Mobile applications to reduce food waste in supply chains: a systematic literature review

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Mobile applications to reduce food waste in supply chains: a systematic literature review

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Abstract

Purpose – With the launch of mobile applications to reduce food waste, this study reviews scholarly articles to answer the questions: (1) What research topics are extensively discussed in relation to food waste mobile applications (FWMA)? (2) How do these applications impact food waste and food poverty? (3) At which stage of the supply chain are digital applications employed?

Design/methodology/approach – This paper conducts a systematic literature review of scholarly articles on the topic of mobile applications and food waste to answer three research questions.

Findings – The article provides a definition of mobile applications to reduce food waste. Most published studies on mobile applications are from developed countries. Over half of the applications address procurement and consumption along the supply chain. The applications are categorized by food saving method and used in studies on innovation management, platform relations and performance, the supply chain activities impacted and platform acceptance.

Research limitations/implications – The articles and applications analyzed suggest more quantitative studies. A wider range of cases in diverse cultural settings is needed, as well as analyses of the factors influencing the development, performance and market acceptance of platforms.

Originality/value – This study is the first study to systematically review the relevant scholarly contributions related to mobile applications, an innovative practice that helps reduce food waste. It allows making an initial progress report on the research carried out.

Keywords Mobile application, Food waste, Literature review, Supply chain, Circular economy

Paper type Literature review

1. Introduction

Food is an essentially physiological need and is crucial to human survival. However, as the statistics affirm, populations in many countries lack food. In its annual report, the United Nations' Food and Agriculture Organization (FAO, 2020) estimated that approximately 690 million people are starving. Annual deaths from hunger and related diseases have reached around 9 million worldwide compared to around 60 million deaths for all other reasons (Our World in Data, 2019). During the COVID-19 pandemic, lockdowns led to the economic downturn of businesses and markets (Ozili and Arun, 2020), with companies going bankrupt, incomes decreasing, homelessness increasing and, as a result, an even greater number of food-needy people.

However, co-existing with the severity of the situation is a huge amount of food loss and waste (FLW). Referring to FAO's (2021a) definition, FLW is the decrease in quantity or quality of food along the food supply. In particular, "food loss occurs along the food supply chain from harvest up to, but not including the retail level", while "food waste occurs at the retail and consumption levels". About 14% of global food is lost (FAO, 2021b) and 17% of

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food production is wasted worldwide (Kafa and Jaegler, 2021). The BIO-Intelligence Service (2013) statistics indicate that annual global food waste is valued at around 750 billion USD. The richest country, the USA, produced annual waste of more than $161 billion, equal to around 60 billion kg in weight, and in Europe, around 88 billion kg (Stenmarck *et al.*, 2016). According to the United Nations Environment Programme (UNEP, 2021), "if food loss and waste were a country, it would be the third biggest source of greenhouse gas emissions".

To reduce food waste, studies have been launched, and their recommendations include household storage (van Holsteijn and Kemna, 2018), cooking guidance (Kim *et al.*, 2020) and waste recycling (Lang *et al.*, 2020). Many entities in the food industry have dramatically increased their productivity with the help of the digital economy and information technology (IT) applications (Kurpayanidi, 2020). People used web-based platforms to share leftover food and meal information to avoid food waste (Zurek, 2016). Engineers can monitor foodstuff information, including farming, production, delivery, storage and nutritional status using mobiles rather computers or manufacturing devices (Kabir *et al.*, 2020).

In the wake of smartphones, digital applications have rolled out their mobile sites. Increasingly popular applications such as Too Good To Go (TGTG) and Phenix offer leftover food information from grocery stores, bakeries, restaurants and other food suppliers to the public with the aim of saving food that will likely go to waste. Some scholars call them food waste mobile applications (FWMAs) (Apostolidis *et al.*, 2021).

Indeed, mobile applications to reduce food waste have become a burgeoning trend and are readily available in mobile application markets such as Google Play and the AppStore. These FWMAs connect people and surplus food generators, aiming to eliminate waste and fight for Zero Hunger, No. 2 of the 17 Sustainable Development Goals (SDGs) of the United Nations 2030 Agenda.

Nevertheless, whether these FWMAs are helpful or how they influence the food supply chain is not yet fully understood. Therefore, to provide an overall picture and support future studies, we carry out a systematic review to answer three research questions.

RQ1. What research topics are extensively discussed in relation to FWMA?

RQ2. How do these applications impact food waste and food poverty?

RQ3. In which stage of the supply chain are digital applications employed?

The remainder of the paper is structured as follows: Section 2 presents the research methodology, Section 3 introduces the findings, Section 4 discusses the research questions and Section 5 concludes.

2. Research methodology

In this study, we undertake a systematic review (Tranfield *et al.*, 2003) in three stages – planning, conducting and reporting– to define the framework in the relevant subject area. We carry out an unbiased search of the main databases using search strings, filter documents with supporting evidence (Starkey and Madan, 2001) and synthetize the analysis (Mulrow, 1994). This methodology allows identifying the contributions and research gaps in a specific field, providing information on the content to orientate future research.

2.1 Key search words

In our study, the key search words are *mobile application* and *food waste*, expanded to others with similar meanings.

(1) The key *mobile application* search words include *app, application, software, digital, smart, platform* and *electronic*. Mobile applications developed from mobile IT are a

type of software or program used in portable electronic devices, especially smartphones or digital phones.

(2) The key *food waste* search words are *food waste, food loss and food save.* Food loss is often discussed in relation to food waste, even if the two concepts differ and food saving is the opposite of food waste.

2.2 Search fields

Scholarly databases usually include various search fields: content (all text, titles, abstracts, keywords, descriptions), author, reference, time (publication year), publication, among others.

The keywords, titles and abstracts of research papers generally summarize the main text and the overall story. Thus, the queries include "keywords", "title" and "abstract" among the content-based fields. To reduce recall noise, the terms "all text" and "description" are avoided in searches of the main body.

Since the smartphone and mobile revolution started with the launch of the first iPhone in 2007, the publication years specified are 2007–2022.

2.3 Query strings

After the steps above, we specified the following search string: *(TITLE = (food AND (waste OR loss OR save) AND ("mobile app" OR "mobile apps" OR "mobile application" OR "app" OR "apps" OR software OR digital OR smart OR platform OR electronic)) OR (ABSTRACT = (food AND (waste OR loss OR save) AND ("mobile app" OR "mobile apps" OR "mobile application" OR "app" OR "apps" OR software OR digital OR smart OR platform OR electronic)) AND PUBLICATION YEAR ≥ 2007 AND PUBLICATION YEAR ≤ 2022.*

(1) The logical operators used in the query are *AND* – where two conditions need to be satisfied – and *OR* satisfying one of the conditions.

(2) The quotation marks help with the accurate search of the specific keywords without any extension.

(3) The full terms in the search fields and their abbreviations are adjusted according to the different retrieval platforms. In addition, if the search engine is unable to apply the related words, keywords are followed by an asterisk (*) supporting plurals and spelling variants.

(4) Only scholarly articles published in academic journals are considered and analyzed in this study.

(5) All languages are considering.

(6) In selecting the publications to search, subjects related to business administration, computer science, economics, engineering, management and social science are included.

2.4 Database selection

The databases used for the search in this study are EBSCO, Emerald, ScienceDirect, Wiley Online Library and Scopus.

2.5 Result filters

(1) Using our query strings, the databases returned numerous articles, but as some include the same records, we checked for and removed any duplicates.

(2) During the filter process, two of the authors systematically read the titles, abstracts and full text and select articles. If case both opinions diverged, the third author would check the process.

(3) In the first-round filter, we read only the titles and those considered relevant to the topic were retained for the next round.

(4) In the second-round filter, we checked the abstracts and those fitting the theme were included in the final round.

(5) In the final round, we read the full text of articles referring to mobile applications and food waste.

The databases returned 7,083 papers, and after removing the duplicates, 4,083 remained. Of these, 387 passed the first round. The excluded articles focused on other industries, marketing, policymaking, food safety, food delivery, food waste recycling, rather than food waste.

152 articles passed the second round. After reading the full texts, only 36 articles remained. Snowball Approach was applied to expand the quantity of targeted articles (Johnson, 2014), and all the references of the 25 articles were checked, but only 1 met the criterion. There were 37 articles totally, which we analyzed using EndNote X9 and Microsoft Excel and PyCharm 2022.3.2 for the statistical tables and figures (see Figure 1).

