

CONSUMER BEHAVIOUR IN CIRCULAR FOOD SUPPLY CHAIN

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ABSTRACT

Purpose: The objectives of this exploratory study are to understand the role of consumer behaviour in the circular economy to reduce food waste and identify alternatives to encourage consumers' contribution to the subject. The study is focused on Singapore, where the high population density and limited resources make the Circular Economy a key tool for reducing waste, improving resource management, and enhancing resource usage.

Design: First, an extensive literature review was conducted to get insights on food waste, consumer behaviour, and the circular economy. Secondly, a comprehensive survey questionnaire was created and distributed via social media platforms to collect qualitative and quantitative data from potential respondents. The collected data was categorised by relevant topics and analysed using descriptive statistics. Based on findings, key recommendations are made.

Findings: Results indicate that Singapore residents are conscious of the impacts of food waste and are willing to take steps to reduce it. However, gaps in knowledge and practical approaches to achieving this goal were also identified. Raising awareness, encouraging appropriate behaviour, enabling sustainable behaviour, and collaborating with stakeholders are strategies proposed and discussed in this study to influence consumer behaviour towards the circular food supply chain in Singapore.

Research limitations: By increasing the pool of respondents and gathering target data for each recommendation presented, a detailed framework for measuring the impact of consumer behaviour and creating targeted measures in the local and international context could be outlined. Perspectives from other stakeholders in the food supply chain may also be explored in future studies.

Practical implications: By understanding the impact of consumer behaviour on the circular economy, policymakers and industry stakeholders can develop more targeted and effective strategies to reduce food waste and promote the adoption of circular economy principles. Identifying gaps in existing measures also presents an opportunity to refine current approaches and achieve better outcomes.

Value: Amidst the current push by several companies, consumers, and authorities to improve sustainability and optimise resource utilisation, this study presents insights on how the circular food supply chain can be leveraged towards these goals.

Keywords: Circular Economy, Consumer Behaviour, Food Waste Reduction, Resource Management, Singapore

Introduction

In the Circular Economy, the supply chain model operates differently from the traditional linear supply chain. Rather than following the "Take, Make, Use, and Throw" strategy, the circular supply chain model follows a "Make, Use, Recycle or Reuse" strategy. In this latest model, the aim is to reduce waste and generate added value for products reaching the end of their useful life, this is achieved by reusing or recycling the materials and reintegrating them into the production cycle (De Angelis et al., 2018; Lavelli, 2021). A circular supply chain model in the food industry enables food waste to be recycled or repurposed, creating new value within the supply chain (Kabadurmus et al., 2022). Globally, different industries, consumers, and authorities are pursuing sustainability and optimised resource utilisation, with many adopting a circular strategy (Zhou et al., 2023; Rojas Lopez and Loh, 2023; MEWR & NEA, 2020; Gu, et al. 2020). This study, which focuses on Singapore, presents insights into how the circular food supply chain can be leveraged towards these goals and what could be the role of consumer behaviour and existing policies in the process.

Singapore has been globally lauded for its economic, urban, logistics and transport developments (LTA, 2019; Rojas Lopez et al., 2020). However, there is still room for improvement in the area of food waste

management. Food waste is one of the largest waste streams in the country, the generation has increased by 20% over the last decade. In 2020 and 2021 alone, the amount of food waste generated was 665,000 tonnes and 817,000 tonnes (23% increase), respectively, with a recycling rate of only 19% on average (Grandhi & Appaiah Singh, 2016; MEWR & NEA, 2020; Siow & Lee, 2020). Hence, there is a need to prioritise sustainability while balancing economic development and consumption needs, it is important to prioritise. By implementing a circular food supply chain, Singapore could not only reduce the waste sent to the landfill (hence reducing greenhouse emission and promoting environmental sustainability), but also strengthens food security and maximise overall usage of resources (NEA, 2023; Rezvani Ghomi et al., 2021).

Despite the growing interest in food waste in Singapore among both authorities and the public (consumers), research publications on the topic have not kept up with this trend, let alone on the overall circular food supply chain. Singapore recognises the importance of implementing a circular economy model to reduce waste generation, enhance resource management, and optimise resource usage (NEA, 2023). Research has indicated that sustainability transition is a collective effort of society (Rut et al., 2020). While transitioning towards a circular economy presents novel ways to generate value through various circular offerings, not all consumers have embraced circular behaviour in their consumption patterns (Chai et al., 2023; Rut et al., 2020). Understanding how consumer behaviour fits into the circular food supply chain, as aimed in this study, can help with the implementation of a top-down approach.

