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Ethical consumption and food recovery hierarchy behaviors: a clustering analysis in Japan

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Abstract

Consumption and waste disposal decisions can have a profound impact on the environment. The present research is focused on understanding the adoption profiles of pro-environmental behaviors (PEB) within the Japanese population. The scope of the evaluated PEB covered the purchase, usage, and disposal of food products. Ethical consumption behaviors (the purchase of little packaging, organic, eco-friendly and/or refillable goods), food waste prevention actions (leftovers avoidance, meal planning, and food waste reduction/avoidance), and alternative disposal measures (feeding animals, composting, giving food to neighbors) were analyzed. The profiles were found via a two-step clustering technique using self-reported data from a survey done in nine Japanese prefectures. The first step of the clustering algorithm comprised a hierarchical technique, and the second was a *K-means* with an Euclidean distance. Four significantly distinct clusters were found, namely: sporadic adopters, average practitioners, responsible consumers, and environmentally involved. Approximately 51% of the sample was allocated to the responsible consumers cluster, which was characterized by having more women in part-time jobs or in-house duties and older respondents than the other groups. Environmentally involved tended to be young respondents with children and gardening/farming interest. They were also the ones who ate plant-based meals more frequently and had healthier eating habits.

Keywords Ethical consumption · Food recovery hierarchy · Waste reduction · Pro-environmental behaviors · Clustering · Japan

Introduction

Consumption and waste disposal decisions can have a deep impact on the environment. Organic waste has been consecutively reported as the most common type of household waste (Ueta and Koizumi 2001; Okayama 2016; Yamada et al. 2017) and it is estimated that, every year, around 17% of food produced ends up being wasted by consumers and retailers (Rukikaire and Loran 2022). This has caused countries and international corporations to set goals, indexes, and strategies to tackle such issues (United Nations 2022). Similarly, literature about food waste generation and ways

of preventing it has increased in recent years (Boulet et al. 2021; Attiq et al. 2021; Simões et al. 2022; Nguyen et al. 2022).

Many of these strategies rely on incentivizing the adoption of pro-environmental behaviors (PEB), which are actions that have a neutral or positive impact on the environment (Steg and Vlek 2009). The opportunity of engaging in a PEB happens in several aspects of one's daily life (home life, apparel, food, work) (Kurusu 2015). These aspects can be further divided into more specific categories. For instance, Kurisu (2015) argued that within the food sphere, PEB can occur during the purchase, usage, or disposal stages. Naturally, PEB adoption rate varies from individual to individual.

Previous literature, especially on the marketing field, have looked at the differences in adoption rate from a lifestyle perspective (Plummer 1974; Brunsø et al. 2004, 2021; Savelli et al. 2020; Choi and Feinberg 2021; Aschemann-Witzel et al. 2021; Arenas-Gaitán et al. 2021, 2022). Segmentation using lifestyles can give important clues to the development of marketing strategies (Qing et al. 2012; Savelli et al. 2020;

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Brunso et al. 2021). Lifestyles were considered an umbrella concept that comprised a person's activities, interests, and opinions (Plummer 1974; Savelli et al. 2020; Arenas-Gaitán et al. 2022). Recent studies have further described them as being a cognitive mediator between life values and behaviors (Brunso et al. 2004, 2021; Arenas-Gaitán et al. 2022).

Motivations for and against ethical food consumption have been used to identify people's heterogeneity toward food products (Burke et al. 2014; Huddart Kennedy et al. 2019). Moreover, scholars have looked for food consumption and food waste behavior patterns by accessing purchasing motives, quality aspects, cooking methods, consumption circumstances, and ways of shopping (Brunso et al. 2004; Aschemann-Witzel 2018; Grunert 2019; Aschemann-Witzel et al. 2021; Arenas-Gaitán et al. 2022; Szymkowiak et al. 2022). Brunso et al. (2021) have also proposed a simpler assessment based on three core dimensions: food involvement, food innovativeness, and food responsibility. Besides sustainable food consumption and food waste behavioral nuances (Gaiani et al. 2018; Bravi et al. 2019; Annunziata et al. 2022), scholars have analyzed these behaviors alongside health-related lifestyles (Scalvedi et al. 2018; Savelli et al. 2020). With the exception of Kunszabó et al. (2022), little attention has been given to food waste recycling patterns. While Kurisu and Bortoleto (2011) associated composting with people who follow a Lifestyle of Health and Sustainability (LOHAS), an integrative study covering eating habits and all stages of food consumption (purchase, usage, disposal) from a food waste avoidance perspective has not been done yet. Under the pro-environmental behaviors sphere and specifically in regard to food waste, frameworks like the 3R's (reduce, reuse, and recycle) and the food waste recovery have been used both as research tools (Kurisu and Bortoleto 2011; Diaz-Ruiz et al. 2018; Attiq et al. 2021; Nguyen et al. 2022) and as promotional strategies (Joshi and Visvanathan 2019; Inaba et al. 2022; EPA 2022; Simões et al. 2022).

The novelty of this work resides in its holistic scope. According to the Food Waste Recovery Hierarchy (FWRH) (Papargyropoulou et al. 2014), food consumption, waste prevention, and disposal can be seen as interdependent components which contribute for a more sustainable world with different degrees of preference. Therefore, to gain a better understanding of Japanese consumers' eco-friendly behavior, it is crucial to consider all stages of FWRH together, rather than treating them as separate actions. Instead of focusing solely on food waste prevention (Bravi et al. 2019), food disposal (Kunszabó et al. 2022), or food consumption (Scalvedi et al. 2018; Huddart Kennedy et al. 2019; Brunso et al. 2021), the current research discusses how Japanese people might practice these actions simultaneously or not, and if they happen alongside healthy food choices. Thus, this analysis was based on the levels of the Food Waste Recovery

Hierarchy incorporated with the steps of a consumption (purchase, usage, and disposal).

A two-step clustering approach (a hierarchical clustering followed by a K-means technique with an Euclidean distance) was used to find behavioral profiles within the Japanese. To further understand the obtained clusters and their ways of living, people were asked to report their gardening interest, cooking, and dietary options, and to rank the behaviors according to their burdensome and positive environmental impact. Respondents also stated their intention on starting/continuing recycling food waste via composting, once it is a primary food recycling process in Japan (Takata et al. 2012).

The present research aims to contribute to food consumption and waste management academia by exploring the patterns and contrasts existent across the Japanese population on the adoption rates of ethical purchasing, waste reduction, and food waste recycling PEB. With such analysis the authors intend to identify: (1) which food related PEB are mainstream and which ones have low engagement; (2) what campaigns and incentives can be efficient based on people's behavioral patterns; and finally, (3) if groups with different behavioral patterns also differ in age, gender, income, eating habits, and perceptions toward pro-environmental behaviors.

Materials and methods

PEB and Food Waste Recovery Hierarchy

The food recovery hierarchy (Papargyropoulou et al. 2014) is a framework in which behaviors are ordered from the most preferred to the least preferred, by considering environmental, economic, and social sustainability (EPA 2022; Nguyen et al. 2022). The most preferred behaviors are food waste reduction and food waste prevention at the source (EPA 2022). The next most preferred behavior is, if still nutritious and safe, the food surplus be distributed to groups affected by hunger, or to people in need within the community (Nguyen et al. 2022). The following behaviors include feeding animals with food scraps or leftovers, engaging in nutrient recovery procedures like composting or green bin separation if such collection type is available in the area (Ladele et al. 2021; Nguyen et al. 2022), and using the waste at an industrial level (generation of energy, biofuel). The least preferred option is landfill disposal or incineration. It is important to note that while some countries like the USA prioritize energy generation and biofuel over composting, the opposite happens in Europe (Imbert 2017). In Japan, it seems the latter order is being followed (Yoshida 2018; Fujii and Kondo 2018).

