

# Green bites: decoding the language and imagery of social media in influencing food waste reduction behavior

Alessio Di Leo  
*LUISS Guido Carli, Roma, Italy*

Giulia Nevi  
*Department of Management, Polytechnic University of Marche, Ancona, Italy*

Camilla Comis  
*Department for Innovation in Biological, Agro Food and Forest Systems (DIBAF),  
University of Tuscia, Viterbo, Italy, and*

Ludovica Principato  
*Department of Business Studies, University of Roma Tre, Rome, Italy*

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## Abstract

**Purpose** – Food loss and waste are a critical global concern, with approximately one-third of global food production lost annually, creating severe environmental and resource challenges. To effectively drive sustainable consumption and minimize waste, collaboration among different stakeholders is essential. This conceptual study explores how food waste reduction strategies can be framed and understood through the lens of value co-creation conceptualized through the service-dominant logic (SD-L) framework, emphasizing the role of digital communication and stakeholder's collaborations and food waste communications strategies across multiple levels.

**Design/methodology/approach** – This study develops a conceptual framework using qualitative methods. It examines 1,560 social media posts from 20 European food brands, applying a hybrid approach that combines manual coding and artificial intelligence-supported content analysis. This analysis investigates value co-creation processes within the SD-L framework across different stakeholder interactions.

**Findings** – This study identifies four dimensions of value co-creation: information and regulation, participation and involvement, motivation and persuasion and innovation for sustainability. Digital tools, such as food-sharing apps, emerged as key instruments for engaging consumers and enabling collaboration among stakeholders.

**Originality/value** – By integrating SD-L into a multilevel context, this research contributes to theoretical insights on value co-creation and trans-contextual value exchange within the food waste ecosystem. It also provides actionable guidance on leveraging digital platforms and collaborative approaches to support sustainable behavior and reduce food waste effectively.

**Keywords** Food waste reduction, Sustainable practices, Consumer behavior, Environmental impact, Social media

**Paper type** Research paper



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## 1. Introduction

Food loss and waste represent an urgent and critical challenge in today's global context, significantly impacting environmental degradation and resource inefficiencies (FAO, 2019). Out of the estimated 1.05 billion tons of food waste produced annually at the retail and consumption levels, with households contributing 60%.

Beyond the economic loss this entails, approximated at \$2.6tn worldwide annually (FAO, 2014), food loss and waste exacerbates global inequalities, with 733 million people experiencing hunger despite substantial quantities of wasted food (FAO, IFAD, UNICEF, WFP and WHO, 2024). The intersection between growing consumer interest in sustainability and the adverse impacts of food loss and waste has made the nexus of sustainability, marketing and consumer behavior a focal area for scholarly inquiry.

Within this context, consumers have demonstrated increasing interest in sustainable options (Munerah *et al.*, 2021). In an era characterized by growing environmental concerns and heightened consumer awareness, the intersection of marketing, sustainability and consumer behavior has become a central focus of scholarly inquiry (Cruz and Manata, 2020). Within these interconnected domains, promoting environmentally responsible consumer behavior emerges as a crucial pathway toward fostering sustainable practices, such as food waste reduction and prevention.

Among various strategies to address food waste, advertising's capacity to influence consumer attitudes and behaviors has gained considerable attention (Zhang *et al.*, 2020). Over the past decade, research has increasingly emphasized the efficacy of tailored marketing strategies for promoting environmentally conscious consumer behavior (Muchenje *et al.*, 2023; Nittala and Moturu, 2021). However, there remain significant gaps in exploring how advertising content, particularly its language and visuals, catalyzes sustainable consumer engagement. Many campaigns overlook the nuanced effects of linguistic framing and imagery, factors shown to drive public engagement with messages related to food waste reduction (Varese *et al.*, 2022).

In addition to advertising's role, research on sustainable behaviors emphasizes the importance of collaboration among different stakeholders in achieving sustainability goals (Dania *et al.*, 2018; MacDonald *et al.*, 2019; Schneider and Buser, 2018).

From this perspective, value co-creation underscores the collaborative process between consumers and producers in generating value through various interactions and engagements (Vargo and Lusch, 2016). Despite the growing interest in the transformative potential of value co-creation for sustainability and environmental consciousness (Vo-Thanh *et al.*, 2021), a significant gap persists in its application to advertising, particularly in terms of empirical studies that explore its practical implementation in green advertising and its influence on consumer behavior. In addition, its implementation across the entire value chain remains fragmented. Indeed, while consumers are frequently at the center of co-creation processes, the engagement of other essential stakeholders – such as suppliers and policymakers – is often overlooked, limiting the holistic impact of sustainability initiatives (Tardivo *et al.*, 2017). Adopting the service-dominant logic (SD-L) framework (Vargo and Lusch, 2004) allow to bridge this gap offering a holistic lens to study value co-creation across consumers, brands and institutions. While widely applied in sustainability-related research (Vo-Thanh *et al.*, 2021), the SD-L paradigm is notably underutilized regarding advertising strategies for food waste prevention. The framework's emphasis on multi-level actor collaboration is particularly suitable for understanding how digital communication facilitates cross-stakeholder alignment in reducing food surplus through value exchange mechanisms (Tardivo *et al.*, 2017).

This lack of comprehensive stakeholder involvement undermines the potential for a truly integrated and impactful strategy, despite strong evidence that stakeholder empowerment and cross-sector collaboration play a crucial role in driving social and environmental innovation (Cortese *et al.*, 2024). Moreover, there is a scarcity of empirical research examining the potential of digital advertising platforms to facilitate co-creation by enabling interactive and collaborative engagement with consumers and other stakeholders (Hussain *et al.*, 2022). Finally, delving into the complexity of promoting sustainable practices, the choice of advertising channels introduces an additional layer of complexity.

In light of these gaps, this study uses the theoretical framework of the SD-L, which is particularly effective for exploring co-creation in sustainable practices as it focuses on value co-creation and interactions among stakeholders, including businesses, consumers and society (Vargo and Lusch, 2004). SD-L examines interactions across multiple levels – micro (between consumers and businesses), meso (among communities and organizations) and macro (involving institutions and society). This multi-layered approach enables a holistic analysis of value co-creation dynamics in food waste reduction efforts, capturing the complexity of stakeholder relationships and their interdependencies (Tardivo *et al.*, 2017). Furthermore, the framework emphasizes how value emerges through collaborative efforts among diverse stakeholders. This aspect is particularly crucial in food waste initiatives, where success fundamentally depends on the coordinated engagement of consumers, businesses and institutions (Apostolidis *et al.*, 2021). Thus, there are several gaps in exploring their impact in this context. First, the role of linguistic strategies in social media contents and campaigns aimed at food waste prevention remains empirically underexplored despite the imperative to reduce and safeguard the planet's resources (Varese *et al.*, 2022). Second, although value co-creation is central in sustainable marketing theory (Vargo and Lusch, 2016), few studies examine how digital advertising platforms can facilitate co-creation between brands, consumers and other stakeholders, particularly in the food sustainability domain (Hussain *et al.*, 2022). Third, the emergent concept of trans-contextual value requires further investigation and analysis to identify and evaluate this new dimension of value for the SD-L (Wieczerzycki *et al.*, 2024).

To guide this investigation, the research questions (RQs) driving this study are:

- RQ1. What factors within social media advertising most effectively promote environmentally responsible consumer behavior, as conceptualized through the SD-L framework?
- RQ2. How do linguistic elements in social media campaigns, aimed at food waste prevention influence sustainable consumer behaviors within the SD-L framework?

To answer these RQs, we use a qualitative research design to examine social media content, including advertising and communication strategies for promoting and raising awareness about food waste prevention.

