Csapody and Fata
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Segmenting generation Z's attitudes towards food rescue in Budapest, Hungary: a Q-methodology study

Bence Csapody[1*] and Flóra Fata[2]

*Correspondence:
bence.csapody@uni-corvinus.hu

[1] Corvinus Institute for Advanced Studies (CIAS), Corvinus University of Budapest, Budapest, Hungary
[2] Department of World Economy, Corvinus University of Budapest, Budapest, Hungary

Abstract

Food waste remains a major sustainability challenge worldwide, driving interest in innovative solutions such as digital food rescue platforms. This study explores Generation Z consumers' perspectives on food rescue technologies, food-related routines, and sustainability practices in Budapest, Hungary. Using Q-methodology, four distinct consumer groups were identified: Open-minded Sustainable Explorers, Sceptic and Conscious Meal Planners, Conservative Habitual Quality Advocates, and Adventurous Food Enthusiasts. This typology reflects diverse motivations, including ethical values, planning orientation, and habitual behaviour. The findings highlight how trust, planning habits, and openness to novelty shape the use of digital food platforms for waste reduction. By applying Q-methodology, this research demonstrates the value of capturing nuanced consumer perspectives beyond binary "green" versus "mainstream" distinctions, offering practical insights for targeted interventions and platform design. The study contributes to the underexplored intersection of food rescue, sustainability, and digital consumer behaviour among Generation Z.

Keywords: Food rescue, Q-methodology, Sustainable consumption, Generation Z, Consumer typology, Hungary, Digital food platforms, Food waste reduction

Introduction

Food loss and food waste have become a critical global concern due to its far-reaching environmental, economic, and social consequences (Cheng et al. 2025). The United Nations' Environment Programme estimates that 1.05 billion tonnes of food are wasted globally, equal to 132 kg per capita (UNEP 2024), implying that 19% of the available food is thrown away. These figures underscore the urgent need for targeted interventions across all segments of the food supply chain (FSC).

Food waste, as defined by the Food and Agriculture Organization of the United Nations, refers to food that is *"appropriate for human consumption being discarded, whether after it is left to spoil or kept beyond its expiry date"* (FAO 2013). While food losses are generated at both upstream (production and supply) and downstream (consumption) stages of the food supply chain, empirical evidence indicates that consumption-oriented sectors, particularly households, hospitality services, and retail, account

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for a disproportionately large share of total food waste. According to the latest available data from the United Nations, the hospitality sector, particularly food service establishments, generates an average of 36 kg of food waste per capita per year, more than twice as much as the retail sector, but still less than half of the household level, that accounts for 79 kg per capita per year (UNEP 2024). In the restaurant context, food waste is typically categorised into three main types: kitchen waste, serving waste, and plate leftovers (Silvennoinen et al. 2015). Plate waste can be attributed to portion size (Heikkilä et al. 2016), food quality (Pirani and Arafat 2016; Filimonau et al. 2023), and menu variety (Ellison et al. 2019), which reflect suboptimal restaurant strategies and consumer habits (Nunkoo et al. 2021).

In recent years, food surplus donation systems and digital redistribution platforms have gained traction as effective tools for food waste reduction. In the Hungarian context, Újhelyi and Cseh (2015) examined the operational model of food banks and found encouraging levels of engagement from both donors (e.g. food producers and retailers) and recipients (e.g. charities and community organisations). The emergence of for-profit food rescue services has further expanded the landscape of waste reduction tools. Applications such as Too Good To Go, operating in 20 countries, and Hungary's Munch connect restaurants, stores, and consumers in a shared effort to rescue unsold surplus food (Munch, n.d.). According to the latest impact report, Too Good To Go saved over 400 million meals globally by the end of 2024, with more than 100 million registered users (Too Good To Go 2024). These platforms offer an efficient way to reduce leftover waste while engaging consumers in sustainability-oriented consumption (Vo-Thanh et al. 2021).

While food waste in the hospitality sector has received increasing academic attention (Pirani and Arafat 2016; Filimonau and De Coteau 2019; Dhir et al. 2020; Cardenas et al. 2024), much of the existing research relies on quantitative indicators (Wang et al. 2022; Curry 2012; Parfitt et al. 2013; Eriksson et al. 2019; de Visser-Amundson 2022) or operational data (Betz et al. 2015; Filimonau et al. 2023; Somlai 2022), often overlooking the diverse subjective perspectives that shape consumer engagement in relation to food rescue technologies. Although prior studies have explored the cognitive and emotional drivers of Generation Z's food waste reduction (Qi et al. 2025; Kristia et al. 2023), most rely on survey data. Despite growing interest, little is known about how young consumers integrate sustainability values, digital trust, and everyday food routines when engaging with such platforms. This study advances the field by uncovering the structure of interrelated motivations: how moral, habitual, and technological factors jointly shape Generation Z's acceptance or rejection of food rescue solutions in Budapest, Hungary. Using Q-methodology, we explore how different attitudes combine into coherent viewpoints, connecting individual perspectives with broader sustainability behaviours. This methodological approach allows us to move beyond binary classifications of "green" versus "mainstream" consumers, offering instead a multidimensional exploration of everyday food decisions in a digitally influenced context. Thus, the main research question is as follows:

RQ: How do sustainability values, digital trust, and habitual food behaviours interact to form distinct attitudinal patterns towards food rescue applications among urban Generation Z consumers?

The article is structured as follows. After the introduction, the literature review examines existing studies on food waste, consumer typologies, Generation Z's food-related behaviours, and the emerging role of digital food rescue platforms. The methodology section then provides a detailed description of the Q-methodological design, including statement development, participant sampling, the Q-sorting procedure, and analytical techniques employed. The results section presents the four consumer groups identified, offering interpretative narratives that highlight distinctive attitudes and behavioural patterns. Finally, the discussion and conclusion sections contextualise these findings within broader sustainability debates, outlining theoretical and practical implications, acknowledging study limitations, and proposing directions for future research.

Literature review

Consumer typologies in food-related behaviour

Research proves that consumer behaviour around food is shaped by cognitive, psychological, and informational factors (Nie et al. 2017; Khan and Pandey 2023; Bamgboje-Ayodele et al. 2019; Liu et al. 2024). In the context of food choices and consumption, segmentation approaches have uncovered diverse consumer groups that differ in how they evaluate, process, and act on food-related information (Mirabella et al. 2025; Felicetti et al. 2023). These typologies reflect not only varying degrees of engagement but also differentiated relationships to food safety, health consciousness, sustainability, and convenience.

Bamgboje-Ayodele et al. (2019) identify consumer groups based on risk perception and information processing in relation to safe food management. Their typology suggest that some consumers actively seek detailed safety-related cues, while others rely on routine behaviours or emotional judgments, with implications for food waste prevention and proper storage practices. Distinct consumer groups rely on sensory cues, such as smell, texture, and appearance, when evaluating food safety, and many develop practical habits for reusing partially consumed food (Gong et al. 2022; Wallnoefer et al. 2024).

Similarly, psychological models of food choice indicate the emergence of consumer types based on health consciousness and food literacy, reflecting the role of internal motivations and environmental influences in shaping dietary patterns (Khan and Pandey 2023). These dimensions also provide insight into how consumers interpret and respond to sustainability-related information. Individuals with higher food literacy or information sensitivity are more likely to notice cues related to freshness, expiry dates, or ethical sourcing, and thus make more informed decisions about whether surplus or rescued food is acceptable. Conversely, consumers with limited food knowledge or low trust in labelling tend to rely on visual or habitual cues, increasing the likelihood of premature disposal or avoidance of surplus food. Hence, informational competence and perceived label credibility influence not only healthy eating but also consumers' willingness to engage in waste-reducing and food rescue behaviours (Khan and Pandey 2023). This is consistent with evidence that information sensitivity and label credibility condition consumer responsiveness (Felicetti et al. 2023) and that neophobic vs. food-curious orientations shape openness to surplus foods (Nezlek et al. 2021).