This study is a preliminary study that reviews existing policies or strategies in Singapore from the consumer perspective. Based on findings, suggestions for the government and private organisations to refine existing policies and/or develop targeted strategies enabling circular behaviour among consumers for better outcomes are proposed. The remainder of this manuscript is organised as follows, an overview of the Singapore context is provided next, including some of the current food waste management practices. Then, the methodology for data collection on consumer behaviour is outlined, followed by the presentation of the main results and discussion. Some concluding remarks, including study limitations and possible directions for future research, finalise the manuscript.

The Singapore Context

Located in Southeast Asia, Singapore is a densely populated island country with a strong economy (DoS, 2022). Considering its limited land and resources, sustainability is a key focus for the country. The government has implemented initiatives to promote sustainability, such as efficient public transport, emission reduction approaches, and providing green areas (CLC, 2020, 2021). Singapore also aims to improve residents' digital literacy, making technology more accessible, and embracing a myriad of digital tools to become a Smart Nation. Technological developments can be seen in finance, healthcare, supply chain, and transport, among other areas, with the main goal of enhancing city efficiency and improving quality of life (SmartNation, 2023). At the same time, the government is also promoting social activities to increase liveability and to foster social support and cohesion – locally referred to as “the kampong spirit” (OurSG, 2022).

High-rise buildings characterise Singapore's landscape, several being residential (Rojas Lopez et al., 2020). These buildings are equipped with common trash chutes where households dispose of food and general waste. Research has indicated that the convenience and simplicity of disposing food waste may decrease each household's responsibility in managing food waste, and consumers might take this convenience for granted instead of actively doing their part to help reduce food waste (Low & Chen, 2023). In contrast, countries like Taiwan and South Korea, implement a pay-as-you-throw system. This system requires consumers to pay for the total waste that they dispose, and this has helped to reduce overall waste. Other research as indicated that Singapore faces major challenges related to the mismatch in supplies and demand for food consumption as well as inefficient inventory management at households, food providers, and retailers' level (Kabadurmus et al., 2022; Siow & Lee, 2020).

The majority of the waste produced at country level, including food waste, is incinerated at Pulau Semakau, the only offshore landfill in Singapore. The process reduces the volume of waste by about 90% and energy is recovered for electricity generation. Noticing that the landfilled is expected to reach total capacity by 2035 (Rezvani Ghomi et al., 2021) and the high amounts of food waste generated, a circular economy approach or a circular food supply chain is critical for the country's long-term subsistence. Herein, active steps have been taken by authorities, including the plan to achieve zero waste by 2030. As such, Singapore could also better optimise the usage of their limited resources and prevent future scarcity (Low & Chen, 2023; MEWR & NEA, 2020; NEA, 2023). In the country, The National Environment Agency (NEA) is a statutory board that oversees environmental-related measures and policies. The National Environmental Agency (NEA) has introduced a hierarchy of four different food waste management approaches as illustrated in Figure 1.



Figure 1: NEA Food Waste Management Hierarchy (adapted from MEWR & NEA, 2020).

The NEA food waste management approach targets stakeholders who commonly generate much food waste and can thus play a crucial role in enhancing the circular food supply chain. The top level of the hierarchy focuses on raising public awareness through education and outreach while encouraging Singaporeans to adopt healthy behaviours that minimise waste. The objective of this technique is to decrease food waste by using consumers. This is accomplished by implementing programs such as the Food Waste Reduction Outreach Program, which provides consumers with a recipe book with advice on food preservation. To encourage other consumers to reduce food waste, the NEA also trains ambassadors for the cause. At the second level, the aim is to encourage consumers and organisations to donate excess food to food distribution organisations and food banks. For this, NEA facilitates by providing guidelines to help consumers donate food responsibly. At the third level, unavoidable food waste is aimed to be reused. This is encouraged at a household level, as well as hawker centres, hotels, schools, and shopping centres. Waste is converted into compost, which is used mainly for compost. The fourth or lower level depicts the traditional or most often used approach in Singapore previously described, where energy is recovered from food waste through incineration.

This focus is not surprising, although food waste is common across the whole supply chain, much of it is generated by consumers, households, and restaurants, and here are plenty of opportunities to implement circular strategies and improve the overall food supply chain (Lavelli, 2021; Rut et al., 2020). Figure 2 depicts a linear food supply chain in Singapore, indicating in red the stakeholders mentioned. Besides these four level approaches, other alternatives or options that can help to close the loop on the food supply chain include developing and implementing on-site systems to treat food waste, building research & development (R&D) capabilities to test recycling innovation (e.g., using soya bean waste into useful food chain products), and legislations to require large industrial and commercial food waste generators to segregate their food waste for treatment and for developers to provide space for treating food waste on-site at new developments (MSE, 2023).