A total of 1,560 social media posts from 20 European food brands on platforms like Facebook and Instagram (July–December 2023) were analyzed, focusing on communication strategies for preventing food waste through a multilevel qualitative analysis (macro, meso, micro) inspired by SD-L. The content was extracted via web scraping and posts were evaluated through a hybrid approach combining manual coding and AI-assisted content analysis to identify themes, techniques and patterns at micro, meso and macro levels checking for reliability. The inductive approach allowed us to identify themes and persuasive techniques to understand the role of language and interaction in co-creating sustainable value.

By concentrating on textual elements, the research offers theoretical and practical advice into organizations' communication strategies. This research contributes to the fields of sustainable marketing, digital communication and consumer behavior by deepening our understanding of the role of social media content, including advertising, promotion and awareness campaigns, in promoting environmentally responsible consumer behavior and reducing food waste through the SD-L framework. Furthermore, it empowers professionals to develop authenticity-driven, impact-oriented and value-coherent content and advertising strategies that align with sustainability goals while avoiding the risk of greenwashing.

## 2. Theoretical background

### 2.1 *Nudging, communication and food waste reduction*

The concept of nudging, as introduced by [Thaler and Sunstein \(2008\)](#), refers to interventions that alter people's behavior in predictable ways without restricting their freedom of choice or significantly changing economic incentives. Through carefully designed choice architecture, nudges can subtly guide individuals toward making better choices, often aligning their decisions with long-term goals and overall well-being ([Kristensson et al., 2017](#); [Zheng et al., 2023](#)). The literature on the impacts of nudging on environmentally responsible behavior, such as food waste reduction, is expanding ([Principato et al., 2021](#); [Principato, 2018](#); [Barker et al., 2021](#); [Vidal-Mones et al., 2022](#)). Indeed, studying how these interventions capitalize on cognitive biases and heuristics could provide insights into the elaboration of strategies aimed at encouraging consumers to make sustainable choices ([Vanhonacker et al., 2013](#)). The extant literature indicates that sustainability plays a pivotal role in influencing consumer perceptions and brand loyalty ([Porter and Kramer, 2006](#)). Nevertheless, the ability of brands to effectively communicate their sustainability efforts is crucial in fostering brand loyalty by leveraging the perception of environmental responsibility ([Watson et al., 2024](#)). In this context, how communication is structured significantly influences consumer behavior.

[Zheng et al. \(2023\)](#), for instance, demonstrate that combining nudging techniques with communication strategies, such as information framing and leveraging social norms, leads to stronger intentions to reduce food waste behaviors. Similarly, [Aschemann-Witzel and Stangherlin \(2021\)](#) show that a targeted information intervention strategy can be an effective tool for promoting sustainable food consumption. In this context, research on the reduction of food waste through digital promotion strategies, such as the use of social media and digital nudging, has become a significant area of interest within the academic literature ([Ong et al., 2023](#); [Young et al., 2017](#)). For instance, [Chai et al. \(2021\)](#) explored the influence of social media on consumers' attitudes and behaviors regarding food waste prevention. The findings indicated that social media significantly influences injunctive norms and attitudes, which are crucial in fostering intentions to reduce food waste. However, they observed that a negative attitude toward food waste does not necessarily translate into actual behavior change, emphasizing the significance of leveraging norms and other motivational factors ([Chai et al., 2021](#)). In a similar vein, [Young et al. \(2017\)](#) conducted an experiment in the retail context to evaluate the efficacy of social media and traditional interventions in influencing consumers' food waste behavior. Their findings demonstrated that while social media contributed to a reduction in self-reported food waste, its effectiveness was comparable to that of traditional methods ([Young et al., 2017](#)). Similarly, [Ong et al. \(2023\)](#) illustrated the potential of social media as positive reinforcement in encouraging food waste reduction behaviors, highlighting the capacity for digital tools to enhance the effectiveness of social media in motivating people to adopt desired behaviors.

These findings underscore the importance of a comprehensive understanding of the interplay between message framing, social media and digital nudging in the context of food

waste reduction. An integrated approach combining these elements creates opportunities for collaborative engagement among consumers, businesses and policymakers, enabling the design of information and communication strategies that could bridge the gap between intention and action. While food waste reduction is often framed as a behavioral challenge, where nudge and similar actions could enhance positive behaviors, recent studies also highlight the importance of value co-creation between brands and consumers in achieving sustainable outcomes and stakeholders behaviors (Principato *et al.*, 2023). Social media platforms serve as key enablers of this process, allowing brands to engage users in co-creating value through shared narratives, interactive campaigns and community-driven initiatives. According to Apostolidis *et al.* (2021), value co-creation in digital environments fosters deeper consumer engagement, which is essential for promoting sustainable behaviors such as food waste reduction.

### 2.2 Value co-creation in food consumer behavior

SD-L provides an insightful approach to value co-creation, guiding actors toward sustainable choices without compromising their autonomy (Vargo and Lusch, 2008). SD-L effectively captures how value is collaboratively created between different actors within service ecosystems (Vargo *et al.*, 2017). This framework necessitates a comprehensive approach that examines the logic of the entire ecosystem (Vargo and Lusch, 2016; Vargo *et al.*, 2017; Vink *et al.*, 2021).

Understanding this context requires adopting a multilevel conceptualization that considers micro, meso and macro levels, each contributing distinctly to the value co-creation process (Chandler and Vargo, 2011). The micro level encompasses dyadic exchanges, such as interactions between consumers and companies, embedded within a broader meso level where relationships become more intricate, incorporating both dyadic and triadic interactions among local communities and inter-organizational connections. At the macro level, interactions occur between numerous actors, where institutions often establish the “rules of the game” (Akaka *et al.*, 2013). This multilayered complexity necessitates a comprehensive examination of the ecosystem to fully understand the value exchange processes (Vargo and Lusch, 2008).

SD-L distinguishes between value in exchange, through which enterprises create value via product exchange, and value in use, where value emerges through a co-creation process that transcends mere transactional exchanges (Saunila *et al.*, 2019; Vargo and Lusch, 2008). The theory posits that actors simultaneously fulfill different roles in the service ecosystem depending on the contextual level. Within the food waste ecosystem, actors should explore the interdependence of co-creation and resource-integration activities to identify potential service innovations at every level (Baron *et al.*, 2018).

While digital platforms such as apps and social media anticipate significant user participation in sustainable practices, the specific mechanisms of co-creative processes, the value generated and the actors involved remain underexplored yet strategically important in addressing food waste. Several studies have examined how digital technologies facilitate food waste reduction processes (Apostolidis *et al.*, 2021; Principato *et al.*, 2023; Principato *et al.*, 2025; Mengting Yu *et al.*, 2025), highlighting that these processes are initiated through content generated by both providers and users (Alalwan, 2020; Xu and Huang, 2019). Given the significance of these multidirectional interactions in creating sustainable value, SD-L emerges as a particularly valuable framework for achieving the research objectives.

The concept of food waste reduction inherently requires companies to reconsider their notion of value, compelling them to develop more sustainable production models and abandon approaches based exclusively on maximizing efficiency and overproduction. The

paradigm of value co-created with various ecosystem stakeholders to encourage responsible consumption behavior warrants deeper exploration. Vo-Tham *et al.* (2021), for instance, applied SD-L to popular anti-food waste applications, demonstrating how they leverage social, functional and emotional values to catalyze sustainable social businesses. Apostolidis *et al.* (2021) while acknowledging the potential of mobile apps in co-creating sustainable value, they cautioned against potentially destructive processes depending on the target audience.

This theoretical lens is particularly valuable as it demonstrates that co-created value is not merely dyadic but is generated through networks of actors in a phenomenological and integrated manner across different encounters (Lumivalo *et al.*, 2024). Moreover, aligned with recent theoretical developments, it is evident that significant value is co-created across different levels of the service ecosystem.

