patterns and food waste is long-established [6,21,27]. As discussed earlier, the economic status of Saudi Arabian people has made them engage in excessive buying behaviour and buy more items than they consume [21]. The high level of income encourages Saudis to buy cooked food or eat outside [7,28]. In general, it was argued that customers tend to waste more food at restaurants than at their homes [29]. The culture of food consumption positively affected food waste [7,30]. Customers engage in impulsive buying behaviour when they have a good income, especially when prices of items are at acceptable level such as in the case of Saudi Arabia [21]. Research on the international context [29] showed that such consumers were not worried about such behaviour of food waste; in fact, they felt that it is a part of their lifestyle. Research on the Saudi context [7,21] has confirmed that the major reason for food waste in countries such as SA is the consumers' behaviour and their pattern of food consumption. The Saudi culture of being generous and hospitable to their visitors and guests was identified as the main predictor of food waste intention among Saudi consumers [7]. Hence, responsible consumption of food halves food waste.

2.1.4. Absence of Legal Frameworks

The Saudi Vision 2030 has prioritised food security and added it to the national agenda by reducing the food loss and waste level to 50% by 2030 [15], which significantly contributes to UN SDG 13.2 on halving global per capita food waste. The SA government has developed a National Program for Food Loss and Waste Reduction [4]; however, there are no published data about the impact of this programme. The government has also launched some initiatives and taken some steps towards the food waste problem. For example, the Shoura Council, a consultative organisation in SA, has claimed a staggering portion of food is wasted in SA and recommended that customers and companies be penalised for such waste [31]; However, the council decision is not yet mandatory for stakeholders involved in food waste. Furthermore, recent research, e.g., [4,6,7,17], confirmed that there is no legal framework to date which penalises both individuals and organisations for their food waste. Baig et al. [17] argued that the lack of legal frameworks regarding food waste by the SA government remains a major concern. In contrast, France has established a legal framework against wasting food by retailers [32] as retailers are obligated to donate excess food that is edible to charity and social organisations. By the same token, the USA government enacted a law in 1996, namely, the "Bill Emerson Good Samaritan Food Donation Act" to assist charitable organisations to give surplus and excess foods to needy people. Similarly, Italy has enforced a law to manage surplus food called "La Legge del Buon Samaritano" since 2003 [10]. Therefore, Baig et al. [17] suggested that the Saudi government should develop legislation to help in managing food waste.

2.1.5. Food Offers and Promotions

Food price plays a vital role in engaging in excessive food buying and generating food waste [33]. It is stated that buyers undervalue food and do not consider the natural resources necessary to create it as a result of low food prices [24,34]. Given that food is a low-effort, quick-moving product for many customers, food purchases are frequently made without much thought [35]. Additionally, as part of their self-identity, rather than out of a sense of financial necessity, customers may look for good prices on food when they go shopping [36]. The study conducted by Katajajuuri et al. [37] showed no association between food offers, discounted price and food waste. However, pricing strategies used in food marketing, such as "buy one get one free" and package promotions, providing big portion sizes, lead to consumers overbuying and overstocking food items because it is more cost-effective to buy larger units [38–40]. This practice means many items are unconsumed and wasted. To conclude, food promotions and offers can motivate customers to purchase more food than they need, which can lead to an increase in food waste if they cannot

consume it all before it spoils. Saudis were found to engage in excessive food buying [21], which could lead to food waste if bulk food is not properly managed.

2.1.6. Personal Attitude, Subjective Norms and Perceived Behavioural Control

A review of available food waste literature showed other causes of food waste by individuals such as personal attitudes towards food waste [7]. Personal attitude has an impact on an individual's perceptions of what is valuable enough to keep and what they should discard. In that sense, several studies, e.g., [7,41,42], confirmed that there is a significant association between personal attitude and intention to reduce the wastage of food. This is because many believe that decreasing food waste would save money and provide other benefits [43]. Hence, an individual's attitude has an impact on his or her intention to waste food. Subjective norms indicate a perception of societal pressures or the opinions of relevant individuals that one should or should not act in a certain manner [44]. Subjective norms in SA have a significant effect on food waste as a collective culture. In Saudi culture, it is customary to provide generous amounts of food to guests whether at a special event or on a traditional visit. This social expectation often pressures Saudi individuals to prepare and serve more food than necessary, resulting in excess food waste [6,7]. Additionally, according to Saudi culture and social influence it is not acceptable to collect the leftover food at a wedding or any social event; hence, such foods are often wasted [7].

Perceived behavioural control (PBC) denotes the perception of a person's capability to engage in a certain action while taking into account both facilitating and barrier circumstances [45]. Studies, e.g., [46,47], have demonstrated that a lack of kitchen skills, time spent making purchases by consumers or food service organisations' provision of large portions stimulates a person's intention to waste food. Definitely, restaurant owners/managers and guests could have greater intentions for not wasting food or redistributing leftovers if they perceive it to be simple than if they perceive it to be difficult [7,40]. To that end, the positive correlation between PBC and intentions to waste food has been recognised by several studies, e.g., [42,48], including Saudi consumers [7]. To conclude, planned behaviour theory revealed that personal attitude, subjective norms and PBC were found to positively and directly impact intent to waste food [41,48,49].

