


Article

Analysis of Attitudes towards Food Waste in the Kingdom of Saudi Arabia Using Fuzzy Logic

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Abstract: Attitudes and feelings towards food waste and positions on management policies have been vastly increased over the past few decades. Most of the available research on the analysis of attitudes towards food waste have been carried out using conventional statistical methods. This paper **aims** to assess and analyse attitudes and preferences of young Saudi females towards a number of policies and plans that are designed to meeting sustainable targets, using fuzzy logic analysis. This is a very important aim, especially since Vision 2030 in Saudi Arabia puts a major emphasis on sustainability, setting many resources to tackle environmental problems and achieving better social standards. The **Methodology** includes designing and collecting data from 199 participants using a questionnaire that includes 23 questions. Data were obtained from students at Princess Nourah bint Abdulrahman University (PNU). The **analysis** includes utilising artificial intelligence (AI) techniques. Fuzzy logic analysis has been widely used in many fields, but has not seen many applications on food waste analysis and attitudes. Fuzzy logic analysis has the advantage of producing efficient results from smaller sample sizes and, in particular, with qualitative characteristics of the used indicators. The participants expressed positive preferences and attitudes towards the programs and policies that are designed to achieve sustainability and manage food waste. The **results** show that over 25% of them prefer the option of “storage for reuse” of food waste, over 35% prefer the option of distribute it to needed families and over 30% opted to the option of recycling to fertilisers. The study also reveals a very good level of awareness and appreciation of food waste and plans associated with it. The **implications** from this study suggest that despite the positive attitudes, there still is more research needed to obtain full understanding of attitudes towards food waste from the whole range of the population in order to gain knowledge and build specific programs to reduce food waste and achieve sustainability in the country.



Citation: Malibari, A.; Alsawah, G.; Saleh, W.; Lashin, M.M.A. Analysis of Attitudes towards Food Waste in the Kingdom of Saudi Arabia Using Fuzzy Logic. *Sustainability* **2023**, *15*, 3668. <https://doi.org/10.3390/su15043668>

Academic Editors: Abdullah Al Mamun, Naeem Hayat and Mohammad Enamul Hoque

Received: 9 January 2023

Revised: 11 February 2023

Accepted: 13 February 2023

Published: 16 February 2023



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Keywords: food waste; students’ attitudes; food waste in KSA; fuzzy logic analysis

1. Introduction

There is a growing demand on policies and programs that are designed to manage food waste as a major item on the national and international agendas to improve sustainability in urban areas; see, for example, [1]. The research presented by [2] recommended a green model for the catering industry under demand uncertainty. Reference [3] provided a food waste analysis for flight catering service, while [4,5] assessed food waste reduction programs at a university dining facility and at a restaurant, respectively. Research on food waste is relatively a new area. The majority of food waste research in restaurants and hospitality has been carried out in Europe and the West, including Sweden, Italy, Germany and the USA [1,4–8]. On the other hand, not much research has been carried out in some other countries, including the Kingdom of Saudi Arabia, Qatar and the United Arab Emirates [9].

The management of food waste is a significant component for sustainability [10]. There are numerous definitions that are associated with food waste. For example, food waste is often used interchangeably. However, there are two different definitions; [11] defines food loss to be associated with the reduction in production in food mass while food waste is often associated with the food loss at the level of consumers and retailers. In many sectors, in particular, hospitality does contribute to food waste. The United Nations Environment Programme (UNEP) states that about 30% of all food produced in the world is wasted, lost or not consumed. These facts can only emphasise the urgency for further efforts to assess and identify the sources of food waste at the household level [12] and possible plans and programs to engineer them [13,14].

The Kingdom of Saudi Arabia (KSA) is classified as a high-developed economy by the UN definition. Considering the purchasing power parity, Saudi Arabia is amongst the 30 richest countries in the world and, with an average annual income of USD 21,540, it is one of the highest-income countries. Food customs are also very specific in the KSA, which might result in higher food waste than in other countries. Food waste forms up to 40–50% of the total waste in the Kingdom, followed by paper, cardboard and plastics [15].

With the development of the Saudi National 2030 Vision, sustainability, health and environmental objectives have been more carefully considered and recognized. Moreover, with the increasingly growing contribution of Saudi women in many sectors in the society including education, it is anticipated that Saudi women will have an important role to play when it comes to food waste management in the family and in society. The investigation of preferences and attitudes of Saudi women towards food waste, therefore, is not only important to assess and report those attitudes, but also for raising awareness about the importance of the subject and about the value of enhancing the community and achieving sustainability.

One study [16] investigated possible management schemes that can positively contribute to reducing food waste in the Kingdom. In particular, the research investigated impacts of social media usage on food waste. Other research recommends investigating methods of influencing behaviour towards food waste [17] and practices to encourage further awareness [18]. There are cultural and socio-economic factors, as well as social customs, that contribute to the quantities and qualities of food waste [19]. An application from a Romanian study emphasized the importance of planning for food shopping in the reduction of food waste [20].

It is very relevant, therefore, to carry out attitudinal studies to assess preferences towards food waste and its management. Questionnaires seem to be a useful tool to gather opinions and attitudes on many aspects, including food waste [21]. One study on food waste in hospitality in Turkey that utilized a questionnaire to collect data on attitudes towards food waste indicated that a large percentage of the participants (about 90%) acknowledge that they waste food. Sometimes this is due to the fact that they can get attracted to special offers and prices reductions that encourage them to purchase more than they need, leading to food waste [10]. A number of studies even investigated willingness to pay in order to reduce food wastage and improve sustainability as a result [22].