Equally important is the recognition of the strong interdependence between these levels (Wieczerzycki *et al.*, 2024), a foundational aspect to consider when evaluating various initiatives and their outcomes. However, such theorizations, as identified by the aforementioned authors, have remained largely unexplored, with much of the literature still focused on dyadic relationships rather than examining this broader perspective. The present study adopts and positions itself within this emerging research stream by proposing the main dimensions of value co-creation generated at the micro, meso and macro levels. Additionally, it explores how the pursuit of innovation and the continuous creation of socially accepted value can enable interchange and relationship-building between different levels, helping to illuminate the recently conceptualized notion of trans-contextual exchange (Wieczerzycki *et al.*, 2024). Building on the role of social media content and advertising in shaping consumer behavior, the next section explores how these platforms thus enable different value creation opportunities in the context of sustainability contexts.

### 2.3 Language and persuasion in advertising and social media content

Advertising constitutes a significant influencing mechanism that shapes consumer attitudinal formations and behavioral patterns (Shavitt, 1990). Empirical investigations have substantiated the considerable efficacy of cultivating pro-environmental dispositions and facilitating the adoption of sustainability-oriented behavioral practices (Goetz, 2010).

The strategic deployment of linguistic methodologies within environmental discourse possesses substantial potential to direct individuals toward the implementation of more ecologically responsible consumption alternatives (Vandenbroele *et al.*, 2020). These communicative strategies operate through complex cognitive and affective pathways, ultimately contributing to the reconfiguration of consumer decision-making processes within sustainability contexts.

The rhetorical structure of messaging, including tonal qualities and narrative construction, demonstrates significant capacity to modulate affective responses and subsequently enhance individuals' propensity to engage in environmentally beneficial activities (Lyu and Huang, 2024; Mooney *et al.*, 2024). This effectiveness is predicated upon sophisticated linguistic mechanisms that facilitate the adoption of ecologically conscious consumption patterns (Li *et al.*, 2023). Concurrently, visual representational elements within advertising communications exhibit pronounced influence on behavioral manifestations among environmentally cognizant consumer segments (Batool and Iqbal, 2016). Message framing methodologies, fundamental to eliciting sustainable behavioral responses, function as deterministic factors in consumer decision trajectories (Amatulli *et al.*, 2019).

Within contemporary digital ecosystems, social media platforms constitute instruments for advertising dissemination and consumer behavioral modification (Smith *et al.*, 2012). Digital platforms such as Instagram and X (previously Twitter) facilitate precisely targeted

communication of organizational sustainability commitments (Lou and Xie, 2021), with empirical evidence indicating that social media engagement significantly reconfigures attitudinal orientations toward food waste reduction practices (Teoh *et al.*, 2022). The systematic evaluation of promotional content represents an essential prerequisite for evidence-based strategic determinations (Yasmin *et al.*, 2015).

Efficacious sustainability campaigns must demonstrate authentic adherence to their articulated values while conscientiously avoiding disingenuous environmental claims characterized as greenwashing (Mangini *et al.*, 2020). Furthermore, such initiatives necessitate transparent communicative protocols with target audiences to establish credibility and foster engagement (Lyon and Montgomery, 2015; Kamboj, 2020). This integrated approach to sustainability communication maximizes persuasive impact while maintaining ethical communicative standards essential for long-term consumer trust.

### 3. Methodology

#### 3.1 Data collection and analysis

This study adopts a qualitative research design to examine the adoption of social media content used for promoting green consumer behavior, specifically focusing on food waste prevention. This approach allows for an in-depth exploration of textual elements, providing rich insights into the nuances of communication strategies used by brands (Sparacino *et al.*, 2023; Rashkova *et al.*, 2023). The analysis was limited to the UK, France, Denmark, Norway and Italy as the most active countries in preventing food waste (World Population Review, 2024). These five countries were selected based on three key criteria:

- (1) their ranking among the top performers in food waste prevention according to the World Population Review (2024);
- (2) their diverse regulatory approaches to food waste management; and
- (3) their significant market size and influence in European food retail.

France leads with its comprehensive food waste legislation (French Anti-Waste Law, 2016-138), while Denmark has pioneered innovative public-private partnerships in food waste reduction. The UK, Italy and Norway represent different stages of policy implementation and consumer engagement in food waste prevention initiatives.

To ensure a comprehensive analysis of industry practices, we selected the largest brands actively engaged in food waste reduction for each country that are active on social media in terms of presence, reach and active communication strategies, identifying a total of 26 brands. Once the sample was identified, we proceeded to select the Instagram and Facebook social profiles for each one to verify their online presence and to select a diverse range of content (Batinca and Treleaven, 2015; Macca *et al.*, 2024). For inclusion, brands were required to have an active presence on both platforms, with at least two weekly publications over the previous six months that explicitly promoted initiatives related to food waste. After this selection process, only 20 brands met the criteria, demonstrating a diverse range of content suitable for robust analysis (Batinca and Treleaven, 2015).

The selected brands include ResQ Club (FI, NO, UK), EatAndTheCity (FI), OptiMiam (FR), SauveTonResto (FR), TooGoodToGo (FR, IT, NO, UK), wearephenix (FR), ZeroGachis (FR), ZeroScarti (IT), cosaporto (IT), MamaBee (IT), Matsentralen (NO), Matsmart (UK), yourkarmaapp (UK), OLIO (UK) and woltapp (UK). These brands were selected for their significant presence and consistent engagement in promoting food waste reduction, offering a variety of services ranging from food-sharing apps to surplus food redistribution networks and operating through diverse yet complementary models – ranging

from food-sharing platforms and surplus redistribution networks to awareness-driven delivery services. Their active presence on social media, particularly Instagram and Facebook, provides a robust corpus of publicly accessible content that reflects both promotional and educational messaging. Moreover, the brands span multiple European countries and include both local and cross-national actors, enabling comparative analysis across regulatory, cultural and market contexts. Their consistent engagement with audiences and use of persuasive communication techniques make them ideal case studies for exploring how digital narratives can foster sustainable consumer behavior. As such, this sample offers both theoretical relevance and empirical richness, supporting the study's aim to uncover patterns, strategies, and impacts for food-waste strategies.

The analysis considers both local and international strategies, as some brands focus on region-specific initiatives while others maintain cross-national campaigns addressing food sustainability. To align with the SD-L perspective, variables were operationalized across three levels: macro (geographical scope, institutional tone, policy references), meso (brand voice, campaign type, partnerships, calls to action) and micro (user engagement, emotional framing, participatory cues). Additionally, the degree of public engagement and interaction with followers was assessed as a criterion, representing the micro-level manifestation of value co-creation, evaluating how brands encourage user participation and foster community involvement in their sustainability efforts. This multi-level structure enabled a trans-contextual analysis of value co-creation in food waste communication. By limiting data collection to a six-month period (July–December 2023), we aimed to capture a dynamic, real-time view of the most current social media strategies and trends across these leading brands. The content for this analysis was extracted through a transparent and methodologically rigorous process of web scraping. To ensure the reliability and credibility of the data, scraping was conducted using publicly available data from the official social media profiles of the selected brands (Facebook and Instagram). This process followed ethical guidelines and respected each platform's terms of service, ensuring no unauthorized data was accessed. The scraping was performed using automated tools designed to capture posts related to food waste initiatives, filtering for those that explicitly mentioned food waste or sustainability-related keywords. We filtered the data set by selecting posts that explicitly contained one or more of the following keywords: primary terms such as “*food waste*”, “*food loss*” or “*food surplus*”; *action-oriented expressions*, including “*reduce waste*”, “*save food*”, “*prevent waste*” or “*reuse food*”; and *sustainability-related phrases* like “*sustainable food consumption*”, “*responsible consumption*” or “*zero waste food*”. These keyword categories served as proxies for meso-level communication strategies related to organizational positioning and value propositions in sustainability discourse. Posts were included if they contained at least one primary keyword combined with either an action-oriented term or sustainability-related phrase. This approach ensured the capture of both promotional and educational content while maintaining analytical relevance. It resulted in the collection of a total of 1,560 contents. All selected materials were systematically recorded and managed using digital archiving tools, carefully documenting details such as brand, publication date, medium and specific messaging related to sustainability and food waste prevention to ensure that each post could be easily identified and tracked. The collected content was translated into English with the support of native speakers to enable comparative evaluation. Textual analysis was performed to identify recurring themes and persuasive techniques, drawing inspiration from established content analysis methods (Krippendorff, 2018). These themes were inductively aligned with SDL concepts such as actor and stakeholders role and engagement, communication strategies and value resonance across levels. Authors examined linguistic patterns including: message framing (informational, emotional, behavioral), narrative structure (problem–solution,