2.1.7. Special Events and Seasons

The culture of Saudi Arabia involves being hospitable with food provision for family members and visitors/guests [6]. Saudi Arabian people typically offer more food than they actually need and usually buy more food in bulk quantities. Providing food for guests is an indication of hospitality, especially during events such as festivals, weddings and gatherings, at which lavish food tables are set up. For instance, the typical quantity of food wasted during a single wedding in Saudi Arabia may feed 250 needy people [7]. In 2016, there was enough food in Makkah to feed a million hungry people [50]. Certainly, special events and seasons contribute to enormous food waste, which can reach up to 70% at special occasions [51]. During religious events such as the month of Ramadan, which is a time of fasting for Saudis, a noteworthy portion of food waste is generated [51]. Food waste peaks in SA during the holy month of Ramadan [2] as the majority of food waste happens during Ramadan [52]. During Ramadan, Saudi people prepare significant portions of food, resulting in increased leftovers [52]. Furthermore, according to several studies, e.g., [53–55], food waste increases during social and religious occasions such as Ramadan and Hajj season.

2.1.8. Social Media and Food Waste

There is evidence that internet shopping supports impulsive purchases [56]. Annually, lots of money is spent on unexpected buying, with food appearing to be the most common item in SA [25]. According to Aragoncillo and Orus [57] social media has an influence on impulsive purchases and overconsuming of food. This could be because of the increased

interest in viewing food preparation or photography on social media sites [25]. For example, Instagram's most liked picture in 2020 was of an egg [58]. Shoppers nowadays intensively use social media to share their knowledge and experiences online, whether positively or negatively [59,60]. This leads consumers to overbuy food to try new food items [61] with a high rate of food waste [62]. To conclude, social media has contributed significantly to wasting food [25]. Some of the negative influences of social media on food waste are: encouraging overconsumption [25]; food fear of missing out (FOMO); and influencer marketing [63], which affect the pattern of consumption and increase food waste. In contrast, social media could create a significant influence on reducing food waste by many ways such as nurturing awareness to decrease food waste by donating excess food to those who want such foods [64].

2.1.9. Demographic Factors and Food Waste

There are thousands of fast food outlets operating in Saudi Arabia, with expected sales revenues of USD 6.9 billion in 2017 [6]. The main reasons attributed to the high demand for these restaurants is the growing participation of young people and females. With the growing proportion of young people (around 70% of Saudi people are below 30 years old) and as females join the labor market, lifestyles have been changed and people have limited time for cooking. Additionally, the Western culture of consumption has affected the growth of these restaurants [6]. In that sense, it was found that the higher the earnings of consumers, the more likely they are to eat out [28]. Parizeau et al. [29] found that restaurant consumers discard more items in restaurants than at home. The size of the household is a factor that has a relationship with food waste in several studies [65–67], with smaller households generating less waste than bigger ones. However, this claim would benefit from further investigation. This is because there may be other factors that influence food waste such as the number of family members and education level. In terms of gender, females create a higher level of waste than males. Additionally, there is more waste produced when females take responsibility for shopping [6,66,67].

2.2. Approaches Undertaken/That Could Be Undertaken for Managing Food Waste in SA

Despite the fact that SA has no strategy to address this issue, multiple initiatives were proposed and undertaken to handle this concern [6]. This was started by a plan suggested to create a reduction in both food loss and waste in 2014 [68]. Nonetheless, Mu'azu et al. [11] asserted that SA has marginally developed a reusing and recycling programme, since there is operational rules or regulations in place to handle food waste. Hence, the practices related to recycling and reusing are carried out informally, employing only a small portion of the entire generated food waste [11]. Food waste recycling initiatives were recently launched in Eastern Province of SA to motivate citizens to preserve food by minimising the quantity of prepared meals [69]. Additionally, the initiative aims to motivate retailers to compost food waste instead of sending it to an untreated landfill. Furthermore, the initiatives to collect and redistribute the edible food waste to needy citizens or to convert the food waste into animals feed are limited because only a small number of Islamic private charity organisations have engaged in these activities [70]. Different efforts undertaken or that could be undertaken by the Saudi government are summarised in Table 1.

Table 1. Approaches undertaken/could be undertaken for FWM in Saudi Arabia.

Approaches of FWM	Application	Challenges	Action	References
Food waste reduction at the source	• The most common and the best valid strategy to handle food waste. • The operations of reduction are typically carried out with individual efforts but there is no indication of application in all organisations. • The strategy fits with food service organisations.	• Changing customer behaviour continues to be a major challenge. • The impacts of culture and social factors make this approach a challenge. • There is no legislation or rules that enforce/motivate organisations to reduce food waste.	• Awareness creation through awareness campaigns for citizens, consumers and children. • For example, the charity It'aam launched an awareness campaign to reduce food waste at the source. • Develop legislation that encourages organisations to reduce food waste.	Abdelaal et al. [71]; Al-Zahrani and Baig [72]; Pirani and Arafat [73]; Biag et al. [6]
Extra food redistribution	• Donating extra/surplus food to charity organisations. • Feeding needy people through charity organisations is an effective approach to prevent waste in food service organisations or of any unconsumed food at home. • Since 2014, SA has had a marginal recycling programme.	• The collection of leftovers and surplus food products requires a large number of well-trained volunteers in order to gather surplus food, package it for redistribution and identify needy people. • Food handling and safety remain a challenge in high temperatures.	• There are some charity and social organisations to combat food leftovers in a professional way such as Saudi Food Bank (SFB) [70] and its charity organisation "It'aam", Kafa'a Association.	Mu'azu et al. [11]; Biag et al. [6]
To Last "Let'doum"	• SAGO has developed a "strategy" as a part of a national programme to halve food waste and reduce food loss since 2019. • There is evidence or information to date that the developed programme is being implemented. • To Last strategy consists of a five-phase initiative.	• Lack of formal directive or legal framework. • Consumers' behaviour and lack of awareness among consumers about consequences of food waste. • Food consumption culture and patterns.	• The strategy measured food loss and waste in SA. • SAGO will cooperate with private sector stakeholders to educate and train them on best practices. • SAGO will work to develop a legislative framework. • Supply chain stakeholders will adopt a recycling and reusing programme.	SAGO [4]