Numerous types of behaviors can be observed within the realms of food prevention and reduction. Bravi et al. (2020)

studied how in-store behaviors, storing practices, and food management in the house impacted the waste produced. Shopping habits and actions like doing a shopping list, meal planning, inventorying supplies (e.g., checking the fridge before shopping), and buying only necessary groceries have also been identified as drivers to waste reduction (Quested et al. 2013; Diaz-Ruiz et al. 2018; Bravi et al. 2019; Sirola et al. 2019; Aydin and Yildirim 2021; Simões et al. 2022; Wu et al. 2023). From a usage perspective, regardless of the proper storing of products or the use of a freezer to extend shelf-life, scholars have often included cooking and/or eating leftovers, using date-labels on food, portioning of rice and pasta (food quantities), cooking skills, and overall eating habits as drivers to waste reduction (Quested et al. 2013; Ponis et al. 2017; Bravi et al. 2020; Simões et al. 2022; Wu et al. 2023).

Many of these behaviors are related to everyday routines and to people's relation with food. Scholars have analyzed food waste behavioral patterns based on food waste reasons, waste prevention motivations, and attitudes toward food waste (Gaiani et al. 2018; Bravi et al. 2019; Annunziata et al. 2022). Overall, higher food involvement and healthy dietary habits have been associated with groups that wasted less food (Savelli et al. 2020; Aschemann-Witzel et al. 2021; Szymkowiak et al. 2022). People with healthier dietary habits also tended to engage more frequently in pro-environmental behaviors like recycling, and ethical consumerism (Scalvedi et al. 2018; Asvatourian et al. 2018; Savelli et al. 2020).

Ethical, green, or sustainable consumerism can be defined as engaging in the practice of buying products/services produced in a manner that reduces social and environmental harm, while avoiding those with a negative impact on society or the environment (Institute of Grocery and Distribution 2007). Burke et al. (2014) identified three distinct profiles related to the reasons to buy sustainable food in Australia. Consumers with positive views tended to be older women which focused on these products' quality as well as their environmental and health benefits. The ambivalent group also had a larger number of women but also a higher skepticism on what ethical meant. The group with negative views on ethical consumption had more men than women. This group was more impacted by indifference, expense, confusion, and skepticism as reasons not to buy green products. This association between food quality, health, expense, and ethical food was also seen on the profiles identified by Huddart Kennedy et al. (2019) when studying food esthetics and ethical food.

Thus, in alignment with the emerging health, well-being, and environmentally sustainable driven lifestyle (LOHAS) (Choi and Feinberg 2021), it would be expected that while shopping, consumers make sustainable decisions beyond the ones which have a direct effect on household food waste. For

example, while grocery shopping customers can purchase organic or eco-friendly products (Talwar et al. 2021), avoid highly packaged products, use their own bag while shopping, and look for refillable or easily recyclable products (Kurusu and Bortoleto 2011; Bortoleto et al. 2012). Organic products, although more expensive (Chekima et al. 2019), are usually seen as of a better quality, safer, and healthier (Tandon et al. 2021; Morais et al. 2024). Additionally, these products use natural fertilizers by default, which are less harmful to the environment and can be derived from kitchen waste (Mihai et al. 2023). This use of kitchen waste to produce fertilizer can promote the cycle of resources and a higher involvement of consumers on top of their buyer role. For these reasons, in present research the authors included, PEB associated with the ways of shopping and cooking that are aligned with a sustainable lifestyle regardless of behaviors associated with food waste recovery.

Japanese market

Food waste in Japan is a critical issue considering the state's low food self-sufficiency rate and shortage of available land-fill sites for waste disposal (Liu et al. 2016). Japanese consumers have been described as informed, possessing strong esthetic values, and more collectively oriented and risk-averse when compared to other cultures (Synodinos 2001; Ando et al. 2007, 2010). Given this risk-aversion, issues like food safety while boosting organic sales (Yang et al. 2022) can also have an impact on how people discard food. For instance, Nakamura et al. (2022) findings suggest that safety awareness and checking labels, if combined with knowledge and especially in large cities, can contribute for less waste generation. However, in absence of adequate knowledge the effect is the opposite (Nakamura et al. 2022).

Overall previous Japanese literature seems to point to women as more aware of household waste generation. They are also more engaged in waste prevention and ethical food consumption PEB by being more responsible for cooking and house chores (Kurusu and Bortoleto 2011; Lee et al. 2013; Qian et al. 2020; Nakamura et al. 2022). This tendency does not seem to be exclusive to Japan, as studies have shown women are keener on ethical consumption in Australia and the U.S. (Burke et al. 2014; Witzling and Shaw 2019), and in waste prevention in the UK, Italy, and Denmark (Barr 2003; Aschemann-Witzel 2018; Annunziata et al. 2022). However, the role of gender toward PEB adoption and environmental attitude has not been consistent in literature (Kurusu 2015; Simões et al. 2022). For instance, Hazuchova et al. (2020) did not find differences between men and women waste generation in Czechia, and in Brazil, men more often engaged in some of the observed reusing activities (Bortoleto et al. 2012). In a multi-country study, there was no clear gender distinction between

related food-related lifestyles (Brunsø et al. 2021); and gender was not significant to organic food purchase in a study in India (Singh and Verma 2017).

Similar contradictions can be found regarding age (Kurusu 2015). In Japan, while older people seemed to engage more frequently in waste prevention PEB, the use of public transportation and “trendy” PEB like the use of one’s own coffee cup was more popular in younger generations (Kurusu and Bortoleto 2011; Lee et al. 2013; Phuphisith et al. 2020). The age often associated with children bearing reported more frequent use of recycling stores and flea markets (Kurusu and Bortoleto 2011; Kurisu 2015). Despite children usually implying more waste (Simões et al. 2022), they can also incentivize families to engage in activities like gardening, composting (Iijima and Egahiro 2014; Coogan 2019; Honami Hirayama et al. 2022), and purchasing organic food (Yang et al. 2022).

Moreover, time availability has been reported as impactful in food waste reduction (Nakamura et al. 2022). Throughout the years, long workdays have become a standard practice in Japanese corporate culture, resulting in significant physical and mental stress as well as impeding women entering the workforce (Ono 2018; Kawashukuda 2022). It would be expected that such workers are less inclined to engage in behaviors considered time-consuming. Interestingly, a study in China found that instead of objective lack of time, subjective lack of time was more of a barrier to food waste curbside separation (Wu et al. 2019).

From a cultural perspective, in the U.S. and the Netherlands traditional values seem to act as a barrier (Aoyagi-Usui et al. 2003; Kawasaki et al. 2022). However, in Japan, environmental concerns and reduction behaviors are positively related with both a traditional education and altruistic values (Aoyagi-Usui et al. 2003; Kawasaki et al. 2022). In particular, Japanese prevention practices and environmental concerns have been associated with the concept of “*mottainai*” (Fujii 2006; MAFF 2019; Sirola et al. 2019; Izumi et al. 2020). “*Mottainai*” implies treating the resources with respect by using them wisely, avoiding wasting them, and showing gratitude for them (MAFF 2019; Sirola et al. 2019; Izumi et al. 2020). Within 3R’s policies, “*mottainai*” has been used by local governments as part of their promotional strategy to reduce waste. Such policies and promotional strategies can differ from town to town (Hotta and Aoki-Suzuki 2014; Inaba et al. 2022), contributing to regional differences in the adoption of waste prevention behaviors (Kurusu and Bortoleto 2011). For example, Kurisu and Bortoleto (2011) highlighted that composting and “Bring Your Own Chopsticks” were unpopular behaviors, whereas refillable products and the use of the own bag when shopping (“my bag”) were among the most adopted, especially in Aichi. Furthermore,

Nakamura et al. (2022) found differences between waste generation motives in urban and rural areas.

Clustering algorithm

Clustering algorithms are exploratory, non-inference techniques used on multivariate *datasets* (Hair et al. 2018). They find “natural” structures among observations based on their response patterns and have been widely used across research fields, with purposes such as consumer segmentation and target marketing in mind (Hair et al. 2018).