3. Results

3.1 Publication information

The 37 papers were published in 20 different journals. *British Food Journal* had 4 articles published, and *Industrial Marketing Management* and *Sustainability* published 2 articles each. The remainder published one article each.

Figure 2 shows the trend of articles published by year. The first relevant paper was published in 2017, with only five published in the first three years. In 2020, the number of

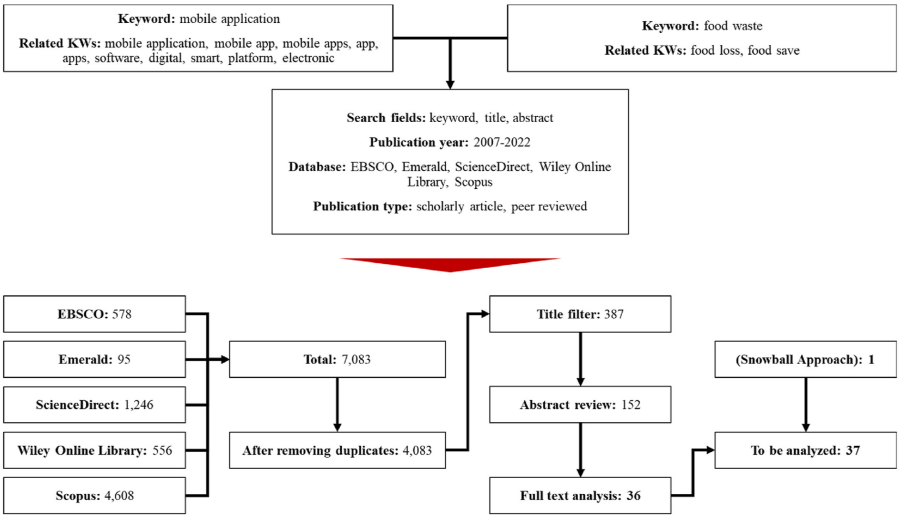
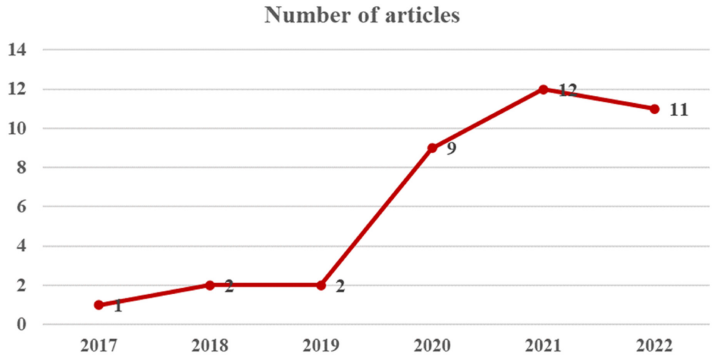


Figure 1.
Mapping the search strategy

Source(s): Authors work



Source(s): Authors work

Figure 2.
Summary of relevant articles by publication year

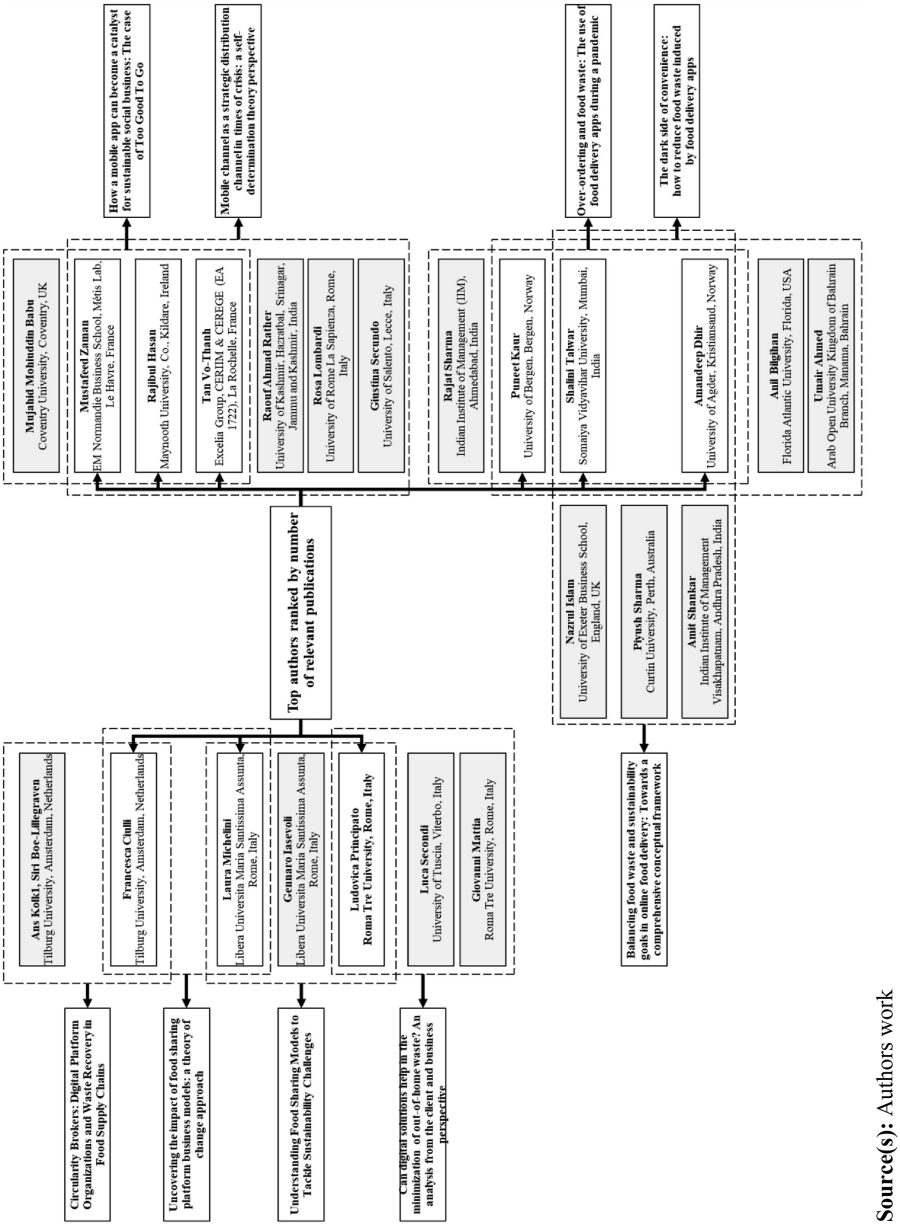
articles increased to nine and by three in 2021 and by two in 2022. 86% (32 out of 37) articles were published in the last three years.

Although 127 researchers participated in these studies, only nine of them had more than one article published (Figure 3). Among them, Dhir and Talwar collaborate with some scholars on three works (Sharma *et al.*, 2022; Shankar *et al.*, 2022; Talwar *et al.*, 2023), two of them were written with Kaur (Sharma *et al.*, 2022; Talwar *et al.*, 2023). Michelini and Ciulli have co-authored one of these articles (Michelini *et al.*, 2020) and published another paper with some other co-authors (Michelini *et al.*, 2018; Ciulli *et al.*, 2020). Principato has 2 publications as well, one was with Michelini and Iasevoli (Michelini *et al.*, 2020) and the other one with Secondi and Mattia (Secondi *et al.*, 2019). Zaman, Hasan and Vo-Thanh have co-published 2 papers (Vo-Thanh *et al.*, 2021; Zaman *et al.*, 2021). These three groups of scholars published more than the others on this topic.

The geographic distribution of the authors' affiliations is highlighted. When authors have affiliations in two or more countries, only the first country registered by the author in the paper is considered. If two or more authors of the same article are from the same country, this is regarded as a duplicate and removed, as shown in Figure 4. The 37 identified articles were written by authors from 25 countries. Italian scholars (23 authors) published the most articles (9), followed by researchers from France (5), the UK (5), Norway (5), the Netherlands (4) and the USA. (4). Broken down by continent (Figure 4), most authors (80) are European and 34 from Asia. Only one article is authored by South American scholars and none from Africa or Oceania. The geographic distribution indicates that developed countries have published more studies than developing nations.