testimonial) and engagement strategy (interactive content, call-to-action). These categories were derived inductively during open coding and validated through triangulation with AI-assisted analysis. To ensure analytical accuracy and reliability, the corpus was meticulously processed and translated, removing irrelevant words that might potentially distort the analysis. This critical step eliminated noise from the data, allowing for a more focused examination of core content related to food waste initiatives. By structuring and refining the data in this manner, we established the foundation for conducting a thorough and meaningful examination. The coding analysis followed a systematic interpretive approach grounded in established qualitative research methodologies (Gioia *et al.*, 2013; Linneberg and Korsgaard, 2019). Our analysis began with open coding, where two independent researchers engaged in line-by-line analysis of 20% of the content sample. This initial phase encouraged the emergence of preliminary codes through an inductive process, allowing patterns to surface naturally from the data rather than imposing predetermined categories (Krippendorff, 2018). The researchers regularly convened to compare and consolidate their codes, achieving an intercoder reliability coefficient of 0.83 using Cohen's Kappa, which exceeds the recommended threshold for qualitative research reliability. To enhance the robustness and efficiency of our qualitative analysis, we implemented a systematic approach integrating artificial intelligence tools with traditional human coding methods. Following recent methodological innovations in qualitative research (Morgan, 2023), we used ChatGPT and Google Gemini as supplementary analytical tools while maintaining rigorous human oversight throughout the process, particularly in the codification and interpretation of results according to the presented literature (Chew *et al.*, 2023).

The AI-assisted analysis followed a structured protocol to ensure consistent AI performance across the data set, in line with established practices where tools such as BERT are accepted for sentiment and content analysis (Grandeit *et al.*, 2020). To ensure reliability and validity in our AI-augmented analysis, we implemented a multi-stage verification process. First, we conducted a preliminary validation phase where both AI tools analyzed a sample of 20% of the data set that had been previously coded by human researchers. This allowed us to assess the alignment between AI and human coding (Krippendorff, 2018). The initial comparison showed a concordance rate of 90% between human and AI coding, providing a baseline for reliability. Second, we used a triangulation approach where three independent methods – human coding, ChatGPT analysis and Bard analysis – were used to analyze the complete data set. This methodological triangulation helped identify areas of convergence and divergence in topic identification (Linneberg and Korsgaard, 2019). We implemented an iterative validation process where AI-generated codes were systematically reviewed by human researchers. This human oversight and interpretation were crucial in ensuring that the identified topics accurately reflected the nuanced meanings present in the data and enabled theory-building activities. Following Gioia *et al.*'s (2013) recommendations for qualitative rigor, researchers maintained detailed documentation of all coding decisions and modifications. To address potential limitations of AI tools, we established clear boundaries for their use. The AI systems were primarily employed for initial data cleaning, topic identification and pattern recognition, while human researchers retained responsibility for theoretical interpretation and contextual understanding. Researchers meticulously integrated their own findings to capture subtle nuances and intricacies of the discourse, ensuring reliability and adherence to the analysis (Haman and Školník, 2023). In this phase, a final selective coding process focused on identifying core themes through pattern recognition and establishing theoretical relationships. To ensure methodological trustworthiness, we used several validation strategies. First, multiple coders analyzed overlapping content segments to maintain interpretive consistency. Second, we

conducted regular peer debriefing sessions to challenge assumptions and explore alternative interpretations. Third, we performed negative case analysis to refine emerging patterns (Krippendorff, 2018); hence, in terms of variable operationalization, we distinguish between: macro-level variables included the geographical scope (local/global), institutional tone and policy references. Meso-level variables focused on brand voice, campaign type, cross-sector partnerships and organizational call-to-action framing. Micro-level variables captured user interactions, participatory cues, emotional appeal and community-building elements.

#### 4. Findings and discussion

The analytical process involved coding each individual contribution to capture both first-order and second-order concepts. These concepts were then mapped to broader dimensions that represent the strategies and processes of value co-creation. The coding analysis identified four main dimensions: information and regulation, participation and involvement, motivation and persuasion and innovation for sustainability. Each dimension was further examined through the lens of SD-L, which allowed researchers to identify the characteristics of value co-creation, the actors involved and the strategies used for food waste reduction (Vargo and Lusch, 2008).

To systematically map the value co-creation process, a value co-creation matrix was created for each dimension, distinguishing in columns the actors involved in the process, the processes through which value is created and the resources used to co-create value (Kuzgun and Asugman, 2015). The co-creation of value in food waste reduction can be analyzed through four main dimensions, each of which relates to specific strategies and processes involving different actors and resources. SD-L provides a theoretical framework for understanding how value is generated through stakeholder interactions, shared resources and collaborative processes. The analysis of the identified dimensions and their associated actors reveals that the information and regulation dimension is predominantly carried out and solicited at the macro level of the service ecosystem (Chandler and Vargo, 2011) and implemented through soft approaches. In this context, institutions act as value activators through public policies, incentives and awareness-raising campaigns, creating the conditions for other actors to participate in sustainable development and circular economy frameworks (Kuzgun and Asugman, 2015).

The second dimension, participation and involvement, operates primarily at the meso level. Strategies within this dimension aim to guide retailers and distributors toward greater accountability for their consumption and waste practices and encourage increased involvement of these actors in terms of adherence to guidelines and good practices, as well as engagement with consumers. This dimension reflects the active role of companies and communities in reducing waste through direct engagement initiatives (Principato *et al.*, 2021). Companies not only provide goods and services but also incentivize sustainable behavior in consumers and communities through strategic engagement approaches.



The third dimension, motivation and persuasion, emphasizes content related to participation and involvement at the micro level, aiming to guide and motivate stakeholders such as consumers and citizens toward specific consumption patterns, civic behaviors and lifestyles that reduce food waste through nudging activities (Ong *et al.*, 2023; Vidal-Mones *et al.*, 2022).



The final level, innovation for sustainability (characterized as a meta-level by Chandler and Vargo, 2011), was found to be transversal to all levels, promoting new approaches and solutions in the fight against food waste among citizens and communities, among companies throughout the value chain, with both profit and non-profit organizations and with national and international institutions where research and innovation (Randl) serves as a catalyst for

food system transformation, requiring stimulation of transformative and transdisciplinary RandI approaches.

In [Appendix](#), we provide a general example of the strategy adopted, followed by specific examples for the first dimension: information and regulation. Each row represents a second-order dimension, associated with first-order codes detailing actions or strategies for value co-creation. Each first-order code is supported by a representative tweet illustrating the connection between theory and collected data. The table in [Appendix](#) demonstrates how various actors and strategies intersect in the fight against food waste, highlighting the importance of policies, education, communication and community engagement.



Based on the content analysis for the information and regulation dimension, we identified several illustrative examples:

In the Drome, this participatory school trains the younger generation in ecology! By   Education.

96% of Francais think it's important to reduce food waste @tns\_sofres   tude food60.

Law on food waste: 10 million meals were given to the most disadvantaged! by @le\_figaro.

After France, Italy in turn adopts a law against waste! #Antigaspì.

In Saintdenis, the Children's Parliament is fighting back against @le\_parisien's food waste ranking!   eco parlement.