Madarász et al. (2022) analysed changes in Hungarian food purchasing during the COVID-19 lockdowns and identified three consumer groups: (1) demanding and

ethnocentric shoppers (hygiene and quality seekers), (2) comfort-oriented consumers, and (3) rational, price-conscious shoppers. Their study also demonstrates how external shocks can temporarily reshape consumption priorities.

Generation Z's food behaviour

Generation Z exhibits complex food-related behaviours. Recent research demonstrates that Generation Z's food waste reduction efforts are associated with subjective norms, perceived behavioural control, and moral identity (Qi et al. 2025; Kristia et al. 2023; Attiq et al. 2025). In this context, digital and social media environments function primarily as mediating contexts: they shape what sustainability-related information and normative cues consumers are exposed to, how these cues are framed, and how easily pro-environmental intentions can be translated into everyday practices. In this sense, influencer-driven and creative digital content may strengthen emotional connection and sustained engagement with sustainability-oriented messages, highlighting the communicative and normative signalling role of digital channels (Bryła et al. 2022). Similarly, online food delivery platforms should be understood less as direct drivers of (un)sustainable behaviour and more as consumption infrastructures that alter convenience, choice architecture, and price salience; consequently, their behavioural implications depend on how contextual cues (e.g. promotions, price framing) and individual orientations interact (Kristia et al. 2023).

Research indicates that Generation Z consumers tend to be highly aware of the environmental impact of food waste, yet this awareness alone is insufficient to ensure consistent pro-environmental behaviour. Instead, food-related decisions are mediated by social context, emotional detachment, and expectations towards food service providers, which collectively shape how sustainability concerns are enacted in practice (Huang et al. 2022; Kymäläinen et al. 2021). In this process, emotional disengagement, perceived inconvenience, and low levels of digital trust weaken the translation of intention into action, contributing to a persistent attitude–behaviour gap. In the context of food rescue platforms, such mechanisms operate through selective attention and perceived control: while Generation Z consumers may support waste reduction in principle, their engagement depends on whether digital tools make this process feel safe, transparent, and personally meaningful. Understanding these mediating factors is therefore key to interpreting how sustainability awareness evolves into or fails to become active food rescue participation. Moral conflicts and feelings of guilt further complicate their food waste behaviours in hospitality settings, especially when balancing freshness with efficiency (Goh and Jie 2019).

Consumer attitudes towards food waste reduction and food rescue

The COVID-19 pandemic has had a significant impact on consumer behaviour related to rescued food. In some regions, the pandemic led to increased food waste due to changes in shopping habits and food consumption patterns (Vasko et al. 2022). However, consumer awareness of food waste and its environmental implications varies widely; targeted marketing campaigns have proved effective in shaping more sustainable food behaviours (Nefovski et al. 2024). In this context, negative emotional stimuli can amplify the impact of sustainability messages on consumers' willingness to pay, suggesting that

negative framing may be more effective in driving prosocial purchasing behaviour (Mirabella et al. 2025).

In the context of food rescue, excess food often remains as leftovers. How these are managed is influenced by environmental attitudes, social norms, and personal sustainability beliefs (Kirmani et al. 2023; Talwar et al. 2023). Attitudes towards leftovers vary: while some consumers view them as opportunities for creative reuse, others perceive them as unappealing or unhygienic (Migliore et al. 2021).

Effective meal planning has been linked to lower levels of food waste and improved sustainability outcomes, while poor planning and over-purchasing, especially of perishable items, remain key contributors to food waste (dos Santos et al. 2022). The dichotomy between experimental and habitual food behaviours reveals the complexity of sustainable consumption: habitual routines can sometimes undermine pro-environmental intentions. Recognising the tension between habit and intention is essential for bridging the attitude–behaviour gap in sustainable food choices (Munro et al. 2023).

Food rescue behaviours are often driven by both emotional gratification and a sense of epistemic value, as consumers perceive such actions as meaningful contributions to sustainability efforts (Vo-Thanh et al. 2021). Studies have shown that individuals with strong environmental concerns and a positive attitude towards recycling are more likely to purchase rescued food (Stöckli and Dorn 2021; Chiaraluce et al. 2024). Additionally, socio-demographic factors such as gender, education level, and food involvement play a role in shaping purchasing decisions. For example, women who are aware of the environmental benefits of upcycled products are more willing to pay a premium for them (Chiaraluce et al. 2024).

Trust in the quality and safety of rescued food is a critical factor influencing consumer purchasing decisions, as perceived food risk and taste anxiety can deter consumers from buying rescued food (Sun et al. 2024). Such confusion often arises from inconsistent or unclear expiration labelling. Evidence from EU and Hungarian contexts indicates that the distinction between "best before" (quality-related) and "use by" (safety-related) labels plays a critical role in shaping consumers' understanding of shelf life and product safety (Cheng et al. 2025).

Safety concerns thus remain a major barrier to the adoption of food rescue applications, particularly when consumers question the hygiene standards of redistributed food (Lai et al. 2022). Studies indicate that transparent labelling and certification schemes can help reassure consumers about the quality of rescued food (Lai et al. 2022; Sun et al. 2024). Evidence from recent experiments shows that "best before" labels are more effective in aligning consumer interpretation with actual shelf life (Cheng et al. 2025). Positive perceptions of food quality and safety are associated with stronger purchase intentions (Berri and Toma 2023). Likewise, experiments show that framing the "use by" date as a safety marker can reduce premature disposal and unnecessary waste (Cheng et al. 2025).

Previous studies demonstrate that providing information about the environmental and social benefits of rescued food can increase consumer acceptance and purchase intentions (Chiaraluce et al. 2024; Rohm et al. 2017). Abstract product descriptions paired with environmental benefit appeals can increase consumer evaluations of rescued food, while concrete product presentations featuring financial benefits can enhance purchase intentions and willingness to pay (de Visser-Amundson et al. 2023).

Additionally, the use of blind boxes for surplus food has been shown to increase purchase intentions when factors such as food quality and perceived sustainability are emphasised (Sun et al. 2024). However, strict time windows for picking up food rescue packages may be perceived as inconvenient or risky, discouraging potential users from engaging with such services (Fraccascia and Nastasi 2023).

In the Hungarian context, Szakos et al. (2021) examined household food waste behaviour and found that everyday cooking and storage habits (such as over-preparing meals, improper leftover handling, and inadequate storage) were the strongest drivers of waste. Their findings highlight the importance of behaviour-focused interventions and education within national prevention strategies. Unger-Plasek et al. (2025) emphasised the role of ecological guilt as a motivator of sustainable consumption, noting that guilt–reactive consumers are more likely to engage in waste-reducing practices, though this emotional trigger has limited long-term effects on deeper behavioural change. Together, these studies contextualise Hungarian food waste attitudes within broader European sustainability trends and underscore the need to consider cultural and situational factors when interpreting Generation Z's engagement with food rescue initiatives.

Digital food practices and food rescue

Digital food practices refer to the application of digital platforms and technologies within the food service industry, significantly transforming how food is produced, distributed, and consumed. This digitalisation has notably accelerated due to the COVID-19 pandemic, which drove consumers to increasingly adopt food delivery platforms as essential elements of their consumption habits (Varese et al. 2024). Digital platforms offer enhanced convenience and variety, effectively disrupting traditional food supply chains by enabling rapid, home delivery networks (Short et al. 2022). Speed of service has become a decisive factor influencing consumer preferences, often outweighing the desire for home-cooked meals (Chandrasekhar et al. 2019).