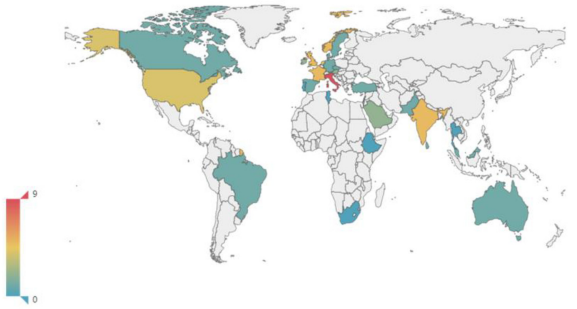
3.2 Data collection methodology

The articles are divided into 13 groups by data sources, including primary and secondary data. Some use a single type, while others use a combination. Among the 13 groups, the survey method is the most common with 12 articles using interviews and 29 using single sources, including case studies. Three articles adopt a link analysis, including the ways of exporting records from databases, tracking online information, website content analysis and new approaches based on Internet technology. The documentary methodology – collecting data from social media, websites, newspapers and public sector reports – is adopted in 5 articles as a secondary data collection method (see Table 1).



Source(s): Authors work

Figure 3.
Top authors ranked by number of publications



Continent	Country	Number of articles	Total
Asia	Saudi Arabia	2	13
	India	5	
	Sri Lanka	1	
	Pakistan	1	
	Malaysia	1	
	Lebanon	1	
	Israel	1	
	Bahrain	1	
Europe	Italy	9	30
	United Kingdom	5	
	Netherlands	4	
	Spain	1	
	Sweden	1	
	Austria	2	
	Norway	5	
	Germany	1	
	France	5	
	Ireland	2	
	Czech Rep	1	
	Turkey	1	
	Denmark	1	
North America	United States	4	5
	Canada	1	
Oceania	Australia	1	1
South America	Brazil	1	1

Source(s): Authors work

Figure 4.
Number of authors in countries after removing duplicates

Data sources	Number of articles
Case study	4
Case study, interviews	4
Case study, interviews, observation, research-related documents	1
Diary	1
Experiment	4
Focus group discussion, link analysis	1
Interview	5
Interview, research-related documents	2
Link analysis	3
Literature review	2
Modeling	1
Research-related documents	1
Survey	8
Total	*37*

Source(s): Authors' work

Table 1.
Data sources of relevant publications

3.3 Mobile applications

No general definition exists for mobile applications used to curb food waste, but people tacitly acknowledge that is their function. A variety of names are used to refer to functional mobile applications dedicated to food waste reduction, including food waste mobile applications (FWMAs) (Apostolidis *et al.*, 2021), Mobile Food-Sharing Applications (Farr-Wharton *et al.*, 2014; Harvey *et al.*, 2020), Food Waste Management Applications (Fadhil, 2018), Digital Food Waste Reduction Applications (Strotmann *et al.*, 2021), Food Redistribution Applications (Hanson and Ahmadi, 2021), Household Food-Management Applications (Hanson and Ahmadi, 2021) and FWMAs (Nisar *et al.*, 2021). Nevertheless, all mobile applications designed to reduce food waste could be referred to as FWMAs. We suggest the following definition of food waste mobile applications based on our findings and the definitions used by other scholars:

> Free and for-profit Food Waste Mobile Applications (FWMAs) aim to reduce food waste. (1) FWMAs connect consumers and food businesses so that the latter can offer end-of-life food products to the former at reduced prices to reduce food waste. These transactions, enabled by the application, are fair and have positive social, environmental, and economic impacts. The food business receives remuneration, the consumer pays a discount price for the consumable, short-lived food is consumed, and food waste is reduced. (2) FWMAs connect food banks and food businesses to provide free food.

(3) FWMAs warn owners (consumers, businesses) when food products are reaching the end-of-life stage to increase the lifespan and avoid waste.

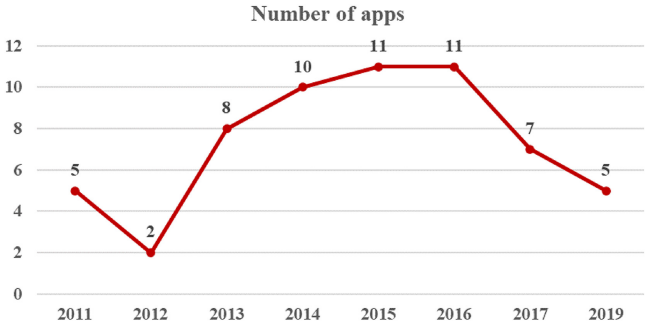
3.3.1 Active products. In the 37 analyzed articles, 59 active FWMAs are under study. Table A1 in Appendix lists their establishment year, country, supply chain stage and model. The supply chain generally includes several business stages: planning, production, procurement, storage, distribution, consumption and disposal. In the food supply chain, planning refers to menu planning and recipes, production refers to the process of producing food products, procurement refers to suppliers (supermarkets, restaurants, stores, or other organizations) offering the food products downstream, storage refers to managing the inventory of the food products; distribution includes the methods of delivering food to users; consumption refers to payment to purchase the food; and disposal deals with wasted food. The data in this table was mainly collected from the introduction on the homepages of the FWMAs.

As Figure 5 shows, five FWMAs related to food waste were established in 2011 with a stable increase until 2016, but only seven FWMAs in 2017, five in 2019 and none in 2018. A similar trend is observed in the number of available applications in the Google Play Store (Ceci, 2022). Although numerous mobile applications have been developed since the popularization of smartphones in the early 2010s, due to the developer strategy, many have been removed from the Google digital distribution service. None of the FWMAs were established after 2019, which could be due to the Covid-19 pandemic, as many businesses were interrupted or suspended.

Among these FWMAs, 12 are from the USA and 37 from Europe, thus nearly 2/3s of all FWMAs (Figure 6). The comparison of the geographic distribution of scholars and FWMAs (Figures 4 and 6) shows they are mainly from Europe and North America, namely Italy, France and the USA. Strikingly, there were no authors or applications from Australia, China, Japan and Russia among the main countries involved in relevant research. In addition, some scholars did not register their African affiliations as first in their papers, like Karar and Amer from Egypt, Dhir from South Africa and Chouikhi from Tunisia (Karar *et al.*, 2021; Sharma *et al.*, 2021; Amer and Chouikhi, 2020), hence no relevant records from this continent.

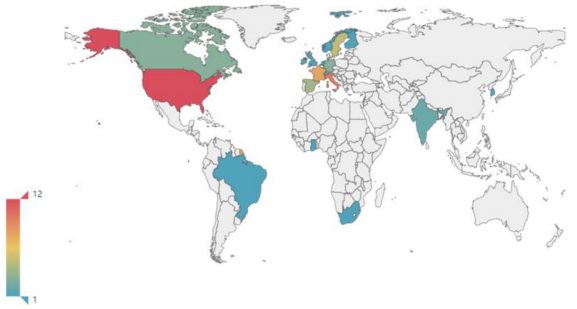
Along the food supply chain, of the 59 FWMAs, 7 concern planning, 37 procurement, 14 storage, 18 distribution, 23 consumption, 1 disposal and no production. The largest number of applications involves procurement and over a quarter concern food waste reduction by the way of storage, distribution and consumption.

The FWMAs can be categorized according to food saving methods. Some authors group the mobile technologies into forecasting, waste analysis, redistribution and measure catalogs (Strotmann *et al.*, 2021), while the Brazilian researchers categorized the platforms according



Source(s): Authors work

Figure 5.
Summary of active mobile applications by establishment year



Continent	Country	Number of apps	Total
Africa	Ghana	1	2
	South Africa	1	
Asia	India	2	4
	Singapore	1	
	South Korea	1	
Europe	Finland	1	37
	France	8	
	Germany	3	
	Ireland	1	
	Italy	10	
	Netherlands	1	
	Spain	4	
	Sweden	5	
	Switzerland	2	
	UK	1	
	Norway	1	
North America	Canada	3	15
	USA	12	
South America	Brazil	1	1

Source(s): Authors work

Figure 6.
Number of mobile applications by country

to purpose, user type and transaction model: sales, donation, sales and donation, exchange and awareness (Moltene and Orsato, 2021).

