

Article

Investigating Food Waste Recycling in Local Food Service Businesses: A Case Study from a Local Government Area in Australia

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Abstract: Worldwide, over 1.3 billion tonnes of food goes to waste each year, and much of this is disposed of in landfill, which is costly to the economy and the environment. This study targeted food waste management in local food service businesses as the third largest producer of food waste and a sector that has received less academic attention than other food waste producers (such as household food waste). Questionnaires and interviews were used to investigate current food waste management practices within food service businesses in a Local Government Area in Adelaide, South Australia. Twenty-two respondents completed the online questionnaire and three of these businesses also participated in an interview—two in-person at their business premises and one via an online teleconferencing system. It was found that 54% (n = 12) of these businesses have practices in place to recycle their food waste, while 46% (n = 10) do not. Insufficient kitchen space and the difficulty of separating food waste from non-compostable rubbish were reasons given for not recycling food waste, and the single most important factor that would encourage food waste recycling cited by businesses was the provision of a free, green organics bin. Motivations for recycling food waste included compassion for the environment and the desire to divert waste from landfill. These insights may help local government implement solutions to reduce food waste from entering landfill.

Keywords: food waste; recycling; composting; food service businesses



Citation: Fogarty, E.; Clarke, B.; Ross, K.E. Investigating Food Waste Recycling in Local Food Service Businesses: A Case Study from a Local Government Area in Australia. *Sustainability* **2021**, *13*, 13846. <https://doi.org/10.3390/su132413846>

Academic Editors: Elena Rada, Marco Ragazzi, Ioannis Katsoyiannis, Elena Magaril, Paolo Viotti, Hussain H. Al-Kayiem, Marco Schiavon, Gabriela Ionescu and Natalia Sliusar

Received: 25 October 2021

Accepted: 12 December 2021

Published: 15 December 2021

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1. Introduction

Globally, many food items perish before they have been eaten or used, and this equates to an annual generation of more than 1.3 billion tonnes of food waste [1]. Up to one third of all food produced ends up as waste [1], and of all waste generated globally, food waste accounts for up to 44 percent [2]. A rapidly growing world population is predicted to increase the volume of food generation as well as food going to waste. This presents many social, economic, and environmental challenges from production to disposal.

Food waste is defined variously, but, in the context of this paper, food waste is a broad term that refers to food fit for, and intended for, human consumption, that was for whatever reason not consumed but discarded, as well as items produced during the food preparation process that cannot be consumed such as skins, peelings, and egg shells [3]. There are many drivers of food waste, and these occur at every stage along the food supply chain [4]. This paper focuses on food waste generated specifically in the food service industry—the end of the food supply chain [4].

In Australia, approximately 7.3 million tonnes of food is wasted each year. This has been estimated to cost Australia AUD\$20 billion annually [3]. A large portion of this food waste ends up in landfill. A South Australian study found that 40% of municipal waste sent to landfill is food waste [3]. This is a concern for many reasons, including the

increased space needed for landfill, fuel needed to transport waste to landfill, greenhouse gas emissions from the anaerobic decomposition of food waste, and other associated costs [3,5].

Common methods of food waste disposal and treatment, such as landfill and incineration, can pollute the environment, negatively affect water, soil, and air quality, and contribute to climate change and public health risks [6–8]. When food waste is disposed of in landfill, it decomposes anaerobically and produces carbon dioxide and methane [7,9,10], a greenhouse gas significantly more potent than carbon dioxide [11]. This is problematic as it contributes to the rapidly rising levels of greenhouse gases causing global climate change. Another problem with landfilling waste is the amount of space required. As the global population increases, more land is needed for agriculture and the built environment and increases pressure on natural resources.

Separating food waste from general waste and recycling it rather than disposing of it in landfill could dramatically reduce the amount of land needed for landfill and also reduce methane emissions [9,12].

The waste hierarchy presents a set of globally accepted priorities for the most efficient use of resources from most to least favored options. Applied specifically to food waste, it is a tiered approach prioritizing actions, with prevention being the most preferred option. However, not all food waste can be avoided [7,13]. Where prevention is not possible and all possible redistribution options have been spent, the recycling of discarded or uneaten food is the next most preferred management method [7].