Table 1. *Cont.*

Approaches of FWM	Application	Challenges	Action	References
Reusing spoiled left-over food for composting "anaerobic digestion and aerobic composting"	• There is no national programme for reusing unconsumed food that cannot be given to needy people. • Limited number of Saudis create compost at home or in their households.	• In arid places with limited arable land and insufficient water provisions, this could help farmers grow plants successfully. The lack of required technological knowledge regarding composting procedures is a challenge to this is strategy.	• The food collected by SFB that is not suitable for consumption is converted into compost through a partnership with a company that specialises in managing organic waste. • The Ministry of Environment, Water and Agriculture has launched a programme called "Enviromate". The programme provides households with composting bins to turn food waste into compost.	Ouda et al. [8]; Mu'azu et al. [11]; Biag et al. [6]
Bioenergy	• The Saudi government is ready to explore other source of energy, while conserving its current sources. Hence, the waste has the potential for producing energy.	• The SA has no FW separation or recovery process. • Food waste is mixed together with other kinds of solid waste. • Inadequate technical expertise necessary to carry out the operation.	• Lately, there has been a growing interest in bioenergy to reduce the country's dependence on fossil fuels and support its efforts to diversify its energy mix.	Ouda et al. [8]; Mu'azu et al. [11] Biag et al. [6]
Dumping and landfilling sites	• This is a widespread approach for handling food waste in every Saudi Arabian city.	• Sanitary landfills are unusual; research into the technical elements of their construction and administration has recently been undertaken.	• The high temperature in SA makes landfill is an easy but not an appropriate task as unconsumed food can be used for other purposes (redistribute, bioenergy or compost) than landfill.	Mu'azu et al. [11]; Biag et al. [6]

The Saudi Food Bank (SFB), established in 2010 as a non-profit organisation known as the "Ita'am initiative", is the most effective effort for food redistribution in SA [70]. The SFB aims at gathering and giving away extra or unconsumed food from events, banquets and weddings to needy people. In parallel with the efforts of SFB and collection of unconsumed food, a charity partner called "The It'aam Food Charitable Society" was founded. It has partnerships with other companies, including Saudi Aramco and the Saudi Press Agency. Furthermore, to provide food to those in need, It'aam intends to print a magazine called "Meerah" to cascade awareness to the public with the campaign title "Do Not Waste Food". The organisation is working to create and release animated short films for young people because they encompass the majority of the population. These efforts aim to improve consumers' behaviour. Such awareness efforts, in the view of their organisers, may benefit society and the economy as a whole.

Recently, in 2019, the Saudi Grains Organization [4] established a strategy as part of a national programme on food waste management to halve food waste and reduce loss in SA. SAGO inaugurated a nationwide initiative to decrease food waste called "Let'doum", which means "To Last". The initiative consists of five phases. The five-phase initiative aims at reducing food waste, especially wheat, dates, rice, vegetables, fruits and red and white meat. The initiative conducted the first phase at Prince Muhammad Bin Saud Islamic University as a research study to measure the levels of food loss and waste [4]. Consequently, the study compared food waste in the kingdom to other countries in the region and around the world. SAGO is going to cooperate with private sector stakeholders to educate and train them on the best practices to reduce food waste and loss. Further, SAGO is going to develop a legislative framework to support legislation. Additionally, supply chain stakeholders are going to promote a reusing and recycling programme as well. The food waste reduction initiative "Let'doum" has six main subinitiatives or activities:

- The first is to raise the level of awareness relating to the value of food conservation.
- The second is to improve production and operation efficiency of the private sector.
- The third is developing associations concerned with managing food waste and activating their role in raising the awareness of consumers.
- The fourth is to reuse and recycle food waste.
- The fifth is developing a general policy to halve food waste and reduce food loss.
- The sixth is establishing a national centre for halving food waste and reducing food loss.

3. Research Methods

3.1. Research Approach

This study is part of a wider study on FWM in SA. This phase of the research adopted a qualitative research inquiry to give a better understanding of the research problem and develop a novel approach for FWM in food service organisations in SA. Unlike most earlier research studies, e.g., [6,7,11,17], on food waste in SA, which adopted a quantitative approach to understand the intent to waste food or the actual food waste behaviour, the current research adopts a qualitative approach as the research strategy. The research adopted the guidelines of Denzin and Linclon [74] for a deeper understanding of individuals' perceptions, attitudes, behaviour and experiences and cultural phenomena. Teherani et al. [75] argued that qualitative research answers questions about how individuals/organisations behave/function, why this behaviour/function occurs and how policy makers overcome challenges in relation to such a behaviour/function. The qualitative research adopted in the current study helps answer these research questions. The study explores the perceptions and experiences of key stakeholders regarding the causes of food waste and FWM in food service organisations in SA. It also explores the perspectives of the key stakeholders on how food waste could be properly controlled for more food security and a sustainable nation.

3.2. The Use of In-Depth One-to-One Interviews

The study implemented semi-structured, one-to-one, in-depth interviews for data collection from the key stakeholders. The reason for adopting semi-structured interviews for data collection was to collect data from participants that cannot be observed or gained through surveys using open-ended questions [76]. A semi-structured interview enables probing the answers of interviewees and collecting in-depth information as participants have the opportunity to justify their opinions and rebuild their answers [76]. A semi-structured interview combines the advantages of structured and unstructured interviews [77]. A list of the themes was drawn up after considering previous studies. They were discussed with interviewees regarding the causes of food waste in food service organisations in SA. Themes also included approaches for appropriate FWM in such organisations and achieving zero food waste. The flow of the conversation in interviews affected the order of questions.