Literature identifies digitalisation as a chance to modernise and engage sustainability-conscious consumers more transparently (Masi et al. 2025). In recent years, digital food rescue platforms have emerged as tools for reducing food waste and addressing food insecurity. These platforms harness digital technologies to redistribute surplus food, facilitating efficient connections between food producers, retailers, and consumers. Digital tools also contribute substantially to waste reduction efforts within industrial canteens, where they help monitor food provisioning and consumption, thereby generating economic and environmental benefits (Principato et al. 2023).

Beyond their environmental impact, food rescue initiatives deliver significant social value. Research indicates a strong social return on investment (SROI), with every dollar invested in food rescue yielding approximately $4.50 in social benefits (Clare et al. 2023). This underscores the importance of supporting food rescue initiatives through targeted policy interventions and financial contributions. Additionally, food rescue organisations extend their value proposition beyond mere nutritional assistance, as evidenced by case studies demonstrating their role in fostering community engagement and social connections (Mannette 2021).

Methodology and sample

This study employed Q-methodology to explore subjective preferences, attitudes, and opinions on food rescue, waste reduction, and digital food consumption. Q-methodology was chosen for its ability to identify shared patterns of thought while preserving the richness and complexity of individual viewpoints. Q-methodology is a research technique developed by William Stephenson in 1935 to study subjectivity systematically. It involves participants (P-sample) sorting a set of statements (Q-sample) according to their relevance or agreement, allowing researchers to identify patterns and groupings of opinions (Kumar et al. 2023; Rhoades and Brown 2019). The process includes defining the research objective and questions, developing the Q-sample, selecting participants, conducting the Q-sort, and analysing the data using factor analysis or other statistical methods (see Fig. 1).

Q-methodology bridges the gap between qualitative and quantitative research by combining the depth of qualitative insights with the rigor of statistical analysis. It has gained significant attention in consumer preference research due to its ability to handle complex, multivariate stimuli and provide nuanced insights into individual and group perspectives (Gao and Soranzo 2020; Gabor and Cristache 2021). The methodology is particularly useful in consumer research because it captures the complexity of human subjectivity and provides a structured yet flexible framework for understanding preferences (Gabor and Cristache 2021; Matzner et al. 2015).

Q-methodology has proved to be a valuable tool for examining consumer attitudes and perceptions in various domains. In the context of technology adoption, it has been employed to investigate consumer attitudes (Berényi 2023), while in the food industry, it has facilitated the exploration of consumer perceptions related to innovative products (Coimbra et al. 2020) and healing foods (Song et al. 2024). Despite these applications,

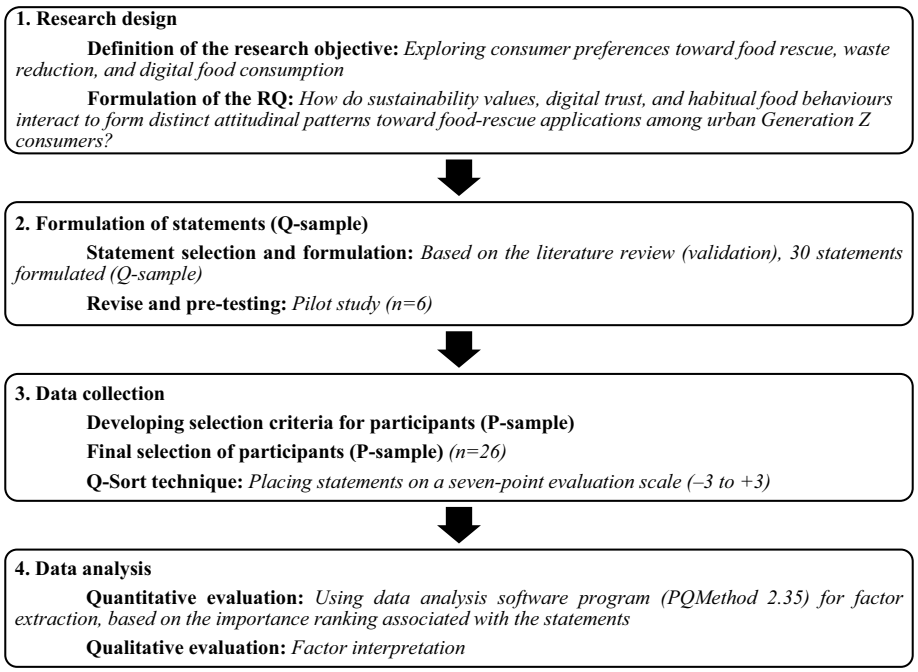

Fig. 1 Overview of the research design, data collection, and analysis process

the use of Q-methodology remains relatively limited within the agrifood sector (Mandolesi et al. 2023) and restaurant management research (Kim 2018). In contrast, its presence in tourism studies has expanded considerably, with a growing body of the literature highlighting its relevance and utility in this field (Ásványi and Chaker 2023; Csapody et al. 2025).

Research design and development of the Q-sample (statements)

Based on the literature review, the main research objective (*"exploring consumer preferences towards food rescue, waste reduction, and digital food consumption"*) and question (RQ) were formulated: *"How do sustainability values, digital trust, and habitual food behaviours interact to form distinct attitudinal patterns towards food rescue applications among urban Generation Z consumers?".*

The Q-sample comprises a collection of statements intended to capture the diversity of viewpoints related to the research topic (Radtke 2024; Song et al. 2024). In this study, the Q-sample was developed through a multi-stage process to ensure coverage, clarity, and balance:

1. First, insights were drawn from a *comprehensive review* of the relevant literature.
2. Then, the results were *structured into content domains* (e.g. digital platforms and trust; planning and routines; price/value; packaging and hygiene; openness/novelty; risk and reliability).
3. From this concourse, the *initial Q-sample was drafted* that was clear, concise, jargon-free, and balanced in positive and negative phrasing to minimise agreement bias.
4. Next, we *refined the list* by removing overlaps and ensuring balanced coverage of attitudinal, normative, and behavioural themes, producing the final set of 30 statements (see Table 1).
5. Finally, *wording and comprehensiveness were validated* via a cognitive pilot with six participants, which led to minor phrasing refinements before data collection.

Participant selection (P-sample) and Q-sorting process

The P-sample refers to the individuals who participate in the Q-sorting process. Participants are typically selected to represent diverse perspectives, ensuring that the study captures a wide range of opinions (Radtke 2024). Data collection was conducted between 15 January and 9 February 2025. In Q-methodology the P-sample is purposive and designed to cover a range of viewpoints rather than to be statistically representative. Generation Z adults were targeted living in Budapest and used two channels: (1) university mailing lists and student organisations and (2) limited snowballing (one wave) from initial respondents to widen the pool.