Recycling food waste through conversion to animal feed or industrial products is the most preferable recycling practice, followed by composting, and then conversion to energy (through incineration or anaerobic digestion) [12,14]. Evidence suggests that composted waste from the food service industry converts to good quality fertilizer [10,15–17]. Compared with disposal, recycling is cheaper and less environmentally damaging. The cost of waste management is influenced by both the magnitude of waste generated and the method of disposal [18]. In principle, by reducing the volume of waste sent to landfill, recycling food waste can reduce the cost of waste management [19].

The food service sector generates a large portion of the world's food waste [20], justifying the focus of this study. The food service industry encompasses businesses and institutions that prepare and serve ready-to-eat meals and snacks outside the home [21,22]. Understanding how the food services industry manages food from production to consumption to disposal is therefore of importance, because its mismanagement has detrimental environmental, social, and economic impacts [6,7,23], and improved knowledge of this sector may assist in more sustainable outcomes.

The most effective way to reduce waste is to deal with it at the source through waste minimization [24]. Therefore, understanding the behavior and motivations of individuals' disposing of waste is essential when designing waste minimization strategies [25]. The Theory of Planned Behavior (TPB) [26] has been applied to many studies at the level of the household to explain recycling behavior (see, for example, [24,25,27,28]). This theory assumes that people's behavior is based on rationally made choices that determine the intention to do or not to do something. The TPB cites three factors underlying intentions: (a) attitude (willingness to perform or not perform a behavior), (b) perceived social pressure that influences if a behavior will be performed, and (c) an individual's assessment of whether they are able to perform the behavior [24].

Attitudes are shaped by opportunities, facilities, and knowledge to recycle. Attitudes are also affected by physical challenges that create obstacles (such as time, space, and inconvenience) [24]. Other important factors that affect recycling behavior include a concern for the community and the consequences of not recycling.

Far fewer studies have applied this theory to the food services sector [29]. In the food services sector, additional factors are suggested to determine the uptake of recycling, including strategies or systems implemented by companies that either encourage or discourage waste minimisation, logistics, and staffing [29].

The aim of the study presented here was to learn how food service businesses (businesses that prepare and serve food to the public) in the City of Mitcham, a Local Government Area in Adelaide, the capital city of South Australia, are currently managing food waste, and to explore what motivates business owners and workers to recycle food waste.

2. Materials and Methods

A triangulation approach to data collection was employed for cross-verification to improve the validity of results and to gain a more complete understanding of the problem [30]. We administered an online questionnaire and conducted face-to-face interviews between August 2020 and May 2021. The target participants were food service businesses within the City of Mitcham, a Local Government Area (LGA) in Adelaide, South Australia. The City of Mitcham LGA has a population of approximately 65,000, and is an area of high socioeconomic status, populated by slightly more female than male residents, and with a median age of 42 [31].

Each LGA in South Australia is responsible for collecting waste and managing it as recycling or landfill. The City of Mitcham LGA currently provides businesses with the option to purchase 240 L green organics bins, which it then collects and empties fortnightly. The cost to businesses for the purchase of one green bin is AUD\$96 (approximately USD\$67). Additional bins can be purchased for AUD\$96, with an ongoing annual waste collection and disposal fee of AUD\$96 per additional bin. It is unclear how many businesses in the City of Mitcham LGA have purchased bins to make use of this service.

Both online questionnaires and face to face interview questions were developed with the intention of discovering: (1) how food service businesses manage and dispose of their food waste and (2) what influences decisions around food waste management. The online questionnaire was developed using Qualtrics® and was comprised of mostly multiple-choice questions. Following ethics approval from the Flinders University Social and Behavioural Research Ethics Committee (No 8590), the questionnaire was piloted on three people with experience as owners or managers of a food service business. The pilot confirmed the relevance of questions for the food service industry and gave an indication of how long it took respondents to complete the survey.

Following the pilot, letters and emails were sent to all food service businesses within the City of Mitcham LGA, inviting them to participate in the study. The City of Mitcham provided a list of all (141) food service businesses within its boundary. An online search was conducted to access contact details for each business on the list. Where possible all businesses were first approached via email. Those without an email address were sent a letter. In total, 141 businesses emails and letters were sent. Embedded in the letters was a Qualtrics® generated QR code or URL linking to the online questionnaire. One week later, follow up telephone calls were made to confirm that letters and emails had been received. This process established a flaw in the method. Many contacts had not found or opened these emails, and many businesses were unaware of the study. A follow-up telephone call confirmed that most business owners did not wish to participate in the study because they were too busy or not interested. One week before the survey closed, a final reminder email was sent to all who had expressed interest in the study but had not yet completed the survey.