3.3. Data Collection Process

As highlighted earlier, the current phase of the study is concerned with FWM in food service organisations. The data collection process for this stage of phase one started in the first quarter of 2023 after the approval of the research proposal and process by the university committee. Participants of this stage of the research were divided into three groups: managers of food service organisations, customers of food service organisations and academics specialised in food service management and food waste management. The reason for involving these three groups in this stage of the study is to give a better understanding of food waste causes and develop a novel approach for FWM in food service organisations. The participants were accessed either through personal networks or through support from the university administrators.

The first group of participants included senior managers of food service organisations. The general manager of these organisations, i.e., restaurants, banquet halls, central kitchens and cafes, were called for participation in the research. Only senior managers with at least 10 years of experience in food service management participated in this study to enrich the discussion about causes of ongoing food waste in these organisations and provide valuable thoughts about FWM in these organisations. This study included food service managers in either Eastern Province or Riyadh. All interviews were conducted one-to-one after the agreement from the participants. The aim of interviews was discussed at the beginning of the interview. Interviews were voice-recorded and transcribed directly after the interviews. The average time of the interviews was 50 min.

The second group of participants included a sample of Saudi Arabian customers, who were invited to participate in a group interview or focus group. There were different focus groups: a group for females, a group for young people (males between 18 and 40 years old) and a group for customers above 40 years old. The reason for dividing participants into groups was to avoid power bias and let females and young people freely share their experiences about food waste and FWM. The Saudi culture does not accept mixing genders; hence, creating separate groups for females gave them the chance to speak freely without any pressure from males. Youth also had separate group to talk freely about their experiences without any pressure from old people. Focus group interviews were conducted with participants after their consent to join the research voluntarily. For female groups, support was given from a female colleague to manage the interviews and facilitate the discussion. The average duration of the group interview was one hour and thirty minutes.

The third group of participants in this phase of the study included a sample of academics in SA universities or research centres, who are concerned with food waste and FWM. They were identified via a database from the university, which included all academics specialised in food service and food management based on their publications. An email was sent to a number of academics to participate in the study. Those who approved their participation were contacted to undertake the interview at their convenience. The aim of

the study was explored at the beginning of each interview. The interviews were recorded after their consent. The average time of the interview was one hour.

3.4. Sampling

With regard to the number of participants, previous research [78] (p. 68) stated "there is no definitive way to know how many in-depth interviews should be conducted . . . But quality, rather than quantity, should be the essential determinant of numbers". In this research, the number of participants was determined after achieving data saturation [79]. Hence, 26 managers were interviewed. There were 7 focus groups: 2 female groups (1 for young females and the other for old females), 2 young male groups and 3 other focus groups for old males. The number of participants in each focus group was between 6 and 8. Additionally, 15 academics/experts in food waste management participated in the current study. All the research participants were informed that their participation was voluntarily and for the research purpose of handling the national phenomenon of food waste. They were also informed that the study was anonymous and their feedback would be reported after coding their responses without any information that shows their identity. Food service organisation managers have the code FSOM00. Consumers have codes FC00 for female consumers, MC00 for young male consumers and NC00 for normal consumers. Academics have code Ac00.

3.5. Data Analysis

As highlighted earlier, two main themes were discussed with all interviewees: causes of food waste and approaches for managing food waste in food service organisations. The concept of zero food waste certification was presented and discussed with key stakeholders, particularly managers and academics. The results from all interviewees are consolidated and presented under these three main themes. It was decided to integrate the results from all interviews together instead of reporting the findings from each group of participants to avoid repetition of some points and give a better picture of the collected information. The collected data were analysed manually using qualitative content analysis.

4. Key Findings

4.1. Causes of Food Waste in SA Food Service Organisations

Interviewees were asked to give their experiences and thoughts about the reasons for food waste in food service organisations in SA, whether the food is consumed at the premises or taken outside for consumption. They were asked about the variables that stimulate food waste, whether related to consumers or food service organisations. A summary of the causes highlighted by the interviewees is shown in Table 2.

Table 2. Causes of food waste in SA food service organisations.

	Main Causes	Short Description
1.	The significant impact of culture (FC, MC, NC, FSOM, Ac) *	SA is categorised as a collective society, which favors social gatherings. A part of this culture is serving gathered people, guests and visitors with large portions, more than they actually need, to express generosity and hospitality. The culture plays a key role in consumption patterns of food among Saudis and in food waste behaviour.
2.	Absence of strategic framework (FSOM, Ac)	There is no national strategy on FWM nor a clear policy on FWM. Although there are some initiatives by the government, they do not have a substantial impact on food waste in SA generally and food service organisations specifically.
3.	Low food pricing and offers (FC, MC, NC, FSOM, Ac)	Foods are affordable. In many cases, cheap prices with additional offers for packages are provided. The food prices and offers in food service organisations promote excessive food buying, which contributes to food waste.