Considering supplier and user types, Hanson and Ahmadi (2021) summarize two categories with subtypes: food redistribution (sale-to-purchase, peer-to-peer and donation) and household food management (recipe recommendation, visual stock list and alert system). Ciulli *et al.* (2020) analyze the position of applications in the supply chain and revenue model, namely business to business (B2B), business to consumer (B2C), business to non-governmental organization (B2NGO) and consumer to consumer (C2C). Some studies adopt similar definitions as (Peer to Peer or Person to Person) (P2P), business to charity (B2CH), consumer to non-governmental organization (C2NGO) and consumer to business (C2B) (Apostolidis *et al.*, 2021; Harvey *et al.*, 2020; Michelini *et al.*, 2018; Rýparová, 2021).

3.3.2 New design. Apart from active applications, 12 new designs are discussed in the articles, proposing prototypes regarding innovation and improvement.

Innovation implies that the new design is based on an original theme and idea, thus not comparable in practice. For example, Pantry was designed to solve inventory problems (Hanson and Ahmadi, 2021; Woolley *et al.*, 2016). Its functions and technical aspects are described in the article and the authors conducted a simple test to verify that it would work rather than a robust comparison.

Similarly, FoodImage is a novel prototype related to food diaries (Roe *et al.*, 2020). The application calculates the quantity of food through the photos uploaded so that users can picture how much food has been eaten and wasted compared with the diary.

Some authors suggest saving food in an educational way through FOODDY to raise awareness of the environmental impact of food by providing trusted information when the food is scanned with the phone camera (Carulli *et al.*, 2022). Users learn a great deal about the sustainability of food products, so that they can reduce the purchase of unnecessary or unfriendly food products, as well as learning to store them correctly. A similar case is FoodEd, which provides an optimal method to guide people in storing and handling various foods before the expiry date (Hanson and Ahmadi, 2021).

To collect food waste from catering operations and households with higher efficiency, Tuah *et al.* (2022) design a gamified FWMA to attract participants. Practical testing showed that the process of food waste collection was simpler with the help of the mobile application and the gamified design incentivized people in the community to learn and adapt a proper way to dispose of food waste; this helped the government with food waste compliance monitoring.

Haas *et al.* (2022) develop a new FWMA called MySusCof offering food management information and tips to reduce food waste. Users gain credits by completing food purchasing

and food management tasks. The pilot study and the usability test show that both utilitarian and hedonic values could be realized by gamification.

AgSAT is an FWMA that schedules crop watering to reduce food waste and loss (Jaafar *et al.*, 2022). Data collected from Google Earth Engine and 18 weather stations worldwide are used to calculate proper watering levels of crops; farmers can access the results using a mobile phone. A prototype of this application was tested successfully in a potato field in Lebanon.

Improvement is another way of upgrading existing products. For example, Expired Monitor is an improvement prototype based on existing mobile applications in the Pakistan context (Nisar *et al.*, 2021). In this study, the authors evaluate the technology using usability principles, proposing a new design and receiving feedback from users to clarify whether the original functions are useable in Pakistan.

Two pest recognition prototypes were designed with cloud computing and Faster R-CNN to help farmers lessen damage to crops (Karar *et al.*, 2021). With these advanced technical modules, five groups of pests could be validated with a 99% success rate during the test in both FWMAs and better performance was believed to be achieved compared to image-based recognition products. The use of pesticides could be more reasonable based on the detecting data and the suggestions issued to the farmer. To improve the drying calculation, a mathematical model was developed to avoid mistakes during the food drying process (Amer and Chouikhi, 2020). Manufacturers could monitor the moisture content of food with higher accuracy to ensure product quality, leading to less food waste.

A platform called eFeed-Hungers used to be a web-application and has been re-developed to be a mobile application (Sharma *et al.*, 2022), which helps to verify the authenticity and appropriateness of donated food. The needy can use a cellphone to check out the free food information posted by donors on eFeed-Hungers and pick it up at the specific place. Besides, charitable organizations including food banks can find donated food resources through the platform as well.

3.4 Topics discussed in relation to FWMAs

In the 37 analyzed articles, except new designs, authors used active FWMAs to discuss the topics of innovation management, platform relations and performance and platform acceptance.

3.4.1 Innovation management. In view of the global environmental crisis, projects in emerging areas of the circular economy have been launched by an increasing number of organizations (Ntsondé and Aggeri, 2017). Some cases of reducing food waste in production and distribution were used to study the processes that enable establishing inter-organizational cooperation and collective strategies. This research led to the responsible innovation ecosystem concept that can be adopted in innovative and sustainable projects in which heterogeneous actors cooperate. More cases are deemed worthy of investigation to fulfill the experience.

One study considers the drivers and barriers to innovative approaches to food waste reduction (Aramyan *et al.*, 2021), concluding that any innovation project that has the potential to reduce food waste must be economically feasible. The smartphone applications business model is a good example of adopting new steps in the technological, organizational and marketing domains, concluding that determining whether marketing and corporate image help save food requires further investigation. A novel public-private partnership attempted to reduce food waste in Los Angeles County through the use of mobile applications (Aramyan *et al.*, 2021). FWMAs were used to create a network connecting different kinds of organizations to not only increase the efficiency of food collection and re-distribution but also reduce energy consumption and greenhouse gas emissions. The methods would need to be adjusted before introducing the program in areas with different cultural backgrounds.

3.4.2 Platform relations and performance. Harvey *et al.* (2020) consider over 50k food-sharing records to study the relationship between donors and recipients, finding that reciprocity and balance are rare, but also that new relations have formed between organizations and consumers. The result challenges existing theories of donor-recipient relations and could be applied to encourage more technological practices in sharing food. However, private relations among the actors were excluded in this study, which might affect the results and could be investigated in the future.

In an analysis of the catalyst for sustaining social business, a multi-country research team used semi-structured interviews to study the relation between customer-value-proposition and value-in-use in the French "Too Good To Go" practice (Vo-Thanh *et al.*, 2021). The results reveal the importance of social, functional and emotional value of FWMAs in the win-win situation of food affordability and less waste. The authors encourage considering more platforms and oversea markets for other potential success factors.

Consumer and retail activities are core elements of the food supply chain (Mullick *et al.*, 2021). Adopting a panel vector autoregression (PVAR) model and impulse response function, a study was conducted to explore their mutual influence, finding the consumer-to-retailer effect is stronger and lasts longer than the opposite direction. To expand the study, the authors advocate investigating the effectiveness of different intervention strategies, the relationship between views and actual purchases and the synergies between food waste reduction initiatives.

To study the impact of the linkages of emerging mobile applications with food waste recovery, Ciulli *et al.* (2020) adopt an interpretive theory-building approach to discuss the role of brokerage (connecting, informing, protecting, mobilizing, integrating and measuring). This research is novel, considering the missing links between waste generators and potential receivers, what the authors call "circularity holes". This concept could be adopted in more industries and countries, not only in the developed world.

Cane and Parra (2020) study a few FWMAs in Italy and Spain to point out their influence on pre-waste food detection and distribution. The findings prove the urgency of food waste reduction awareness and promoting new consumption habits. The authors suggest that digital platforms are essential to help build the supply chain. Moreover, they propose a cataloged classification of FWMAs, even if the relevant references are not easy to find.

Mobile technology is considered a potential solution for food waste reduction activities, and Hanson and Ahmadi (2021) review the relevant literature on its effectiveness in Canada. The authors acknowledge that FWMAs are helpful in reducing food waste, but to achieve this goal, the solution portfolio should also include adequate awareness, resources and infrastructure.

Since the Covid-19 pandemic, contactless transactions have become popular for food purchases. Strotmann *et al.* (2021) conduct two online surveys and show that only 11% of respondents engaged in further food waste reduction measures, a number reflected in food service companies. In addition, the authors systemized the FWMAs, developing a classification scheme (forecasting, waste analysis, redistribution and measures catalog) indicating the effects on generating food waste. They suggest future studies should identify the barriers (including the relations among actors) of these digital technologies.

Another study explores the success of mobile channels in the pandemic through the TGTG case and interviews with restaurant owners and customers (Zaman *et al.*, 2021). The authors find that health, functional, social and economic factors underlie the motivations of both, while control and autonomy is only relevant to customers. Motivations could lead to meaningful outcomes for the model actors and society. To enrich the idea, the weight of factors and other countries, suppliers and applications are suggested for future research.

Given the scarce use of mobile applications related to food waste generation, a study was conducted to explore the factors influencing consumer behaviors that might lead to food waste through over-ordering (Sharma *et al.*, 2021). Using a conceptual model with data collected from users, the mediating role of trust is shown as positively associated with attitude and shopping routine, but price advantage only with attitude. However, the authors find no associations moderated by perceived severity (pandemic threat perceptions) or moral norms. The nationality of consumers, the use in diverse countries and more enablers and barriers should be considered in further research.