At the conclusion of the study, 22 respondents completed the online questionnaire, and three of these businesses also participated in an interview—one via an online teleconferencing system and two in-person at the business premises. Data from Qualtrics® were imported into SPSS® and Excel® for analysis. Data were analyzed and results were assessed using descriptive statistics, frequency tables and cross tabulations. Statistical significance of cross tabulations was calculated using the Chi-square test, a statistical analysis method suited to nonparametric data [32]. Chi-square tests determine whether two variables are independent of each other (i.e., that the null hypothesis—assuming that the variables are independent—is true).

Interview questions.

- Q1. Keeping in mind that food waste recycling refers to food waste that is composted, disposed of in the green organics bin, used as animal feed or converted to something useful, could you explain more about the method of food waste recycling your business uses?
- Q2. What kind of systems do you have set up to ensure food waste gets recycled?
- Q3. How is food waste recycling encouraged in your business?
- Q4. What motivates or encourages you to recycle food waste?
- Q5. What benefits, if any, have you experienced (in this business) from recycling food waste?
- Q6. Is there anything difficult about food waste recycling for your business?
- Q7. Do you recycle food waste at home?
- Q8. I am interested to know how your dedication to recycling started. Can you tell me a little about how you came to be dedicated to recycling food waste?
- Q9. Do you remember if your family/parents recycled food waste during your childhood?
- Q10. Do you train staff about food storage, handling, and disposal? If yes—How? Which staff get trained?
- Q11. Does your business aim to be environmentally friendly in any way? If yes—what do you do, for example, to be eco-friendly here?
- Do you advertise your environmental efforts to customers? If yes—Do you think this is a marketing point to customers? (do they appreciate your environmental efforts?)
- Q12. If your business were supplied with a green organics bin, would you use it to dispose of food waste?
- Q13. What sources of information have been most helpful in guiding your recycling choices?
- Q14. What information or incentive do you think might help a food business owner to recycle food waste from their business?
- Q15. Is there anything you find concerning about sending food waste to landfill?
- Q16. Are you aware of what happens to food waste and organic material that is put in the green bin?
- Q17. Is there any additional information or support that would help your business enhance/improve its recycling practices?
- Q18. Is there anything else you would like to add about the way your business recycles food waste? (what other needs, issues or questions you would like addressed?)

3. Results

The 22 businesses surveyed included four restaurants, nine cafes, two bakeries, four fast-food outlets, two take-away shops, and one conference facility. Respondents included more business owners ($n = 16$) than managers ($n = 6$). The gender balance of respondents was quite even, with 11 female, 10 male, and one not specified. Most respondents were aged between 36 and 45, and 46 and 55 (seven participants in each category), with the remainder falling evenly across the 18–25, 26–35, and 56–65 age categories. One respondent did not answer this question.

According to respondents just over half of the businesses in this study (12) practiced some form of food waste recycling. Of these 12, seven estimated they recycle between 80–100% of the food waste they generate, while two recycle between 50–80%, and three recycle less than 50%.

Most of these businesses use more than one method of recycling. Five businesses pay a contracted recycling company to pick up some or all their organic waste; seven take food scraps home to feed domestic animals (e.g., backyard chickens), or take food scraps home to compost (six businesses); and one business sends their used coffee grounds to a community garden.

3.1. Volume of Waste

To gain an idea of the volume of food waste being generated, respondents were asked for a daily estimate of how many 9-L bucket-loads of food waste their business filled. Ten businesses estimated that they generated less than one 9-L bucket daily, with a further eight estimating they filled between one and five 9-L buckets daily. Three

respondents' (a restaurant, café, and bakery) estimated they filled more than six buckets per day (See Table 1).

Table 1. Volume of food waste generated per day in each business.

Business Type	<1 Bucket	1–5 Buckets	6–10 Buckets	Unsure
Restaurant	2	1	1	0
Cafe	4	4	1	0
Bakery	0	1	1	0
Fast food	2	2	0	0
Take away only	2	0	0	0
Other	0	0	0	1
Total =	10	8	3	1

Of the recyclers, five estimated their daily food waste generation volume to be less than one 9-L bucket. Four estimated between one and five 9-L buckets, while two estimated they generated between six to ten 9-L buckets. One participant wasn't sure about the volume of food waste produced.