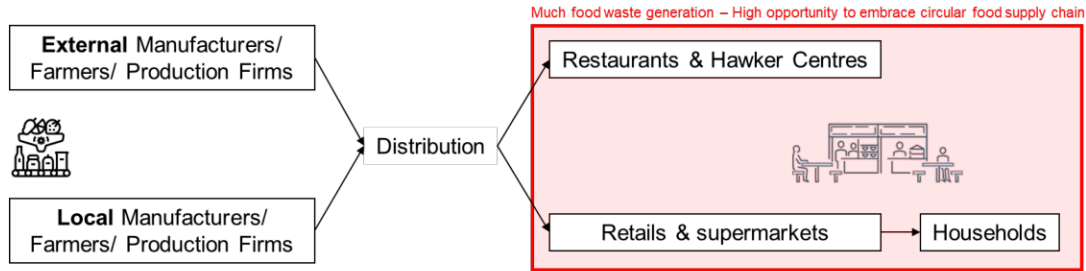


Figure 2: Linear Food Supply Chain in Singapore with Potential Areas of Waste/Improvement.

Data Collection

Data was collected through an online survey consisting of a combination of multiple-choice, ranking, and open-ended questions. The survey questionnaire was designed considering the online data collection approach and was thus kept simple and easy to complete. Questions were set based on information from the literature review and aimed to understand the role of consumer behaviour in the circular food supply chain and food waste management. The (possible) adoption of sustainability measures were also considered. The survey included questions aimed at evaluating the possible effectiveness and/or limitations of current measures to manage and reduce food waste in Singapore. Additionally, demographic information was collected from the respondents.

At this preliminary stage of the study, a chain-referral sampling approach was used, whereby the survey link was disseminated to the authors' personal and business contacts through messaging platforms and social media channels. After data cleaning and organisation, a total of 74 complete survey responses were used to analyse data for this study. Descriptive statistics are used to illustrate quantitative data. Qualitative data was organised by common themes. The data facilitated the identification of relationships between consumer behaviour and the circular economy principles, and it was discussed in relationship with existing measures. Based on identified gaps, possible (more targeted and effective) strategies to reduce food waste and promote a circular economy are proposed.

Results and Discussion

Out of the total 74 responses analysed, the gender distribution was almost equal, with close to 50% of the respondents being male and female. Nearly half the respondents (35 or 47%) were between 25 and 34 years of age, one young participant reported to be less than 16 years old (1%) and two participants were between 55 and 64 years of age (3%). At the time of the survey, three in five respondents (64%) held a university degree, and in slightly over one in five (20%) households, the average combined monthly income was reported to be more than 15,000 SGD or approx. 11,130 USD. Overall respondents' demographics are presented in Table 1. The group of respondents presents a good representation across various demographics. It comprised of individuals who, through their education, have been exposed to awareness of recycling, and also members from the older generation who offer varied perspectives. In terms of gender distribution, the group is also well-balanced. This comprehensive mix of respondents helps ensure a multidimensional understanding of the topic and provides perspectives from a spectrum of educational backgrounds, income levels and age. Based on responses and taking into consideration existing measures, some possible strategies are presented. The strategies are focused on raising awareness, encouraging and enabling sustainable behaviour, and collaborating with stakeholders. Being the main objective to influence consumers' behaviour and work towards improving the circular food supply chain in Singapore. These are explained in detail following the related findings.

Table 1. Survey Respondents' Demographics.

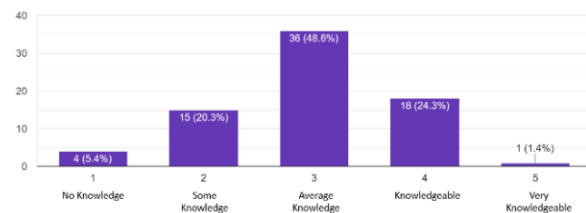
Age	Respondents (%)	Gender	Respondents (%)
Under 16 years	1 (1%)	Male	39 (53%)
16-24 years	22 (30%)	Female	33 (45%)
25-34 years	35 (47%)	Prefer not to say	2 (2%)
35-44 years	4 (5%)		
45-54 years	10 (14%)		
55-64 years	2 (3%)		