Other studies that assessed the realization of consumers towards food waste and their behaviour in restaurants include utilizing the Theory of Planned Behaviour [23,24]. Another study identifies the factors and elements of food waste generation during dining at restaurants using a sample of 496 [25]. Studies investigated food waste in relation to the type of food [25], and cultural factors in Bangladesh [26] and Taiwan [27]. The internet's and civic participation's impacts on food waste have also been investigated [28,29]. The findings show that some factors, including age, gender, and marital status, were not significant factors in identifying food waste behaviour. The group size and larger orders, however, were found significant; that is, the higher the number of people in the group and the larger orders were more significant in the amount of food waste.

Other findings from the literature review include some research that investigated the causes of food losses, which include product defects, technical faults, expiry of the

best before date, retail requirements, trading standards, bad planning, over production, food scandals and requirements of the consumers [8]. Princess Nourah bint Abdulrahman University (PNU) in Riyadh in KSA is the first university for women in Riyadh that was established in 2006, with the aim of increasing the contribution of Saudi women in society.

In this paper, an investigation of attitudes of Saudi women towards food waste were investigated using a questionnaire. The study was carried out in Riyadh city using a pre-designed questionnaire. Data were collected from 199 Saudi women at Princess Nourah bint Abdulrahman University (PNU) to assess their attitudes towards food waste aspects and its management. This study utilized a fuzzy logic analysis approach which is more suitable to the smaller sample size and to the categorical nature of the parameters in this study. The paper is structured as follows. Section 1 introduces the background of the work by reviewing relevant literature. The methodology is described in Section 2. Section 3 briefly introduces fuzzy logic systems. The results, discussions and conclusions are presented in Sections 4–6, respectively.

2. Methodology

The main aim of this investigation is to examine attitudes and preferences of Saudi women on the topic of food waste and its management in the Kingdom of Saudi Arabia. The case study is investigated at PNU with a sample of students. A questionnaire in the English language is designed to include five sections and just over 20 questions. The data were collected from university students at PNU using a Google form. The survey was initially piloted with 35 students before finalizing the latest form. The findings from the pilot were used to assess the length of the survey and its contents. A number of modifications have been implemented on language and structure.

The five sections of the questionnaire include socio-economic characteristics of the participants, which include age, gender, income, education and perceived body mass, questions attitudes and perceptions on food waste, assessment and acceptability questions and, finally, questions on measures of management policies that are aimed at food waste and a few questions to raise awareness about the topic. Figure 1 shows an illustration of the five sections of the survey. In this paper, the data from the first four sections are analysed and reported.

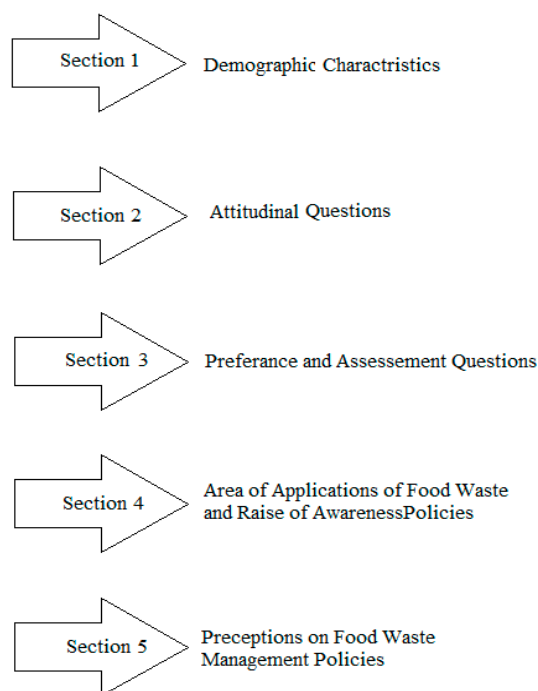


Figure 1. An illustration of the five sections of the survey.

The questionnaire was distributed to a total of 199 students at PNU. This survey was approved for ethical compliance by PNU Institutional Review Board (IRB). No personal data were collected in order to keep the survey and the participants anonymous. The study was completely voluntary. The data were collected and analysed using statistical analysis, tabulation of the results and graphical illustrations.

The attitudes of Saudi women in Riyadh towards food waste were investigated through the statistical analysis of the data collected using the questionnaire, and also using an artificial intelligence system. Data were collected from 199 Saudi women at PNU to measure their attitudes towards food waste. After the initial analysis of the data, the attitudes towards food waste were also predicted using a fuzzy logic system in order to assess the feasibility of utilizing fuzzy logic modelling in assessing attitudinal data, to maximise the efficiency of the outcome from this study in relation to its small sample size and to the categorical nature of the parameters used in the analysis. Figure 2 below shows the flow chart of the fuzzy system used in this research.