Table 2. *Cont.*

	Main Causes	Short Description
4.	Absence of legislation (FC, MC, NC, FSOM, Ac)	To date there is no legislation that penalises those who waste food for either organisations or individuals. The absence of laws on food waste means organisations and individuals pay less attention and engage in food waste.
5.	Economic state of consumers (FC, MC, NC, FSOM, Ac)	The income of Saudis and expatriates encourages them to dine out or buy cooked food in big portions; hence, they engage in excessive food buying, which ultimately affects food waste as some foods are unconsumed and mostly go to waste.
6.	Missing role of religiosity (FC, MC, NC, FSOM, Ac)	Saudis are Muslims and most residents are Muslims, who believe in God and follow God's guidelines, but most of them engage in food waste due to the missing influence of religiosity as well as the significant effect of other factors such as cultural and social norms.
7.	Positive attitude towards food waste (FC, MC, NC, FSOM, Ac)	Saudis have a positive attitude towards food waste. This positive attitude is mainly because they are less aware of the positive consequences of halving food waste. Culture and social norms promote this positive attitude of food waste with the absence of awareness.
8.	Perceived behavioural control and ignorance of negative consequences (FC, MC, NC, FSOM, Ac)	Consumers perceive handling food waste as a hard task. They do not know what to do with the unconsumed food and find it easier to waste it than to handle it in a more effective way. It is easier for them to waste food than to waste time in halving food waste. They are not fully aware of the negative consequences of food waste on their society, economy and environment.
9.	Food portion size served (FC, MC, NC, FSOM, Ac)	The portion of food provided to an individual at food service organisations/households is more than he/she needs. For almost all meals provided at food service organisations a large proportion is left unconsumed and is mostly wasted although it is bought. Most consumers do not prefer to take away their extra or unconsumed food.
10.	Mobile applications and social media (FC, MC, NC, FSOM, Ac)	Mobile applications for food and social media encourage consumers to try foods at their convenience, which has led to excessive food buying of a variety of items that are more than consumers need, leading to food waste because some items are unconsumed.
11.	Young people's and females' consumption patterns (FC, MC, NC, FSOM, Ac)	The attitude of young people and females is a cause of growing food waste because they order a lot of food but consume a small proportion. They are fascinated by Western food culture, hence they buy lots of fast food but they do not consume some of these items, leading to food waste.
12.	Workers' skills of food production and service (NC, FSOM, Ac)	Workers' skills are a cause of food waste either during the preparation of food, such as cutting skills, or during service, such as filling dishes and packaging.
13.	Food management system (FSOM, Ac)	Ineffective management of the food chain is a reason for food waste during storage, issuing, pre-preparation, cooking and serving. Foods are wasted at different stages of the food chain if not properly managed.

* Interviewees, who commented on this point (FC = female consumers; MC = male consumers, NC = normal consumers; FSOM = food service organisation managers; Ac = Academics).

There was a consensus among the interviewees that culture is the most significant cause of food waste. Saudis are a collective society and prefer social gatherings. The culture of Saudis encourages them to provide more food and drinks than they need for their guests, visitors and friends to express their hospitality and generosity. The interviewed consumers argued that it is unacceptable among Saudis to serve small portions of food

for their visitors and friends when eating together. Hence, when they order foods at any food service organisation, they often order more than they need, which means a lot of food is unconsumed and wasted. Both managers and academics agreed that the Saudi culture plays a key role in consumption patterns in food service organisations, leading to a high volume of food waste.

Another factor raised by managers and academics is the absence of a strategic framework and/or clear policy concerning food waste. Academics commented on the different initiatives undertaken by the government to deal with food waste in SA generally and food service organisations specifically. They argued that they had not had a positive impact yet in relation to this national problem. These initiatives were ad hoc and not proactive practices. One of these initiatives is "Nemah Conservation", which redistributes extra or unconsumed food to needy people. It was argued that these practices are excellent but they have to be part of a strategic framework that has a clear strategic direction with certain procedures and key performance indicators. This strategic framework should meet the legislation and/or regulation on FWM, however, there is no law to date that handles food waste problems. Managers commented on the Regulation of Waste Management system issued in June 2021 by a Royal Decree, which focuses on handling waste in general such as plastic and toxic waste. However, the absence of legislation and regulation gave the chance for organisations and individuals to pay less attention to food waste.

The economic state of consumers, whether Saudis or foreign workers, who are also paid well, encouraged them to engage in excessive buying behaviour and leave many food items unconsumed, which goes to waste. The good monthly income encourages Saudis and expatriates to dine out, especially since the prices of food items are affordable. Additionally, the interviewed consumers commented that there are often good offers, especially for groups and packages. These offers and price caps encouraged consumers to engage in excessive buying and ultimately in food waste behaviour. Foods are often served in food service organisations in big portions, especially for rice and bread, that are more than an individual needs. Food service organisations provide items such as rice, salad and bread in big portions with no charge or with very cheap prices. Most of these items are wasted after consumers are done with their meals. Furthermore, consumers and managers commented about the portions of food served at banquet halls during weddings or meetings. They argued that the food in most cases is three times that needed by attendees but the organisers want to express their respect and appreciation for and hospitality to their guests by providing a lot of food that is more than they actually need. The unconsumed foods during these occasions are wasted.

The three groups of interviewees agreed that consumers have a positive attitude towards food waste. They added that this positive attitude of consumers towards food waste was shaped by the food consumption culture and social influence, which made them view food waste as normal behaviour and not a problem. Moreover, this behaviour of food waste is not rejected by most community members. Food wasters perceive their behaviour as accepted and do not feel shame for such behaviour. Furthermore, the majority of community members are involved in this behaviour and encourage each other to engage in this behaviour. The interviewees added that this positive attitude towards food waste was because customers are less aware of undesirable outcomes of food waste. In this context, interviewees confirmed that young people and females pay less attention to food waste than other groups of the community. Young people and females are fascinated by fast food and Western food culture. Social media and mobile apps stimulate excessive food buying as well as food waste. Food advertisements on social media and mobile apps encourage consumers to try new food, especially with food offers, which leads to food waste. They prefer to try different types of food and consume small portions of food, leaving the rest of the portion that is often wasted. Additionally, consumers find it easier to waste food than to handle unconsumed food and save it for future consumption. There was agreement among consumers that they do not prefer to save the rest of the food for

consumption at the next meal or on the next day. They added that Saudis do not eat such saved food and only eat newly cooked food.