Highest Education Level	Respondents (%)	Average combined monthly household income (SGD)*	Respondents (%)
Primary School	1 (1%)	Less than 3,000	9 (12%)
Secondary School (A-levels)	2 (3%)	3,000 to 4,999	15 (20%)
Diploma	18 (24%)	5,000 to 6,999	9 (12%)
University Degree	47 (64%)	7,000 to 8,999	12 (16%)
Masters	6 (8%)	9,000 to 10,999	6 (8%)
		11,000 to 12,999	3 (4%)
		13,000 to 14,999	3 (4%)
		More than 15,000	17 (24%)

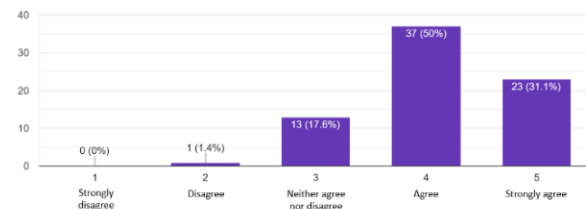
* 1 SGD = Approx. 0.74 USD

Respondents were asked about their perceptions of their own knowledge regarding food waste in Singapore and their actions towards it using five points scale questions as shown in Figure 3. Most respondents (36 or 49%) reported having only an average understanding of the food wastage situation in Singapore. This indicates a potential gap that could be targeted with strategies focused on education to increase knowledge on the subject. They were also asked about their perception regarding food waste as a major/worrying issue in Singapore. In general, most respondents agreed or strongly agreed with it, with 50% (37) and 31% (21) responses, respectively. Furthermore, they were asked about their view or actions on aiming to reduce their own food wastage. A total of 34 respondents (46%) reported being very active in aiming to reduce it. However, when asked regarding how easy they find it to do so, the same number (34 respondents or 46%) presented a neutral answer, neither agreeing nor disagreeing with finding it easy. These responses indicate that while respondents are willing and actively taking action towards reducing food waste, more can be done to facilitate the process.

How much do you know about food wastage in Singapore?
74 responses



Do you think that food waste in Singapore is a major issue?
74 responses



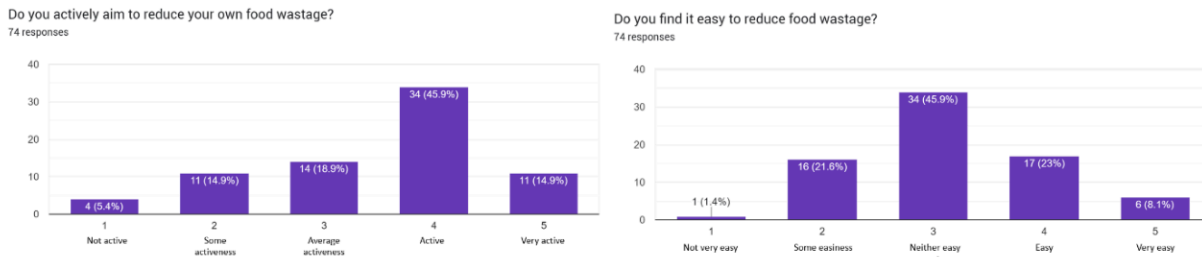


Figure 3. Perceptions of Knowledge and Actions Taken Regarding Food Waste.

Raising awareness can help overall consumers better know how to manage and reduce food waste. It is important for existing educational campaigns to be reviewed to bridge the gap in knowledge identified. Campaigns should be made appealing to the audience and possibly reflect local trends. Trends can help consumers to identify their role in the circular food supply chain, and this awareness could result in them becoming more mindful of their consumption and food waste habits. Leveraging Singapore’s high internet access and tech-savvy population (DoS, 2022), Campaigns can be conducted through various social media channels, messaging platforms, or even dedicated apps. To reach a diverse audience, educational events at schools and organisations, as well as community outreach and engagement can also be considered. Being the aim to inform the public about the magnitude of the food waste issue in the country, its environmental and social impacts, and practical tips on reducing waste at home, during shopping, and dining out hence closing the supply chain loop.

Noticing that respondents consider being active in reducing their food waste, but the easiness of doing so is perceived at an average level, strategies to enable sustainable behaviour by improving the infrastructure and providing incentives to facilitate food waste reduction should be considered. In line with Singapore’s efforts to become a smart nation and relying on its digital society (SmartNation, 2023), this could be achieved using innovative technology, such as smart refrigerators or meal-planning apps. Furthermore, promoting social/communal activities in residential areas like establishing edible community gardens and composting can also be considered. These would not only facilitate a circular food supply chain, but can contribute towards the kampung spirit of the country. Eventually, a more sustainable food system can be generated with the reduction in the environmental impact of food waste disposal.

