

Assessing the Sustainability Impacts of ICT-mediated Surplus Food Sharing in Japan

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This study explores ICT-mediated food sharing platforms solution to reduce food waste and lead larger sustainable impacts in Japan. A case study of 12 food sharing platforms in Japan evaluates the food redistribution efficiency and identified challenges encountered by surplus food suppliers. Quantitative and qualitative data collected from a web-based search and interviews is compiled through the ShareIt framework, highlighting the need to increase systematic reporting on sustainability impacts to encourage consumers' behavioural change. A consumers-side analysis, based on a Japan-wide survey of 10,000 respondents, evidences food safety concerns towards non-traditional food distributors and a lack of awareness on food sharing's sustainability benefits. Price conscious younger to middle-aged individuals are identified as prospective users. Overall, food sharing is seen as an entry point to sustainability.

Key Words : *food loss and waste, surplus food redistribution, food sharing, food supply chain, sustainable impact assessment.*

1. INTRODUCTION

The issue of food loss and waste (FLW) has gathered increasing attention in recent years due to its role in threatening environmental, social and economic sustainability. The colossal 1.3 billion tonnes of food production wasted every year around the world¹⁾ evidences the inherent unsustainability of the current economic and food systems, not only resulting in significant waste of resources but also failing to feed people appropriately, with 820 million people suffering from hunger worldwide²⁾.

The 2015 United Nations Sustainable Development Goals³⁾ highlight the importance of tackling the issue of food waste by setting the target 12.3 of halving food waste at the retail and consumer levels and reducing food loss along the food value chain by 2030. Beyond achieving this sustainable production and consumption goal, tackling food loss and waste presents an entry point to confronting complex systemic causes of unsustainable and inequitable food systems.

Food waste is a particularly critical issue in Japan with regards to its low food self-sufficiency rate as 60% of its food supply is imported, and limited available landfill sites for waste disposal⁴⁾. Discarding approximately 40 percent of its food production, Japan

stands as one of the biggest emitters of food waste per capita in the world⁵⁾. According to the Ministry of Agriculture Forestry and Fisheries⁶⁾, in 2017 Japan generated a total of 25.5 million tons of food waste. Within this amount, 6.12 million tons was estimated to be avoidable and edible.

While the underlying causes and drivers of food losses and waste remain multidimensional, a key factor is the failure to efficiently redistribute surplus food to feed people, or, in dernier ressort, to be recovered to feed animals or create energy. Having a more efficient surplus food management through better distribution and redistribution systems could increase the ability to respond to the global food demand without a further increase in resources use⁷⁾.

Innovative mechanisms based on ICT have gained attention as ways to redistribute or share available surplus food. ICT-mediated food sharing designates any form of “technologically-augmented collective or collaborative practices around growing, cooking, eating and redistributing food”, according to MacKenzie and Davies⁸⁾. The use of ICT was rapidly integrated into longstanding food redistribution organisations and spurred the development of independent initiatives, as it allows the immediate identification of offers and needs of surplus food, and provides an

efficient way to build trust among the sharing community through reputation building and fraud prevention mechanisms⁹⁾⁽¹⁰⁾. In recent years, several mobile applications and other web-based food sharing initiatives attempting to reduce food waste have emerged globally. This trend has been closely followed in Japan.

The aim of this study is to provide an assessment of a potential bridging practice presented by ICT-mediated surplus food sharing. The present study will examine the potential solution presented by ICT-mediated surplus food redistribution from the national level – encompassing the entire food supply chain (FSC) –, to the consumers level and their attitudes towards the practice. The first section of this paper reviews literature related to food loss and waste across the food supply chain and the sharing economy. Then, the second section draws from a case-study of twelve food sharing platforms operating in Japan to include the Japanese experience into a pre-existing global typology. The third section explores and assesses the sustainability aspects of food sharing initiatives available in Japan. Finally, attitudes and behaviours around food waste and surplus food in Japan are discussed.