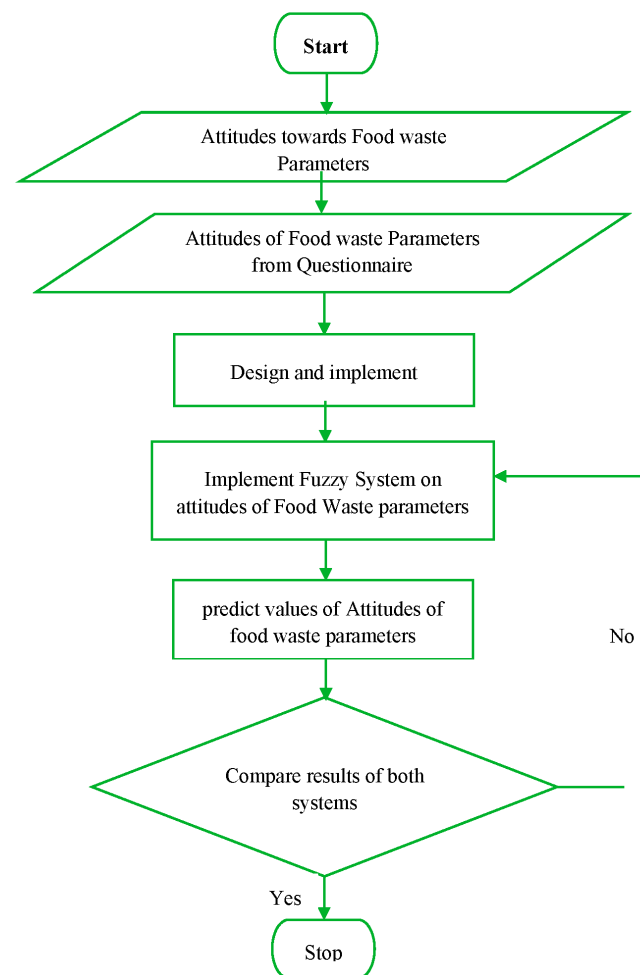


Figure 2. Flow chart of fuzzy system to predict attitude of food waste.

3. Fuzzy Logic System

3.1. Introduction

Analog input values are analysed in terms of 1 (true) or 0 (false) distinct values by the fuzzy logic system. The fuzzy system sets group objects smoothly depending on membership [1,30]. The fuzzy logic scheme is based on the concept of assigning outputs based on the likelihood of the input status. Following that, if-then rules are used because they are the most effective in developing fuzzy system [2,31].

Architecture of Fuzzy Logic Control System.

Figure 3 shows the key components of a fuzzy controller for any managed system: fuzzifier, information base, fuzzy rule base and defuzzifier.

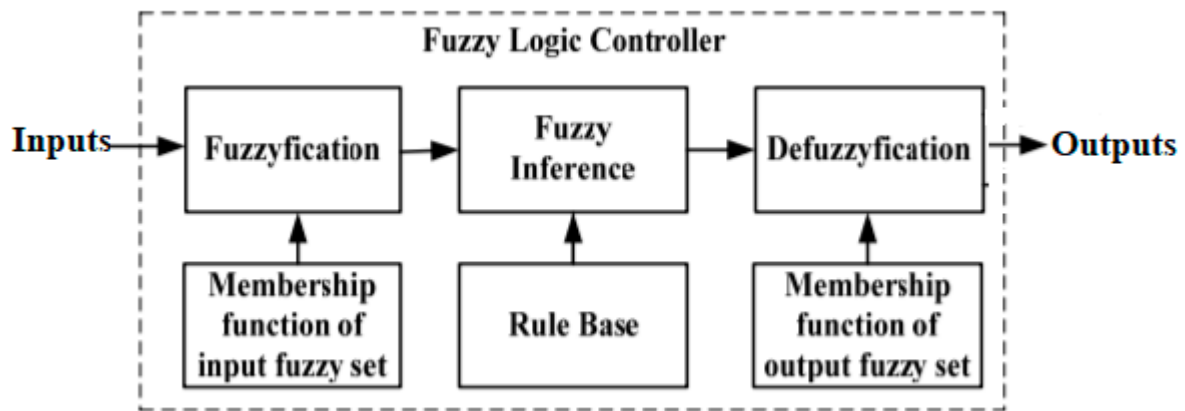


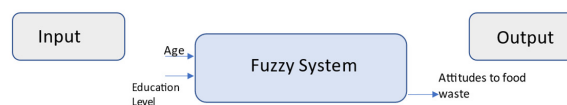
Figure 3. Fuzzy Logic system structure.

The fuzzification stage in the fuzzy system converts crisp input values to fuzzy values. Information of fuzzy relationships is stored in the form of membership functions for each of the inputs and outputs [3,32]. For joining membership functions of inputs and outputs, the fuzzy rule base used the if-then rule. Since it conducts approximate reasoning, the inference engine is at the heart of every fuzzy system [4,33]. The defuzzification step is the last step in the fuzzy system process, which involves using a defuzzifier to convert the fuzzy values of the fuzzy inference engine into new values [5,34]. The fuzzy logic system is designed and implemented using MATLAB’s fuzzy logic toolbox [6,35].

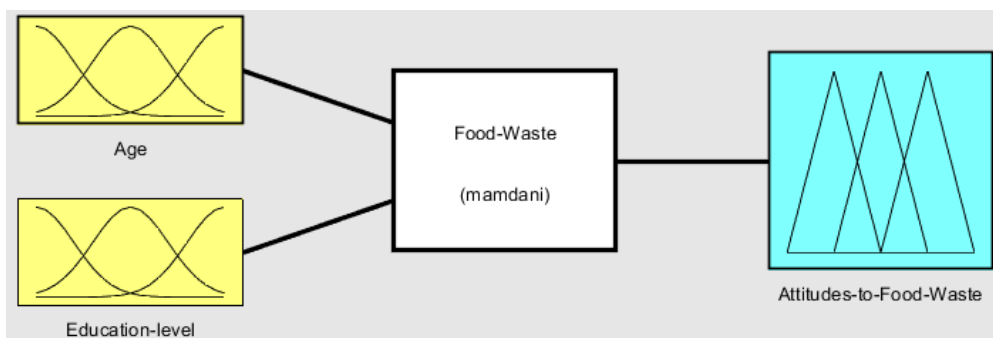
3.2. Fuzzy System of Human Balancing Test

In this work, a fuzzy logic control system with two inputs and one output is designed to assess the attitudes towards food waste parameters. The parameters that are included into the food waste fuzzy system are the age and education levels of females to predict attitudes towards food waste.