In the survey, to identify the factors influencing the behaviour of respondents when buying groceries and food, they were asked to indicate ALL the factors/options they consider applicable from a list. In addition, they were also asked to indicate which of the selected factors is, in their view, the MOST IMPORTANT factor taken into consideration. The list of factors contained a total of 7 factors that were determined from the literature review and an “others” option as an open-ended answer for respondents to add any other factor they consider relevant. When purchasing food and groceries, the majority of respondents reported considering five key factors: Price, Flavour/Taste, Ingredients, Serving size, and Brand. It is noteworthy that, an equal number of respondents rated Flavour/Taste, Ingredients, and Serving size as important. Interestingly, upon analysing the responses regarding the factor of utmost importance, the majority of participants chose Price, Flavour/Taste, and Ingredients as their top choices. Only a few individuals selected the other available options, as indicated in Figure 4.

Note: the list was not presented in the above order in the survey, but instead in aleatory order was used for each response

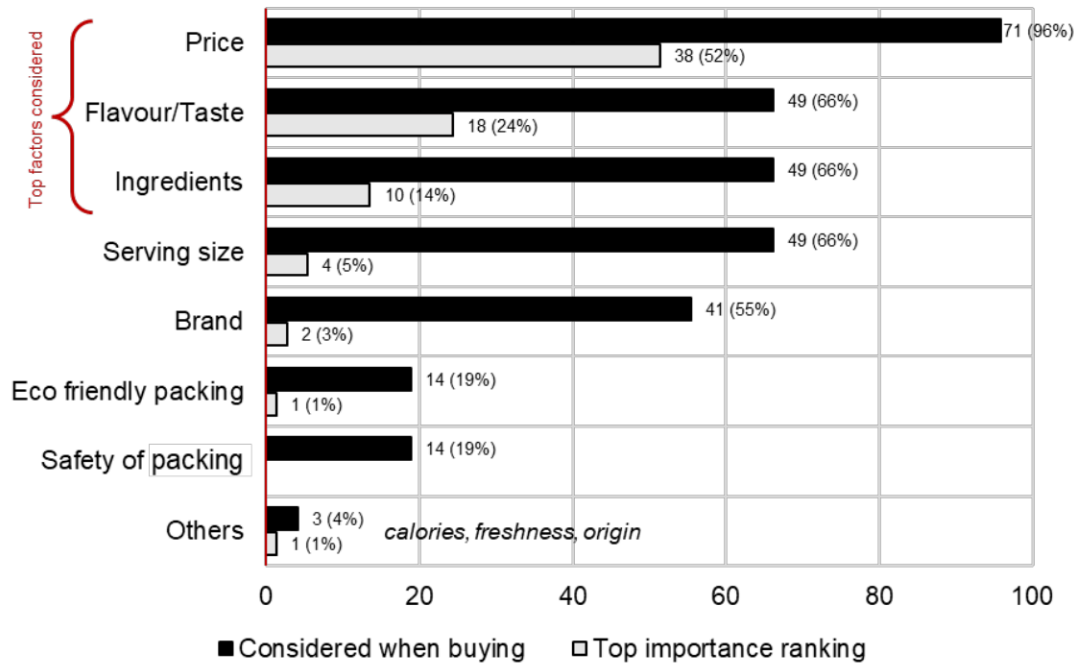


Figure 4. Factors Influencing Shopping Behaviour.

It is important to consider the mentioned shopping habits or factors that consumers value in the food waste management strategies, as this could help to enhance engagement and hence greater adoption of sustainable practices in reducing food waste. For example, in view that respondents (as consumers) prioritise price and flavour in their purchasing decisions, campaigns can highlight how reducing food waste can lead to cost savings and emphasize the support of flavourful sustainable brands. The strategies can consider include simple tips on meal planning (ingredients), portion control (serving size), and overall smart shopping choices. This can make the strategies relatable and actionable. Overall, it has been found that when consumers demand sustainable options and disposal alternatives (e.g. easy to compost food in case of any leftovers), organisations are motivated to adopt sustainable practices as well (Kabadurmus et al., 2022; Rut et al., 2020). This, in the longer term, can foster a collective responsibility and generate a better-informed society that makes positive decisions to improve the circular food supply chain.