In this study, clustering is used to identify differences on the practice rates of ethical consumption behaviors and Food Waste Recovery Hierarchy-related PEB. In accordance with the idea that PEB and ethical choices may be presented hierarchically (Wooliscroft et al. 2014), the authors would expect individuals who practice time consuming or costly PEB like buying organic food (Sakagami et al. 2006; Chekima et al. 2019; Dorce et al. 2021) or compost (Wu et al. 2019) also engage in more mainstream practices like recycling, while the contrary does not necessarily hold (Wooliscroft et al. 2014). Eating habits, PEB perceptions, composting intention, and socio-demographics were used to profile the obtained clusters. Based on the profiles gathered in the previous literature, it would be expected to see an association between women, healthy lifestyles, and environmental involvement (Scalvedi et al. 2018; Asvatourian et al. 2018; Savelli et al. 2020; Choi and Feinberg 2021), as well as between gardening interest and composting (Kunszabó et al. 2022).

Among several clustering techniques, a two-step clustering approach was applied. The present algorithm included a data reduction step, a hierarchical clustering followed by a *K-means* method, and a profiling step.

Data reduction

When the sample contains a large number of variables, the task of visualizing and interpreting the clusters’ results becomes more complex (Hair et al. 2018). Thus, before applying the clustering methods and to further support the suggested categorization of the analyzed PEB, a principal component analysis (PCA) with a promax rotation was done. According to Hair et al. (2018), a PCA “*considers the total variance and derives factors that contain small proportions of unique variance and, in some instances, error variance.*” A promax rotation was used to better interpret the obtained factors. Other orthogonal and oblique rotations were explored, but the promax rotation had the clearest results. Even though oblique rotations allow correlation between the factors, such was not considered a major issue given the clustering nature of the analysis.

On a first instance a Kaiser–Meyer–Olkin (KMO) test, a Bartlett’s test, and a Cronbach’s Alpha index were calculated to verify if the data could be factorized. Next, the ideal number of factors was decided and summated scales were calculated.

Hierarchical clustering and K-means

Hierarchical clustering solutions are fast and can be used with a wide range of measures of similarity; however, once they group (if agglomerative) or ungroup (if divisive) observations recursively, two observations cannot be separated after being paired (Han et al. 2012; Hair et al. 2018). The criteria to group the data are based on the distance matrix between observations and which points are used to merge two clusters (linkage criteria). On the current application, the distance matrix was calculated based on the Euclidean distance and the selected linkage was the Ward’s linkage criteria. Such linkage method attempts to minimize the sum-squared errors (SSE) (Hair et al. 2018). On the following step, a *K-means* was used. A *K-means* is a partitional-based clustering technique, commonly used by researchers (Hair et al. 2018). It separates the data into a user-specified number of groups, and in this case, the ones suggested in the hierarchical algorithm. The grouping occurs iteratively until the homogeneity within the cluster cannot be improved (Hair et al. 2018).

Data collection and questionnaire

The present analysis is based on the results of an online survey which was conducted by a marketing research company between 2022–09–20 and 2022–09–21. The sample includes 1500 Japanese adults over 30 years old residing in 9 different prefectures (Aichi, Chiba, Fukuoka, Hyogo, Kanagawa, Kyoto, Osaka, Saitama, and Tokyo). As of first October of 2020, Japanese adult population was 126.146 million people from which around 60% was residing on the prefectures selected on the study. Besides being among the most populated prefectures in Japan, their different policies toward waste management were also considered during selection. For instance, according to Kurisu and Bortoleto (2011) and Hirose (2015), Aichi Prefecture invested earlier in waste reduction campaigns and composting subsidies. Within the selected areas, Tokyo is the most populated area followed by Kanagawa, Osaka, and Aichi.

A quota sampling technique was used to ensure a sample that closely matched the general population in terms of age, gender, and prefectures’ population density. However, it is important to note three aspects about the sample.

Firstly, as the survey was written in Japanese, it only addressed Japanese citizens. Second, it was the authors’

decision to focus on the over 30-year-old population. Finally, even though the survey sample does include a marginal number of elders over 70, the quota of the elderly group in proportion to the population composition was based on the population with ages between 60 and 69. Such was preferred as the percentage of elders that registered for internet surveys tends to be small.

The survey included questions concerning pro-environmental behaviors related to waste management and responsible consumerism. In particular, this study focused on food related behaviors aligned with the food recovery hierarchy (Papargyropoulou et al. 2014) and ethical behaviors that can occur while shopping for groceries. Additionally, questions about the positive impact and convenience of the analyzed PEB, intention of engaging in composting, and dietary choices were made. With the exception of gardening interest and eating/cooking frequencies, most questions were addressed in a 6-point Likert-scales (e.g., 1-never, 6-always, 1-strongly disagree, 6-strongly agree). A 6-point Likert-scales was preferred to a 7-point Likert-scales due to the Japanese disposition for “neutral” answers (Kurisu 2015). The current analytical approach considered Likert-scales as interval scales. Previous literature on PEB such as Attiq et al. (2021) and Dorce et al. (2021) have found meaningful results under this assumption. Moreover, Norman (2010) pointed out that Likert-scales hold robust results for use in several parametric applications, even in presence of unequal variances, small sample sizes, and non-normal distribution.

Results and discussion

The data was analyzed with *R* (4.2.1) coding language via *Rstudio* (5.5.4). The clustering analysis was based on *NbClust* 3.0.1 (to find the ideal number of cluster) and *Stats* 4.2.1 (hierarchical clustering and K-means).

Descriptive analysis

The original sample size was 1500; however, two observations were excluded due to missing data. Female respondents made up 49.7% of the respondents, while 50.3% were men. The sample only included Japanese adults over 30 years old, 22% of them were between 30 and 39 years old, 30% in their 40 s, 26% in their 50 s, and the other 22% of the sample was over 60 (Table 1). Approximately 30% of the respondents had at least one child residing with them, and the most common household had the respondent living with another person (e.g., parent, spouse, or children).

In terms of education and career, 66% of the people held a university degree or equivalent (e.g., vocational school), 30% had completed high school, and 4% had finished junior high school. The most frequently reported household

Table 1 Socio-demographics of the sample

Variables	Categories	<i>N</i>	<i>N</i> %
Gender	Male	754	50.3%
	Female	744	49.7%
Age	30 s	334	22.3%
	40 s	442	29.5%
	50 s	392	26.2%
	> 60	330	22.0%
Region	Saitama	166	11.1%
	Chiba	143	9.5%
	Tokyo	324	21.6%
	Kanagawa	213	14.2%
	Aichi	167	11.1%
	Kyoto	55	3.7%
	Osaka	195	13.0%
	Hyogo	122	8.1%
	Fukuoka	113	7.5%
Educational level	Junior High Sch. (or equivalent)	68	4.5%
	High Sch. (or equivalent)	448	29.9%
	College	176	11.7%
	University degree (undergraduate and postgraduate)	806	53.8%
Marital status	Single	572	38.2%
	Married	926	61.8%
Household size	1	271	18.1%
	2	685	45.7%
	3	296	19.8%
	4	136	9.1%
	> 4	110	7.3%
Living with children	Yes	447	29.8%
	No	1051	70.2%
Yearly income (before taxes)	< 2 million yen	160	10.7%
	2–4 million yen	295	19.7%
	4–6 million yen	355	23.7%
	6–8 million yen	260	17.4%
	8–10 million yen	180	12.0%
	10–12 million yen	94	6.3%
	> 12 million yen	154	10.3%
Job	Corporate Worker	610	40.7%
	Housewife/husband	296	19.8%
	Part-timer	204	13.6%
	Unemployed	170	11.3%
	Self-Employed	81	5.4%
	Others*	137	9.1%

1 million yens were approximately 7000 UDS in September of 2022 (the period when the data was collected)

“Others” includes professions like public officer, lawyer, accountant, teacher, designer, and company director

income range was between 4 and 6 million yen a year with approximately 41% of the sample being corporate workers and 20% housewives/husbands. According to the Japanese Ministry of Health, Labour, and Welfare (MHLW) wage

report of 2022 (MHLW 2023a), the average salary in Japan was 3.7 million yen/year (311,800 yen/month). Among the analyzed prefectures the values ranged from 3.6 million yen/year (296,100 yen/month) in Fukuoka to 4.5 million yen/

year (375,500 yen/month) in Tokyo. Despite existing a clear gap between women's and men's wages (MHLW 2023a) and an average of 1.05 income earners per household (Statista 2023), the results of this analysis do not express these issues directly once the survey question was about the total income available in the household. In Japan, the average available income in a household was 5.5 million yen/year in 2021 (MHLW 2023b) which is in accordance with the survey statistics.