There were two causes of food waste related to food service organisations raised by managers and academics. These are the ineffective food management system and poor skills of workers. Food can be wasted in the food chain in food service organisations if not properly managed. This includes food storage, issuing, pre-preparation, cooking, serving and home delivery. For example, food can be wasted due to improper food storage and issuing new items before old items. Food can also be wasted due to improper food preparation and cooking or service. Poor workers' skills contribute to food waste, especially during food pre-preparation, such as food cutting skills. Poor workers' skills during food cooking and service can also contribute to food waste.

4.2. Managing Food Waste in SA Food Service Organisations

The three groups of interviewees were asked about how food waste in food service organisations could be properly managed and/or controlled. Ten solutions were identified for halving food waste in food service organisations (see Table 3).

Table 3. Solution for FWM in SA food service organisations.

	Suggested Solution	Application
1.	Effective implementation of a national strategy for FWM (FSOM, Ac) *	The developed national strategy for FWM of "Let'doum" should be effectively implemented. The strategy should involve all stakeholders from private and public sectors as well as consumers to ensure effective implementation of the strategy.
2.	The critical role of education (NC, FSOM, Ac)	Universities, academic institutions and schools have a critical role in building appropriate consumption culture which does not accept food waste. Education should stimulate negative attitudes towards food waste.
3.	The urgent need for legislation (FC, MC, NC, FSOM, Ac)	There is an urgent need for legislation which penalises both organisations and individuals for wasting food. The penalty of food waste should start with a fine for organisations and individuals, which can be doubled if repeated.
4.	Put principals of Islam first (FC, MC, NC, FSOM, Ac)	The role of mosques is important to strengthen the principal of Islam about controlling food waste. Muslims leaders, "Imams", should engage in a campaign to ensure that everyone is aware that food waste is against principles of Islam.
5.	Raising the awareness of consumers (FC, MC, NC, FSOM, Ac)	The responsiveness of society regarding the negative consequences of food waste should be raised. Media campaigns are needed to create social influence and highlight the positive consequences of managing food waste.
6.	Expanding national redistribution programmes (FC, MC, NC, FSOM, Ac)	The initiatives undertaken by some civil organisations for redistributing unconsumed food for feeding needy people should be expanded. Each food service organisation has a part in this initiative to reduce food waste.
7.	Developing national recycling programme (FSOM, Ac)	All food service organisations have to recycle unconsumed food that cannot be redistributed to needy people. This recycling can be part of a national recycling programme operated by the municipality of each city or in collaboration with civil organisations.
8.	Effective role of social media (FC, MC, NC, FSOM, Ac)	Social media can be an effective platform for raising the consciousness of consumers regarding the significance of saving food and negative consequences of food waste.

Table 3. *Cont.*

	Suggested Solution	Application
9.	Effective food management system (FSOM, Ac)	Effective management of the food chain in food service organisations helps in minimising food waste. This includes, for example, adopting FIFO methods for issuing food from storage.
10.	Staff training and development (FSOM, Ac)	Staff should be trained in food preparation skills, e.g., cutting skills and food service skills, to reduce food waste in food service organisations.

* Interviewees, who commented on this point (FC = female consumers; MC = male consumers, NC = normal consumers; FSOM = food service organisation managers; Ac = Academics).

Academics agreed with managers that there is an urgent need for effective implementation of a national strategy such as "Let'doum" on FWM in general and food service organisations in particular. This strategic framework should involve all stakeholders, e.g., government, food service organisations, civil organisations, educational institutions and local communities to ensure effective implementation of the FWM strategy. This strategy could include several initiatives that aim to halve food waste in food service organisations. After the reduction of food waste in food service organisations, reuse is the second option in the strategic framework, such as saving unconsumed food or redistributing it for feeding needy people. The third choice is food recycling for producing compost and/or bioenergy (see Figure 1).

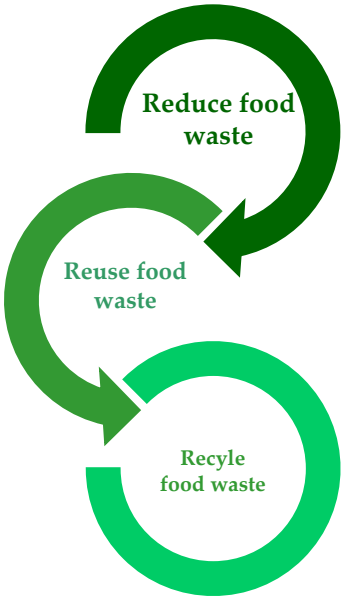

Figure 1. A strategic framework for handling food waste in food service organisations in SA.

Academics commented on handling food waste and that it has to be circular, which starts with reduce, then reuse and finally recycle. They commented on the initiatives of reusing by redistributing unconsumed food in food service organisations as good practice in handling food waste. They added that these initiatives should be expanded and integrated into the national strategic framework on FWM. Managers argued that every food service organisation should be part of a national programme on food reuse and then recycle if food reuse is not possible. This national programme should involve non-governmental and/or civil organisations.

The role of education and educational institutions, e.g., schools and universities, in shaping a consumption culture which rejects food waste behaviour cannot be underestimated. Educational institutions should play a critical role in building a consumption culture that does not accept food waste and stimulate negative attitudes towards food

waste. The significance of food conservation for both food security and environmental sustainability should be integrated into academic issues to face this national problem. Interviewees agreed that the role of mosques is vital to strengthen the principal of Islam about food waste reduction. Interviewees suggested that the leaders of mosques, "Imams", could have an important role in raising the awareness of individuals. They could present clear messages that food waste is against the principles of Islam. The leaders should make it clear that Islam does not accept food waste, wasting food is a "sin" and that no Muslims should be involved in such behaviour. Raising the awareness of organisations and individuals through media campaigns is also important to create social influence that does not accept such behaviour. The media campaign should focus on the negative consequences of such behaviour from Islamic, economic, social and environmental perspectives. Interviewees argued that social media sites should be effectively used as a media platform for reaching a great number of consumers and disseminate short videos and messages about the negative consequences of food waste.