A study of consumer shopping habits in food mobile applications was conducted with the theory of planned behavior (TPB) (Shankar *et al.*, 2022). Data from 487 Indian users revealed that trust, intentions and leftover reuse routine were positively associated with shopping routine, possibly resulting in over-ordering and food waste. In a similar empirical case, the TPB was utilized to study consumer behavior in food mobile applications (Talwar *et al.*, 2023). The correlations between attitude, subject norms, leftover reuse intention and over-ordering behavior were positive. These two empirical studies could be expanded to generalize the findings by including more parameters, considering the characteristics of food mobile applications and incorporating more countries.

Apostolidis *et al.* (2021) study the relevance of FWMAs in the process of co-creating sustainable value in the Bottom of the Pyramid market. The gaps in perceived affordances and end goals are notable and a burden to value construction, while opportunism, stigma and goal misalignment might even ruin it. As to the subsequent stages, the authors suggest increasing the number of interviewees, quantifying the findings and considering the impact of NGOs.

Theory of Change is used to construct a framework of the activities, outcomes and influencing factors to outline the main domains (economic, social, environmental and political) of food-sharing platforms by Michelini *et al.* (2020). The findings emphasize the need and practicability of the platform to assist, mediate and solve some social problems. This framework is beneficial to help managers, practitioners and policymakers face the challenges, albeit not universal.

To study the change in food redistribution with Internet plus, Michelini *et al.* (2018) categorize 52 online food-sharing platforms through a hierarchical cluster analysis. The models are divided into three groups (sharing for money, sharing for charity and sharing for community). To the authors' surprise, the social supermarket is seemingly oriented to sharing for money. These findings provide new solutions to social inequalities. However, more cases and specific variables should be analyzed to identify the key success factors.

A survey conducted in Italy studied the influence of consumers' out-of-the-home habits and doggy bag usage on the amount of food waste (Secondi *et al.*, 2019). Using the results of the survey, the authors analyzed the possibility of digital solutions to surplus food management. They found that promoting this FWMA at cultural events and local schools raised food waste awareness efficiently and had economic, social and ethical advantages in both the non-profit and business sectors, stimulating further research on ways to curb food waste.

An FWMA called OLIO and data from seven scenarios were used to analyze whether food-sharing behavior would result in higher environmental impact and if there was a rebound effect (Meshulam *et al.*, 2023). The authors found that a portion of the potential environmental benefits could be offset by the rebound effect from sharing. But more details on the influence of re-spending patterns would be needed to better understand the main rebound effect.

Interviews were conducted to evaluate the influence of the use of two FWMAs on financial expenses, healthy diet and food waste (Mathisen and Johansen, 2022). Awareness of food waste increased, but there were no statistically significant improvements on the indices of

expenses, diet and food waste. To strengthen the findings, future studies should include more participants and test the FWMAs over a longer period.

3.4.3 Platform acceptance. Fuentes *et al.* (2021) investigate the reasons for promoting mobile applications in the food saving domain with a field experiment of the Karma app. The empirical study concludes that functional glitches and practice conflicts could affect the interest and patience of users, resulting in quitting the application. However, this may depend on the user sample considered and their characteristics.

To study the determinants of food-sharing models, Mazzucchelli *et al.* (2021) analyze the impact and connection among drivers. The result shows consumer perceptions of environmental and social responsibility, consumer familiarity and community social support significantly support consumer behavior on food-sharing applications. Future research could include an empirical analysis of more FWMAs as well as studying the actors separately.

Similarly, Schanes and Stagl (2019) interviewed a group of Austrian food savers of digital platforms to explore the drivers of food sharing. The results reveal five motivations (emotions and morality, identity and sense of community, reward, social influence and instrumentality) to reach the goals (save food from being wasted, food redistribution, food surplus prevention and reinvigorating a new consciousness around food), which could mutually re-enforce each other. These findings contribute to policy research to eliminate obstacles and create a better environment for food-sharing activities.

To identity the factors related to the acceptance and use of digital platforms, Moltene and Orsato (2021) study the Ecofood app with the extended unified theory of acceptance and use of technology (UTAUT2). They find effort expectancy is a key to user behavior and trust and gratefulness associated with user behavior mediated by behavioral intention. They recommend qualitative and quantitative studies of other platforms and the relations among actors.

The intrusiveness of FWMAs was studied by considering four dimensions of privacy of smartphone users (Gonzalez and Siadou-Martin, 2019). These applications were found to enter the lives of users through the collection of personal data, continuous notifications, advertisements and monitoring of daily activities. Although FWMAs are regarded as legitimate if they address the problem of food waste and offer intrinsic reasons for people to use them, their intrusiveness—the possibility of being tracked, monitored and influenced by moralizing words like "it is not good to waste"—may make users anxious and reluctant to use FWMAs in the future.

A study explored motivations for building food-sharing platforms in the Czech Republic from the perspectives of the environment, economy, education and social relationships (Rýparová, 2021). Some platforms facilitate monetary transactions, although their founders initially expected to share their food surplus without any monetary compensation. The author admits that the inclusion of a certain profit for both sides can help to form a virtuous circle but recommends the study of why some people are reluctant to join such projects as well as how to price the shared food. Fragapane and Mortara (2022) conduct a case study on TGTG and the experiences shared in Facebook groups to evaluate the acceptance of FWMAs. They found that "economic advantage" and "sustainability" were significant drivers for the adoption of FWMAs projects, although the discount obtained as well as the quality of food were the two main criteria taken into consideration by survey respondents.

4. Discussion and implications

This article presents a literature review of studies focusing on FWMAs aiming to answer three research questions.

(1) What research topics are extensively discussed related to food waste mobile applications? The studies analyzed concern 59 active mobile applications and 12 prototypes that facilitate food waste reduction, considering innovation management, platform relations and performance and platform acceptance. The authors discuss these topics in relation to the innovation ecosystem and economic feasibility, investigating the effects among supply chain actors (e.g. donors and recipients, retailers and customers), the factors (e.g. environmental, functional, health, political and social) that influence platform performance and the aspects (e.g. behavior, emotions, function, morality, trust) that affect platform acceptance.

Nowadays, more and more circular economic projects are being launched while several projects have disappeared. The main reasons behind such successes and failures are examined in different papers. Rýparová (2021) categorize food-sharing projects into three groups: collection, gifts and barter and exchange, meaning that FWMA models are either for profit or not for profit. Harvey *et al.* (2020) point out that FWMAs raise moral issues. Although some founders launch digital platforms and let people use them freely, questions naturally arise about their long-run financial sustainability. FWMAs have operating costs and not every project can survive without generating revenue, which in turn raises moral concerns, given the nature of the activity. Social supermarkets are operating profitably and reduce food waste effectively (Michelini *et al.*, 2018). To create a virtuous cycle in the food waste reduction industry, projects must be not only sustainable from an economic point of view but also be efficient in marketing, technology optimization and service enhancement if they are to minimize bugs and avoid consumer impatience and uninterest (Fuentes *et al.*, 2021). Davies *et al.* (2017) warned against using FWMAs as a marketing tactic, which would destroy the industry's reputation and make people reluctant to use the applications to save food. Harvey *et al.* (2020) find that reciprocity and balance were rarely met between donors and recipients in the case of FWMAs. This might be due to the presence of a single food supplier, but multiple consumers based on a retailer case (Mullick *et al.*, 2021). Retailers' sales activities, including promotions, are designed to increase consumption. FWMAs send notifications (of promotions and other issues) through mobile applications. Prompted by promotions, some consumers over-order food that they do not really need, which results in household food waste (Sharma *et al.*, 2021). Yet the use of mobile applications to prompt consumers to change bad habits might be considered intrusive (Gonzalez and Siadou-Martin, 2019) because most can scan smartphones and, like a moral arbiter, critique how consumers react to food promotions. Nevertheless, the need for FWMAs to reduce food waste and their practicability is clear (Michelini *et al.*, 2020; Rýparová, 2021). The familiarity of FWMAs, their contributions to social responsibility and the community support that they receive are significant positives. With adequate promotion, FWMAs could enhance consumer familiarity and trust, increasing the use of such applications to reduce food waste.

(2) How do these applications impact food waste and food poverty?