Data reduction

The principal component analysis was done for a set of 17 PEB; however, due to high cross-loadings and low loadings, 3 behaviors were excluded during the PCA and the procedure was repeated for the restricted group. The final results are visible in Table 2, where the 14 behaviors were divided into 3 factors. The sample passed the tests regarding PCA fitness to the data, with a p -value = 0 on Bartlett's test, a KMO = 0.88, and a Cronbach's Alpha index of 0.88 (> 0.70). As mentioned earlier, according to the food recovery hierarchy, the most preferred behaviors relate to preventing waste production, either at a purchase or usage level. As expected, one of the factors comprises waste prevention behaviors in-house (PREV) such as not throwing away food, avoiding leaving leftovers, and planning the meals. The second factor covers other levels of the hierarchy like giving food to neighbors, feeding animals

with leftovers, using a machine to reduce the volume of the waste, and composting organic waste. Thus, it was named after diverging waste from landfills (DIV). The last factor covers the prevention of food waste at the in-store level (making a shopping list) and other aspects of ethical consumerism (EC). It includes behaviors which help the reduction of pollution at the moment of purchase like making a shopping list, bringing their own water bottle, choosing products with less packaging, using eco-friendly goods, using recycled or refillable products, and purchasing organic food. Thus, the results support the theoretical categories hypothesized.

Apart from PEB3 and PEB9, all the items had a loading close to/or superior to 0.7 implying a well-defined structure (Hair et al. 2018). Despite the loadings of PEB3 and PEB9 being lower than the rest of the items, they meet the minimal level for interpretation (± 0.3 to ± 0.4) (Hair et al. 2018). It is relevant to mention that item PEB3 had a loading superior to 0.3 on both EC and PREV resulting in a ratio of variance of 1.78 ($0.44^2/0.33^2$). According to Hair et al. (2018), this ratio may imply a potential cross-loading. However, as the item was theoretically aligned with the designated factor (prevention in-house), the authors decided to keep it. Moreover, as previously mentioned under a clustering analysis, the independence of the factors is not a strict assumption as in other multivariate techniques.

Table 2 Items' average, standard deviation, principal component analysis' (PCA) factor loadings, and explained proportion

Item	Mean	Std	DIV	PREV	EC
PEB1: Do you avoid throwing away food?	4.79	1.15	0.00	0.97	−0.11
PEB2: Do you avoid leftovers?	4.83	1.16	−0.05	0.96	−0.14
PEB3: Do you plan your meals?	4.12	1.35	0.11	0.44	0.33
PEB4: Do you try to reduce food waste?	4.20	1.44	0.02	0.75	0.10
PEB5: Do you usually give food to your neighbors?	2.12	1.50	0.77	−0.04	0.14
PEB6: Do you use leftovers or scraps to feed the animals/pets?	1.77	1.53	0.94	0.00	−0.11
PEB7: Do you use a volume reducer waste machine?	1.89	1.53	0.90	−0.01	−0.05
PEB8: Do you engage in composting/reusing organic waste?	1.91	1.55	0.80	−0.01	0.05
PEB9: Do shop with a shopping list?	3.70	1.67	0.17	0.20	0.42
PEB10: Do you bring your own water/tea bottle when going out?	3.66	1.86	−0.10	−0.09	0.74
PEB11: Do you opt for products with less packaging?	3.60	1.55	−0.03	−0.07	0.90
PEB12: Do you use eco-friendly goods?	3.43	1.49	0.01	−0.09	0.93
PEB13: Do you opt for recycled or refillable products?	4.20	1.44	−0.23	0.16	0.69
PEB14: Do you purchase organic food?	3.09	1.51	0.15	−0.12	0.80
PEB15: Do you bring your own bag when shopping?	5.02	1.46	-	-	-
PEB16: Do you avoid water running?	4.43	1.36	-	-	-
PEB17: Do you recycle?	4.96	1.36	-	-	-
SS loadings	-	-	3.05	2.64	3.60
Proportion explained	-	-	0.33	0.28	0.39

DIV: food recycling actions that diverge waste from landfills; PREV: in-house waste prevention; EC: ethical consumption

Clustering and profiling

The value of the Hopkins test was 0.98 implying a pattern may exist within the observations. Given the low to moderate correlation between factors (< 0.6) (Mukaka 2012), the authors decided to use a Euclidean distance during the clustering process. As mentioned on the methodology section, this analysis used a hierarchical clustering technique followed by a *K-means*. Based on the indices provided by the *Nbclust* package, the suggested number of clusters was either 3 or 4. Therefore, initially, the algorithm was executed for both options. After running the algorithm with both alternatives, the authors found clearer groups under 4 clusters and so proceeded with the analysis using the latter setting. For more detail on the metrics available on the package, check Halkidi et al. (2001).

Table 3 shows the key features of the obtained clusters including their size, centers' coordinates, and major attributes. To evaluate if the factors were significantly different

across groups, a Kruskal–Wallis' test followed by Dunn's test with a Bonferroni correction (once there are more than 2 groups) for the pairwise group comparisons was done. The Kruskal–Wallis' test was preferred to ANOVA due to the latter's assumption toward normality. All the null hypotheses were rejected at a p -value $< 5\%$ implying all the groups have distinct behavioral profiles regarding their ethical consumption, food waste prevention and food recycling habits. The four clusters were named: sporadic adopters, average practitioners, responsible consumers, and environmentally involved. The environmentally involved represented 10.3% of the total sample, the average practitioners 13.4%, the sporadic adopters 25.4%, and finally, the responsible consumers comprise approximately half of the sample (50.9%).

The responsible consumers group (cluster 1) has respondents that, even though they rarely engage in waste diverging behaviors, frequently try to reduce their waste and leftovers. Moreover, they sometimes (more frequently than not) buy products that have, in principle, a smaller environmental impact than

Table 3 Clustering results and clusters' profiles

Attribute	(1) Responsible consumers	(2) Average practitioners	(3) Environmentally involved	(4) Sporadic adopters
Cluster size	762	261	154	381
DIV (center)	1.32	3.35	4.85	1.19
PREV (center)	4.86	3.94	5.32	3.33
EC (center)	4.09	3.51	5.17	2.03
Gender				
Women (%)	62.9%	38.8%	45.5%	30.7%
Men (%)	37.1%	61.2%	54.4%	69.3%
Job				
Corporate worker (%)	31.5%	57.2%	55.8%	44.4%
Part-time (%)	17.2%	8.5%	8.4%	11.3%
Housewife/husband (%)	28.0%	9.5%	14.9%	10.8%
Unemployed (%)	10.8%	6.0%	5.2%	17.8%
Self-employed (%)	4.6%	6.0%	8.4%	5.5%
Yearly income (before taxes)				
< 2 million yen (%)	8.9%	9.5%	7.1%	16.3%
2–4 million yen (%)	20.6%	19.9%	11.7%	21.0%
4–6 million yen (%)	27.6%	19.9%	21.4%	18.9%
6–8 million yen (%)	16.9%	19.9%	14.9%	17.8%
8–10 million yen (%)	12.5%	13.4%	10.4%	11.0%
10–12 million yen (%)	5.0%	8.0%	13.6%	5.0%
> 12 million yen (%)	8.5%	9.5%	20.8%	10.0%
Marriage (%)	68.8%	57.7%	65.6%	48.6%
Children (%)	29.3%	32.8%	45.5%	23.1%
Age (mean)	53.1	47.4	47.2	47.9
Household (mean)	2.6	2.7	3.1	2.6
1st most populated prefecture	Tokyo (19.2%)	Tokyo (26.9%)	Tokyo (26.0%)	Tokyo (22.0%)
2nd most populated prefecture	Kanagawa (15.1%)	Kanagawa (12.4%)	Kanagawa (16.2%)	Osaka (16.0%)
3rd most populated prefecture	Saitama (12.3%)	Saitama (12.4%)	Aichi/Osaka (16.0%)	Kanagawa (12.6%)