2. IMPACTS, DRIVERS, OBSTACLES OF FOOD-SHARING INITIATIVES

ICT-mediated food sharing is associated with various sustainability claims such as environmental improvements through waste reduction, economic benefits, and the development of social networks. In theory, the sharing economy facilitates the redistribution of existing resources rather than encouraging the creation of new resources^{11) 12)}. Ciaghi and Villafiorita¹³⁾ consider that applying the sharing economy approach to food distribution and consumption could offer a potential new pathway to sustainability as it may positively impact all three dimensions of sustainable development through increased social relations and savings as well as decreased environmental footprint through reduced waste.

Despite numerous claims of potential sustainability benefits brought by ICT-mediated sharing, there is a lack of empirical data evidencing their efficiency in achieving more sustainable production and consumption, especially in the area of food sharing¹⁴⁾.

Fisher¹⁵⁾ raises his concerns over the fact that redistribution of surplus food can perpetuate rather restructure unsustainable food systems. Nevertheless, Weymes and Davies¹⁶⁾ argue that the heightened awareness around food wastage resulting from the rising popularity of such initiatives might translate into a change of behaviour. While raising awareness

is admittedly not the sole factor in initiating a behavioural transition, it remains a key part of a sustainable transition.

Schanes & Stagi¹⁷⁾ evidences that food sharing can be motivated by either or both moral considerations and the economic benefit of having access to discounted or free food. Rombach and Bitschb¹⁸⁾, in their investigation of various food movement members (slow food, food sharing, dumpster-diving) in Germany, show that anti-consumerism convictions and strong awareness on food waste usually constitutes key motivations to participate in such alternative food movements.

Nonetheless, economic, infrastructural and legal constraints might present obstacles to an efficient redistribution^{19) 20)}. Donors might also not want to draw attention to the amount of surplus food they emit, which could be seen as sign of inefficiency²¹⁾. On the consumers-side, Cappellini²²⁾ highlights that food surplus tends to be perceived by many customers as unsafe and “as food that has lost its original qualities and aura”.

Much of the studies undertaken by other researchers on food-sharing mechanisms are comparative in nature by analysing the various food-sharing ICT initiatives identified globally or over specific countries or regions^{12) 13) 14) 23)}. Davies and Legg¹⁴⁾ developed a database of urban food sharing initiatives. A total of 492 initiatives identified twenty-seven countries where mapped. A high concentration of food sharing initiatives was observed in English-speaking and Western cities such as London, Vancouver, and Toronto. This highlights the need to conduct more in-depth research in native languages to identify food sharing activities in South America, Asia, and Africa.

This variety of comparative analysis offers a much-needed basis of empirical data on ICT-based food sharing initiatives and develops a comprehensive approach to categorising the collected data. Nevertheless, most of these studies fail to include the Japanese experience. As a result, providing empirical data on the Japanese case could offer a broader understanding of food waste sharing and bridge the current gap in the literature.

3. ICT-MEDIATED FOOD SHARING INITIATIVES OPERATING IN JAPAN AND DEVELOPMENT OF A TYPOLOGY

(1) Typology of food sharing platforms operating in Japan

A representative dataset of surplus food matching platforms available in Japan at the time of the investigation (October 2019- January 2020) was built

through a snowball approach. A web-based search with relevant keywords (“food sharing”, “food loss”, “food waste”, or “food waste reduction”) led to the identification of a total of twelve ICT-mediated surplus food redistribution initiatives operating in Japan. A pre-existing typology was applied to the sample to allow the inclusion of the Japanese experience into a global framework and facilitate future comparison. The typology developed by Micheleni et al.¹²⁾ was adapted to the specificities of initiatives operating in Japan (**Table 1**).