Inclusion criteria were: age within Generation Z (birth years ranging from 1995 to 2009), residence in Budapest, and willingness to complete a Q-sort on food rescue and food waste topics (users and non-users of rescue apps were both eligible). Although geographically confined to Budapest, the sample included participants from both central urban neighbourhoods and outlying suburban areas. Targeting this population enabled

Table 1 Q-sample (statements) applied for the research

No	Statements	Theoretical background
1	I frequently patronise restaurants or utilise food delivery platforms such as Foodora and Wolt	Varese et al. (2024)
2	The price of meals does not considerably influence my dietary choices	Chiaraluce et al. (2024)
3	I consciously plan my meals in advance and therefore resist unanticipated deviations in my dietary routine	dos Santos et al. (2022)
4	I engage with food rescue services as a means of actively contributing to the reduction of food waste	Nefovski et al. (2024), Vo-Thanh et al. (2021)
5	When evaluating food spoilage, I prefer to rely on digital tools or sensory indicators (e.g. smell, appearance, texture) rather than solely depending on expiration dates or packaging labels	Gong et al. (2022), Wallnoefer et al. (2024)
6	I find personal enjoyment in experimenting with new recipes and diverse culinary techniques	Munro et al. (2023)
7	I intentionally avoid storing food for extended periods due to concerns regarding spoilage	Nefovski et al. (2024), Vo-Thanh et al. (2021)
8	I find it difficult to adjust to unfamiliar food options once I have developed preferences for certain products	Nezlek et al. (2021)
9	I prefer food delivery services primarily due to their efficiency and timely service	Chandrasekhar et al. (2019)
10	I have consistently received high-quality service and have rarely experienced dissatisfaction with service standards	Vo-Thanh et al. (2021)
11	I regard the use of high-quality ingredients as fundamental to my cooking practices	Migliore et al. (2021)
12	I place considerable trust in food service providers, which positively influences my decision to order from them	Sun et al. (2024)
13	I remain sceptical about the potential of individual actions to significantly alleviate the issue of food waste	Nefovski et al. (2024); Vo-Thanh et al. (2021)
14	Due to the inconvenience associated with cleaning greasy containers, I typically discard them after a single use	Gallego-Schmid et al. (2019)
15	I frequently rely on food rescue applications, especially because I seldom prepare meals myself	Munro et al. (2023)
16	I am reluctant to consume food that does not meet my visual or aesthetic expectations	Migliore et al. (2021)
17	I exhibit a strong preference for purchasing domestically produced food products	Migliore et al. (2021)
18	I choose food rescue applications primarily due to their cost-efficiency relative to other food sources	Chiaraluce et al. (2024)
19	I am concerned about the environmental implications of excessive packaging	Migliore et al. (2021)
20	I rarely make use of disposable containers, plastic bags, or single-use cutlery	Munro et al. (2023)
21	I am open to culinary novelty and look forward to discovering the contents of food rescue packages	Migliore et al. (2021)
22	I avoid using food rescue services due to concerns about their reliability	Lai et al. (2022)
23	I prioritise familiarity and quality by ordering exclusively from trusted establishments	Munro et al. (2023)
24	I intentionally select affordable ingredients when preparing meals	Roy and Harrington (2021)
25	I am not deterred by the condition that food rescue orders must be collected after business hours	Fraccascia and Nastasi (2023)
26	I consider minor aesthetic imperfections in food acceptable as long as food safety is maintained	Migliore et al. (2021)
27	I prefer to consume pre-prepared meals over multiple days rather than discard leftovers	Kirmani et al. (2023), Talwar et al. (2023)
28	I consistently check expiration dates before consuming food products	Wilson et al. (2017)

Table 1 (continued)

No	Statements	Theoretical background
29	I favour food and beverages packaged in secure materials such as foil, boxes, or bags; due to the high priority I place on hygiene	Munro et al. (2023)
30	I take pleasure in exploring unfamiliar and exotic culinary experiences	Migliore et al. (2021), Munro et al. (2023)

Table 2 Control questions applied for this research

Questions	Answers
1. In the past 3 months, how often have you used a food delivery service (e.g. Wolt, Foodora)?	(a) at least once a week (b) a few times per month (c) once (d) never
2. In the past 3 months, how often have you used a food rescue application (e.g. Munch, Too Good To Go)?	(a) at least once a week (b) a few times per month (c) once (d) never
3. Have you ever consumed food that was sold near its best before date?	(a) yes (b) no
4. Have you ever chosen to buy or consume food that had a slight visual imperfection (e.g. odd shape, damaged packaging)?	(a) yes (b) no

the exploration of emerging food consumption behaviours within a digitally literate and environmentally aware generation, aligning with the study's objective. From 79 invitations, 28 completed the Q-sort (35.44% response rate). Following quality control procedures, 26 responses were deemed suitable for analysis, while 2 sorts were excluded due to incomplete data or inconsistencies with the control criteria (see Table 2). The sample size is consistent with the norms of Q-methodology, which emphasises variety and depth of perspective over statistical representativeness (Kumar et al. 2023).

The majority of the participants (53.85%) were born between 2000 and 2004, followed by 30.77% in the 1995–1999 cohort and 15.38% in the 2005–2009 cohort. In terms of place of residence, most participants lived in central urban neighbourhoods (73.08%), while a smaller proportion (26.92%) resided in suburban areas. Regarding housing situation, half of the sample (50.00%) lived in student dormitories or residence halls, 30.77% rented private accommodation, and 19.23% lived with parents or family (see Table 3). This purposive sampling strategy ensured the inclusion of diverse subjective perspectives from a digitally literate demographic that regularly engages with online food platforms and is increasingly targeted by food rescue and sustainability initiatives.

The Q-sorting process involves participants arranging the Q-sample statements on a grid according to their level of agreement or disagreement. This process was conducted using tables developed in Microsoft Excel and accompanied by comprehensive instructions to support participants in completing the evaluation grids. These materials were distributed directly to participants, and researchers remained available throughout the process to assist with the sorting and address any questions. Q-sorting stage applied a

Table 3 Socio-demographic characteristics of the P-sample

Variable	Category	n	%
Birth year	1995–1999	8	30.77
	2000–2004	14	53.85
	2005–2009	4	15.38
Gender	Male	15	57.69
	Female	11	42.31
	Non-binary/Third gender	0	0
	Prefer not to say	0	0
Place of residence	Central urban area	19	73.08
	Suburban area	7	26.92
Housing situation	Student dormitory/residence hall	13	50.00
	Private rental accommodation	8	30.77
	Living with parents or family	5	19.23

Table 4 Distribution grid applied for the Q-sorting process

most disagree *most agree*

-3 *3 statement*	-2 *4 statement*	-1 *5 statement*	0 *6 statement*	+1 *5 statement*	+2 *4 statement*	+3 *3 statement*

forced quasi-normal distribution (−3 to+3), allowing only a limited number of statements per ranking level. Each participant was asked to rank the 30 statements along a quasi-normal distribution grid (see Table 4), ranging from −3 (most disagree) to+3 (most agree), according to the degree to which each statement reflected their personal viewpoint. The Q-sorts were then entered into a data analysis software program (PQMethod Version 2.35) for factor extraction and interpretation.

Data analysis

The Q-sort correlation matrix (see Appendix 1) provides an overview of the intercorrelations between individual Q-sorts, illustrating the extent to which participants share similar viewpoints. Higher positive correlations indicate stronger consensus in the sorting patterns, while lower or negative values reflect divergent subjective perspectives. This pattern confirms that the study sample captures a meaningful range of shared and contrasting attitudes towards food rescue behaviours.