Percentages of other jobs (e.g., teachers or self-employed) were omitted from the table

a conventional one. For instance, they regularly tried to buy organic vegetables instead of regular ones or purchase refillable/reusable products instead of single-use packages. This group was the only one in which the percentage of women superior to men (63% versus 37%) and where the concentration of housewives/husbands and part-timers was the highest. This could justify the high adoption of prevention behaviors and consumption related PEB, as they are chores related with household duties (Qian et al. 2020; Nakamura et al. 2022). As expected, given the percentage with housewives/husbands, and similarly to what happened in group 2 and group 3, the majority of the cluster was married. Age was found statistically different across the clusters (Kruskal–Wallis' test), as this cluster's respondents were older than in the other groups. Nonetheless, not all the hypotheses of the Dunn's test to age were rejected.

A person belonging to group 2 (average adopters) was characterized by engaging in all PEB somewhat frequently. Mostly men working in a corporate job, had lower practice rates than group 1 both on prevention and ethical consumption PEB rates. On the contrary, the engagement in diverging actions is substantially higher, though not as much as group 3. As the previous literature suggested, recycling may have an adverse effect in which people end up consuming more resources (Ma et al. 2019; Oláh et al. 2022). Similarly, it may be that people who have a recycling plan for leftovers or spoiled food end up relaxing their prevention actions (Tucker and Farrelly 2016).

Group 3, the environmentally involved, was the most balanced in terms of gender; however, the percentage of men is slightly higher. It is also the group with the largest households, and the highest percentage of children (Table 3). This cluster reported high frequency rates in all PEB. Even though the present study did not assess the waste quantity per se, and it was based on self-reported qualitative data, it seems that this cluster was the one which tried to have

the lowest environmental footprint. It was the group that had the higher percentage of people in their 30's (36.8% of the group) when compared with group 1's 15.0%, group 2's 30.8%, and the sporadic adopters' 26.8%. In fact, while environmentally involved respondents accounted for 10.3% of the total sample, they represented 16.8% of the people in their 30's. Interestingly, it was also the group with more people over 70-years-old percentage wise (and absolute wise apart from cluster 1), resulting in a larger age variance than in the other groups. This is a nuance that may be camouflaged by looking only at the cluster's average age (Table 3) or at the results of the age Dunn's test once it is a non-parametric rank test comparing the groups' means.

The final cluster, the sporadic adopters, had the lowest PEB practice rates. The second largest cluster was composed mostly by men (69%) working in a company (44%) or unemployed (18%). It was the group with the highest percentage of unemployed respondents and with the lowest income available. It also had fewer children and less married people than the other clusters. The age distribution was similar to the average practitioners.

In terms of place of residence, most of the groups seemed to follow the overall sample distribution (Table 1). However, only 5% of the group 3 lived in Saitama (contrary to the sample total of 11%), while the percentage of people residing in Tokyo, Kanagawa, and Aichi prefectures was slightly higher. The percentage of Tokyo residents within group 2 and 3 was also higher than in the total sample. Groups 1, 2, and 3's most populated region was one of the prefectures adjacent to Tokyo, whereas after Tokyo, the sporadic adopters tended to live in Osaka.

From a factor's perspective, prevention behaviors seemed to be the most adopted, followed by responsible consumerism and finally diverging behaviors (Fig. 1). Additionally,

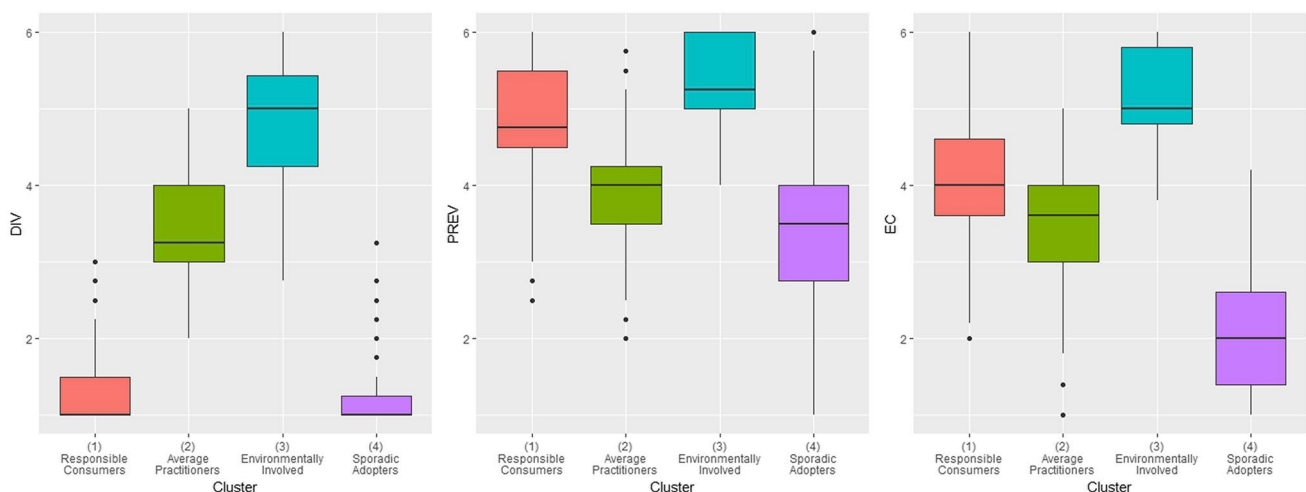


Fig. 1 Clusters' boxplot

Fig. 2 includes frequency rates of water management, waste recycling (plastic, cans, bottles, cardboard), and the use of one's own bag while shopping (these were the behaviors which were excluded on the PCA step) as well as dietary concerns of the respondents. responsible consumers seemed to have high practice rates on these PEB, being the “my bag” PEB more frequent than on the environmentally involved. The latter is not unexpected as housewives/husbands are commonly responsible for chores like grocery shopping. The average practitioners kept the trend of medium to high rates. Finally, sporadic adopters had interesting results when compared with the average practitioners. Even though the

latter group had more average to avoid practitioners, the former had a larger fraction of people who try to save as much water as possible and bring their own bag when shopping. These rates on water saving are aligned with the high “eco-friendliness” perception reported by this cluster (Table 4), but also with fact that water saving and the use of the own bag (in Japan, many supermarkets charge extra for the plastic bag) can contribute directly for money saving.