The existing NEA Food Waste Management Hierarchy was presented to survey respondents, and they were asked to rank the strategies based on the frequency with which they implement it/them. A maximum of 4 points was assigned to the most commonly implemented strategy and 1 point to the least commonly implemented strategy. Interestingly, strategies across all 4 levels received a similar rating, with a grand average of 2.46 points. Respondents most commonly implement the top level of the pyramid strategy that focuses on “reducing food waste at the source” (average 2.55 points) and is related to education and increased awareness of food waste. The next frequently implemented strategy was reported to be “recycling food waste” (average 2.54 points), followed by “disposing of excess food” (average 2.43 points) – which is then recovered for energy, a strategy that is at the lowest level of NEA’s hierarchy. The least frequently adopted strategy was reported to be “donating excess food” (average 2.31 points). Herein, upon further review of the NEA website, it was noted that contact details of food distribution organisations and food banks are presented on the website. However, there is no address provided, and these are not categorised by location/region (NEA, 2023). Hence, this could be an indication that it is difficult for consumers to locate the closest organisation/food bank hindering food donation.

As part of the survey, respondents were also asked how they deal with excess perishable and non-perishable food, overall responses are summarised in Table 2. For excess (or left-over) perishable food, a large majority of respondents (49 respondents or 66%) indicated that they would keep it for the near future. Around one in four respondents (21 or 29%) indicated that they would discard the food, and a minority (4 respondents or 5% indicated that they would reuse the food for other purposes. The options of “sharing the food with friends or neighbours” and “donating it to food banks/less fortunate” were also presented. Interestingly, however, no respondents selected this option. This could be related to either food safety concerns, or to the mindset that sees sharing cooked food excess or leftovers as rude, which is often observed in the Asian culture. On the other hand, related to excess non-perishable food, it was also observed that most respondents (43 or 58%) indicated they would discard excess non-perishable food. This is an interesting observation, as excess non-perishable food could still be fit for consumption. For this category, sharing and donating were more selected as compared to excess perishable food with 11 (15%) and 9 (12%) respondents indicating it, respectively. Additionally, 10 respondents (14%) indicated that they keep the food for use in the near future. Similar to perishable food, a minority – in this case 1 respondent (1%), indicated that they reuse it for other purposes.

Table 2. Actions Taken on Excess/Leftover Food.

What do you do with excess/leftover food?	Perishable Respondents (%)	Non-perishable Respondents (%)
Discard	49 (66%)	43 (58%)
Share it with friends/neighbours	0	11 (15%)
Donate it to food banks/less fortunate	0	9 (12%)
Keep it for the near future	21 (29%)	10 (14%)
Reuse for other purposes	4 (5%)	1 (1%)

The reduced adoption of food donation strategies, especially for perishable food excess/leftovers, can be related to the inconvenience of locating (or accessing) food banks and food distribution organisations. One recommendation is to have a centralised portal providing detailed information on food distribution organisations, mainly on how to access them. In complement, collaborations between retailers, non-profit organisations, and government agencies can be leveraged to develop systems to collect and redistribute excess/leftover perishable and non-perishable food. This may include setting up accessible collection points for consumers (e.g. at supermarkets, food courts, and/or hawker centres) and partnering with delivery platforms to facilitate the distribution of excess/leftover food. Moreover, while the attitude towards and receiving food donations remains to be fully explored, it is important to showcase the potential benefits of sharing and donating food. Not only to collaborate with less fortunate individuals but also as an environmentally sustainable practice. An important consideration is to address misconceptions related to food safety concerns and cultural norms surrounding sharing cooked food excess. Community fridges and food-sharing platforms, coupled with success stories and positive impacts of food donation and food waste reduction efforts can motivate individuals to take action. These strategies can help Singapore to establish a more sustainable and efficient food circular supply chain with great community involvement.

Incentives and/or penalties could also be used to manage food waste, these might have a high impact considering that many respondents indicated price as the main factor considered with buying food. It is important for government agencies and organisations with thriving circular food supply chains to get involved in developing guidelines for incentives and penalties. This can ensure an ethical implementation, information tracking, exchanges of best practices and facilitation of peer-to-peer learning in the industry. Incentives can be considered for individuals/ households who donate and/or reuse excess food/leftovers. These may be provided in the form of rebates that has a direct impact on consumers’ everyday lives and funding or support for organisations. On the other hand, penalties could be imposed on those with excess food waste generated. Herein, technology could be leveraged, for instance, the amount generated could be

tracked using tech-enhanced trash chutes. Noticing that implementing technological infrastructure can take time and cost considerations must be considered against the potential benefits.

Finally, while most of the above-mentioned strategies are mostly targeting individuals, different stakeholders must be involved and participate actively in their implementation. Authorities, supermarkets, restaurants, hawker centres, NGOs, and logistics companies play a crucial role. For instance, supermarkets can promote the sale of "imperfect" produce at discounted prices or using biodegradable packing, or food shops can offer smaller portion sizes, takeaway, and "doggy bag" options to help reduce overall food waste along the supply chain. An accessible and user-friendly platform can also help the dialogue and cooperation among various stakeholders involved in food waste management. Specialised task forces can also be created to assist in overseeing circular food supply chain undertakes and to establish specific guidelines to do so. Businesses may collaborate with research institutes to leverage technology and develop novel methods of creating waste-derived products and apply them to the industry. These strategies, among others, can aid Singapore in its quest to improve the circular food supply chain, reduce food waste, and foster a more sustainable and responsible food culture in the community.