Compared to the recyclers, the ten non-recycling businesses had similar daily food waste generation estimates by volume. For example, half (five) estimated a daily volume of food waste to be less than one 9-L bucket, and four estimated their food waste volume to be between one and five 9-L buckets. Only one non-recycler estimated their daily volume of food waste to be between six and ten 9-L buckets.

Figure 1 shows that there is little relationship between the volume of food waste generated and recycling behavior. Some respondents reasoned that their business did not create enough food waste to warrant recycling it. Yet, recyclers and non-recyclers of food waste gave similar volume estimates of daily food waste generation.

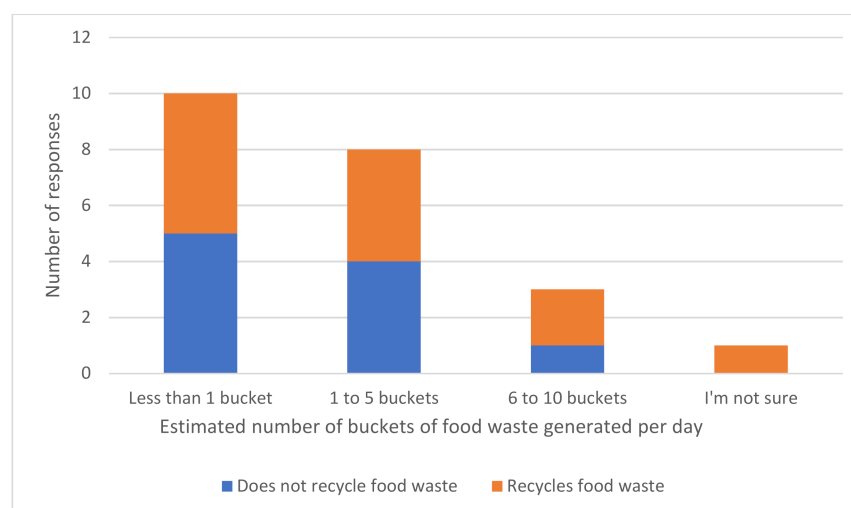


Figure 1. Volume of food wasted per day in businesses that do vs. businesses that do not practice food waste recycling.

3.2. Motive to Recycle Food Waste

The 12 recyclers were asked what encourages them to recycle their food waste. All 12 indicated they do so because 'it is good for the environment' (Figure 2). The other most frequently selected responses were 'it diverts waste from landfill', 'it feels like the right thing to do', and because 'it is easy and convenient'. One respondent who selected 'other', explained that they do not like to see anything go to waste.

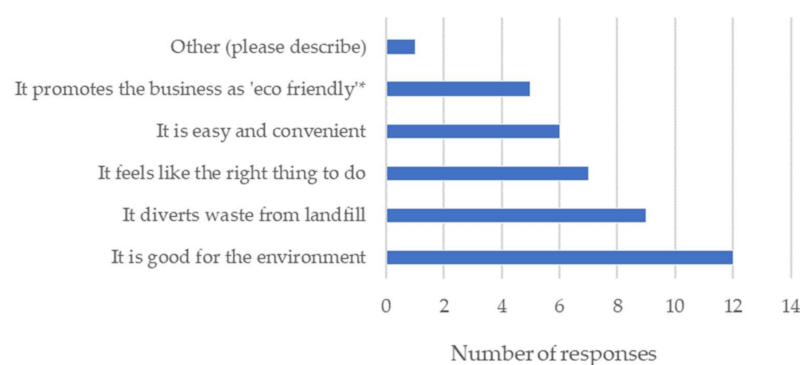


Figure 2. What encourages businesses to recycle food waste? (* original text shortened for graph readability).

Interview participants were asked whether there are any benefits experienced by their business from recycling food waste. Responses varied. For example: ‘no major benefits—we would have to pay for it to be taken away in a red bin or green bin either way’, ‘it feels good and is cost saving’ and,

“it goes beyond just what we benefit from. To me, it’s the external benefit for the planet—I just can’t bear the thought of landfill and destruction to the ecosystem. That’s the biggest benefit to me, knowing that the little things we do in our shop impacts a much bigger space.”