The typology revealed the trends of ICT-mediated food sharing platforms available in Japan. Identified food sharing online platforms operating in Japan covered a wide range of stages within the food supply

chain, from the agricultural stage to the consumer stage. The most common surplus food supplier appeared to be the food service sector (four platforms) and the food manufacturing sector (four platforms). This reflects literature suggesting that implementing food waste reduction initiatives is often easier at the manufacturing stage which has the capacity to stock and deliver large amounts of products⁷⁾. On the contrary, attempts to propose Consumer to Consumer (C2C) systems were rare in Japan with only Olio identified, compared with more largely available Business to Consumer (B2C) or Business to Business (B2B) models.

Table 1 Typology of food sharing platforms operating in Japan (adapted from Micheleni et al., 2018)¹²⁾

Platform	Organization profile	Technology	Delivery model	Type of donor	Type of beneficiary	Type of transaction	Sustainable impact	Geographic area
<i>Food passport</i>	For profit	App	B2C	Food service	Consumer	Discount	Waste reduction And social contribution	Local (kanto and kansai)
<i>Furifuru</i>	For profit	Website and app	B2C	Farmer	Consumer	Free	Waste reduction And social contribution	National
<i>Kuradashi</i>	For profit	Website	B2C	Manufacturer	Consumer	Discount	Waste reduction And social contribution	National
<i>Loss zero</i>	For profit	Website	B2C	Manufacturer	Consumer	Discount	Waste reduction And social contribution	National
<i>Olio</i>	For-profit	App	B2C and C2C	All	Consumer	Free	Waste reduction And social contribution	Local (neighbour to neighbour)
<i>Otameshi</i>	For profit	Website	B2C	Manufacturer	Consumer	Discount	Waste reduction And social contribution	National
<i>Rebake</i>	For profit	Website	B2C	Food service	Consumer	Discount	Waste reduction	National
<i>Reduce go</i>	For profit	App	B2C	Food service	Consumer	Discount	Waste reduction And social contribution	Local (tokyo)
<i>Shareshima</i>	For profit	Website	B2B	Manufacturer	Manufacturer	Discount	Waste reduction	National
<i>Tabekifu</i>	For profit	App	B2C	Food service	Consumer	Discount	Waste reduction And social contribution	Local (tokyo)
<i>Tabeloop</i>	For profit	Website	B2B and B2C	Farmer, manufacturer, wholesaler	Food service and consumer	Discount	Waste reduction	National
<i>Tabete</i>	For profit	App	B2C	Food service	Consumer	Discount	Waste reduction	Local (tokyo, kanagawa, saitama)
Total	For profit: 12	App: 6 Website: 5 Website and app: 1	B2C: 9 B2B: 1 B2C: 1 B2C and C2C: 1	Farmer: 1 Manufacturer: 4 Food service: 4 Farmer, manufacturer, wholesaler: 1 All: 1	Consumer: 10 Food service and consumer: 1 Manufacturer: 1	Discount: 10 Free: 2	Waste reduction And social contribution: 8 Waste reduction: 4	National: 8 Local: 5

(2) Identified Barriers to Sustainable Surplus Food Redistribution in Japan

Conducting interviews with six food sharing platforms owners enabled to identify the most common barriers faced by both surplus food suppliers at every stage of the food supply chain. A number of barriers to surplus food redistribution were identified on both the supplier side and the platform side. The most common challenges experienced on the supplier side were the desire to protect the brand by denying any emission of food waste and the lack of trust towards food sharing platforms being mostly start-ups. Many platforms have identified these barriers and adapt to suppliers needs in order to bridge any barriers preventing surplus food redistribution. As a way to protect suppliers' brand image, many platforms allow suppliers to redistribute their products on their platform without any reference to their brand.

Regarding the shame associated with the emission of food waste, all platforms aim to increase awareness on the issue of food waste and loss. Raising awareness and showing the difficulty of not creating any surplus food for business should allow for the blame to be lifted from businesses and rather encourage the matching of surplus food to people in need. Businesses which publicly recognise their food waste emissions and strive to minimise their waste by redistributing their surplus food should be increasingly valued. Larger corporations which were shown to be more hesitant in engaging in food sharing initiatives might also start taking action on the matter after seeing potential corporate social responsibility (CSR) benefits.