The analysis of Q-methodology data typically involves factor analysis to identify shared patterns of opinion among participants. This step helps in grouping participants into clusters or factors that represent distinct consumer segments (Gabor and Cristache 2021; Matzner et al. 2015). In our research, a four-factor solution was extracted, based on three criteria:

(1) An eigenvalue of at least 1.00 (see Table 6),
(2) A maximum correlation of 0.50 between factors (see Table 5), and

Table 5 Correlations between factor scores

	Factor 1	Factor 2	Factor 3	Factor 4
Factor 1	1.0000	0.2511	0.1990	0.4474
Factor 2	0.2511	1.0000	0.2919	0.2018
Factor 3	0.1990	0.2919	1.0000	0.1580
Factor 4	0.4474	0.2018	0.1580	1.0000

Table 6 Factor matrix with defining sorts indicated

Q-Sorts	Factor loadings			
	Factor 1	Factor 2	Factor 3	Factor 4
R01	**0.6832**	0.4811	-0.0288	0.1278
R02	**0.8057**	0.0943	0.2245	0.2501
R03	0.1067	**0.6004**	0.2221	-0.0387
R04	**0.7416**	-0.0143	-0.2838	0.0991
R05	**0.5734**	-0.1204	0.3295	0.1521
R06	0.3422	-0.2376	-0.2725	**0.4482**
R07	**0.5202**	0.0607	-0.2717	0.1488
R08	0.0262	0.2219	**0.7542**	0.1202
R09	**0.5896**	0.0305	0.2186	0.5002
R10	**0.4829**	-0.3815	-0.3191	-0.4307
R11	**0.606**	0.4654	-0.0632	0.0988
R12	0.362	0.136	0.1102	**0.7091**
R13	0.2465	**-0.6168**	0.4018	-0.1973
R14	**0.5808**	0.2912	-0.054	0.4816
R15	-0.1946	0.0044	**0.5586**	0.0674
R16	-0.0347	0.0264	0.0575	**0.8196**
R17	0.1668	0.3859	-0.1028	**0.7269**
R18	0.2898	0.0819	-0.3013	**0.4412**
R19	0.1621	0.069	**0.6189**	-0.3236
R20	0.348	**0.4749**	-0.2254	0.1403
R21	0.4094	-0.3056	0.2546	**0.6176**
R22	**0.5713**	0.3737	0.148	0.1991
R23	0.223	**0.729**	0.2561	0.0055
R24	**0.8148**	-0.0668	0.0786	0.0382
R25	0.3986	0.3261	**0.6195**	0.3586
R26	0.076	**-0.6495**	-0.1317	-0.0426
# of defining variables (n)	11	5	4	6
Explained variance (%)	21	13	11	14
Eigenvalue	7.4247	3.0911	2.4722	2.2031
Composite reliability	0.978	0.952	0.941	0.960

Bold values indicate defining sorts (participants loading significantly on each factor)

(3) A minimum of two Q-sorts loading significantly on each factor (see Table 6).

Prior to interpretation, factor extraction was performed using centroid factor analysis with varimax rotation, following the standard Q-methodological procedure. Varimax rotation was chosen for its ability to maximise factor simplicity and minimise

cross-loadings, thereby facilitating clear interpretation of shared viewpoints. The initial unrotated solution yielded five factors with eigenvalues greater than 1.00, explaining 66% of the total variance. However, the fifth factor was retained by only one significantly loading Q-sort (0.35), failing to meet the minimum criterion of two defining sorts per factor. The four-factor solution explained 59% of the total variance (Factor 1 = 21%, Factor 2 = 13%, Factor 3 = 11%, Factor 4 = 14%), offering a clear and interpretable structure without unnecessary complexity. Composite reliability values (0.941–0.978) exceed the recommended threshold of 0.80 (see Table 6), indicating high internal consistency and robust factor reliability.

Factor loadings were computed and examined, with marked defining sorts indicating which participants loaded significantly on each factor (see Table 6). Each factor was then interpreted through its idealised Q-sort (the composite ranking of statements), with both Z-scores and Q-sort values analysed to determine the relative salience of each statement. In addition to the factor arrays, distinguishing statements (those that significantly differentiate one factor from others) and consensus statements (those ranked similarly across all factors) were identified. Distinguishing statements provided the basis for constructing rich, qualitative interpretations of each factor, while consensus statements revealed areas of shared value among participants.

Results

Consumer typology

This section presents the four consumer groups identified through Q-methodology, each representing a distinct set of subjective viewpoints related to food rescue applications, digital food practices, and food-related behaviours. To contextualise the four groups, Table 7 reports the segment-specific gender composition, mean age, and housing situation shares based on defining Q-sorts.

Factor 1—open-minded sustainable explorers

Participants loading on Factor 1 reflect a profile of resourceful, ethically driven individuals who prioritise sustainability, culinary creativity, and mindful food use. Labelled as Open-minded Sustainable Explorers, these consumers actively engage in behaviours that reduce food waste, appreciate variety and experimentation in their meals, and maintain

Table 7 Factor level socio-demographic profiles

Variable/Category	Factors							
	Factor 1		Factor 2		Factor 3		Factor 4	
	n	%	n	%	n	%	n	%
Gender								
Male	6	54.55	3	60.00	2	50.00	4	66.67
Female	5	45.45	2	40.00	2	50.00	2	33.33
Housing situation								
Student dormitory or residence hall	6	54.55	2	40.00	2	50.00	3	50.00
Private rental accommodation	3	27.27	2	40.00	1	25.00	2	33.33
Living with parents or family	2	18.18	1	20.00	1	25.00	1	16.67
Mean age (years)	24.2		23.5		22.5		24.0	

high hygiene standards. Their food practices are guided more by intrinsic motivation and values than by external convenience or cost-based incentives.

The highest ranked item, *"I find personal enjoyment in experimenting with new recipes and diverse culinary techniques."* (Z = 2.036), underscores their openness to creative culinary practices. They are also pragmatic in accepting imperfections in food appearance, provided safety is ensured (Z = 1.388), and emphasise hygienic standards (Z = 1.330) as part of responsible food use. This group strongly supports sustainable behaviours: consuming leftovers (Z = 1.320), avoiding disposables (Z = 0.856), and minimising packaging waste (Z = 0.753). They show financial mindfulness through selecting cost-effective ingredients (Z = 1.212), aligning economic practicality with ecological values.

Despite aligning with the goals of food rescue applications, these individuals do not use them regularly. Their rejection is not rooted in distrust or scepticism, but in their own effective food planning and self-sufficiency. They disagree with statements indicating reliance on food rescue platforms (Z = − 1.249 and Z = − 1.197), setting them apart from app-driven sustainability consumers.

Open-minded Sustainable Explorers represent a values-driven, proactive factor whose sustainable behaviours are deliberate and embedded in their culinary identity. Their limited use of food rescue apps stems from personal efficacy in managing waste, rather than opposition to the concept. While they are generally positive towards food rescue concepts, their app engagement reflects a self-directed interaction between sustainability values and perceived autonomy. They would use platforms such as Munch or Too Good To Go mainly as creative sustainability tools, when digital trust and control over preparation remain in their hands. Their limited use thus reflects confidence in their own food management habits rather than scepticism towards technology.

Factor 2—sceptic and conscious meal planners

This factor captures individuals who value planning, consistency, and local sourcing. Sceptic and Conscious Meal Planners exhibit food behaviours rooted in discipline and caution, trusting familiar routines and domestic food systems. Their decisions are guided by predictability, verifiability, and scepticism towards externally controlled services like food delivery or rescue apps.

Their defining statement, *"I consciously plan my meals in advance and therefore resist unanticipated deviations in my dietary routine"* (Z = 1.839), highlights a strong reliance on structure and foresight. Additional markers include regular checking of expiration dates (Z = 1.181) and resistance to dietary novelty (Z = 0.976, $p < 0.01$). They prefer domestically labelled products (Z = 1.345) and care about packaging waste (Z = 1.029), yet express low engagement with digital convenience tools. Notably, they score low on statements such as *"I frequently patronise restaurants or utilise food delivery platforms such as Foodora and Wolt"* (Z = − 1.981) and *"I frequently rely on food rescue applications, especially because I seldom prepare meals myself"* (Z = − 1.875).

Sceptic and Conscious Meal Planners are cautious, consistency-oriented consumers who trust their own planning and routines over unfamiliar innovations. They uphold sustainability and quality, but within a traditional, self-directed consumption model that avoids convenience-driven behaviours. This group represents the highest attitudinal resistance to food rescue apps, not due to opposing sustainability values but because

of perceived risk and loss of control. Their potential engagement with these platforms depends on visible reliability cues (e.g. traceability badges, transparent sourcing, and fixed pick-up times) that could align digital trust with their structured routines.