The structure of food waste fuzzy system with age and education levels as inputs, and attitudes towards food waste as outputs, are shown in Figure 4a,b, respectively.



(a) The structure of food waste fuzzy system with age and education levels as inputs



(b) The structure of food waste fuzzy system with age and education levels as inputs, and attitudes towards food waste as outputs

Figure 4. Food waste Fuzzy System (Inputs and Outputs).

3.3. Inputs and Outputs Membership Function

The membership function of a fuzzy set is a generalization of the classical set's indicator function.

In a fuzzy scheme, fuzzification is accomplished by converting a new set of inputs into a fuzzy quantity by defining deterministic quantities as nondeterministic. Figure 5 shows the triangular membership function that was used to fuzzify each input to the built fuzzy system in three levels of fuzzy (Low, Medium and High).

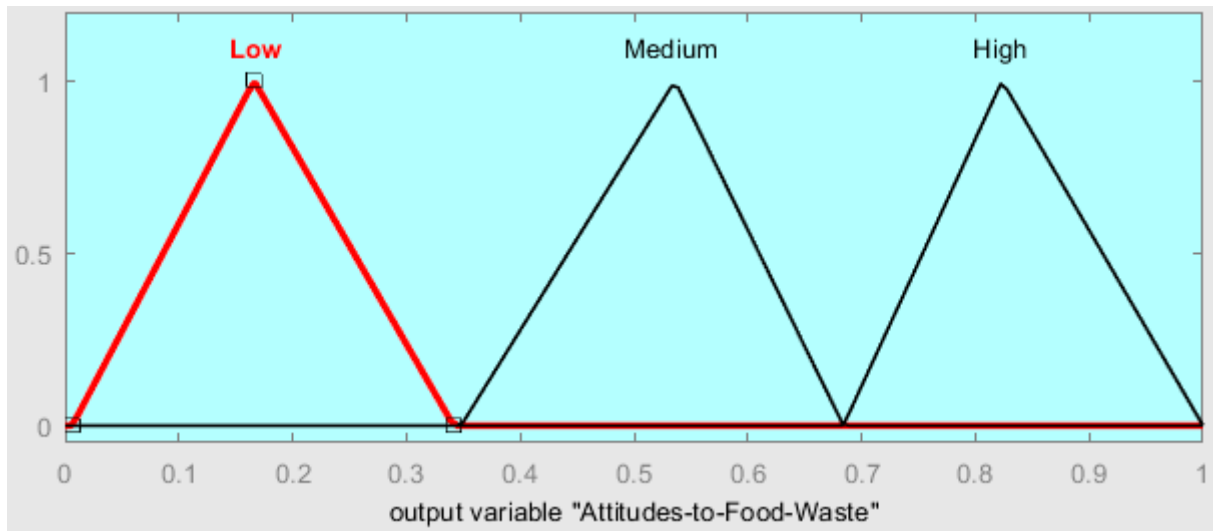


Figure 5. Triangular Membership Functions for Fuzzy System Inputs.

As shown in Figure 5, a triangular membership function was used to fuzzify the inputs in a fuzzy system (age and education levels). The three levels of Low, Medium and High food waste fuzzy system inputs are represented in Table 1.

Table 1. Membership Functions of Fuzzy System Inputs.

Fuzzy System Input Variables	Membership Function	Range of Inputs		
		Low	Medium	High
Age	Triangular MF	15–30	30–50	50–70
Education levels	Triangular MF	0–2	2–30	30–80

Figure 6 shows how defuzzification, which is required for the food waste fuzzy system, maps a fuzzy set to a new one using a set of rules that turn multiple variables into a fuzzy result for given fuzzy sets and appropriate membership degrees.

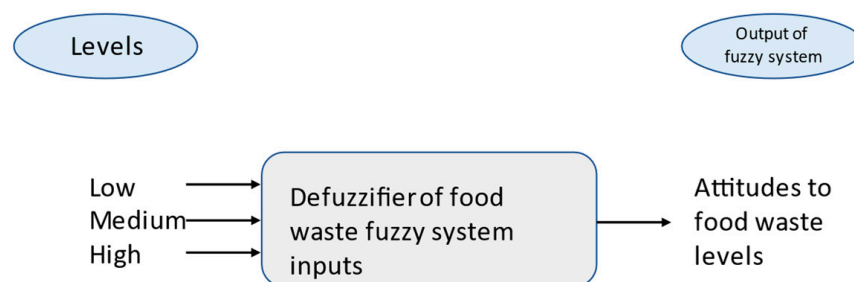


Figure 6. Defuzzification Process in Fuzzy System.

3.4. The Fuzzy Logic System in the Study

Figure 7 presents the use of a triangular membership function in the defuzzification phase for fuzzy outputs of low, medium, and high levels to obtain values of attitudes towards food waste levels. Table 2 shows the performance levels of the fuzzy system.