Different researchers group the FWMAs according to food saving methods, including forecasting, waste analysis, redistribution, measure catalog, sales, donation, exchange and awareness. Although the categorization varies, it reflects that the supply-side consists of food businesses and consumers, while charities, food businesses and consumers are demand-side users in the redistribution models. B is short for Business and in the food supply chain, it stays at the upstream or supply-side and includes farmers, producers, wholesalers, retailers, restaurants and other organizations. NGO includes all charities and non-profit organizations, food banks and volunteering groups. C represents Consumer, which includes individual users (including their families and households) to the FWMAs and usually stays at the downstream or demand side. Both C2C and P2P mean participants (individuals in this study) sharing

resources (food) with equal privileges in a network. The B in C2B refers to nonprofit organizations (Michelini *et al.*, 2018), and thus, C2NGO would better describes these. Therefore, the redistribution applications could be marked B2B, B2C, B2NGO, C2C and C2NGO based on who provides or receives the surplus or expiring food.

Aside from redistribution, household food management is the second half of FWMAs (Hanson and Ahmadi, 2021) that only aim to make full use of food. However, waste analysis and measure catalogs could be considered food management (Strotmann *et al.*, 2021). Although these categories are open to all kinds of digital technologies in food waste reduction, a new mobile application prototype called FoodImage mentioned in one article works on detecting food waste, while FOODDY provides educational information (Carulli *et al.*, 2022). The Brazilian researchers Moltene and Orsato (2021) hint at awareness to promote people's consciousness through education or ethical means. Therefore, in this review, the scope of food management expands to recipes, stock lists, alert systems, waste analysis and education and thus not only household issues.

Some of the FWMAs rely on two or more models. Among the redistribution applications, 2 belong to the B2B model, 27 to the B2C, 12 to the B2NGO, 8 to the C2C and 4 to the C2NGO model. Among the food management applications, 7 incorporate recipes, 5 stock lists, 5 alert systems, 0 waste analysis and 1 education. B2C is the most popular model to reduce food waste with 16 NGO applications, which points to the fact that donation is considered an important part of food waste reduction. However, waste analysis and education applications lack studies.

Most FWMAs deal with food waste distribution, especially business-to-consumer (B2C) distribution, possibly because of the convenience of establishing a sustainable model. The revenue of B2C FWMAs is based on transaction fees and/or subscription fees (Giménez, 2019), whereas other business models depend on in-app advertising opportunities or other sponsors (Logan, 2017). Consumer behavior is one of the main drivers of food waste. The founders of future FWMAs could integrate new functionalities such as recipes, improved stock management, daily expiration monitoring and educational programs.

Several FWMAs, including TGTG, Phenix and OLIO, compete in various local markets. In those mature markets, food store owners, bakers, restaurant owners and other supply-side businesses, as well as consumers on the demand side, can offer (order) food baskets or bags on (from) any of these platforms to generate revenues or save food. In this competitive market structure, the supply may find it harder to meet the demand and the use of a food waste aggregator (resembling services such as Expedia.com or Hotels.com) may help boost activity on these platforms.

To date, no researchers have reported on active FWMAs in China or Japan. One possible reason for this is that FWMAs are less popular in Asian countries than in Europe and the U.S. Other explanations might be found in the future to help us understand what drives those international difference in the study (and use) of FWMAs.

Some authors question the ability of FWMAs to curb food waste significantly. Mathisen and Johansen (2022) reported no significant impact of FWMAs on the quantity of food waste, and Meshulam *et al.* (2023) find that FWMAs had negative environmental externalities. However, both studies used small samples; expanding them to include more cases and more interviews with participants would make it possible to draw more convincing conclusions. A majority of the articles dealing with FWMAs conclude that they increase awareness of the urgent need to curb food waste and improve the well-being of most users.

(3) In which stage of the supply chain are digital applications employed?

The active application statistics show that more than half the FWMAs involve procurement, and nearly 40% consumption, whereas production is scarce. Food production and disposal

lack attention in the industry, likely because the study of causing and dealing with food waste relies on other food supply chain stages. Food waste as the FAO defines it does not have anything to do with production and farming while food loss has.

The procurement stage is more willing than the other supply chain stages to attempt to reduce food waste through mobile applications (Buzby *et al.*, 2014). As to unconsumed food, food waste particularly concerns food suppliers (e.g. supermarkets, restaurants), but also individuals and households. Several organizations that seek to save food start with obtaining surplus food from these suppliers and pass it on to needy groups. Applications including 11th Hour (11thhr.co.uk), Eat You Later (eatyoulater.com), and Food For All (foodforall.com) display the discounted menus of local eateries at the end of the day, but need to promote themselves and attract local food retailers to join.

The consumption part takes second place, which is unsurprising given that the applications tend to sell vouchers of superfluous food based on the information gathered on the platform. Profitable platforms, such DamoGO (damogo.co) and OptiMiam (optimiam.com), earn bonuses and subscription fees from every purchase and from the food suppliers. As we have discussed, B2C models is the most common business type developed in FWMAs.

5. Conclusion

Smartphones have infiltrated every aspect of our lives, and some mobile applications have been designed to help deal with severe food wastage.

5.1 Theoretical implications

To the best of our knowledge, this paper is the first attempt to review all scholarly papers related to dedicated mobile applications to reduce food waste. We examined all relevant academic articles found in five databases and analyzed them by publication information, data collection methodology and how they related to FWMAs. We also studied the FWMAs mentioned in the papers analyzed and documented how and why they were developed, where they were studied, the stage of the supply chain they operated in and how they helped market participants curb food waste. Our findings help scholars by identifying topics that are already well documented and those that require further investigation.

The systematic literature review we conducted shows that the number of publications increased dramatically in the last five years, with more authors from Europe than any other continent. However, as the number of publications has recently increased, some articles may not have been returned in our search. About the methodology adopted, interviews and case studies are mostly used in the reviewed articles.

5.2 Managerial implications

The review leaves out an overview to the firms running FWMAs. The findings show that 71 FWMAs (59 active and 12 new concepts) are studied in the articles on the topics of innovation management, platform relations and performance, platform acceptance. Most of the online projects started in the years 2013–2016 in developed countries. The authors categorized the platforms according to food waste reduction method, and the biggest proportion of applications focus on procurement and consumption along the supply chain, also called redistribution.

These results reveal where FWMAs are located and what functions they offer to curb food waste. Based on this knowledge, platform developers may learn from existing businesses and the issues that those businesses have addressed. Moreover, scholars may be interested in learning about the main drivers of consumer adoption of FWMAs at a time when such applications are experiencing growing popularity. We also found that there is room for

improvement in the management of these platforms and possibly the need for the development of an aggregator in this market.

5.3 Limitations and future research avenues

Four future research avenues are provided. First, with the paucity of relevant data and the variation of samples (Cane and Parra, 2020), scholars face difficulties in researching this topic, but it is important and necessary to conduct more quantitative and experimental studies to empirically demonstrate the findings (Apostolidis *et al.*, 2021; Carulli *et al.*, 2022; Mazzucchelli *et al.*, 2021; Moltene and Orsato, 2021).

In addition, studies should be expanded to a wider range of cases, samples and cultures to obtain more variegated results and ideas, shedding light on neglected issues in research and in practice (Michelini *et al.*, 2018; Roe *et al.*, 2020; Sharma *et al.*, 2021). In addition, as some scholars mention, studies are needed in developing economies to advance the field meaningfully (Ciulli *et al.*, 2020; Nisar *et al.*, 2021).

Moreover, as a new approach to this social issue, running these platforms well is a challenge and good practices for innovation project managers and policymakers are needed as well as support for their better operation for a beneficial impact on the development and performance of food waste reduction and the circular economy.

Finally, the market elements should be further explored. Some projects that failed to meet market needs have gone offline and/or merged with other entities, for example, the Spanish weSAVEeat app has been taken over by the Italian TGTG and MyFoody, now part of Phenix. Market acceptance will determine the future of these FWMAs and every platform should adhere to the economic viability principal (Aramyan *et al.*, 2021). Only if more upstream and downstream users join the programs can cash flow be generated to guarantee the success of these projects in the fight against food waste.

References

Amer, B.M. and Chouikhi, H. (2020), "Smartphone application using a visual programming language to compute drying/solar drying characteristics of agricultural products", *Sustainability*, Vol. 12 No. 19, p. 8148.