Moving to the burdensome and positive impact perceptions, it is relevant to mention that the overall ranking of the most eco-friendly PEB within the clusters were calculated as the sum of the following: $3 * N_{ij1} + 2 * N_{ij2} + 1 * N_{ij3}$, being

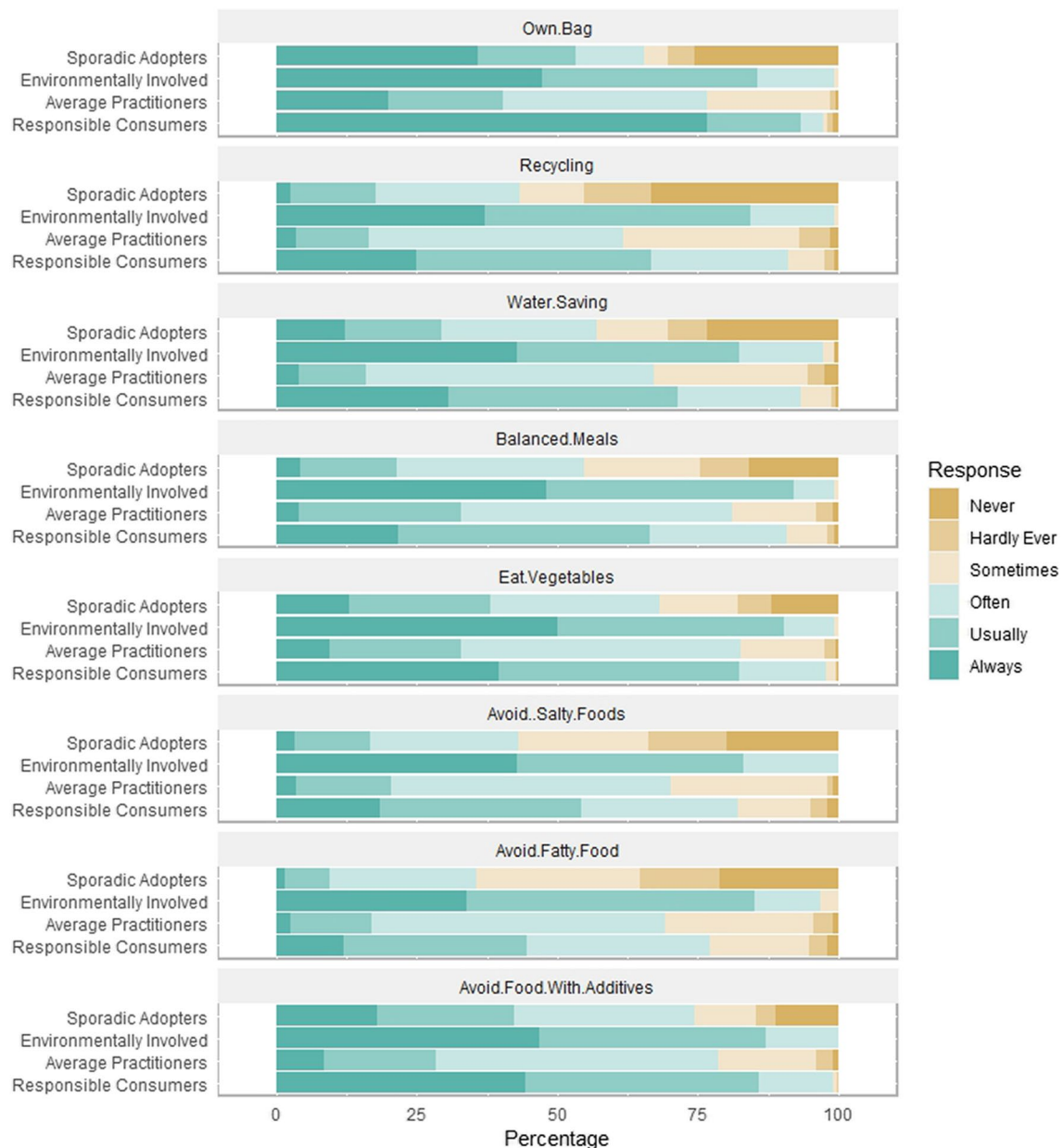


Fig. 2 PEB excluded during the PCA and dietary concerns

Table 4 Eco-friendly and bothersome ranking

Position	(1) Responsible consumers	(2) Average practitioners	(3) Environmentally involved	(4) Sporadic adopters
1st eco-friendly	Food waste reduction	Food waste reduction	Compost organic waste	Food waste reduction
2nd eco-friendly	Separate and recycle waste	Compost organic waste	Food waste reduction	Separate and recycle waste
3rd eco-friendly	My bag	My bag	My bag	Make a wise use of water resources
1st burdensome	Compost organic waste	Compost organic waste	Compost organic waste	Compost organic waste
2nd burdensome	Purchase organic food	Purchase organic food	Food waste reduction	Purchase organic food
3rd burdensome	Use eco-friendly goods	Food waste reduction	Purchase organic food	My bottle

N_{ijg} the number of people in the cluster $i \in I = \{1, 2, 3, 4\}$ that classified the behavior $j \in J = \{1, 2, \dots, 11\}$ in the position $g \in G = \{1, 2, 3\}$.

When asked to pick three out of eleven behaviors, depending on which they considered the most eco-friendly, all the groups mentioned the reduction of food waste. The responsible consumers considered reducing food waste, recycling, separating waste, and bringing one's own bag when shopping the most positive behaviors. The average practitioners and the environmentally involved pointed out composting, reducing food waste, and bringing one's own bag when going shopping ("my bag"). Finally, the sporadic adopters' rank included food waste reduction, recycling, and the wise use of water resources.

Regarding burdensome, all groups positioned (on a 6-point Likert-scale) composting as the most demanding behavior. Purchasing organic food was also mentioned across all clusters. Although this study does not specify what kind of burden these PEB have on people's routine, it would be expected that on the case of organic food it is related with its price (Sakagami et al. 2006; Chekima et al. 2019; Dentsu Macromill Insight Inc. 2021; Dorce et al. 2021). The current study seems to be aligned with previous scholars, since the sporadic adopters were the ones with the lowest available income and highest reported burden level toward organic food. On the other hand, the burden reported toward organic food by the responsible consumers was the lowest. Responsible consumers, in general, tended to report the lowest burden levels when compared to the rest of the sample. For instance, while responsible consumers commonly answered that PEBs were not much of a burden (on a 6-point Likert-scale, the median value of 7 PEB was 2), the other clusters more often reported some kind of burden (3 and 4 in the Likert-scale). Apart from composting and the purchase of organic food, the environmentally involved tended to report the highest levels of burden.

Moreover, food waste reduction and compost organic waste were both considered extremely eco-friendly behaviors and quite demanding by the average practitioners and the environmentally involved. This demonstrates that despite the additional burden, they still decided to practice those PEB, either for environmental reasons or others. Composting

has been considered, and atypical PEB highly influenced by non-environmental factors (Edgerton et al. 2009). For example, studies like Tucker and Speirs (2003) and Loan et al. (2019) mentioned gardening and farming as a relevant point for engaging in composting. The present analysis somewhat supports such literature once groups with a higher gardening/farming interest were also the ones adopting more frequently waste diverging behaviors.

Regarding eating habits and dietary concerns, groups with more housewives/husbands were the ones with the highest cooking frequencies. The fact sporadic adopters ate out less than other groups is congruent with the reported income and unemployed rates. On the other hand, the environmentally friendly group, where around 20% of the group declared to receive more than 12 million yen/year, ate out more frequently. Although overall the vegetarian meals frequency was extremely low, the environmentally involved and average practitioners tended to do it more times than the others. Eating vegetables and having balanced meals were the highest dietary concerns across all groups (Fig. 2). This may be traced back to the traditional dietary culture of Japan ("washoku") where the basic set meal ("teishoku") is regarded as well-balanced and nutritious (Kumakura et al. 2023; MAFF 2023). A traditional set meal should include a soup (usually miso soup), a staple dish (e.g., rice), a main dish (rich in protein products like soybeans, meat, or fish) and a vegetable/pickle-based side dish nutritious (Kumakura et al. 2023; MAFF 2023). To this set seasonal fruits and milk products may be added nutrition (MAFF 2023). The differences between each group dietary concerns were statistically significant on the Kruskal–Wallis' test and Dunn's pairwise comparison for all the aspects analyzed except for the pairwise comparison between the 1st and 3rd clusters and the 2nd and 4th groups on the attention given to vegetables. Environmentally involved and responsible consumers reported higher concerns about making healthy decisions. Sporadic adopters were the ones that registered less concern on all the aspects analyzed.