The ten non-recyclers were asked what would encourage them to recycle food waste generated by their business (Figure 3). The single most important factor expressed by eight businesses was the provision of a free, green organics bin (to be collected regularly by the City of Mitcham LGA). Other suggested motivations included education and/or training in food waste management, and environmental impact of food waste; policy mandating food waste recycling; customer demand for green practices; and being paid to recycle. Two indicated, however, that nothing would encourage them to recycle food waste.

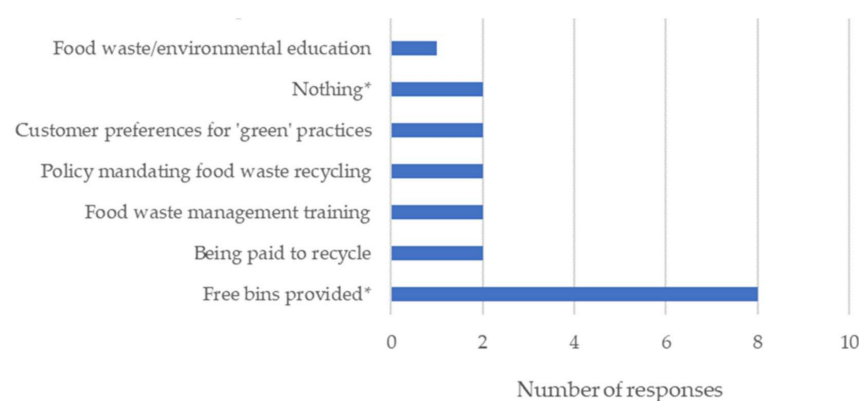


Figure 3. What might encourage businesses that are not already doing so to recycle food waste (* original text shortened for graph readability).

3.3. Challenges of Food Waste Recycling

Interview participants were asked whether food waste recycling was difficult. One participant found nothing difficult about recycling food waste. However, two interviewees said it was difficult to separate uneaten food from other items left on customers’ plates, such as aluminum foil or plastic packaging. Accordingly, these two businesses choose to only recycle food scraps from the kitchen. Food waste from their dining rooms is discarded with general waste.

This difficulty of separating food waste from non-organic waste was also raised in the online questionnaire. Non-recyclers were asked to identify factors discouraging their

business from recycling food waste (Figure 4). Insufficient kitchen space and the difficulty of separating food waste from non-compostable waste were the two most common reasons given, followed by ‘it is time consuming’ and ‘it is confusing/complicated’. Of the four respondents selecting ‘other’, three reasoned that their business produced only a small volume of food waste—and, for this reason, recycling was burdensome. Another stated that lack of a City of Mitcham-supplied green organics bin posed a barrier to disposing of food waste. This respondent explained that, if City of Mitcham furnished their business with a green organics bin, along with a training program to educate staff on how to manage food waste effectively, they may be encouraged to recycle their food waste.



Figure 4. What discourages businesses from recycling food waste (* original text shortened for graph readability).

3.4. Environmental Awareness

Respondents were presented with several statements about climate change, pollution, nature, and recycling to explore relationships between environmental concern and willingness to participate in environmentally friendly practices (illustrated in Figure 5). The recyclers’ responses suggested that they held slightly stronger pro-environmental views than non-recyclers. Nevertheless, several of the non-recyclers’ responses were ‘pro-environmental’ and suggested a concern for nature. There was no significant difference in attitudes between those who recycled and those who did not regarding climate change, pollution, or enjoyment of nature.