The main struggle identified by platform is the lack of active suppliers and users to be able to sustain their activity. The low levels of active engagement from both suppliers and users could be explained by the new behaviour and lifestyle promoted by food sharing platforms. While the idea of food sharing might appeal to many, concretely changing either business routines or lifestyle might be an extra step that many are not ready to make. Furthermore, platforms remain largely reliant on the emission of surplus food resulting from the inherent unsustainability of food supply chains.

4. PLATFORMS' SUSTAINABLE IMPACT BEYOND FOOD WASTE REDUCTION

Various sustainability impact claims were gathered from both interviews and web content analysis evidencing the variety of social, environmental and economic goals pursued by surplus food redistribution initiatives in Japan with outcomes often extend-

ing beyond food waste reduction. While sustainability claims through references to the SDGs and the reduction of food waste were numerous, there was a lack of empirical data to support these claims.

As a way to better evidence and assess sustainable impacts claimed by food sharing initiatives, the gathered claims were subsequently compiled into the below **Table 2**, adapted from the SHAREIT Sustainable Impact Assessment (SIA) Framework developed by Mackenzie & Davies²⁵. The SIA framework aims to evaluate and communicate on the sustainable impacts of surplus food redistribution initiatives by systematically mapping their stated sustainability outcomes in their respective field and identifying appropriate improvement strategies. As food systems connect all three sustainable development pillars and interconnect the 17 SDGs, the Share IT framework captures the variety of sustainability impacts criteria through four sustainability pillars (economics, social, environment and governance) and 36 indicators linked to defined SDGs.

Table 2 Sustainability Impact Assessment on ICT-mediated surplus food sharing platforms (adapted from Davies and Mackenzie, 2019)²⁵

<i>Sustainability pillar</i>	<i>Impact area</i>	<i>Indicators</i>	<i>SDGs impacted</i>
<i>Social</i>	Community integration and sharing	3. Fostering a wider food and sharing culture	9, 11, 17
	Accessibility of food	4. Increased access to and consumption of fruit and vegetables	2, 3, 10
		5. Increased access to and consumption of fresh food	2, 3, 10
	Health and well-being	6. Connecting and creating new support networks within communities	3, 11
		7. Boosting levels of meal sharing	2, 3, 11
		12. Thinking about issues beyond price when buying food	12
	Education and food choices – social	13. Increasing engagement in growing food	11
		14. Increased confidence and participation in cooking	3
		15. Discovery of new fresh foods	3, 10
	Food waste	20. Food waste reduction	11, 12, 13
<i>Environmental</i>	Carbon footprint	21. Reducing the carbon footprint of the food system	12, 13
<i>Economic</i>	Jobs	24. Training and jobs	4, 8, 9, 10
	Affordability of food	25. Fairly paid wrk	8, 9, 10
<i>Governance</i>	Civic engagement	27. Reducing pressure on food budgets	1, 2, 10
		30. Contributing to policy development	16, 17
	Strategic planning	31. Sharing knowledge and good practice	16, 17
		32. Strategic planning and sustainability	17

Note: The original SHAREIT SIA framework containing 36 indicators was simplified into 17 indicators, to match the offers and models of ICT-mediated food sharing initiatives operating in Japan.

As the SHAREIT framework was designed to assess a large variety of food sharing initiatives, its application reveals that many of the criteria could not be met by the initiatives available in Japan, or data could not be collected. Consequently, the framework was simplified into 17 indicators. Compiling initiatives impact data in the framework, evidenced some of the limitations encountered by developing initiatives which often face logistical difficulties when having to gather meaningful quantitative evidence of their impacts. This flexibility conversely resulted in significant limitations in the accuracy of the reported and assessed sustainable impacts.

It was noted that, regarding social impacts, three platforms are fostering a wider food sharing culture by partnering with other similar initiatives to join forces and collaborate on tackling food waste at different levels. Social contribution was also made through charity and food banks donations. However, none of the platforms were proactive in developing a form of support network based around food sharing to increase levels of well-being, communication, and resilience.