Factor 3—conservative habitual quality advocates

Factor 3 reflects a group with strong attachments to familiar routines and established food preferences. Identified as Conservative Habitual Quality Advocates, these consumers prioritise quality and sustainability, but their behaviours stem from habit rather than planning or exploration. Emotional comfort and consistency are central to their food-related decisions.

Their highest ranking items include a preference for high-quality ingredients ($Z = 1.808$) and concerns about waste and disposables ($Z = 1.410$, 1.230, and 1.178). However, they strongly agree that they find it difficult to adopt new food alternatives ($Z = 1.766$, $p < 0.01$) and reject planning and experimentation ($Z = -1.114$ and $Z = -1.083$, respectively). They neither strongly support nor reject food rescue or delivery services. Their behaviours suggest passive disinterest rather than ideological opposition—they simply rely on what is familiar.

Here, habitual food behaviour dominates over both sustainability and digital curiosity. Their relationship to food rescue platforms is largely passive acceptance: they would not reject Too Good To Go in principle but require minimal disruption to established routines. If the platforms reinforced existing trust relationships (e.g. same merchants, predictable bundles), adoption could occur without demanding behavioural change. Conservative Habitual Quality Advocates embody a stability-seeking factor whose sustainable behaviours are internalised and habitual. They are less likely to adopt new tools or practices, not due to opposition but due to their deep-rooted culinary habits.

Factor 4—adventurous food enthusiasts

Participants in Factor 4 express a distinctive combination of ecological awareness, openness to novelty, and active digital engagement. Referred to as Adventurous Food Enthusiasts, they integrate sustainability into their lifestyle not through rigid planning but through curiosity, discovery and experimentation. They view food choices as opportunities for creative learning and social connection rather than moral duty. High positive rankings for statements such as "*I find personal enjoyment in experimenting with new recipes*" ($Z = 1.954$) and "*I enjoy discovering the contents of food-rescue packages*" ($Z = 1.320$) highlight a playful and exploratory attitude that is both sensory and ethical.

Unlike the Open-minded Sustainable Explorers, whose motivation stems from intrinsic ecological responsibility and self-sufficiency, Adventurous Food Enthusiasts are externally oriented, seeking stimulation and meaning through interaction with broader food cultures and digital communities. They value global diversity ($Z = 0.918$) and are receptive to cultural fusion in cuisine, linking sustainability with personal enrichment and social experience. Their trust in digital platforms is comparatively higher: they perceive apps such as Munch or Too Good To Go not only as waste reduction tools but also as gateways to new tastes, stories, and ethical discovery.

Behaviourally, they differ from other groups by combining risk taking and value alignment, willing to try "imperfect" food items or untested vendors when the process feels

authentic, transparent, and environmentally beneficial. They appreciate gamified features (e.g. "impact meters" or "challenge badges") and community aspects of sustainable consumption, often sharing their experiences online. In this sense, their sustainability is experiential and expressive, rather than procedural or habitual. Adventurous Food Enthusiasts represent a globally oriented, value-driven factor. They actively seek novelty and uphold sustainability, navigating food decisions with intentional flexibility and ethical awareness.

Consensus statements: shared values across divergent perspectives

Despite the divergent viewpoints captured through the factor analysis, Q-methodology also provides insight into underlying commonalities: values that transcend the differences in how participants relate to food practices. In the present study, two statements emerged as consensus items, meaning that they did not statistically distinguish between any pair of the four extracted factors.

The first consensus statement *("I frequently rely on food rescue applications, especially because I seldom prepare meals myself.")* was rejected across all four factors, with Z-scores ranging from −1.35 (Factor 4) to −1.88 (Factor 2). This item was also non-significant at the $p > 0.05$ level, suggesting particularly strong agreement across the sample. This widespread disapproval indicates that participants are reluctant to associate food rescue apps with a lack of cooking. Even for those who value sustainability or convenience, reliance on external services as a substitute for home preparation is not seen as desirable. The rejection of this statement likely reflects an underlying value placed on personal responsibility in food preparation, a cultural ideal that persists even as food technologies and delivery platforms proliferate. For participants across all four factors, the act of cooking appears to be tied to notions of autonomy, control, or quality assurance, and is not easily outsourced to app-based systems.

The second consensus item (*"I am concerned about the environmental implications of excessive packaging."*) achieved moderately to strongly positive Z-scores across all factors (ranging from 0.75 to 1.41). Although there were slight variations in the intensity of agreement, the statement did not distinguish significantly between any of the factors and thus serves as a shared marker of environmental concern. The consistent endorsement of this view suggests that packaging waste represents a cross-cutting issue, one that resonates with a broad spectrum of consumers. Whether their motivations are rooted in planning, habit, ethics, or exploration, participants uniformly acknowledge the environmental impact of food packaging. This finding reflects the increasing salience of ecological awareness in public discourse and consumer behaviour and may point to opportunities for unified messaging in policy or advocacy efforts.

The two consensus items show that (a) food rescue services are seen as a complement to home cooking, not a substitute; and (b) excess packaging is widely disliked. These points hold across all segments, even though they differ in routines, risk tolerance, and motivations.

Discussion

This Q-methodological typology illustrates that engagement with sustainable food practices is not uniform but is shaped by differing priorities such as creativity, structure, routine, and ethical curiosity (Table 8). While some consumers are proactive and

experimental in reducing food waste, others rely on habitual or tradition-based consumption patterns, and their openness to food rescue services varies accordingly. Thus, the findings demonstrate that sustainability-related behaviours intersect with digital food practices and personal routines in diverse ways, offering insight into the nuanced drivers of consumer engagement. Prior models of pro-environmental behaviour (such as the Theory of Planned Behaviour and value-belief-norm frameworks) conceptualise sustainability-related action through interrelated attitudinal, normative, and control-related determinants (Qi et al. 2025; Kymäläinen et al. 2021). These frameworks do not assume that such determinants act independently, nor that they cannot coexist within individuals. Building on this foundation, the present typology does not challenge existing behavioural theories but complements them by illustrating how these multiple determinants are subjectively integrated into qualitatively distinct orientations towards food, trust, and digital mediation. Rather than positioning sustainability engagement along a single linear scale of environmental concern, the findings reveal diverse configurations in which similar concerns are organised, prioritised, and enacted differently across consumer profiles. In this sense, the contribution lies in offering an interpretive perspective that captures how established determinants are combined in everyday food rescue practices.

Open-minded Sustainable Explorers, characterised by their intrinsic motivation and culinary openness, align closely with previous findings by Qi et al. (2025) and Kristia et al. (2023), emphasising the role of subjective norms and moral identity in shaping proactive sustainability behaviours. Similarly, Adventurous Food Enthusiasts reflect the combination of digital and exploratory tendencies discussed by Varese et al. (2024). In contrast, Sceptic and Conscious Meal Planners exhibited strong preferences for reliability, predictability, and local sourcing (Felicetti et al. 2023; Bamgboje-Ayodele et al. 2019). Their scepticism towards digital food rescue platforms underscores barriers identified by Lai et al. (2022) and Sun et al. (2024), such as concerns over food safety and trustworthiness. Conservative Habitual Quality Advocates further exemplify the habitual dimension of food behaviour, resonating with research by Munro et al. (2023) that suggests habitual practices can both support and undermine sustainability goals, depending on consumer perceptions and routines.

Regarding the consensus statements, agreement that rescue apps should not replace cooking suggests that Generation Z value cooking as a skill and routine that gives them control. Platforms are more acceptable when they help with planning, add variety, and reduce waste, rather than trying to replace cooking. Second, broad concern about too much packaging points to a general environmental expectation.