We still love this campaign: anti waste stories via @ministryofagriculture!   .



Camilla Parker Bowles helps @jamieoliver turn food surplus into a feast! by   anti-waste.

Small meeting between @fhollande and @laaminou co-founder of vivatech launch! Startup anti waste food-tech.

From these examples, we constructed a value co-creation matrix ([Table 1](#)) that clearly identifies the actors, processes and resources used in this dimension of food waste reduction.


The following examples illustrate the relevant quotes for the participation and involvement dimension:

600 grocery stores pledge against food waste by redistributing their unsold [products] to individuals! by by @novae\_CA.

  Do an action to recycle live cooking classes to raise awareness against food waste! @emetropolitana.

The big ride against food waste by @lepoint!   initiatives define sensitization.

Like them, enjoy your Optibox for only 1€! And since it's almost noon, we say bon appétit!

How distributors and industrialists decided to take FoodTech to Bras-Le-Corps from @LSA\_CC! .

Croissants saved with @GetCleanio, offer your enterprise to fight food waste! #SaveCroissant.

Give us a treat at @CarreFourFrance's retail lab at the Vivatech show! #Startup.

[Table 2](#) presents the value co-creation matrix for the dimension that emerged from the analysis.

The following are the quotes and the value co-creation matrix for the motivation and persuasion dimension, [Table 3](#):

**Table 1.** Value co-creation matrix for information and regulation for food waste

Information and regulation value co-creation matrix	
Creator of value	<ul style="list-style-type: none"> <li>– Institutional actors</li> <li>– International organizations</li> <li>– Nongovernment, social and no profit organizations</li> <li>– Media</li> <li>– Key authorities</li> </ul>
Process of value co-creation	<ul style="list-style-type: none"> <li>– International and public policies and regulations</li> <li>– Dissemination and education on sustainability practices</li> <li>– Promote guidelines or fiscal measure</li> <li>– Dissemination and awareness of sustainable and recycling practices</li> <li>– Promotion of initiatives, projects and events</li> <li>– Mentions, awards, petitions</li> <li>– Fostering community and civic engagement</li> </ul>
Resources used	<ul style="list-style-type: none"> <li>– Technology platform</li> <li>– Social media</li> <li>– Law and public policies</li> <li>– Tax or incentive on recycling</li> <li>– Creating better citizen lifestyle</li> <li>– Regulation and communication efforts</li> <li>– Partnerships and solidarities initiatives</li> <li>– Social and civic engagement</li> </ul>

**Source(s):** Authors' elaboration

**Table 2.** Value co-creation matrix for participation and involvement in food waste

Participation and involvement for value co-creation matrix	
Creator of value	<ul style="list-style-type: none"> <li>– Firm</li> <li>– Network partners (restaurants, supermarkets suppliers and local businesses)</li> <li>– Media, content creator and influencer</li> <li>– Social and non-profit organizations</li> <li>– Citizens</li> </ul>
Process of value co-creation	<ul style="list-style-type: none"> <li>– Sharing engaging content</li> <li>– Marketing offers, alternative consumption of products</li> <li>– Engagement: individual and at community level</li> <li>– Challenges for reduce food waste</li> <li>– Dissemination and awareness of sustainable and recycling practices</li> <li>– Initiatives, projects and events</li> <li>– Mentions, awards, petitions</li> <li>– Connecting with potential customers</li> <li>– Driving pro environmental app downloads</li> <li>– Increasing brand awareness</li> </ul>
Resources used	<ul style="list-style-type: none"> <li>– Technology platform</li> <li>– Social media</li> <li>– Coupon/discount/low prices and special offers</li> <li>– Promotional and original content</li> <li>– Tickets to events and giveaway</li> <li>– Storage facilities</li> <li>– Marketing and communication activities</li> <li>– Partnerships with businesses</li> </ul>

**Source(s):** Authors' elaboration

**Table 3.** Value co-creation matrix for motivation and persuasion

Motivation and persuasion value co-creation matrix	
Creator of value	<ul style="list-style-type: none"> <li>– Firm</li> <li>– Network partners (restaurants, supermarkets suppliers and local business)</li> <li>– Media, content creator and influencer</li> <li>– Social and no profit organizations</li> <li>– Citizens/customer</li> </ul>
Process of value co-creation	<ul style="list-style-type: none"> <li>– Enhance loyalty actions</li> <li>– Marketing offers, alternative consumption of products</li> <li>– Dissemination and awareness of sustainability practices</li> <li>– Communicate projects and events</li> <li>– Propose new product use</li> <li>– Propose practical solutions</li> <li>– Connecting with potential customers</li> <li>– Create reinforcement initiatives to sediment food wasting behavior</li> <li>– Driving nudge activities</li> <li>– Increasing brand awareness</li> </ul>
Resources used	<ul style="list-style-type: none"> <li>– Technology platform</li> <li>– Social media content</li> <li>– Marketing actions in times</li> <li>– Promotional and original content</li> <li>– Initiatives and events</li> </ul>

**Source(s):** Authors' elaboration

Fighting food waste through Digital: this is Roadath Aminou's creed! 📱🌱🍴 by @Bizzofeminin.

Engage your friends on the app and win a FREE meal! 📱🌱🍴 anti waste bons plans.

Some psychological mechanisms lead the consumer to food waste! @Sciences\_avenir 📱🌱🍴

A free produce distributor for the needy was born in Nottingham! Soon the same initiative in France? Via @ledeauphine.

Less food waste also results in better food preservation. Become an anti-waste pro with these 10 tips.

The following are some relevant quotes for innovation for sustainability and the value co-creation matrix they allow to define (Table 4):

Roundtable discussion around innovations in food distribution with @ap\_fodals! UnGrandPasconTrelegaspiller.

On Thursday, July 9, come talk about new collaborative consumption methods with @mytrocofficer and Mutum! 📱 Here for more info.

4 kg of bread is wasted per person each year! Here are 8 recipes so it doesn't end up in the trash anymore! 🍞.

Re\_pizza (📌) Zero food waste, only great tastes: the innovative concept to fight against food waste! 🍴🌱.

The "food waste hotline", the new anti-gaspé initiative launched by @tesco! Via @Mescourses\_plp! 📱🌱🍴.

**Table 4.** Value co-creation matrix for innovation for sustainability

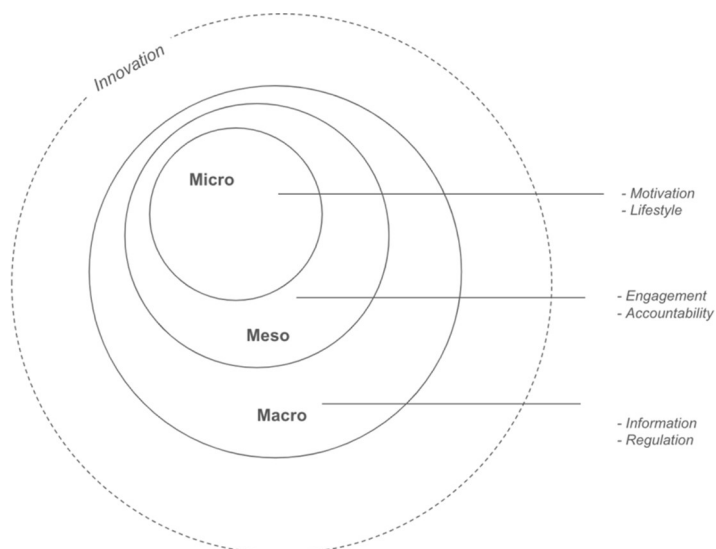
Innovation for sustainability value co-creation matrix	
Creator of value	<ul style="list-style-type: none"> <li>– Firm</li> <li>– Network partners</li> <li>– Suppliers and local business</li> <li>– Media, content creator and influencer</li> <li>– Social and non-profit organizations</li> <li>– Citizens/customers</li> <li>– Institutional actors</li> </ul>
Process of value co-creation	<ul style="list-style-type: none"> <li>– Sharing engaging content</li> <li>– Marketing offers, alternative consumption of products</li> <li>– Dissemination and awareness of sustainability practices</li> <li>– Practical solutions and update on new normative and practices</li> <li>– Fostering community engagement and connections</li> <li>– Dissemination and awareness of sustainable and recycling practices</li> <li>– Initiatives, projects, events, challenges</li> <li>– Mentions, awards, petitions</li> <li>– Enhance start-up growth and innovation</li> <li>– Driving app downloads</li> <li>– Increasing brand awareness</li> </ul>
Resources used	<ul style="list-style-type: none"> <li>– Technology services and devices</li> <li>– Social media</li> <li>– Open innovation activities</li> <li>– Promotional and original content</li> <li>– New firm processes</li> </ul>