Academics argued that there is an urgent need for legislation that penalises wasting food, whether by organisations or individuals. Although the emergence of legislation cannot guarantee food waste reduction, some academics commented that the suggested legislation would contribute to food waste reduction. They added that legislation should penalise food wasters not only by fees but also by doing social activities to serve needy people, their society and environmental activities. They also confirmed that the legislation should not tolerate food wasters. The penalty for wasting food should be high to control such behaviour. The penalty should also be doubled if such behaviour is repeated by organisations or individuals.

There were two solutions for handling food waste specific to food service organisations, which are an effective food management system and staff development. An effective management system of the food chain in food service organisations is crucial for reducing food waste. Managers confirmed that the operating procedures should ensure no food waste during any stage of the chain. For example, following "first in first out" (FIFO) for issuing food reduces the possibility of food waste since items bought first are prepared first. Training and development of staff are important for enhancing the skills of workers to decrease food waste along the food chain, particularly in food preparation and food service, in food service organisations.

4.3. The Saudi Zero Food Waste Certification

There was a consensus among interviewees, particularly managers and academics, that there is a need for a new approach or strategy for halving food waste in food service organisations. Therefore, a new strategy was discussed with food service managers and FWM academics or experts, which is the "Saudi Zero Food Waste Certification". This certificate accredits organisations that comply with the standards (discussed later) under four different levels. Bronze certification is awarded to organisations that comply with the standards between 60 and 70%. Silver certification is awarded to organisations that comply with the standards between 71 and 80%. Gold certification is awarded to organisations that comply with the standards between 81 and 90. Diamond certification is awarded to organisations with a score above 90%. It was agreed that achieving zero food waste is a very difficult goal to achieve in food service organisations due to overlaps between several causes; hence, these four categories were suggested to achieve part of this goal. Interestingly, all interviewees, whether managers or academics, strongly supported this idea as an effective approach for FWM in food service organisations in SA. Interviewees commented about the percentage of each category of certification, and there was a consensus about the above-mentioned categories and percentages.

This certification of organisations aims to not only reduce food waste but also prevent food waste in the long term and achieve zero food waste in food service organisations in SA. The certification appreciates the best practices of handling food to achieve zero food waste as an ultimate goal. The certification is based on the principle of prevention and not

on treatment or an ad hoc basis. The certification considers critical points in the food chain in organisations where food waste could happen. These points will be predicted during the various stages of food handling. They will be controlled to prevent errors and best practices will be adopted for handling food throughout the chain. This certification brings benefits to all parties involved, including participating organisations and consumers, as well as the community as a whole, by preventing food waste and achieving food security and environmental sustainability.

Based upon the discussion with managers and academics, the following standards are discussed and suggested for the organisations that want to adopt the certification:

1. Adopting a specific policy to prevent food waste in food service organisations.
2. Applying a food waste management system at all stages of the food chain.
3. Controlling the critical points of food handling stages.
4. Effective participation of workers in the food management system.
5. Continuous improvement of procedures.
6. Customer participation in achieving waste prevention.
7. Adopting a reuse programme (when needed) to prevent waste.
8. Adopting a recycling programme (if needed) to better handle leftovers.

The discussion with interviewees also highlighted that each standard should have a description (it could also have sub-standards if needed) and key performance indicators to ensure that the performance meets the standard. This certification could motivate food service organisations to control food waste by involving management, staff and consumers to ensure successful implementation.

5. Discussion

Reports and studies [1,2,4–6,10] confirmed that SA is one of the top food wasting nations despite the country having several challenges for agriculture development [15]. However, food waste creates several negative consequences on the economy, society and the environment. Economically, food waste costs the world USD 750 billion directly and the kingdom USD 11 billion annually [4,11]. Socially, it contributes to food hunger and strengthens inequality between members of society because of food insecurity [9]. It was argued that the proportion of food loss and waste can feed 1.26 million hungry people every year [12]. Environmentally, food loss and waste contribute to 10% of the greenhouse gas emission globally [13]. Hence, the government has undertaken several initiatives to handle the growing food waste in the kingdom; however, the government has not yet achieved positive impacts of these initiatives. The government of the kingdom has added food security and environmental sustainability as key priorities in the Saudi Vision 2030 [14], which contributes to UN SDG 13.2 on reducing food loss and halving food waste.

Research on food waste in SA has focused mainly on addressing the status quo of food waste and factors that cause food waste [6,7,11]. The research often undertook a quantitative approach or a systematic review to examine food waste behaviour among consumers [7–9]. This research adopted a qualitative research approach using in-depth one-to-one semi-structured interviews with managers of food service organisations and academics specialised in food service management as well as focus groups with a sample of food service consumers. The research explored the causes of food waste and solutions for proper FWM in food service organisations. The results showed 13 main causes for food waste in food service organisations and provided 10 solutions for handling food waste properly.

This research showed that the thirteen causes are associated with each other and connected to three main causes: consumer behaviour, the absence of legal and strategic frameworks and an ineffective food management system. The main driver of consumers' behaviour is the Saudi culture of generosity and hospitality. The culture encourages consumers to provide foods for friends, visitors or guests with very large portions, leading to food waste and/or a positive attitude towards food waste. This culture of the consumption food with large portions leaves a lot of food unconsumed, which often goes to waste [7].