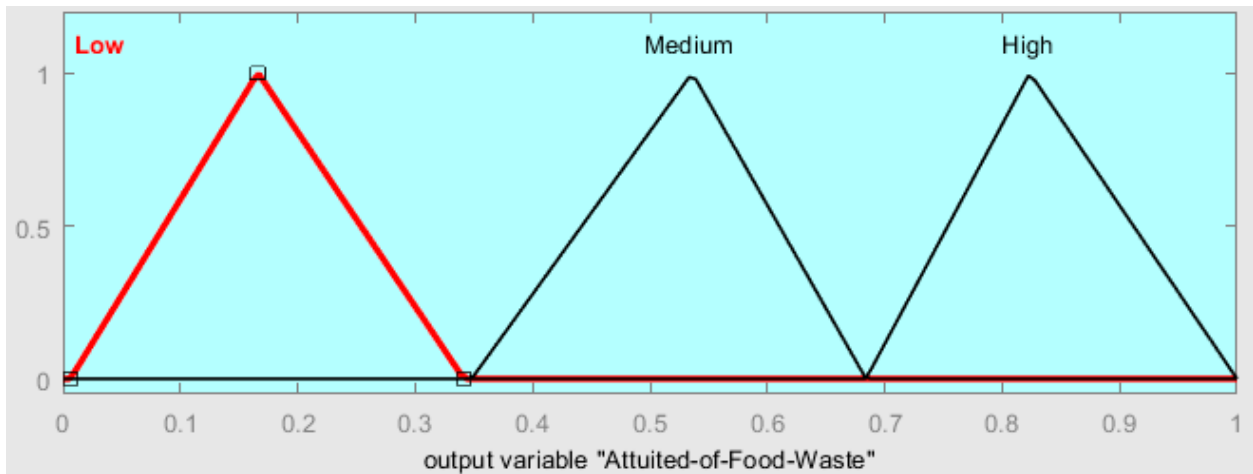


Figure 7. Outputs of food waste fuzzy system.

Table 2. Membership Functions of Fuzzy System outputs.

Fuzzy System Outputs Variables	Membership Function Used	Range of Outputs		
		Low	Medium	High
Attitudes towards Food Waste Levels	Triangular MF	0–15	15–30	30–70

3.5. Fuzzy Logic Base Rules

Fuzzy rules based on the if-then rule were constructed to allocate relationships between food waste fuzzy system inputs and output, as displayed in Table 3.

Table 3. Some of Human Balancing Fuzzy Systems If-Then Rules.

Fuzzy Rules (If-Then Rules)
If (Age is Low) and (Education-level is Under-Graduate) then (attituded -of-Food-Waste is Low)
If (Age is Medium) and (Education-level is Under-Graduate) then (attituded -of-Food-Waste is Medium)
If (Age is High) and (Education-level is Diploma) then (attituded -of-Food-Waste is High)
If (Age is High) and (Education-level is Diploma) then (attituded -of-Food-Waste is High)
If (Age is High) and (Education-level is Postgraduate) then (Attituded-of-Food-Waste is High)
If (Age is Medium) and (Education-level is Postgraduate) then (Attituded-of-Food-Waste is High)

4. Results

4.1. Socio Economic Characteristics

Each participant was asked to provide their information on age, occupation and education level. A summary of participants is presented in Table 4 below. The sample is composed of 199 who are all females, since the survey took place at PNU which is an all-female university. Just over 80% of participants are in the 18–30 age group. About 15% of participants are in the 30–50 age group and only 2% were in the >50 age group. While this might be expected and reflects the fact that the survey was carried out at the University, and that most participants are students, it also reflects the fact that the younger population

are more interested in food waste management and sustainability. In fact, from the survey data, 75% of participants were students and only 25% were university workers, including academics and staff. In terms of qualifications of participants, the percentage of students is 70%, the percentage of those with university and higher degrees (master's and PhD) is 28.6 and the percentage of those with a diploma qualification is 1.4%. A total of 49 out of 199 (25%) respondents are married and 150 (75%) are single. The participants were asked if they perceive themselves overweight, underweight or moderate. A total of 33.7% reported that they see themselves as overweight. A percentage of 52.8% of participants felt that they are normal and 13.6% reported that they see themselves as underweight.

Table 4. Profile of respondents (n = 199).

	Item	Percentage (%)
Gender	Female	100
	Male	0
Age	18–30	82.4
	30–50	15.5
	>50	2.1
Occupation	Working	25.0
	Student	75.0
Qualifications	UG Students	70%
	Postgraduate	28.6%
	Diploma	1.4%
Weight to height ratio	Proportionate	52.8%
	Overweight	33.7%
	Under weight	13.6%

From the results, it appears that majority of participants (>80%) were in the age group of 18–30 years old. Figure 8 below shows the % frequency of age distributions of all participants.

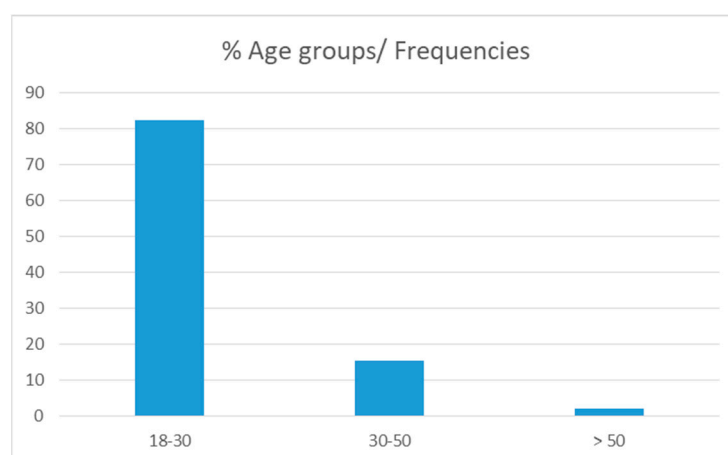


Figure 8. Percentage distribution of age groups in the survey.