Theoretical implications

This article provides theoretical and methodological contributions by demonstrating how Q-methodology can be applied to explore subjective viewpoints within the emerging field of digital food rescue consumption among Generation Z consumers. Although Q-methodology has previously been used to study waste management and food loss prevention (Mbeng et al. 2009a, 2009b; Nasso et al. 2024), its use in connecting digital trust,

Table 8 Overview of consumer groups emerging from Q-methodology analysis

FACTOR	CORE ORIENTATION	VIEW ON FOOD RESCUE APPS	VIEW ON DIGITAL FOOD PRACTICES	SUSTAINABILITY APPROACH
FACTOR 1: OPEN-MINDED SUSTAINABLE EXPLORERS	Creative, eco-conscious, and pragmatic; sustainability through personal initiative and experimentation	Supportive in principle, but do not use due to self-sufficiency	Do not rely on delivery services; prefer self-prepared meals	Deliberate and value-driven; reduce waste, avoid disposables, cook resourcefully
FACTOR 2: SCEPTIC AND CONSCIOUS MEAL PLANNERS	Structured, traditional, and quality-driven; emphasises routine, planning, and domestic sourcing	Sceptical and disengaged due to a preference for control and familiarity	Avoid delivery apps; trust in familiar routines	Embedded in structure; support local sourcing, avoid excess packaging
FACTOR 3: CONSERVATIVE HABITUAL QUALITY ADVOCATES	Routine-based and emotionally attached to familiar practices; passive sustainability through habit	Low engagement; neither strongly reject nor actively adopt	Neutral to low engagement; prefer long-established patterns	Internalised but passive; driven by habit, not active planning
FACTOR 4: ADVENTUROUS FOOD ENTHUSIASTS	Curious and globally open; combines intentional planning with culinary and ethical exploration	Selective use based on value alignment; reject convenience-based use	Open to digital solutions if aligned with sustainability and novelty	Ethically engaged; reject overconsumption, embrace diverse, sustainable choices

habitual routines, and sustainability values within a consumer segmentation framework remains limited.

In line with earlier reviews emphasising the diversity of consumer behaviour towards food waste (Kymäläinen et al. 2021; Norton et al. 2024), this study does not challenge the existence of heterogeneity but builds upon it. Its added value lies in identifying how this heterogeneity manifests specifically within the digital food rescue context of urban Generation Z consumers. By integrating attitudinal, normative, and behavioural dimensions into a unified typology, the research refines our understanding of how pro-sustainability intentions intersect with technological engagement and everyday food practices.

Methodologically, this article demonstrates how Q-methodology effectively captures and articulates nuanced consumer attitudes that traditional quantitative surveys might overlook. The methodological rigor of combining qualitative richness with quantitative factor analysis not only deepens the understanding of consumer segments but also provides a replicable framework for future consumer behaviour research in similar contexts. This study fills a methodological gap by demonstrating the value and adaptability of Q-methodology for investigating emerging consumer behaviours towards food rescuing.

Practical implications

This study offers practical implications for stakeholders aiming to enhance consumer engagement with sustainability initiatives, particularly within the context of digital food rescue platforms. As recent reviews of social media-based sustainability communication show (Bryła et al. 2022), effective digital engagement relies on emotionally resonant storytelling and influencer content that connect ethical values with daily routines, an insight that complements the segment-based recommendations proposed here. By identifying distinct consumer groups, the research provides insights into segment-specific motivators and barriers. To translate these insights into actionable guidance, Table 9 outlines segment-specific messaging strategies, platform features, and policy interventions designed for Generation Z. For instance, platforms and policymakers could leverage the intrinsic motivation and openness to culinary experimentation observed among Open-minded Sustainable Explorers by highlighting innovative recipes and diverse food experiences within marketing strategies. In practice, this may include recipe cards for rescued items, ingredient kit filters, and a checkout impact meter (e.g. food saved or CO_2e avoided), together with options like 'no extra packaging' and reusable containers. Additionally, recognising Sceptic and Conscious Meal Planners' preference for planning and routine, food rescue services could enhance consumer trust through transparent labelling, detailed product information, and consistent service quality. Concretely, this may include offering guaranteed pick-up time windows, traceability or HACCP badges, clear origin and allergen information, more consistent bundle composition, and a "favourite vendors only" filter to strengthen reliability cues. For Conservative Habitual Quality Advocates, platforms can reduce friction by offering default weekly bundles, one-tap reorders, gentle habit-based reminders (such as same-day, same-merchant suggestions), and "classic and familiar" tags that reduce the perceived risk of novelty. For Adventurous Food Enthusiasts, engagement can be strengthened through discovery-oriented features, including surprise boxes with dietary or ethical filters, gamified badges, map-based "new-to-you" suggestions, and themed "global flavours" weeks.

Table 9 Factor–specific practical recommendations

Factor	Messaging angle	Platform features (operators)	Policy levers (policymakers)
Factor 1: Open-minded Sustainable Explorers	Creativity + impact	Recipe cards for rescued items; ingredient kit filters; impact meter at checkout (kg food saved/CO_2e); "no extra packaging" toggle; reusable container option	Support reusable/returnable packaging pilots; clarify date label standards in youth-facing campaigns; micro-grants for community kitchens using rescued food
Factor 2: Sceptic and Conscious Meal Planners	Reliability + proof	Pick-up time window guarantees; HACCP/traceability badges; origin and allergen sheets; consistent bundle composition; "favourite vendors only" filter	Voluntary food safety transparency code for rescue platforms; incentives for provenance/labelling standards
Factor 3: Conservative Habitual Quality Advocates	Routine kept, waste cut	Default weekly bundles; one-tap reorders; gentle habit nudges (same-day, same-merchant); "classic and familiar" product tags	Campus/dorm partnerships for routine-based education (menu planning without waste)
Factor 4: Adventurous Food Enthusiasts	Explore ethically	Discovery and surprise boxes with dietary/ethical filters; gamified badges; map-based "new-to-you" suggestions; themed 'global flavours' weeks	Enabling frameworks for experimental packaging/refill; partnerships with city festivals for zero waste pop-ups

Across all segments, the shared concern about packaging waste can be addressed through reusable or returnable options, a "no extra packaging" toggle, and clear information about the packaging footprint. These steps should be accompanied by visible labelling, provenance details, and safety cues that support trust. Taken together, these segment-specific measures offer practical guidance for improving platform design, communication, and policy alignment, complementing the educational initiatives outlined earlier.

In the Hungarian context, these insights align with national food waste prevention strategies coordinated by National Food Chain Safety Office and complement the growing impact of food rescue platforms such as Munch and Food For Free in promoting everyday consumer engagement with sustainable food practices.

Limitations and future research

While the study provides a multifaceted view of food-related subjectivities, several limitations must be acknowledged. First, the small, purposive sample (n = 26) is suitable for Q-methodology but does not support statistical generalisation. The study prioritises depth, meaning that while the factors reflect coherent viewpoints, they cannot be statistically projected onto larger populations. The relatively low response rate and urban purposive recruitment may introduce non-response bias (e.g. over-representation of participants engaged with food waste). Furthermore, as the geographic scope is restricted to Budapest, an urban context, that may differ from other Hungarian regions in socioeconomic structure, food environments, and cultural influences. Moreover, the Q-set was developed to cover a wide range of food behaviours, certain nuances, such as religious dietary norms, family influences, or specific regional practices, may not be fully captured. Future work should broaden recruitment to include rural and smaller urban settings and more diverse socioeconomic backgrounds to assess these viewpoints across contexts.