Finally, when asked about their intention on starting/continuing composting organic and kitchen waste, the answers portrayed an interesting picture. On the Kruskal–Wallis' test and pairwise Dunn's test, the answers were statically

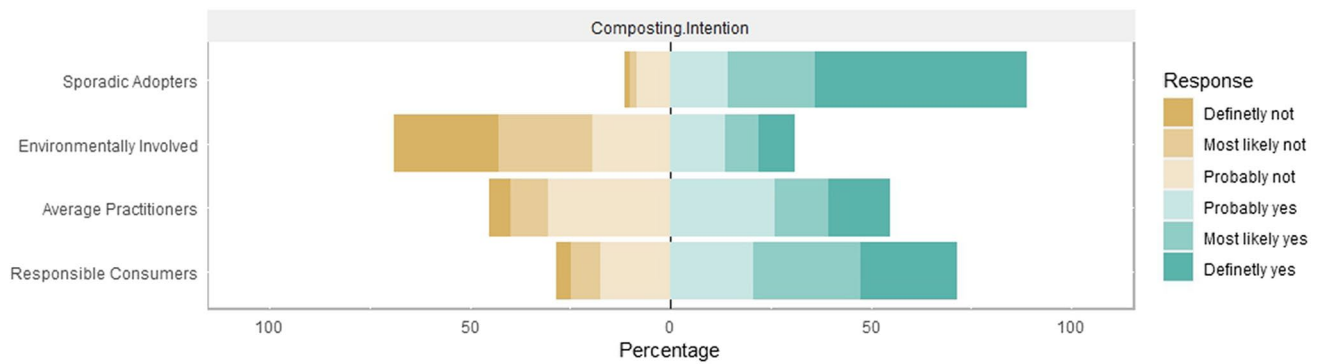


Fig. 3 Composting intention

different and, as visible in Fig. 3, the clusters that had been reported doing composting, were the ones with the lowest will to continue/start, whereas the sporadic adopters, who tented to have low DIV adoption rates, reported the highest intentions.

Discussion

Starting with the theoretical contributions, this study is one of the few that presents a holistic perspective on the food consumption steps (purchase, usage, and disposal). Contrary to previous works, it not only included prevention measures but also covered other stages of the food recovery hierarchy, such as giving food to neighbors, feeding the animals with scraps, and composting organic and kitchen waste.

From a social and management perspective, several points should be discussed. The clustering algorithm found 4 distinct clusters given their practice rates of the studied PEB. The first remark relates to the difference in the cluster's size. Only a small part of the sample belongs to the average practitioners and even a smaller percentage to the environmentally involved cluster. These results are somewhat in agreement with Kurisu and Bortoleto (2011) and Liu et al. (2016), which mentioned low composting adoption rates in Japanese society. Kurisu and Bortoleto (2011) also mentioned differences in PEB adoption rates across Aichi, Osaka, and Tokyo prefectures. Notwithstanding the geographic distribution of the clusters was quite similar with the exception of the sporadic adopters' concentration in Osaka, and the environmentally involved having a slightly higher percentage of respondents living in Tokyo, Kanagawa, and Aichi. Recently, in Chigasaki city (Kanagawa), the waste disposal began being charged by weight with incentives on composting (RareA 2022), and Nagoya city (Aichi) has funding for Non-Profit Organizations (NPOs) working with food waste recycling (Nagoya City Hall 2023). Several other cities within these prefectures have available composting grants and incentives for households who wish to purchase

composters or food drying machines (Island land Co. Ltd 2023), which can be related to the geographic distribution of the latter cluster. Nonetheless, marketing approaches (e.g., direct communication from city officials) often influence the success of the policies (Hotta and Aoki-Suzuki 2014) and such aid or incentives are at the city level. The present study did not have enough specificity or information to properly access the effectiveness of such campaigns and to further explore how they impacted the current analysis.

Both Qian et al. (2020) and Nakamura et al. (2022) stated that, in Japan, women tended to engage more in food waste prevention behaviors. The results of the current paper are aligned with previous literature, but an interesting nuance was revealed once alternative disposal actions were included. The largest cluster, the responsible consumers, were mostly housewives or women with part-time jobs. This was in agreement with the high cooking percentage and the high adoption of behaviors related to consumption, once doing the groceries falls under household chores. They also reported paying attention to their dietary options more often. Similarly, the environmentally involved, which was the second group with a higher percentage of housewives, also seemed to cook frequently and report higher practice rates on ethical consumption and waste prevention PEB. On contrary, average adopters, which were mainly married men, had lower PREV and EC rates than the latter clusters, but had higher DIV rates than the responsible consumers. This may be derived from the relaxation point mentioned previously but can also be related to the gender dichotomy of the house tasks in Japan (Ono 2018). This implies that even if environmentally concerned, they have less chances of engaging in green purchase or waste prevention acts.

Previous scholars related ethical food consumption and food waste prevention to healthy consciousness (Savelli et al. 2020; Tandon et al. 2021; Dorce et al. 2021; Morais et al. 2024), and segmentation works have often found groups that had high PEB engagement also had higher dietary concerns

(Burke et al. 2014; Scalvedi et al. 2018; Asvatourian et al. 2018). This study's findings confirm such tendencies to a certain extent. It seems that also in Japan, the environmentally involved, in accordance with the LOHAS lifestyle, were both health and environmentally conscious in all the aspects analyzed. However, the relationship between food disposable alternatives and eating habits does not seem as straight forward and further studies should approach this component. While the average practitioners did have a higher adoption rate on DIV than the responsible consumers, the latter group had a higher food involvement in all the other accessed behaviors. Being the responsible consumers group composed by a higher percentage of older women, it showed similar characteristics to food involved groups identified in Italy, Germany, the Netherlands, Denmark, Sweden, and Australia (Burke et al. 2014; Scalvedi et al. 2018; Aschemann-Witzel et al. 2021). Aschemann-Witzel et al. (2021) and Burke et al. (2014) also identified groups with low food involvement which seem to share traits with the sporadic adopters on regards of income, gender, and behavioral pattern.

Moreover, the present analysis showed interesting results regarding the perceived burden level of each cluster, as the responsible consumers had the lowest stated levels and the environmentally involved had the highest. One possible explanation may derive from the higher concentration of housewives/husbands in the responsible consumers' group, thus easing burdens associated with inflexible or oversaturated time schedules. Aspects like inconvenience and lack of time have been reported as barriers to PEB engagement (Hjelmar 2011; Wu et al. 2019) and, as previously mentioned in the Materials and Method section, Japan has a physically and mentally demanding work culture, which has even resulted in death cases ("*karoshi*") (Ono 2018; Kawashukuda 2022). Another explanation for the distinct burden level across groups might be derived from the sense of responsibility or guilt of oneself. The Japanese word used on the survey was "*futan*" which can also be read as bearing a responsibility. Therefore, the burden levels reported by the environmentally involved are aligned with literature that has used the sense of guilt and perceived responsibility to explain PEB adoption (Kurusu 2015). Nonetheless, further analysis on the clarification of these burdensome dimensions is needed.

In agreement with scholars like Tucker and Speirs (2003), Loan et al. (2019), and Kunszabó et al. (2022), the interest in gardening/farming was parallel to the adoption levels of food recycling methods. Both average adopters and environmentally involved mentioned composting as quite demanding, but extremely eco-friendly, and despite currently engaging in such PEB they did not seem particularly enthusiastic about continuing (at least when comparing with other clusters). This reinforces the complexity of the

trade-offs related to PEB. These differences in the intention may derive from factors like practical knowledge or by a novelty aspect from the respondents that were not familiar with the concept prior to the survey (on the survey a definition about composting was given). This gap between intention and the actual practice seems to be in agreement with the results of Tanaka et al. (2011). The latter found differences between the composting intention effect on the actual behavior among prior composting practitioners and non-practitioners. However, the study was narrowed to a specific city in Hyogo Prefecture, and so further research including environmental and functional aspects should be addressed in a more diversified sample.