In terms of working status, the results show that 75% of the participants are students while only 25% are workers. The percentage distribution of the qualifications, including studentship, shows that of the 150 students, about 70% are UG, 28% are graduates and 2% are diploma students.

4.2. Attitudinal Questions

This section includes the survey questions on attitudes to food waste and its impacts. These questions were analysed and discussed below.

Participants were asked to report on their eating out behaviour. They were asked about the frequency of eating out. Figure 9 shows that over 42.5% of participants reported that typically they eat out once a week, 44% reported that they eat out about three times a week, 8.5% of participants reported that they eat out about five times a week and about 5% of them reported that they eat out every day.

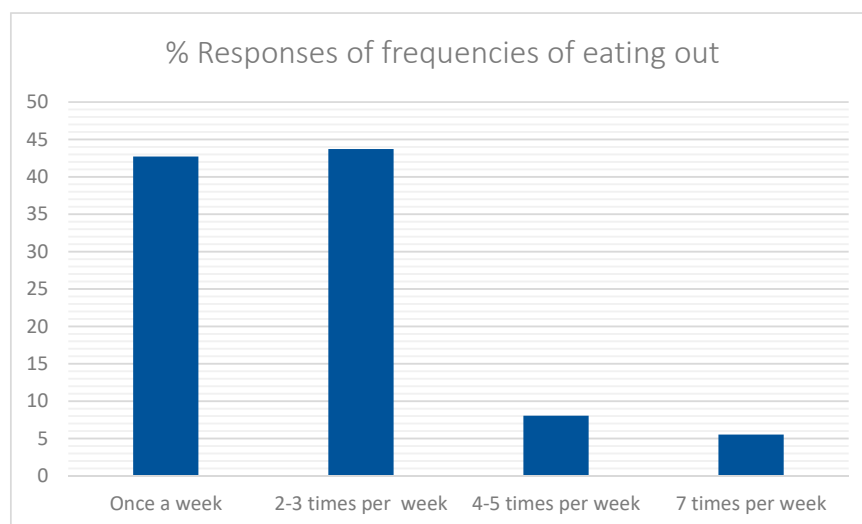


Figure 9. The percentages of responses of frequency of eating out.

In terms of type of food eaten outside, results show the type of meals for those who reported they eat out. Interestingly, it seems that over 80% of participants reported that their meals when they eat out are light meals while only about 18% reported that their meals are of the fatty type.

Participants were asked about leaving food in plates. From Table 5, it appears that about 10% of them reported that they always leave leftovers in the plate, 38% said they do not leave leftovers and the remaining 52% said they sometimes do and sometimes do not, depending on many factors. From these figures, it seems that the majority of participants reported that they leave leftovers.

Table 5. Perceived effective measures to reduce food waste. Attitudinal questions.

	Item	Percentage (%)
Eating out behaviour	Once a week	42.7%
	2–3 times per week	43.7%
	4–5 times per week	8.0%
	7 times per week	5.5%
Type of food	Fatty	18.5%
	More healthy	81.5%
Leave over food on plate	Always	10%
	No	38.6%
	Not always	56.4%

4.3. Preferences and Attitudes towards Food Wastages

The following section includes preferences and attitudes towards food wastage and its utilisation. Attitudes towards food waste were investigated using four questions.

Participants were asked to express their attitudes as to how food waste can be controlled. Most of participants (over 70%) felt that all offered options together should be utilised to reduce food waste; see Figure 10 and Table 6. At least about 25% of participants felt that taking leftovers home would make a good solution. Other options included raising awareness, give leftovers away, use leftovers to produce other products, etc., which were not very favoured by participants.

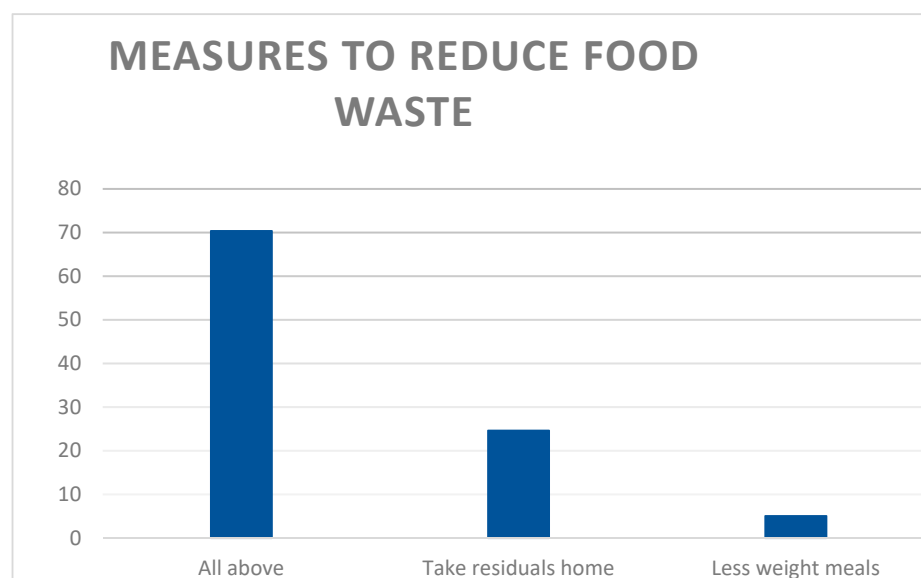


Figure 10. Perceived effective measures to reduce food waste.

Table 6. Responses to preferences and assessment of measures and policies.