**Source(s):** Authors' elaboration

The analysis of digital content related to food waste elucidates the mechanisms of value co-creation and the promotion of responsible consumption, framed within [Chandler and Vargo's \(2011\)](#) service ecosystem model. The food waste sector involves key stakeholders, including catering services, retailers, restaurants, delivery platforms, communication agencies and institutional organizations.

At the micro level, strategies focus on fostering consumer and civic behavioral shifts toward responsible and healthy lifestyles ([Macca et al., 2024](#)). Awareness and information emerge as critical drivers, necessitating multi-stakeholder collaboration – even minor actors like individual consumers – to nudge behavior changes ([Macca et al., 2024](#); [Cortese et al., 2024](#); [Vandenbroele et al., 2020](#)). A knowledge-centric approach enhances corporate performance ([Rehman et al., 2024](#)) while fostering win-win outcomes across the ecosystem, see [Figure 1](#). Personal innovativeness – the propensity to adopt new green practices – transcends all three dimensions of service ecosystems, acting as a catalyst for sustainability ([Hasudungan and Saragih, 2024](#)). Organizations operating within structured regulatory frameworks and clear policies demonstrate higher rates of sustainable practice adoption ([Sreenivasan and Suresh, 2024](#)).

At the meso level, firms play a central role in value co-creation through engagement and accountability initiatives. Advanced technologies, such as waste-tracking tools and transparency campaigns, enable organizations to monitor and optimize waste reduction strategies. These dynamics are reinforced by collaborative frameworks – for example, industry-wide standards or cross-sector partnerships – that leverage shared knowledge to amplify impact ([Lumivalo et al., 2024](#)). This level also facilitates *trans-contextual exchange*,



**Figure 1.** Food waste ecosystem and value co-creation strategies

**Source:** Authors' elaboration

linking individual actions (e.g. community composting programs) to systemic transformations (e.g. municipal waste policies).

At the macro level, value co-creation relies on systemic interventions governed by informational and regulatory mechanisms. The former involves disseminating data to support policymaking and consumer decisions (e.g. national food waste metrics); the latter includes incentive-based policies, such as tax breaks for sustainable packaging, while balancing regulatory constraints to avoid stifling innovation (Vink *et al.*, 2021). Interactions among stakeholders – businesses, NGOs and citizens – drive cross-level innovation, ensuring ecosystem adaptability. Feedback loops between levels help address inherent paradoxes in waste management (Brozović and Tregua, 2021), though disparities in resource allocation persist (Vink *et al.*, 2021).

In accordance with and extending the findings of Apostilidis *et al.* (2021) and Principato *et al.* (2023), digital platforms, social media engagement, advertising and content marketing and co-opetition strategies emerge as critical enablers of value co-creation.

At the micro level, value co-creation is driven by individual consumers' motivations and lifestyle choices. Drawing on the principles of SD-L, consumers are conceptualized as active co-creators of value. Their motivation stems from an enhanced understanding of the environmental impact of food waste and the recognition of personal benefits associated with sustainable consumption. Behavioral changes, such as adopting mindful consumption practices, exemplify the application of these competencies.

At the meso level, value co-creation is facilitated by group interactions that enhance engagement and accountability. This level underscores the collaborative nature of value co-creation by leveraging collective knowledge and shared resources to curb food waste (Lumivalo *et al.*, 2024). Engagement manifests through coordinated initiatives that embody SD-L principles at a collective level. Accountability mechanisms ensure participant responsibility and monitoring actions, fostering trust and transparency within the ecosystem.

Furthermore, this level enables the new concept of trans-contextual exchange, exchanges taking place across different layers of the service ecosystem, bridging individual actions with broader societal transformations.

At the macro level, value co-creation is underpinned by systemic interventions driven by information dissemination and regulatory frameworks. Informational mechanisms involve the provision of data and knowledge to inform policy making and consumer decision-making. Regulatory mechanisms, in turn, establish policies that incentivize food waste reduction and enforce accountability among stakeholders guiding the rule of the game (Akaka *et al.*, 2013). Effective information dissemination and regulatory enforcement facilitate trans-contextual exchange, fostering an environment conducive to sustainable food practices across all ecosystem levels (Wieczerzycki *et al.*, 2024). Innovation serves as a catalyst for value co-creation across all levels by enabling trans-contextual exchange; in fact, it guarantees the continuity of value co-creation in aiming to reduce food waste and translating micro-level consumer efforts into systemic transformations and vice versa. It involves developing new technologies, processes and business models that enable more sustainable food practices. Innovation is crucial for translating value co-creation across levels, ensuring individual efforts are supported by systemic changes and vice versa.

## 5. Conclusion

### 5.1 Theoretical implications

This investigation yields significant theoretical contributions to our understanding of value co-creation within anti-food waste ecosystems. Through systematic analysis of stakeholder interactions across multiple levels, we have identified four critical dimensions that collectively form a comprehensive framework for conceptualizing and addressing food waste challenges.

The study's theoretical significance lies primarily in its elucidation of how the SD-L paradigm manifests within food waste reduction contexts. By examining brands' digital content strategies, we observe how communication approaches engage diverse stakeholders in promoting anti-waste behaviors. This analysis reveals the mechanisms through which value emerges from coordinated interactions across the ecosystem's layers – micro, meso, macro and transversal – each characterized by distinct yet interconnected processes of resource integration and knowledge exchange. From the analysis of the different levels of the ecosystem, a fourth, broader level was found to provide greater clarity to the new concept of trans-contextual exchange, where interactions between different levels of the ecosystem link individual actions to broader social transformations. By analyzing brands' social content, the study reveals communication styles and strategies that engage different stakeholders, promoting anti-waste behaviors. The integration of technologies and regulations further supports these practices, ensuring a dynamic and adaptive ecosystem, thereby offering a more refined framework for understanding and designing strategies within this unique context. These dimensions provide theoretical clarity on how resources, interactions and actors function collectively to combat food waste, filling a gap in existing literature that has not explicitly mapped out such dimensions. The inclusion of these dimensions broadens the applicability of the SD-L framework in specific, impactful social and environmental issues like food waste. Building on Lumivalo *et al.* (2024) and Wieczerzycki *et al.* (2024), the study challenges the dyadic approach traditionally seen in co-creation studies, which typically focus on interactions between two parties (e.g. a business and its consumers). Instead, it takes a networked, multilevel view that reflects the complexities of the food-waste ecosystem, which is a global phenomenon that involves complex supply chains. This approach not only acknowledges the dynamic interactions among multiple actors but also emphasizes how

these connections operate across micro, meso and macro levels and transversal levels, requiring involvement through different practices such as empowerment and knowledge exchange, as well as cooperation and innovation between all the stakeholders (Cortese *et al.*, 2024; Rehman *et al.*, 2024). By doing so, the study contributes to a broader perspective, advancing the literature with an integrated, phenomenological lens that addresses value co-creation across interconnected layers.