Conclusion

This exploratory study has helped to shed light on consumers' knowledge and the role of their behaviour in the circular economy to reduce food waste. Based on the Singapore context, a survey was conducted. Responses were used to understand views on the food waste management situation in the country, consumer behaviour when grocery/food shopping, views and usage of current measures related to food waste management, and the most common approaches when dealing with excess/leftover food. Findings were used to point possible alternatives to encourage consumers' positive contribution to food waste management and the overall circular food supply chain.

Overall, respondents present a positive attitude towards working on reducing their own food waste, however, they admit to having only an average knowledge of the issue in the country. Price was the most commonly considered factor when shopping for groceries/food, followed by flavour/taste, and ingredients. Regarding the existing NEA Food Waste Management Hierarchy, most respondents indicated taking actions related to the top of the pyramid that can be related to education and awareness and the least frequently adopted strategy was reported to be donating excess food. This was again reflected in respondents' answers for actions to deal with excess/leftover food, where a minority or no respondents mentioned sharing or donating non-perishable or perishable food, respectively. The most common approach for dealing with excess/leftover food was to discard it. The suggested strategies for food waste management and towards a circular food supply chain were in line with these findings.

It is proposed to raise awareness and knowledge on the topic through educational campaigns that clearly indicate the role that individuals play in it and some local trends. The utilisation of digital platforms that align with Singapore's digital advancements is suggested. This will aid to inform a broad public about the magnitude of the food waste issue and offer practical tips for minimising it. Strategies enabling sustainable behaviour through facilitation of the sharing/donation process, incentives/penalties, infrastructural, and technological solutions to facilitate food waste reduction are also presented. Some of these include smart refrigerators, tech-enhanced trash chutes, and meal-planning apps. Understanding that there are several players in the food supply chain, some collaboration strategies among the different stakeholders are presented. This collaboration is crucial for Singapore to towards an efficient and sustainable circular food supply chain.

While the current study provides valuable insights into consumer behaviour in the circular food supply chain in Singapore, there are certain limitations that should be acknowledged and that will be addressed in future research. First, the sample size might not be fully representative of the diverse population in Singapore due to the chain-referral sampling approach used and this will be addressed by expanding the sample size to different segments of the population. Second, the study focused on consumer behaviour in general, without

much differentiation on occasions, types of food, or types of food waste. Each of these might represent distinct challenges for circular practices. Future research can delve deeper to present tailored strategies addressing the unique characteristics associated with each category. Finally, the main focus of the study was on consumer behaviour in Singapore and other areas where food waste is generated in the supply chain were not investigated at this stage. A holistic approach encompassing all different – and possibly international – areas can be considered further on for a more comprehensive picture of a circular food supply chain.