As for the reported environmental impacts, while all initiatives claim to reduce the ultimate amounts of food waste, only three of them publicly disclose the amounts of surplus food that were redistributed through their activities and thereby diverted from waste. Further, reductions of carbon emissions and water consumption through food sharing was often claimed as an environmental impact but failed to be systematically reported. This reflects either the lack of transparency on environmental impacts or the lack of capacity to accurately evidence their environmental contribution.

Economic contributions aside from the affordability of food were also limited. However, collected interviews revealed active efforts made by some of the initiatives to fairly pay their suppliers.

In terms of governance impacts, only the two largest initiatives, Kuradashi and Tabete, disclose their participation in consultation processes towards the development of policies related to food waste. What all platforms operating in Japan have in common is their motivation to raise users' awareness on food waste issues, promote food sharing practices, and encourage behavioural change.

Overall, despite the general lack of monitoring on sustainable impacts, investigated platforms were developed with sustainable motivations in mind and desires to communicate on larger issues around food waste and sustainability. Food sharing can therefore be seen as an entry point to sustainability awareness with the long-term aim of behavioural change.

5. CONSUMER SIDE COMPREHENSIVE APPROACH TO ICT-MEDIATED SURPLUS FOOD SHARING

A Japan-wide survey collected 10,000 responses to develop a consumers'-side comprehensive approach. The survey aimed to gain a thorough understanding of the general feelings associated with food waste reduction behaviour and surplus food sharing.

(1) Awareness on Food Loss and Waste Issue

The survey emphasized that it is widely acknowledged that food should not be thrown away, some respondents pointed to the ethical implication of wasting food when others suffer hunger (58%). However, the connection between environmental issues and food waste appeared not to be established, as the lack of landfill space (12%) and the GHG emissions (14%) resulting from food waste were largely not seen as the biggest concerns.

An analysis of the demographic distribution of issues related to food waste reveals that a larger proportion of respondents above 65 years old are generally more concerned with the impacts of food waste (**Figure 1**). On the contrary, male under the age of 35 express comparatively less concern with issues related to food waste (20%). The gendered distribution shows that women in a relatively larger proportion demonstrate bigger concerns regarding food waste issues.

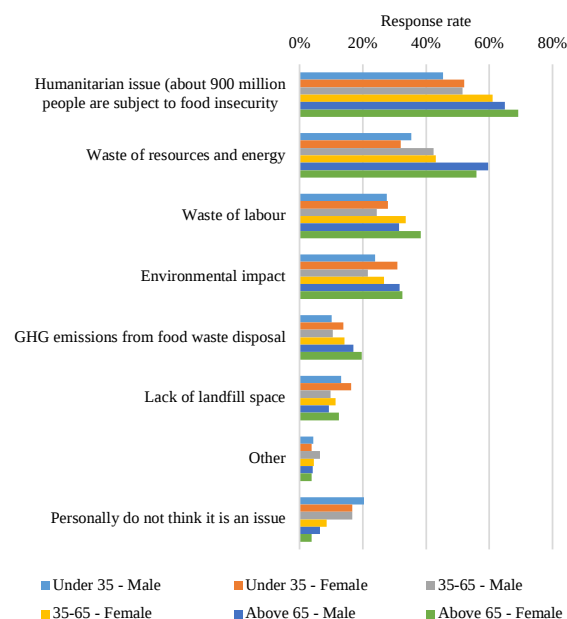


Figure 1 Demographic multi-choice distribution of multiple responses on concerns regarding FLW impacts

(2) Perceptions on Food waste reduction behaviours

Multi-choice responses reveal that the most common way consumers reduce their food waste focuses on prevention through responsible purchase and consumption of purchased food: buying the necessary amount of food (66%), not having left-over food (67%), and eating food past their best-before date (54%). Comparatively, this data highlights the relatively low levels of surplus food redistribution as a food waste reduction mechanism in survey responses: going to supermarkets selling products nearing their best-before or expiration date (22%), purchasing at shops selling surplus food (12%), sharing surplus food within community (11%), donations to food banks (3%) and the use of food sharing applications (2%).