Apostolidis, C., Brown, D., Wijetunga, D. and Kathriarachchi, E. (2021), "Sustainable value co-creation at the bottom of the pyramid: using mobile applications to reduce food waste and improve food security", *Journal of Marketing Management*, Vol. 37 Nos 9-10, pp. 856-886.

Aramyan, L., Grainger, M., Logatcheva, K., Piras, S., Setti, M., Stewart, G. and Vittuari, M. (2021), "Food waste reduction in supply chains through innovations: a review", *Measuring Business Excellence*, Vol. 25 No. 4, pp. 475-492.

BIO-Intelligence Service (2013), "Food wastage footprint: impacts on natural resources – summary report", available at: https://www.fao.org/3/i3347e/i3347e.pdf (accessed 25 July 2022).

Buzby, J.C., Farah-Wells, H. and Hyman, J. (2014), "The estimated amount, value, and calories of postharvest food losses at the retail and consumer levels in the United States", USDA-ERS Economic Information Bulletin Number 121, available at: http://dx.doi.org/10.2139/ssrn.2501659 (accessed 18 July 2022).

Cane, M. and Parra, C. (2020), "Digital platforms: mapping the territory of new technologies to fight food waste", *British Food Journal*, Vol. 122 No. 5, pp. 1647-1669.

Carulli, M., Bordegoni, M. and Spadoni, E. (2022), "Applications virtually augmenting real experiences for behavioral change", *Computer-Aided Design and Applications*, Vol. 19 No. 1, pp. 176-190.

Ceci, L. (2022), "Google Play: number of available applications 2009-2022", available at: https://www.statista.com/statistics/266210/number-of-available-applications-in-the-google-play-store/ (accessed 25 July 2022).

Ciulli, F., Kolk, A. and Boe-Lillegraven, S. (2020), "Circularity brokers: digital platform organizations and waste recovery in food supply chains", *Journal of Business Ethics*, Vol. 167 No. 2, pp. 299-331.

Davies, A.R., Edwards, F., Marovelli, B., Morrow, O., Rut, M. and Weymes, M. (2017), "Making visible: interrogating the performance of food sharing across 100 urban areas", *Geoforum*, Vol. 86, pp. 136-149.

Fadhil, A. (2018), "A review of empirical applications on food waste prevention and management", *arXiv:1803.05986*.

FAO (2020), "The state of food security and nutrition in the world 2020. Transforming food systems for affordable healthy diets", available at: https://www.fao.org/3/ca9692en/online/ca9692en.html (accessed 25 July 2022).

FAO (2021a), "The state of food and agriculture 2021. Making agrifood systems more resilient to shocks and stresses", available at: https://www.fao.org/3/cb4476en/online/cb4476en.html (accessed 25 July 2022).

FAO (2021b), "International day of awareness of food loss and waste", available at: https://www.fao.org/international-day-awareness-food-loss-waste/en/ (accessed 20 June 2022).

Farr-Wharton, G., Choi, J.H.J. and Foth, M. (2014), "Food talks back: exploring the role of mobile applications in reducing domestic food wastage", *Proceedings of the 26th Australian computer-human interaction conference on designing futures: The future of design*, pp. 352-361.

Fragapane, S. and Mortara, A. (2022), "The value of networks against food waste: the case of 'too good to go'", *Italian Sociological Review*, Vol. 12 No. 3, pp. 1111-1137.

Fuentes, C., Cegrell, O. and Vesterinen, J. (2021), "Digitally enabling sustainable food shopping: app glitches, practice conflicts, and digital failure", *Journal of Retailing and Consumer Services*, Vol. 61, 102546.

Giménez, C.H. (2019), "Normalizing sustainable consumption: how marketing is used to fight food waste", Lup. Lub. Lu. Se,(June), available at: http://lup.lub.lu.se/student-papers/record/8992332

Gonzalez, C. and Siadou-Martin, B. (2019), "Vers une clarification de l'intrusivité des applications mobiles servicielles: le cas du gaspillage alimentaire", *Décisions Marketing*, Vol. 94 No. 2, pp. 13-34.

Haas, R., Aşan, H., Doğan, O., Michalek, C.R., Karaca Akkan, Ö. and Bulut, Z.A. (2022), "Designing and implementing the MySusCof app—a mobile app to support food waste reduction", *Foods*, Vol. 11 No. 15, p. 2222.

Hanson, V. and Ahmadi, L. (2021), "Mobile applications to reduce food waste within Canada: a review", *The Canadian Geographer/Le Géographe Canadien*, Vol. 66 No. 2, pp. 402-411.

Harvey, J., Smith, A., Goulding, J. and Illodo, I.B. (2020), "Food sharing, redistribution, and waste reduction via mobile applications: a social network analysis", *Industrial Marketing Management*, Vol. 88, pp. 437-448.

Jaafar, H., Mourad, R., Hazimeh, R. and Sujud, L. (2022), "AgSAT: a smart irrigation application for field-scale daily crop ET and water requirements using satellite imagery", *Remote Sensing*, Vol. 14 No. 20, p. 5090.

Johnson, T.P. (2014), "Snowball sampling: introduction". Wiley StatsRef: Statistics Reference Online.

Kabir, A.T., Debnath, N., Ta-sin, A.J., Zinnurayen, N. and Haider, M.T. (2020), "IoT based low cost smart indoor farming management system using an assistant robot and mobile app", *Paper presented at the 2020 10th Electrical Power, Electronics, Communications, Controls and Informatics Seminar (EECCIS)*, doi: 10.1109/EECCIS49483.2020.9263478.

Kafa, N. and Jaegler, A. (2021), "Food losses and waste quantification in supply chains: a systematic literature review", *British Food Journal*, Vol. 123 No. 11, pp. 3502-3521.

Karar, M.E., Alsunaydi, F., Albusaymi, S. and Alotaibi, S. (2021), "A new mobile application of agricultural pests recognition using deep learning in cloud computing system", *Alexandria Engineering Journal*, Vol. 60 No. 5, pp. 4423-4432.

Kim, J., Rundle-Thiele, S., Knox, K., Burke, K. and Bogomolova, S. (2020), "Consumer perspectives on household food waste reduction campaigns", *Journal of Cleaner Production*, Vol. 243, 118608.

Kurpayanidi, K.I. (2020), "Problems of the use of digital technologies in industry in the context of increasing the export potential of the country", *Theoretical and Applied Science*, Vol. 10 No. 90, pp. 113-117.

Lang, L., Wang, Y., Chen, X., Zhang, Z., Yang, N., Xue, B. and Han, W. (2020), "Awareness of food waste recycling in restaurants: evidence from China", *Resources, Conservation and Recycling*, Vol. 161, 104949.

Logan, K. (2017), "Attitudes towards in-app advertising: a uses and gratifications perspective", *International Journal of Mobile Communications*, Vol. 15 No. 1, pp. 26-48.

Mathisen, T.F. and Johansen, F.R. (2022), "The impact of smartphone apps designed to reduce food waste on improving healthy eating, financial expenses and personal food waste: crossover pilot intervention trial studying students' user experiences", *JMIR Formative Research*, Vol. 6 No. 9, e38520.

Mazzucchelli, A., Gurioli, M., Graziano, D., Quacquarelli, B. and Aouina-Mejri, C. (2021), "How to fight against food waste in the digital era: key factors for a successful food sharing platform", *Journal of Business Research*, Vol. 124, pp. 47-58.

Michelini, L., Principato, L. and Iasevoli, G. (2018), "Understanding food sharing models to tackle sustainability challenges", *Ecological Economics*, Vol. 145, pp. 205-217.

Meshulam, T., Font-Vivanco, D., Blass, V. and Makov, T. (2023), "Sharing economy rebound: the case of peer-to-peer sharing of food waste", *Journal of Industrial Ecology*, Vol. 27, pp. 882-895.

Michelini, L., Grieco, C., Ciulli, F. and Di Leo, A. (2020), "Uncovering the impact of food sharing platform business models: a theory of change approach", *British Food Journal*, Vol. 122 No. 5, pp. 1437-1462.

Moltene, L. and Orsato, R.J. (2021), "The sharing economy in practice: an exploratory study of the acceptance and use of digital platforms in food waste reduction", *Revista de Administração de Empresas*, Vol. 61 No. 5, pp. 1-20.