The culture creates a positive attitude towards food waste, especially among young people and females who are fascinated by the Western food culture of fast food. Females are contributing more to the labor market than before since the emergence of Saudi Vision 2030 in 2016. Working females have less time to cook and hence they buy cooked food in bulk. They have a more positive attitude to food waste than males, especially in food service organisations. Additionally, the culture makes consumers perceive food waste as not a problem and they do not recognise its negative consequences. Consumers found it difficult to handle food waste; however, they found it easier to waste it. This refers to perceived behavioural control in Ajzen's theory of planned behaviour [45], which positively affects food waste behaviour. Serving food with big portion sizes as well as side items, such as rice, bread and salad, that are more than consumers need is part of the Saudi culture and makes food waste apparent. Furthermore, the economic state of consumers encourages them to engage in excessive buying, especially when food prices are affordable with many offers for packages. This means many items are unconsumed and often go to waste.

The absence of legal and strategic frameworks is a main cause of food waste as neither organisations nor individuals recognise the significant negative consequences of food waste for them nor the benefits of consuming food responsibly, especially with the absence of the role of religiosity. The absence of legislation encourages them to pay less attention to food waste, and consumers continue engaging in food waste behaviour due to the lack of a penalty and recognition in the case of responsible consumption behaviour. This strengthens the need for raising the awareness of consumers and organisations as a part of a national strategy with the involvement of various stakeholders. Supporting the call made by Baig et al. [6], there is an urgent need for effective implementation of a national strategy to handle food waste supplemented with a legal framework to ensure proper implementation. There is also a need for national media campaigns, which have to clearly focus on the principles of Islam that reject food waste and encourage responsible consumption of food. Islamic leaders of mosques should be involved in such campaigns. The campaigns should also use social media platforms to strengthen the principal of Islam, highlighting the negative consequences food waste and showing the positive effects of responsible consumption. Educational institutions should also have an important role by raising the awareness of young people and females since they are the top food wasters within the community. This could be carried out by integrating the culture of responsible consumption in curricula.

Ineffective management of food is another main cause of food waste in food service organisations. This includes improper management of food in the chain, poor staff skills and the lack of an effective system for dealing with unconsumed food. Hence, it is important that an effective management system should be made to reduce food waste in the chain. Moreover, training staff and developing their operational skills such as preparation, cooking and service of food are important to reduce food waste. There should also be a programme in each food service organisation. The programme should ensure reducing food waste at the beginning by serving portions of food that are consumed and refilling food items when needed instead of serving big portions and allowing the rest of the food to go to waste. The second stage of the programme could be reusing food by saving it and redistributing it to needy people in collaboration with civil organisations. The third stage could be recycling unconsumed food instead of sending to landfill to ensure environmental sustainability.

This research showed that food waste is a national concern that has a diverse range of causes related to various stakeholders. For example, the absence of strategic and legal frameworks is connected to the government whereas the lack of awareness and positive attitude towards food waste are associated with consumers and ineffective systems of operation are related to the management of food service organisations. Hence, collaboration between these stakeholders is key for handling this deep-rooted cultural and social problem. The involvement of other stakeholders such as academic institutions and non-governmental organisations is important in raising awareness and handling unconsumed food by reusing and then recycling. The current research builds on the effective integration of stakeholders to reduce food waste in food service organisations.

The research proposed a novel approach for FWM in food service organisations where food waste is apparent. The certification appreciates the best practices of handling food to achieve zero food waste as an ultimate goal. The certification aims to prevent, not just reduce, food waste. The research shows that achieving zero food waste is a very tough goal in food service organisations. Hence, the research suggested four different categories, bronze, silver, gold and diamond, based on the scores in the suggested standards. For this reason, eight main standards were suggested based on the discussion with various stakeholders. These standards should have sub-standards with key performance indicators for measuring the performance of food service organisations in relation to FWM. This approach encourages food service organisations to reduce their food waste at the critical points where food waste could happen. The successful implementation of certification contributes significantly to FWM in food service organisations and helps in managing this national problem, which affects the economy, society and environment. This contributes to the national agenda of the SGI and the Saudi Vision 2030 [80], which contributes to several UN SDGs such as SDG1, SDG 2 and SDG13.

6. Conclusions

The current research adopted a qualitative research approach to explore the perceptions and experiences of consumers, senior managers of food service organisations and academics specialised in food management in SA regarding the causes of food waste and solutions for effective FWM. The research identified 13 causes of food waste in food service organisations that are correlated with each other and connected to the cultural and social norms of food consumption. The research provided 10 solutions that require collaboration between various stakeholders for effective implementation of a strategic and legal framework on FWM. A novel approach was suggested for effective FWM in food service organisations, which is the "Saudi Zero Food Waste Certification" that appreciates best practices of food management and has an ultimate goal to prevent food waste. The certification draws on the successful integration of the key stakeholders to handle this national problem that threatens the economy, society and environment and has an impact on the national agenda of food security and environmental sustainability.

The current study has some limitations, which could be addressed in future research. These include adopting a qualitative research approach with participants from Eastern Province and Riyadh, who may not be representative of the whole of SA. The research did not integrate the perspective of government officials, who are responsible for handling food waste and developing the strategic and legal framework for FWM. They could include participants from the General Food Security Authority and the Ministry of Environment, Water and Agriculture. Further research should develop the key indicators for Saudi Zero Food Waste Certification with the involvement of various stakeholders and examine the effective implementation of this certification in a sample of these organisations. In addition, the current research did not examine the effect of the educational level of consumers on their food waste behaviour, which could be addressed in future research opportunities. Although food waste is a worldwide challenge, the SA government could face additional challenges to reduce food waste during Hajj and Ramadan events, since the vast majority of consumers are foreigners who come to the Holy City of Makkah for pilgrimage or Omerah. This issue could also be addressed in future research on how to tackle this problem that has national and international causes.

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