A cross-analysis of age and the precautionary approach to reduce food waste (responsible purchasing and consumption behaviours) showed a predominance of women aged above 65 years old (Figure 2). The responses on the most common food waste reduction behaviours highlighted the focus on prevention behaviours for most respondents. The responses on motivations and barriers in engaging in active food waste reduction behaviours mainly focused around financial and convenience concerns. In order to bridge these potential barriers and appeal to general motivations, food sharing platforms have focused their message on their financial benefits and offered convenient supply options such as delivery or pick up of the surplus food.

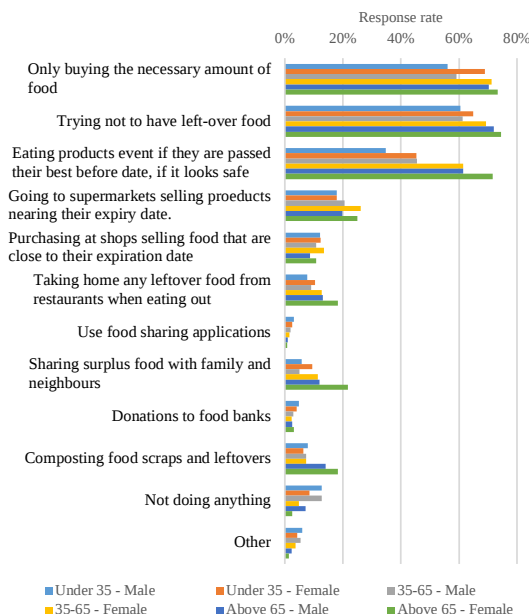


Figure 2 Demographic multi-choice distribution of food waste reduction behaviours

(3) Perception on Surplus Food Redistribution and Food Sharing

Upon enquiry on their knowledge on food sharing, responses reflected a largely low awareness and an associated low interest of the concept (43%). Upon examination of supporting arguments for engaging in food sharing within their neighbourhood, the main factors guiding their purchase of surplus food are: financial savings (65%), and their limited concerns over food safety (60%) (Figure 3). Concerns over food safety (33%) and the unwillingness to engage in a food sharing community (28%) were some of the perceived obstacles to share food (Figure 4).

These findings reflect past research on the general perception of surplus food as food which lost its original qualities and might present safety risks qualities²²). Regarding the sharing community, Farr-Wharton et al.²³) highlight that the preferred sharing space was the community composed of friends and relatives, and that inversely, the lack of social relationships, and associated lack of trust, have negative impacts on the perception of food sharing practices.

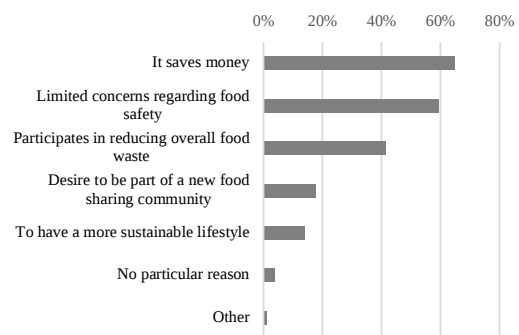


Figure 3 Multi-choice distribution of surplus food sharing determinants

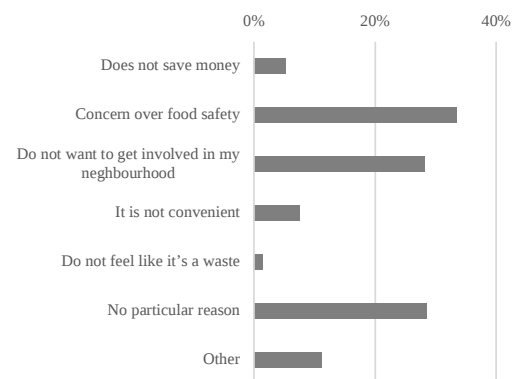


Figure 4 Multi-choice distribution of surplus food sharing barriers

(4) Perception of ICT-mediated food sharing

The understanding gained on food sharing perceptions among the surveyed samples allows to explore the possibilities offered by ICT-mediated food sharing.