A key theoretical advancement is our operationalization of trans-contextual exchange – a concept previously identified by Lumivalo *et al.* (2024) and Wiczerzycki *et al.* (2024) but insufficiently developed in empirical contexts. Our findings demonstrate how interactions across individual, organizational and institutional levels build shared narratives and value structures within the anti-food waste ecosystem. This mechanism bridges individual actions with broader social transformations, addressing a significant gap in co-creation literature that has typically focused on dyadic relationships rather than multilevel interconnections (Zhang *et al.*, 2024).

At the micro level, our research positions individual consumers as active agents in waste reduction efforts, capable of initiating change through responsible choices and influencing others as “anti-food waste fighters”. This perspective expands co-creation theory by recognizing consumer agency not merely as a response to organizational initiatives but as a catalyst for systemic change. The meso level reveals how organizations leverage accountability mechanisms and collaborative frameworks to amplify impact through knowledge sharing and resource integration.

At the macro level, the study illuminates how strategic collaboration among companies, nonprofits and institutions can transform societal norms and contribute to sustained value creation in food waste reduction. Significantly, our findings suggest that innovation practices that traverse all ecosystem levels, particularly those related to measurement and accountability. This represents a crucial enabler of behavioral change toward more sustainable food consumption patterns (Aschemann-Witzel and Stangherlin, 2021).

Through this multilevel, integrated analysis, we advance the theoretical understanding of value co-creation beyond isolated exchanges, addressing the often-overlooked interdependencies among actors and levels that characterize complex social and environmental challenges such as food waste.

### 5.2 Practical implications

The study offers several practical implications for organizations of the entire food-waste ecosystem. First, it helps companies understand the key dimensions of value co-creation. Second, it provides a framework for companies to use in designing and implementing value co-creation strategies. For instance, it is important to spread multilevel co-creation practices. Companies should adopt approaches that embrace all levels (micro, meso and macro) of value co-creation. This perspective helps companies to collaborate not only with consumers but also with institutional actors and network partners, exploiting the reach of ‘trans-contextual exchange’ to broaden the impact of their sustainability initiatives. Moreover, there is still much potential for platforms that, enabled by new AI solutions, can deploy integrated solutions and create ecosystems that connect partners, companies, institutions and consumers in a seamless and integrated exchange. These platforms can facilitate the sharing of resources, discounts and anti-waste promotions and create engaged communities, as in the case of initiatives between supermarkets, restaurants and FoodTech start-ups. AI could proactively predict the amount of unsold food and suggest automated redistribution options, minimizing waste in outlets such as supermarkets and restaurants, at the customer side, it could analyze what is in the fridge and suggest creative recipes or sharing practices between friends or colleagues to not waste anything. In France, apps such as Phenix use AI to anticipate waste peaks and propose discounts in real time. These apps and platforms could

implement progressive discounting systems for expiring products, modeled on platforms such as Phenix or Too Good To Go or propose some credit points or other gaming strategies. For example, customers who buy products close to expiry or use food recovery apps (Too Good To Go, Olio) receive credits to spend in the shop or in affiliated restaurants. Experiment with last-minute offers or subscriptions for the recovery of food products close to expiry, similar to subscription box models. Not only could they become reporting points for bad practices or citizenship tools by promoting petitions and shared actions and commitments. Managers and companies should motivate consumers to consume responsibly by incentivizing a healthy and sustainable lifestyle, and they should communicate the actions to reduce the environmental impact involved in engaging in such behavior or, in any case, linked to their commitment to valorize the sustainable development concept, they could launch specific challenges, for example, the “1 Week Without Waste” challenge: users have to share videos with practical tips, and the best ones win eco-friendly prizes”.

An actionable strategy could be to create content, including video tutorials on how to best preserve food at home and use leftovers to prepare new dishes, and hosting influencers or micro influencers that could be used to create interactive infographics on the environmental and economic damages related to food waste or in how reduce, promote podcasts featuring stories of citizens who have reduced food waste in their daily lives. Organize flash mobs or pop-up events in public spaces where chefs prepare meals using surplus food. These events can draw attention and engage the public in a fun and interactive way, highlighting the importance of reducing food waste. Companies can train employees to become promoters of sustainable behavior, both within the company and in the external community. Involving them in anti-waste projects and initiatives, such as the redistribution of food surpluses, can improve engagement and strengthen the company’s commitment to sustainability. Experimenting with a public certification system with stamps or accreditations like The Fork to identify bars, restaurants and supermarkets with anti-waste best practices visible on Google Maps and review apps could create more engagement and recognition with a gain in reputation as in food waste reduction. It will be important for managers and for the entire corporate strategy to rethink their actions toward long-term strategies to reduce food waste, at which level, for example, starting partnerships with other companies or third-sector organizations or thinking of exploiting digital channels and building a shared platform. Olio and Too Good To Go are platforms that connect individuals and shopkeepers to share surplus food.

Many cities have experimented with similar apps, but the success of these platforms suggests that companies and governments could expand such tools with local versions or even integrate them into public systems. Governments could create official platforms and incentivize their use to facilitate the redistribution of surpluses. It could be done through agreements with large chains, markets and local producers, with AI supplements that can predict and suggest actions to avoid food surpluses.

Additionally, the model of “progressive incentives” could be replicated to reward companies that achieve specific reduction targets. Thus, on a social level, institutions and other organizations should use social media and other communication channels to disseminate inspirational content for others, stories that can create strong, mostly emotional engagement also involving influencers or other well-known faces, while for the rational system, it is good to offer educational content and alternative food consumption as well as strategies for saving money. Institutions could apply to companies with high levels of waste to pay a tax or a similar fee or to engage in beneficial social or environmental actions so that the value created is not only economic but also of general well-being and circular business models. In counterbalance, companies that reduce waste receive bonuses or other recognitions. Households can also get refunds on their bills if they reduce food thrown away. Content to create includes videos and

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articles on the corporate blog describing how the company is implementing anti-waste solutions and why it is important to adopt them, social media campaigns to show the company's commitment to waste reduction using testimonials and concrete data and corporate challenges among employees or branches to reduce food waste, creating a monthly ranking published on social media and developing a food-wise mentality to fight food waste. Institutions and non-profit organizations could host hackathons where tech enthusiasts and innovators come together to develop new solutions for reducing food waste. These events can generate fresh ideas and technologies that can be implemented in communities and businesses.

Financial incentives remain consistently effective in driving consumer engagement, particularly through mechanisms such as coupons, food discounts, preferential pricing and streamlined ordering processes that outperform competitors. These tactical elements should be strategically integrated within comprehensive loyalty programs to foster sustainable consumption patterns rather than merely transactional relationships.

At the micro level, individuals should be encouraged not only to adopt more responsible consumption behaviors but also to become change agents who influence their social networks as "anti-food waste advocates". Consumer engagement should extend beyond passive participation to active co-creation through online communities where innovative product applications can be shared, subsequently adopted by broader audiences and potentially incorporated into corporate initiatives.

While monetary incentives and traditional marketing approaches remain valuable, organizations should develop multidimensional engagement strategies that address experiential and personal dimensions of consumption. These approaches should aim to fulfill deeper psychological needs that underpin consumption behaviors, moving beyond transactional benefits to create meaningful connections with sustainability initiatives.

Strategic partnerships with influencers and public figures in institutional campaigns, coupled with time-bound social challenges (e.g. "waste-free week" or "zero-waste holiday"), can significantly enhance visibility and strengthen public commitment to waste reduction efforts. Such initiatives leverage social proof mechanisms and normative influence to accelerate behavioral change across broader population segments.