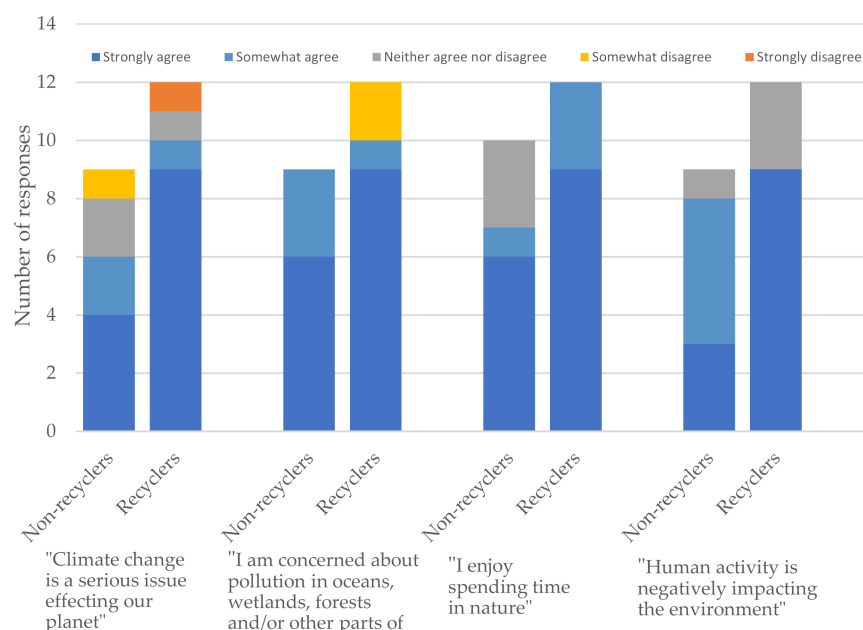


Figure 5. Attitudes to nature and the environment compared with food waste recycling behavior.

Cross tabs indicated that more recyclers ‘strongly agreed’ that ‘human activity negatively impacts the environment’, and a Chi-square test revealed a significant relationship here ($p = 0.013$).

3.5. Interviews

Two business owners and one business manager agreed to a semi-structured interview. All three had ‘pro-environmental’ views, which they said motivated food waste recycling in their businesses. One participant also listed cost-saving as a reason for recycling. The other two participants said they would have to pay the same if they recycled their food waste or disposed of it in the general rubbish. All three businesses had support from their staff in food waste recycling. The interviewees reported that many of their staff were ‘eco-conscious’, and either pushed to have more environmentally sustainable practices (such as food waste recycling) or helped to execute these practices by taking food scraps home for chickens or for disposal in their own green organics bin. The influence of family and friends was also mentioned as motivation to recycle food waste. Additionally, two interviewees mentioned that consumer demand for sustainable practices is increasing, and they felt that recycling food waste (amongst other eco practices) was a good selling point to attract customers.

4. Discussion

4.1. Motives for Recycling Food Waste

In this study the environmental attitudes of business owners and managers were very similar regardless of whether they recycled or not. Previous work has suggested that there is a relationship between ecological values or environmental concern and willingness to participate in environmentally friendly behaviors [33–36]. However, that was not evident in this study. Previous research has found that a person’s waste management behaviors can be influenced by the amount of time spent in and appreciating nature, the subjective norm (what is perceived as normal or good by peers and/or society), level of environmental knowledge or education, and the environmental habits of parents or peers [37–39]. Fifty-eight percent of those in this study who recycle food waste do so because they ‘feel it is the right thing to do’, this suggests that social pressure or a moral compass influenced the recycling behavior of survey respondents. Interviewees also explained that staff, family, and friends motivated them to recycle food waste and to implement other pro-environmental practices within their business.

While respondents who recycled food waste held positive environmental attitudes, so did most of the non-recyclers. One possible reason is that the study might have attracted more environmentally conscious participants, another may be ‘social desirability bias’ [40], a phenomena whereby survey respondents tend to over-report socially desirable behaviors and under-report undesirable ones [40,41]. However, the online questionnaire might have counteracted such an effect, as respondents could complete the survey in a private location. Another possible reason is that business owners and managers really do want to recycle their food waste, but do not yet have the facilities or support to do so successfully. This is affirmed by most of the non-recycling businesses, indicating they would start recycling their food waste upon receipt of a free green organics bin. Respondents were aware of the benefits of, and would be willing to, recycle food waste if the process was made cost-effective, simple and convenient.

4.2. Challenges of Food Waste Recycling

The study identified perceived challenges or barriers to food waste recycling that included difficulties separating customer food waste from other waste, a lack of time to sort waste, limited space in kitchens for green organics bins, cost, and perceived insufficient volume of food waste generated to off-set the bother of managing it. Sorting compostable from non-compostable materials (such as aluminum, plastic packaging, or plastic eating utensils) is one of the challenges preventing the recycling of food waste by food service

businesses. It is difficult to quickly dispatch mixed-waste items into separate bins designated for recycling and too time consuming to separate wastes. The interviews conducted for this study confirm this. Two of the participants in this study recycled only food waste generated in food preparation. Food waste left on customers' plates was not recycled due to contamination and difficulty in sorting. Only one of the three participants recycled both food waste from the kitchen and from the dining room. It was easy for this business to recycle because all their food packaging and eating utensils were compostable, meaning that all waste left on customers' plates could be put into a single bin. There was no need for sorting.