	Item	Percentage (%)
Perceived alternative uses of food waste	Storage for reuse	27%
	Distribute to needed families	36%
	Recycled to fertilizer	32%
Participants' attitudes towards food waste minimisation	All above	5%
	Very keen	67.5%
	I don't know	5.5%
Perceived effective measures to reduce food waste	Supportive of idea	27%
	All measures	70.3%
	Take residuals home	24.6%
Perceived responsibilities to manage food waste	Less weight meals	5.0%
	Social charities	20.1%
	Families	64.3%
	Governmental authorities	15.5%

When asked whose responsibility it is to sort out food waste problem, a total of 20% of participants felt that it was the responsibility of the social charities in the first place. Majority of respondents were of the opinion that it is the family's and household's responsibilities. About 15% of participants considered this issue to be a responsibility of the local authorities or the government, as presented in Table 6. Participants were further asked about their attitudes and preferences towards the concept of food waste policies and measures. This

is another area of great importance. Raising awareness and educating people about the shared responsibilities and duties related to food waste matters.

Just under 70% of respondents supported any measures to control and manage food waste. Only about 5% of participants were not supportive of the concept, while the rest of the sample did not seem to be knowledgeable about such measures; see Figure 11.



Figure 11. Participants’ attitudes towards food waste minimisation.

Four options were presented to the participants, which were “Storage for reuse”, “distribute to needed families”, “recycled to fertilisers” and “all the above”. Results presented show that just over 25% of participants prefer the option of “storage for reuse”, over 35% prefers the option of distribute to needed families, over 30% opted to the option of recycle to fertilisers while just under 5% expressed preferences to “all option”. Participants were further asked to express their opinion on some selected areas of applications of food waste and awareness-raising policies.

4.4. Areas of Applications of Food Waste and Raise Awareness Policies

Table 7 presents the findings of the final section. This section includes questions on areas of applications of food waste and awareness-raising policies. According to participants’ opinions, it was observed that more than 60% are in support of food waste management and believe that reduction should be families’ responsibility. In second place, 20% of participants indicated that social charities should have a responsibility, followed by the governmental authorities. This might well be due to the Arabian culture, which often considers family social responsibility in first place.

Table 7. Responses to questions on areas of applications of food waste and raise awareness policies.

Item	Percentage (%)	
Percentage accepting the idea of producing plant fertilisers from food waste recycling	Do not now	29.1%
	Yes	62.8%
	No	8.1%
Support of food waste recycling	Yes	68.8%
	No Idea	26.6%
	No	4.5%
Perceived responsibilities to manage food waste	Families	64.3%
	Social charities	20.1%
	Governmental authorities	15.5%

Another area of the application of food waste and awareness-raising is recycling policies for the waste, which was preferred by most of the participants—nearly 70%. The recycling idea was accepted by 63% of the participants to produce plant fertilisers.

5. Results of Fuzzy Logic Analysis

The food waste fuzzy system output is the attitudes towards food waste which change with women's age and their education levels, as shown in Table 8.

Table 8. Food waste fuzzy system inputs and output.

Variables	Inputs Frequency		Output Defect
	Age	Education Level	Attitudes towards Food Waste
	15–30	Diploma	50%
	15–30	Postgraduate	50%
	15–30	Undergraduate	17%
	30–50	Diploma	50%
	30–50	Postgraduate	84%
	30–50	Undergraduate	53%
	50–70	Diploma	80%
	50–70	Postgraduate	83%
	50–70	Undergraduate	20%

These results are also comparable with the results obtained from the general data. The general results show that most participants (over 70%) felt that all offered options together should be utilised to reduce food waste. At least about 25% of participants felt that taking leftovers home would make a good solution. Other options including raising awareness, giving leftovers away, using leftovers to produce other products, etc., were not very favoured by participants.

The results from the fuzzy analysis provided further clarifications of attitudinal responses. The results showed that with increasing age and education levels, the attitudes towards food waste have increased. The attitudes were measured as three categories: low, medium and high. High attitudes reflect high importance and high opinion on food waste matters, medium and low reflects medium importance and low importance, respectively. These results indicate that raising awareness and education on measures and policies could well be very effective in terms of increasing positive attitudes towards sustainable policies. It is important to highlight in this context that fuzzy logic analysis proved useful in assess attitudes—in this case, attitudes to food waste issues.

6. Discussions

The results from this research suggest that there is still a huge amount of food leftovers that is wasted and not made use of. The participants were asked to express the perceived acceptability of specific measures to manage and control food waste. The study investigated eating out behaviour. Over 80% of participants reported that typically they eat out at least once a week, with about 5% of them reported that they eat out every day; out of those 80% reported that their meals when they eat out is of the type of light meal. When asked about leftover food when eating outside, just under 40% reported that they never leave leftover. This is rather a very encouraging finding that indicate awareness of food waste issues. However, it should be noted that this sample is university students and, therefore, expectations are that their level of awareness would be higher than the average population. Over 55% of those surveyed, on the other hand, reported that they do leave leftovers sometimes. Of those, 25% reported that they usually take the leftovers as a takeout. The results from another study in Ireland [36] shows that 62.56% of the sample

were 'uncaring' consumers while 37.44% of them were 'caring' consumers. Participants were asked to express their opinion on some selected areas of the application of food waste and awareness-raising policies. When asked about the best reuses of food waste, over 25% of participants preferred the option of "storage for reuse", over 35% preferred the option of distributing to needing families and over 30% opted to the option of recycle to fertilisers. Participants suggested that the responsibility of controlling food waste is mainly that of the families. The results of that study show that consumers are aware of the environmental and economic impacts of food waste, and that food waste is perceived to be the responsibility of the household. The results are well-matched with a study in Italy, which also investigated attitudes of households towards food waste and the reduction of food waste [37]. A UK study investigated whether household food waste is linked to a lifestyle and household attitudes towards food waste. The results show that subtle behavioural and socio-economic, as well as cultural factors, do impact on food waste behaviour [38]. Further research in the area of food waste could include work on assessing the controlling and managing policies that could include investigation of men's attitudes towards food waste and its management, and specific policies that could be implemented to control and manage food waste in the KSA.