## 6. Limitations and future research directions

This study presents methodological and conceptual limitations that warrant consideration. From a methodological perspective, while large language models (LLMs) significantly enhance analytical efficiency and semantic depth (Morgan, 2023; Zhang *et al.*, 2023), their implementation requires careful consideration. Our approach necessitated methodological adaptations, including segmented analysis of social media content across multiple processing instances to prevent system overload – a technical constraint that potentially impacts analytical continuity (Xu *et al.*, 2023). The practice we developed involved requesting analysis for small data samples and distributing processing across multiple sessions to maintain system stability and analytical integrity. Additionally, the qualitative approach adopted, while providing rich contextual insights into value co-creation mechanisms, cannot establish causal relationships between identified strategies and food waste reduction outcomes. This limitation constrains our ability to quantify the effectiveness of the co-creation dimensions identified across ecosystem levels.

Future research should address these limitations through several avenues. First, complementary quantitative methodologies could validate and extend our findings, particularly through experimental designs that isolate specific co-creation mechanisms and measure their impact on food waste behaviors. Such approaches would help quantify the

relative effectiveness of different value co-creation strategies across contexts and stakeholder groups.

Future research could explore how trans-contextual exchange operates in other sustainability-focused ecosystems, such as circular fashion or renewable energy, to assess the generalizability of the proposed framework. Longitudinal studies might investigate how consumer-led initiatives evolve over time and interact with organizational and institutional dynamics to foster sustained behavioral change. Additional inquiry could focus on the role of digital platforms and technologies in enabling multilevel co-creation and enhancing accountability within the anti-food waste ecosystem. Cross-cultural comparative analyses would also be valuable to understand how different societal norms and institutional contexts affect the success of multilevel collaboration in reducing food waste. Furthermore, future studies could analyze the visual content and representations used in anti-food waste communications to evaluate their persuasive and behavioral impact. Experimental research involving both consumers and ecosystem actors could assess which actions function as effective nudges against food waste and verify whether specific types of communication, with informative and regulatory messages at the meso level and lifestyle or motivational content at the micro level, can enhance engagement and accountability and ultimately support systemic change.

Finally, ethnographic approaches could provide a deeper understanding of how consumers and organizations navigate the tensions and trade-offs inherent in food waste reduction efforts. Such immersive methodologies would illuminate the lived experiences of stakeholders and potentially reveal barriers to implementation not captured in digital content analysis.

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### Data availability

Data will be made available on request.

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**Table A1.** Example of the coding for the first dimension of “*information and regulation*”

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Example tweet	First-order codes	Second-order dimension
<p>“Law on foodwaste: 10 million meals were given to the most disadvantaged! by @le_figaro”</p> <p>Anti-waste in the form of tales by @Min_Agriculture, we approve! And like all tales, you need an #antigaspi #hero: YOU!)</p> <p>“After France, Italy in turn adopts a law against waste! #Antigaspi”</p> <p>“In the Drome, this participatory school trains the younger generation in ecology! By @WedeMai 🧑🏫🍎🍌 Education”</p> <p>“The Green Schools Initiative is teaching kids how to reduce food waste at every meal!”</p> <p>Limit the #Gaspillage and it's a collective effort! We are ready to motivate all students to create the diff between DDM and DLC and much more when our webinar tomorrow with @refedd and @enactusfrance (🤝)</p> <p>“We still love this campaign: antiwaste stories via @ministryofagriculture! 🍌🍎🍌”</p> <p>“Join us for a special event on reducing food waste, organized by @eco_group!”</p> <p>“New law in place to support businesses that reduce food waste with tax benefits! #foodwastefree”</p> <p>“France promotes a new set of national guidelines for reducing food waste across restaurants and food industries!”</p> <p>“96% of Francais think it's important to reduce food waste @tns_sofres 🍌🍌🍌 tude food60”</p> <p>“Help us spread the word about the importance of recycling food packaging and reducing waste! ♻️”</p> <p>“Camilla Parker Bowles helps @jamieoliver turn food surplus into a feast! by @bbc 🍌🍌🍌 anti-waste”</p> <p>How retailers and manufacturers are embracing #foodTech by @LSA_CC</p> <p>We're at the #InnoFoodCorner at @AtelierChefs: come and say hello #antigaspi until Saturday!</p> <p>“Attend our upcoming event to learn more about reducing food waste in your community!”</p>	<p>Legislative actions, legal incentives</p> <p>Policy enforcement</p> <p>Government support for food waste reduction</p> <p>Sustainability education</p> <p>Environmental programs</p> <p>Green courses</p> <p>Project promotion, campaign communication</p> <p>Public awareness campaigns, media outreach</p> <p>Fiscal support for sustainability, subsidies for waste reduction</p> <p>Government guidelines on waste management, fiscal guidelines</p> <p>Recycling programs, public education on recycling, circular economy awareness</p> <p>Recycling campaigns, sustainability awareness</p> <p>Promotion of sustainability events, public initiatives</p> <p>Community projects for waste reduction</p> <p>Local community engagement</p> <p>Event marketing</p>	<p>International and public policies and regulations</p> <p>Dissemination and education on sustainability practices</p> <p>Communicate projects</p> <p>Promote guidelines or fiscal measures</p> <p>Dissemination and awareness of sustainable and recycling practices</p> <p>Promotion of initiatives, projects, and events</p>

(continued)

Table A1. Continued

Example tweet	First-order codes	Second-order dimension
“Small meeting between @fhollande and @laaminou co-founder of vivatech launch! Startup anti waste food-tech”	Social influence	Mentions, awards, petitions
Hey @N_Hulot we hope you didn't miss Too Good To Go's pitch at #ANEDD2017: we even won the 'Coup de Coeur' Award! 😊	Awards for sustainability efforts	
“Sign the petition today to recognize eco-friendly initiatives across the food industry!”	Public petitions for change	
“In Saintdenis, the Children's Parliament is fighting back against @le_parisien's foodwaste ranking! 🌱🌱 ecoparlement” “We're looking to partner with local restaurants to launch a zero-food-waste campaign. Let's work together!”	Strategic partnerships, networking for sustainability, business collaborations Cross-industry collaborations, stakeholder engagement	Connecting with potential actors
“Join the movement! Learn how you can reduce food waste with these simple tips. Let's make the world more sustainable, one meal at a time”	Volunteering opportunities	Fostering community engagement
October is the month to fight food waste! With OptiMiam, 1 meal = €1. We're all responsible!	Community-based initiatives	
32 New signatures for our #MavilleantigaspiSaS Charter! They join the 140 signatory candidates running in the 2nd round of #Municipal2020 Discover all the candidates in the thread	Civic action	
“Volunteers needed for our local food recovery initiative. Let's fight food waste together!”	Volunteer mobilization	
💡 i new home! We are launching an anti-GASPI action partnership; Solidarity with the @assoandes Association to support producers in the anti-waste fight! Discover the strength of this partnership of #solidaires and #Environélils	Call to action for local communities	

**Source(s):** Authors' own elaboration

### **About the authors**

Dr. Alessio Di Leo is a Research Fellow at the Luiss University. His research interests refer to the following domains: sustainability issues, consumer behavior and customer experience in the fields of agri-food and luxury sectors.

Dr. Giulia Nevi is currently a Research Fellow at the Marche Polytechnic University. Her main research interests are in innovation management, with a focus on the acceptance of technology on the business and human side, and marketing of services with a focus on the dynamics of the health-care sector and sustainability concerns. Giulia Nevi is the corresponding author and can be contacted at: [p024007@staff.univpm.it](mailto:p024007@staff.univpm.it)

Dr. Camilla Comis is a Research Assistant and Scientific Consultant at the University of Tuscia, Viterbo, Italy. Her main research interests include the sustainable management of agri-food systems, with a focus on food loss and waste and sustainable consumption models.

Dr. Ludovica Principato is an Assistant Professor of Business Administration and Sustainability at Roma Tre University. She is a global expert and advisor on food loss and waste, sustainable consumption models and consumer health. [www.ludovicapricipato.com](http://www.ludovicapricipato.com)