This gap also points out that theoretical behavioral modeling of composting data collected only at one point in time should be done carefully. There seems to exist a large gap between intention and the behavior, the Theory of Planned Behavior (TPB) (Ajzen 1991), which posed intentions precede behavior. This may not be the most suitable framework, at least in the Japanese case.

The people from the environmentally involved cluster were the ones with larger households and more children. These results are somewhat contradictory with previous research where household size and children were positively related with food waste produced (Boulet et al. 2021; Nakamura et al. 2022). Nevertheless, from a qualitative perspective it can represent that people try harder to prevent waste or diverge waste from incineration (or landfills) despite producing more of it. Aligned with the current results, Iijima and Egahiro (2014), Coogan (2019), Honami Hirayama et al. (2022), and Yang et al. (2022) did point out how children may contribute to the purchase of organic food and to engagement in gardening and composting. However, the current study did not examine in detail how parenting might have changed throughout the years. For instance, parents of young children may pay more attention to fostering their children's connection with nature, whereas in later years, both the children's and parents' focus may shift to school performance, club activities, and cram school (Ishida et al. 2005).

This study results support the PEB hierarchy proposed by Wooliscroft et al. (2014) to a certain extent. While people which engaged "costly" PEB also adopted mainstream practices, it is important to keep in mind what was earlier mentioned about the opportunity of engaging in such behaviors. Additionally, both average practitioners and environmentally involved ate plant-based meals more frequently. This was in line with idea that reducing meat consumption or adopting plant-based diets have environmental benefits (Chai et al. 2019; Cheah et al. 2020). It seems, nonetheless, that despite recent increasing trends on plant-based diets in countries like the UK (Alae-Carew et al. 2022), this is not the case in Japan yet.

Across the groups, the burden of both composting and purchasing organic food was unanimous. According to Kurisu and Bortoleto (2011) and Dentsu Macromill Insight Inc. (2021) price can be a relevant barrier to the purchase of organic products. Thus, having efficient marketing strategies, relying on promotional campaigns, mascots, celebrities, or tasting campaigns are some of the examples of possible ways to boost the awareness about these products' pros and cons. This allows for a more educated choice, and a better understanding of the trade-off between the price paid and product quality. Such campaigns might be especially effective for average practitioners, who seem to have an interest in eco-friendly products but not to the same extent as both environmentally involved and responsible consumers.

Kim et al. (2019) and Sewak et al. (2021) discussed different social marketing components to boost waste reduction, waste-sorting, and composting. The present research contributes to the segmentation component. From a general perspective, taking into consideration the clusters' dimensions, the profile of the responsible consumers and sporadic adopters should be prioritized. Responsible consumers were mostly housewives in their 50 s and 40 s who did not compost but consumed in an ethical way. Thus, using the purchasing moment to foster food recycling and showing the link between organic food and food recycling can be an effective way to promote composting to this group. Promoting it as a community activity may also be beneficial. As the sporadic adopters seem to be more sensitive to money and convenience issues, waste charges, composting incentives, or organic waste collection policies should be prioritized. For example, cities like Nagai in Japan (Okayama et al. 2021) and Porto in Portugal (Weidner et al. 2020) have organic waste collection programs, Chigasaki city has a waste charge policy (RareA 2022), and cities like Hamamatsu in Japan subsidize the purchase of several types of composting containers (Hamamatsu City Hall 2023).

Moreover, as the environmentally involved and the average practitioners showed low intention to continue composting, having different focus groups and programs to see what strategies are more effective to easing the sustained adoption of those PEB might be beneficial. For instance, while many towns give incentives to purchase a composter container, not many finance the materials needed to sustain this activity. Additionally, the environmentally involved had a higher percentage of children cohabitation than the other groups, so programs targeting children's education may boost the PEB adoption of the whole family. Despite some papers on children's education and PEB adoption (Zsóka et al. 2013; Hirose 2015; de Leeuw et al. 2015; Izumi et al. 2020), more research on the field is needed especially due to nuances between countries' education systems and cultural values.

Conclusion

The present analysis extended previous segmentation studies on food consumption to comprise food recycling behaviors. The results showed that health concern, and high adoption rates on ethical consumption and food waste prevention are not necessarily associated with high engagement on alternative food waste disposal in Japan. Prevention, and to a certain extent ethical consumerism seem to be more common practices, while the adoption of alternative disposal methods is rarer. And so, even though the biggest group, the responsible consumers, frequently tried to prevent waste, had healthy eating habits, and purchased in a sustainable way, they rarely composted or recycled their food waste in any way. Four clusters were found: sporadic adopters; average practitioners; responsible consumers; and environmentally involved. Approximately 51% of the sample was allocated to the responsible consumers cluster, which was characterized as older than the other clusters and with more women in part-time jobs or in-house duties. environmentally involved tended to be young respondents with children and gardening/farming interest. They were also the ones who ate plant-based meals more frequently and often paid attention to the healthiness of their meals. Thus, they seem to live under a lifestyle of health and sustainability.

The nuance of the reported intention to engage on composting shows the importance of understanding how habits are created and sustained to design effective adoption strategies (Steg and Vlek 2009). Its findings and limitations set ground for further research on food waste management specially in the Japanese Market.

Limitations and future research

Firstly, this analysis relied on self-reported qualitative data, and only considered respondents over 30 years old and from 9 of the 47 prefectures. The prefectures included are among the most populated in Japan, but further analysis is needed before generalizing these conclusions to all Japanese spheres, especially to younger generations. According to the results, the environmentally involved respondents belonged to the younger generations or the oldest in the sample. Hence, understanding whether the clustering profiles still hold on a wider age spectrum could be relevant for designing effective adoption strategies. This latter point also suggests that if researchers wish to focus on an older sample, other collection alternatives, such as mail survey, or interviews, might be preferable, as older people are not as prevalent in survey agencies' databases. Additionally, once the data was

qualitative, there was no indication of what kind of food waste was thrown away (opened, leftover, expired date) (Okayama et al. 2021) and how much was thrown away. It may occur that people who reported high engagement on PEB produce more waste than people who reported smaller rates. For example, it might be a numerous household (Nakamura et al. 2022).

This research had a mostly exploratory scope, and further analysis should be done regarding the decision-making process, especially on food recycling behaviors. These behaviors are still under-explored from a psychological and behavioral theory perspective (Sewak et al. 2021), especially when compared to both ethical consumption and preventing behaviors. In the Japanese market, to the authors' knowledge, the only paper looking at composting from a theoretical behavior model perspective was Tanaka et al. (2011). The current findings also call for the importance of better understanding possible facilitators for adoptions of these behaviors (Bernstad 2014; DiGi- acomo et al. 2018; Leeabai et al. 2022), the relevance of assessing how marketing campaigns worked in different regions (Hotta and Aoki-Suzuki 2014; Zheng et al. 2017; Duque-Acevedo et al. 2022), and the urgency of discussing alternative ways to treat organic waste (both at a central and decentralized level) that are socially, legally, economically, and environmentally viable given the unique characteristics of the area (Takata et al. 2012; Okayama 2016; Pai et al. 2019; Babalola 2020).

Finally, although the food recovery framework mentions collective and community-based actions like food banks (Liu et al. 2016) or the use of food waste-reducing (digital) platforms (de Almeida Oroski and da Silva 2023), those were not included. Thus, similar to works like Ando et al. (2010), Bamberg et al. (2015), Christie and Waller (2019), and Roseira et al. (2022), further exploration of ethical consumption, waste prevention, and food recycling methods from a collective and community perspective could show interesting results.

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Data availability The dataset generated for this study is available on request to the corresponding author.

Declarations

Conflict of interest The authors declare no competing interests.

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