These findings are supported by Fieschi and Pretato [42], who found that using compostable tableware made it quicker and easier for food service staff to recycle food waste, as everything left behind by the customer could go into the same recycling bin. However, this may not be the most sustainable option, as single-use products, whether compostable or not, use more resources and contribute a larger ecological footprint than reusable tableware [43–45]. Reusable items improve environmental performance and are an important component of a circular economy [43].

The second most cited challenge to food waste recycling was a lack of kitchen space. The literature suggests that it is more difficult for small businesses to engage in sustainable practices such as food waste recycling [46]. This does not, however, mean that food waste recycling is unattainable for small businesses. Several small businesses included in this study recycled food waste. It would be worth learning from these enterprises to illustrate to others how small spaces can be better set up to accommodate waste processing.

An insufficient volume of food waste generation was offered as a reason for not recycling. Other studies have experienced the same argument [47–49]. However, this study found that the volume of food waste estimates given by businesses who were recycling were roughly the same as business not recycling. Here, the quantity of food waste generated was not a determining factor in the decision to recycle food waste. Studies from Northern Ireland and Scotland rejected the idea of 'not enough waste to recycle', and mandatory food waste recycling schemes for food service businesses are in place. Businesses producing a volume of 5 kilograms of food waste per week are required to recycle [50,51].

4.3. Viability of Food Waste Recycling

More than half of the businesses in this study practiced food waste recycling. These businesses found it easy and convenient to recycle their food waste. It could be postulated that recycling food waste is a viable and practical and diversion from landfill is possible. This would assist in reducing space needed for landfill, fuel needed to transport waste to landfill, greenhouse gas emissions from the anaerobic decomposition of food waste, and associated costs [3]. Infrastructure exists for food waste collection and recycling in the City of Mitcham LGA. However, it seems that few, if any, of the food service businesses are taking up the option of having their food waste collected for recycling by the City of Mitcham [52–54]. If the City of Mitcham LGA provided food service businesses with free bins and free collection, this may encourage a greater uptake of recycling.

5. Conclusions

Millions of tonnes of food waste are sent to landfill each year, causing detrimental economic, social, and environmental impacts. In the attempt to gain a better understanding of food waste management habits and attitudes within food service businesses, this study investigated the practices and attitudes of food service business owners and managers within the City of Mitcham, a Local Government Area of the capital city of Adelaide, in South Australia. Respondents elicited their general acceptance of the concept of food waste recycling. Over half of the surveyed businesses recycle food waste. Many of those not recycling indicated that free local government provided 'green' bins, collected regularly by their LGA, would encourage them to recycle. A logical next step would be for LGAs to issue recycling bins and audit the engagement of businesses in food waste recycling.

Some barriers to food waste recycling were more difficult to resolve, including a lack of kitchen space and difficulties encountered in sorting food waste. A multi-faceted approach is needed to address food waste and the challenges it presents. Government, businesses, and the public can each contribute towards a more sustainable food service sector and its management of food waste. This study confirmed the support of businesses to recycle food waste. With enhanced support government, it appears that management and reduction of food waste is achievable.

Author Contributions: Conceptualization, B.C., K.E.R. and E.F.; methodology, B.C., K.E.R. and E.F.; investigation, E.F.; resources; data curation, E.F.; writing—original draft preparation, E.F.; writing—review and editing, B.C. and K.E.R.; supervision, B.C. and K.E.R. All authors have read and agreed to the published version of the manuscript.

Funding: This research received no external funding.

Institutional Review Board Statement: This study was approved by the Flinders University Social and Behavioural Research Ethics Committee (Approval number 8590).

Informed Consent Statement: Informed consent was obtained from all subjects involved in the study.

Data Availability Statement: Raw data are available on request from the corresponding author.

Acknowledgments: The authors acknowledge the support of the City of Mitcham for this project, including provision of food service business contact details.

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

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