First of all, the study focused on identifying the average profile of food sharing platform users. Among previous food sharing platforms users (only around a 100 of them), male under 35 years old was the most common profile. This contradicts the users targeted by platforms which generally aim to attract middle-aged women.

An examination of potential food sharing platform users highlights future expansion opportunities for platforms. Among these respondents interested in the prospect of using food sharing platforms, there is a portion of respondents who are already familiar with other forms of sharing services (3%), including a larger age ratio of individuals under 35 years old (5%), as compared to respondents between 35 and 65 years old (3%), and above 65 years old (2%) (**Figure 5**). The other category of respondents interested in using food sharing services gathered 15% of responses and includes a large proportion of women aged between 35 and 65 years old (4%), followed by men aged between 35 and 65 years old (3%).

Most significant barriers for individuals interested in food sharing are concerns over food safety (40%), and the unwillingness to get involved in a neighbourhood (34%). The obstacle of community socialisation can be overcome by ICT-mediated food sharing services offering a way to match offer and demand of available food with previous or future contact.

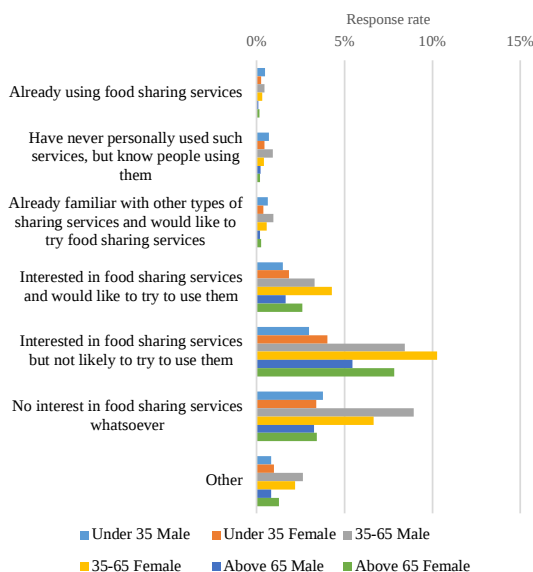


Figure 5 Demographic distribution of level of usage and awareness of ICT-mediated food sharing platforms

A gradual analysis the reported degree of awareness on food waste, attitudes to reduce food waste, perception of food sharing and ICT-mediated food sharing allowed to get a layered understanding of both the level of awareness, motives, concerns and a demographic profile of food sharers and prospective food sharers. Nevertheless, the survey carried limitations in its design as scholars have shown the weak link between attitude, which tends to reflect aspiring behaviour, and lifestyle, especially regarding food²⁶.

6. CONCLUSION

This study provides several initial contributions on the Japanese experience around ICT-mediated food sharing. It explored the potential solution offered by ICT-mediated food sharing to reduce food waste and have larger sustainable impacts. A case study of the efficiency of platforms operating in Japan evidenced that food sharing platforms operating in Japan remain in the process of testing the market and developing their specificity to better adapt to the Japanese demands and expectations. Assessing the extent of sustainability impacts evidenced the future steps to be taken by these initiatives in systematically and transparently reporting their sustainable impacts. The consumer-side investigation confirmed the gap between environmental and social motivations expressed by platforms. Key prospective users' profile identified were young and middle-aged individuals showing price consciousness. Future research should further investigate the development of sustainable implications and opportunities of food sharing in Japan. A future food sharing consumer-side investigation could benefit from a more situational research design rather than an attitudinal and behavioural one which was shown not to always be related.

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