Further, the explanation and investigation of the attitudes towards food waste and food waste management were also investigated using fuzzy logic analysis. The advantages of using a fuzzy logic system are that it is more efficient in dealing with smaller samples and parameters that are qualitative in nature. In our research, the sample was 199 female participants from an all-female university in Riyadh. Three qualitative levels of attitudes were used in the fuzzy logic analysis (low, medium, high) to create the fuzzy sets. Other studies present an application of fuzzy logic analysis for evaluating the social attitudes and acceptance of measures associated with waste treatments [39]. Their fuzzy analysis was used due to the lack of data, and the qualitative character of the utilized indicators. Therefore, the fuzzy analysis can provide an effective way to include knowledge and gained experience from the data. Their analysis shows the highest level of social acceptance in their city (57.47%). The results from our fuzzy logic analysis indicated similar patterns of results to those obtained from statistical analysis of the data. The findings show that age and education levels have an impact on attitudinal perceptions on food waste. These findings in particular also revealed positive attitudes and responses towards food waste to be increasing with increasing the age and education levels. These results indicate that raising awareness and education measures and policies could well be very effective in terms of increasing positive attitudes towards sustainable policies. It is important to highlight that our study proposes a novel procedure for evaluating the level of attitudes towards food waste management using fuzzy logic analysis. This could also have other relevant applications such as assessing measures and programs that aim at raising awareness towards many sustainable approaches.

Whilst the presented results from this research show very positive attitudes towards food waste management and policies and programs that are implemented to improve the situation in this area, it should be noted that this study is very limited to university females in a certain age group in Riyadh. It is recommended therefore, that further research on other categories of the population, as well as other geographical areas, would be carried out to include, for example, males, other age groups, other social class groups, etc. This is in order to gain a fuller understanding of attitudinal responses of the whole population in the Kingdom. It is also relevant to investigate the relevance of education at early ages, awareness in schools, local authorities and media on future attitudes and behaviour towards sustainable studies.

7. Conclusions

Food waste is one of the major sectors to be targeted to improve sustainability in urban areas. Food waste needs to be identified, analysed and assessed in order to be managed and minimised. There has been a considerable academic interest and research in

various food waste sectors such as hotels, restaurants, schools' canteens, factories, airlines and domestic spaces, especially over the last few decades. There is a shortage, however, in research that reviews and assess public opinions and attitudes towards food waste in restaurants and hospitality sectors. Evidence from the literature suggest that cultural as well as socio-economic factors do affect behaviour and attitudes towards food waste and the management and control of food waste. These findings strongly support the need for research and investigations of cultural impacts on food waste. Such studies could be of great aid to policy makers when driving policies and programs to manage and control food waste, in particular at the family level.

This paper is centred around a preliminary study that was carried out in Riyadh in the Kingdom of Saudi Arabia (KSA) at PNU. The study aims at assessing attitudes and preferences of participants from all-female university in the city. While the study is based on a small sample, it does, however, provide a useful preliminary investigation that sheds light on the factors that affect attitudes and behaviour towards food waste in the Kingdom. The study also provides a useful reference for future investigations in this research area. The results reveal that food waste and food waste control seem to be a significant topic that is widely supported by majority of participants. The sample of this study is 100% female, and therefore further research could well be conducted with male Saudi citizens to be able to provide an understanding and comparative analysis of the findings. This study was conducted at an all-female university in Riyadh of mostly age group of 18–30 years old. While the results from this research show very positive attitudes towards food waste management and policies and programs that are implemented to improve the situation in this area, it is recommended that further future research including other categories of the population be carried out in order to gain a fuller understanding and awareness of the other population groups in the Kingdom. That would include males, other age groups, other social class groups, etc. It is also crucial to investigate the relevance of education at early age, awareness in schools, local authorities and media on future attitudes and behaviours towards sustainable studies.

Author Contributions: Conceptualization, W.S. and G.A.; methodology, W.S., A.M. and M.M.A.L.; software, M.M.A.L. and A.M.; validation, A.M., W.S., G.A. and M.M.A.L.; formal analysis, W.S., M.M.A.L. and A.M.; investigation, M.M.A.L., A.M., G.A. and W.S.; resources, A.M.; data curation, M.M.A.L. and G.A.; writing—original draft preparation, W.S.; writing—review and editing, G.A., A.M. and M.M.A.L.; visualization, G.A.; supervision, W.S.; project administration, A.M.; funding acquisition A.M. All authors have read and agreed to the published version of the manuscript.

Funding: This research was funded by Princess Nourah bint Abdulrahman University Researchers Supporting Project number (PNURSP2023R151), Princess Nourah bint Abdulrahman University, Riyadh, Saudi Arabia.

Institutional Review Board Statement: Institutional Review Exemption Certificate Number: IRB Log Number: 22—0683-PNU.

Informed Consent Statement: Written informed consent has been obtained from the patient(s) to publish this paper.

Data Availability Statement: Not applicable.

Conflicts of Interest: The authors declare no conflict of interest.

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