References

- Chai, G., Bte Abu Bakar, K. N., Lee, S., & Bajaj, T. (2023). Waste not, Want not: Understanding Online Public Concerns Toward Foodwaste Reduction in Singapore. Lee Kuan Yew Centre for Innovative Cities. <https://lkycic.sutd.edu.sg/blog/waste-not-want-not/>
- CLC. (2020). Enhancing Liveability, Fostering Communities: Estate Management for Singapore's Public Housing. Centre for Liveable Cities, Singapore. <https://www.clc.gov.sg/research-publications/publications/urban-systems-studies/view/enhancing-liveability-fostering-communities-estate-management-for-singapore-public-housing>
- CLC. (2021). Transport: Overcoming Constraints, Sustaining Mobility. Centre for Liveable Cities, Singapore. [https://www.clc.gov.sg/research-publications/publications/urban-systems-studies/view/transport-overcoming-constraints-sustaining-mobility-\(revised\)](https://www.clc.gov.sg/research-publications/publications/urban-systems-studies/view/transport-overcoming-constraints-sustaining-mobility-(revised))
- De Angelis, R., Howard, M., & Miemczyk, J. (2018). Supply Chain Management and the Circular Economy: Towards the Circular Supply Chain. *Production Planning & Control*, 29(6), 425–437. <https://doi.org/10.1080/09537287.2018.1449244>
- Grandhi, B., & Appaiah Singh, J. (2016). What a Waste! A Study of Food Wastage Behavior in Singapore. *Journal of Food Products Marketing*, 22(4). <https://doi.org/10.1080/10454446.2014.885863>
- Gu, Y., Loh, H. S., & Yap, W. Y. (2020). Sustainable port-hinterland intermodal development: Opportunities and challenges for China and India. *Journal of Infrastructure, Policy and Development*, 4(2), 228–248. <http://dx.doi.org/10.24294/jipd.v4i2.1227>
- Kabadurmus, O., Kazançoğlu, Y., Yüksel, D., & Pala, M. Ö. (2022). A Circular Food Supply Chain Network Model to Reduce Food Waste. *Annals of Operations Research*. <https://doi.org/10.1007/s10479-022-04728-x>
- Lavelli, V. (2021). Circular Food Supply Chains – Impact on Value Addition and Safety. In *Trends in Food Science and Technology* (Vol. 114). <https://doi.org/10.1016/j.tifs.2021.06.008>
- Low, C., & Chen, J. (2023). Food Waste Management in Singapore: Envisioning the Possibilities of a Zero Waste Nation. Lee Kuan Yew Centre for Innovative Cities. <https://lkycic.sutd.edu.sg/blog/food-waste-management-singapore-envisioning-possibilities-zero-waste-nation/>
- LTA. (2019). Land Transport Master Plan 2040. Land Transport Authority, Singapore. <https://www.lta.gov.sg/ltmp2040>
- MEWR, & NEA. (2020). Zero Waste Masterplan Singapore. Ministry of the Environment and Water Resources (MEWR), Singapore and National Environment Agency (NEA), Singapore. <https://www.towardszerowaste.gov.sg/zero-waste-masterplan/>
- MSE. (2023). Food Waste. Ministry of Sustainability and the Environment (MSE), Singapore - Towards Zero Waste. <https://www.towardszerowaste.gov.sg/foodwaste/#:~:text=What%20is%20the%20government%20doing%3F,-Minimising%20food%20wastage&text=Ongoing%20food%20waste%20reduction%20publicity,the%20to%20minimise%20food%20wastage.>
- NEA. (2023). Food Waste Management. National Environment Agency (NEA), Singapore. <https://www.nea.gov.sg/our-services/waste-management/3r-programmes-and-resources/food-waste-management#:~:text=The%20total%20amount%20of%20food,remained%20at%2019%20per%20cent.>

- OurSG. (2022). Rekindling the Kampung Spirit with Technology. Our SG - Singapore Together. <https://www.sg/stories/sgkampung>
- DoS. (2022). Population Trends 2022. Department of Statistics, Ministry of Trade & Industry, Republic of Singapore. <https://www.singstat.gov.sg/publications/population/population-trends>
- Rezvani Ghomi, E., Khosravi, F., Tahavori, M. A., & Ramakrishna, S. (2021). Circular Economy: a Comparison Between the Case of Singapore and France. *Materials Circular Economy*, 3(1). <https://doi.org/10.1007/s42824-020-00016-w>
- Rojas Lopez, M. C., Toan, T. D., & Wong, Y. D. (2020). Transitioning different stages of transport planning in urban areas: Experiences of Singapore and Vietnam. In *Lecture Notes in Civil Engineering* (Vol. 54). https://doi.org/10.1007/978-981-15-0802-8_152
- Rojas Lopez, M. C. & Loh, H. S. (2023). Last-Mile Delivery Innovations for Parcels Collection in Singapore. *Sustainability, Economics, Innovation, Globalisation and Organisational Psychology (SEIGOP) 2023*.
- Rut, M., Davies, A. R., & Ng, H. (2020). Participating in Food Waste Transitions: Exploring Surplus Food Redistribution in Singapore Through the Ecologies of Participation Framework. *Journal of Environmental Policy and Planning*. <https://doi.org/10.1080/1523908X.2020.1792859>
- Siow, L. G., & Lee, C. C. (2020, September). Singapore's 2030 Zero Waste Masterplan (ZMP): Is it Achievable? *Proceedings of the International Conference on Environmental Science and Applications (ICESA'20)*. <https://doi.org/10.11159/icesa20.125>
- SmartNation. (2023). Pillars of a Smart Nation. Smart Nation Singapore. <https://www.smartnation.gov.sg/about-smart-nation/pillars-of-smart-nation#:~:text=Singapore%20has%20set%20its%20sights,businesses%20live%2C%20work%20and%20play>.
- Zhou, Q., Li, H., & Loh, H. S. (2023). A model for sustainable development of the ship recycling industry: Empirical evidence from China. *Sustainable Development*. (forthcoming) <https://doi.org/10.1002/sd.2647>