Additionally, the quasi-normal forced distribution limits how many statements can be placed in each category, which may not fully reflect the natural spread of participants' attitudes. Although the study was anonymous and instructions were neutral, social desirability concerns related to sustainability may still have influenced how some statements were ranked. In addition, the exact wording of statements may have affected how participants interpreted their importance. Future studies could use cognitive interviews or alternative phrasings to check whether different formulations lead to consistent interpretations. Future research should also build directly on the four factors identified in this research:

- First, experimental and scenario-based Q-studies could explore how trust cues, price framing, or packaging design influence each consumer group's willingness to adopt food rescue apps.
- Second, a comparative study between digital-native Generation Z and other cohorts could reveal how habit formation and risk perception evolve across generations.
- Third, given that the Budapest context is highly urban and digitally saturated, replicating the study in rural or small-town environments would clarify how infrastruc-

tural accessibility and local community norms shape participation in food rescue ecosystems.

- Finally, integrating Q-methodology with behavioural data (e.g. eye-tracking) could provide a multi-layered understanding of how sustainability-related decisions are formed in real digital contexts.

These directions directly extend the current findings and offer an innovative pathway for refining both theory and practice around sustainable digital food consumption.

Conclusions

This research advances our understanding of the complex and sometimes contradictory ways that Generation Z consumers relate to food rescue and sustainability in a digitalised food environment. By identifying four distinct consumer groups in Budapest, Hungary, namely Open-minded Sustainable Explorers, Sceptic and Conscious Meal Planners, Conservative Habitual Quality Advocates, and Adventurous Food Enthusiasts, this research demonstrates that young urban consumers' engagement with food rescue initiatives and broader sustainable consumption is far from homogeneous. Rather, it is shaped by a complex interplay of personal values, habitual routines, planning behaviours, and levels of openness towards digital innovations.

A key contribution of this study is its confirmation that pro-environmental attitudes do not automatically translate into uniform behavioural patterns. By illuminating the diverse ways through which sustainability is embedded or resisted in everyday food practices, this study provides a robust basis for designing more targeted, value-driven interventions that can bridge the attitude–behaviour gap. Instead, sustainability is negotiated through everyday food decisions that reflect varying degrees of intentionality, trust, and flexibility. While Open-minded Sustainable Explorers and Adventurous Food Enthusiasts actively integrate sustainability into creative culinary practices, other groups, such as Sceptic and Conscious Meal Planners and Conservative Habitual Quality Advocates, exhibit more cautious or routine-based approaches, indicating that even within a sustainability-aware generation, distinct motivational profiles persist.

From a methodological standpoint, this research reinforces the value of Q-methodology in advancing consumer behaviour studies. By capturing the richness of subjective perspectives and mapping them into coherent typologies, the study moves beyond binary classifications of "green" versus "mainstream" consumers, offering a more detailed understanding of how sustainability values intersect with digital food practices. This approach should encourage future research to adopt similarly nuanced designs, particularly in contexts where behavioural intentions and everyday practices diverge.

Appendix 1 Correlation matrix between Q-sorts.

Sort	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25	26
1	100	58	30	51	41	11	37	10	42	2	61	52	− 20	56	− 15	7	37	10	3	57	29	53	52	50	41	− 9
2	58	100	11	57	47	43	47	26	61	12	52	37	19	59	7	11	35	26	11	22	56	60	35	64	54	− 18
3	30	11	100	− 6	16	− 4	5	20	11	− 20	31	11	− 33	16	11	15	11	6	19	0	− 27	44	29	21	41	− 32
4	51	57	− 6	100	29	24	40	− 9	40	40	47	25	5	50	− 19	7	19	37	− 18	41	31	27	12	49	23	17
5	41	47	16	29	100	11	4	16	49	15	24	32	30	41	− 1	19	21	12	18	− 2	33	43	11	49	30	6
6	11	43	− 4	24	11	100	33	− 20	28	12	24	22	− 9	39	− 15	29	31	39	− 16	− 25	40	12	− 15	47	− 1	− 2
7	37	47	5	40	4	33	100	− 6	11	30	27	24	− 5	41	0	11	22	26	− 8	41	35	21	10	39	11	0
8	10	26	20	− 9	16	− 20	− 6	100	24	− 31	23	20	10	16	42	11	1	− 19	35	7	27	9	34	− 8	55	− 18
9	42	61	11	40	49	28	11	24	100	6	50	66	4	45	− 7	36	45	27	− 2	25	50	54	12	51	62	0
10	2	12	− 20	40	15	12	30	− 31	6	100	23	− 15	24	− 17	− 23	− 31	− 24	3	10	− 2	3	− 14	− 28	31	− 33	18
11	61	52	31	47	24	24	27	23	50	23	100	35	− 28	37	0	8	37	42	14	45	12	43	33	40	32	− 23
12	52	37	11	25	32	22	24	20	66	− 15	35	100	− 14	55	− 6	52	61	20	− 6	37	58	42	10	28	54	3
13	− 20	19	− 33	5	30	− 9	− 5	10	4	24	− 28	− 14	100	2	16	− 23	− 29	− 9	17	− 19	23	− 6	− 14	21	9	36
14	56	59	16	50	41	39	41	16	45	− 17	37	55	2	100	− 28	31	57	37	− 16	37	34	54	44	49	47	− 17
15	− 15	7	11	− 19	− 1	− 15	0	42	− 7	− 23	0	− 6	16	− 28	100	5	3	5	22	− 18	12	− 20	7	− 7	24	− 21
16	7	11	15	7	19	29	11	11	36	− 31	8	52	− 23	31	5	100	52	37	− 6	14	46	19	− 1	3	31	2
17	37	35	11	19	21	31	22	1	45	− 24	37	61	− 29	57	3	52	100	35	− 22	30	36	32	34	10	31	− 42
18	10	26	6	37	12	39	26	− 19	27	3	42	20	− 9	37	5	37	35	100	− 22	25	25	22	7	29	14	− 12
19	3	11	19	− 18	18	− 16	− 8	35	− 2	10	14	− 6	17	− 16	22	− 6	− 22	− 22	100	− 8	8	19	21	20	31	− 12
20	57	22	0	41	− 2	− 25	41	7	25	− 2	45	37	− 19	37	− 18	14	30	25	− 8	100	14	34	41	1	26	4
21	29	56	− 27	31	33	40	35	27	50	3	12	58	23	34	12	46	36	25	8	14	100	19	6	28	39	10
22	53	60	44	27	43	12	21	9	54	− 14	43	42	− 6	54	− 20	19	32	22	19	34	19	100	26	47	48	− 15
23	52	35	29	12	11	− 15	10	34	12	− 28	33	10	− 14	44	7	− 1	34	7	21	41	6	26	100	11	47	− 60
24	50	64	21	49	49	47	39	− 8	51	31	40	28	21	49	− 7	3	10	29	20	1	28	47	11	100	43	− 2
25	41	54	41	23	30	− 1	11	55	62	− 33	32	54	9	47	24	31	31	14	31	26	39	48	47	43	100	− 19
26	− 9	− 18	− 32	17	6	− 2	0	− 18	0	18	− 23	3	36	− 17	− 21	2	− 42	− 12	− 12	4	10	− 15	− 60	− 2	− 19	100

Abbreviations

COVID-19	Coronavirus disease 2019
FAO	Food and Agriculture Organization
FSC	Food supply chain
NGO	Non-Governmental Organisation
P-sample	Participant sample
Q-sample	Set of statements used in Q-sorting
Q-sort	Sorting grid of statements
SDG	Sustainable development goal
SROI	Social return on investment
UNEP	United Nations Environment Programme
WTW	Willingness to waste
Z-score	Standardised score in Q-methodology

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Data availability
The datasets generated and analysed during the current study are not publicly available due to ethics approval and informed-consent restrictions that limit processing of individual-level Q-sorts to the research team.

Declarations

Ethical approval
[…].

Competing interest
The authors declare no competing interests.

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