Mullick, S., Raassens, N., Haans, H. and Nijssen, E.J. (2021), "Reducing food waste through digital platforms: a quantification of cross-side network effects", *Industrial Marketing Management*, Vol. 93, pp. 533-544.

Mulrow, C.D. (1994), "Systematic reviews: rationale for systematic reviews", *The BMJ*, Vol. 309 No. 6954, pp. 597-599.

Nisar, M., Rehman, M., Anjum, M., Murawwat, S., Bashir, K. and Saleemi, M. (2021), "Usability evaluation of food wastage mobile application: a case of Pakistan", *Sustainability*, Vol. 24, 14027.

Ntsondé, J. and Aggeri, F. (2017), "Building responsible innovation ecosystem, a new approach for inter-organizational cooperation", *EURAM 2017*, Glasgow.

Our World in Data (2019), "How many people die and how many are born each year?", available at: https://ourworldindata.org/births-and-deaths (accessed 10 August 2022).

Ozili, P.K. and Arun, T. (2020), "Spillover of covid-19: impact on the global economy", available at: https://mpra.ub.uni-muenchen.de/99850/ (accessed 25 July 2022).

Roe, B.E., Qi, D., Beyl, R.A., Neubig, K.E., Martin, C.K. and Apolzan, J.W. (2020), "The validity, time burden, and user satisfaction of the FoodImage™ smartphone app for food waste measurement versus diaries: a randomized crossover trial", *Resources, Conservation and Recycling*, Vol. 160, 104858.

Rýparová, A. (2021), "Digital food sharing: motivation and practice of sharing in Czechia", *Journal: Geografie*, No. 3, pp. 263-287.

Schanes, K. and Stagl, S. (2019), "Food waste fighters: what motivates people to engage in food sharing?", *Journal of Cleaner Production*, Vol. 211, pp. 1491-1501.

Secondi, L., Principato, L. and Mattia, G. (2019), "Can digital solutions help in the minimization of out-of-home waste? An analysis from the client and business perspective", *British Food Journal*, Vol. 122, pp. 1341-1359.

Shankar, A., Dhir, A., Talwar, S., Islam, N. and Sharma, P. (2022), "Balancing food waste and sustainability goals in online food delivery: towards a comprehensive conceptual framework", *Technovation*, Vol. 117, 102606.

Sharma, R., Dhir, A., Talwar, S. and Kaur, P. (2021), "Over-ordering and food waste: the use of food delivery apps during a pandemic", *International Journal of Hospitality Management*, Vol. 96, 102977.

Sharma, S., Shandilya, R., Kim, K., Mandal, D., Tim, U.S. and Wong, J. (2022), "eFeed-Hungers 2.0: pervasive computing, sustainable feeding to purge global hunger", *Sustainable Computing: Informatics and Systems*, Vol. 35, 100694.

Starkey, K. and Madan, P. (2001), "Bridging the relevance gap: aligning stakeholders in the future of management research", *British Journal of Management*, Vol. 12 No. S1, pp. S3-S26.

Stenmarck, Â., Jensen, C., Quested, T. and Moates, G. (2016), "Estimates of European food waste levels", available at: http://eu-fusions.org/phocadownload/Publications/EstimatesofEuropean foodwastelevels.pdf (accessed 20 July 2022).

Strotmann, C., Baur, V., Börnert, N. and Gerwin, P. (2021), "Generation and prevention of food waste in the German food service sector in the COVID-19 pandemic: digital approaches to encounter the pandemic related crisis", *Socio-Economic Planning Sciences*, Vol. 82 No. Part A, 101104.

Talwar, S., Kaur, P., Ahmed, U., Bilgihan, A. and Dhir, A. (2023), "The dark side of convenience: how to reduce food waste induced by food delivery apps", *British Food Journal*, Vol. 125 No. 1, pp. 205-225.

Tranfield, D., Denyer, D. and Smart, P. (2003), "Towards a methodology for developing evidence-informed management knowledge by means of systematic review", *British Journal of Management*, Vol. 14 No. 3, pp. 207-222.

Tuah, N.M., Ghani, S.K.A., Darham, S. and Sura, S. (2022), "A food waste mobile gamified application design model using UX agile approach in Malaysia", *International Journal of Advanced Computer Science and Applications*, Vol. 13 No. 5.

UNEP (2021), "Food waste index report 2021", available at: https://www.unep.org/resources/report/unep-food-waste-index-report-2021 (accessed 3 June 2022).

van Holsteijn, F. and Kemna, R. (2018), "Minimizing food waste by improving storage conditions in household refrigeration", *Resources, Conservation and Recycling*, Vol. 128, pp. 25-31.

Vo-Thanh, T., Zaman, M., Hasan, R., Rather, R.A., Lombardi, R. and Secundo, G. (2021), "How a mobile app can become a catalyst for sustainable social business: the case of too good to go", *Technological Forecasting and Social Change*, Vol. 171, 120962.

Woolley, E., Garcia-Garcia, G., Tseng, R. and Rahimifard, S. (2016), "Manufacturing resilience via inventory management for domestic food waste", *Procedia CIRP*, Vol. 40, pp. 372-377.

Zaman, M., Vo-Thanh, T., Hasan, R. and Mohiuddin Babu, M. (2021), "Mobile channel as a strategic distribution channel in times of crisis: a self-determination theory perspective", *Journal of Strategic Marketing*. doi: 10.1080/0965254X.2021.1959629.

Zurek, K. (2016), "Food sharing in Europe: between regulating risks and the risks of regulating", *European Journal of Risk Regulation*, Vol. 7 No. 4, pp. 675-687.

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Appendix

Table A1. Active food saving mobile applications under study in the analyzed articles

	Name	Establishment year	Country	Planning	Production	Procurement	Storage	Distribution	Consumption	Disposal	Model
1	11thHour	2016	Singapore			×			×		B2C
2	Breading	2014	Italy			×		×			B2NGO
3	BringTheFood	2014	Italy			×	×	×			B2NGO
4	CheckFood	2013	France	×			×				Alert system, Stock list
5	Cheetah	2016	West Africa			×	×	×			B2C, B2NGO
6	DamoGO	2019	South Korea			×			×		B2C
7	EatYouLater	2017	Spain			×			×		B2C
8	Eatizz	2015	Canada			×			×		B2C
9	EcoDalFrigo	2016	Italy				×				Recipes
10	Ecofood	2019	Brazil			×			×		B2C
11	EGGup	2016	Sweden				×				Alert system
12	FameZero	2014	Italy			×		×			C2C, C2NGO
13	FeedApp	2014	Sweden			×		×			B2NGO
14	FeedingIndia	2015	India			×					B2NGO, C2NGO
15	FlashFood	2015	US			×			×		B2C
16	FoodCloud	2012	Ireland			×	×	×			B2NGO
17	FoodCowboy	2013	US			×		×			B2NGO
18	FoodForAll	2016	US			×			×		B2C
19	FoodLoop	2015	Germany			×			×		B2C
20	FoodMesh	2015	Canada			×		×			B2B, B2NGO
21	FoodSaveApp	2013	Switzerland	×							Recipes
22	Foodsharing	2011	Germany			×	×	×			B2B, B2NGO, C2C, C2NGO
23	Food.com	2017	US	×							Recipes
24	FridgeCam	2017	France				×				Stock list
25	FrigoMagic	2015	France								Recipes
26	GoCopia	2016	US			×		×			B2NGO
27	GoMkt	2017	US			×			×		B2C
28	ImperfectFood	2016	US				×	×	×		B2C
29	Karma	2016	Sweden			×			×		B2C
30	LastMinuteSottoCasa	2015	Italy			×			×		B2C
31	LeftoverSwapApp	2013	Canada					×			C2C

(*continued*)

Table A1.

	Name	Establishment year	Country	Planning	Production	Procurement	Storage	Distribution	Consumption	Disposal	Model
32	Leloca	2013	US			×					B2C
33	Matsmart	2013	Sweden				×		×		B2C
34	MyFoody	2015	Italy	×							B2C
35	NextDoorHelp	2013	Italy					×	×		C2C
36	NiLasMigas	2016	Spain			×			×		B2C
37	NoFoodWaste	2014	India			×	×	×			B2NGO
38	Nofoodwasted	2013	Netherlands			×			×		B2C
39	OLIO	2015	UK			×		×			C2C
40	OptiMiam	2014	France			×			×		B2C
41	PareUp	2014	US			×			×		B2C
42	PartageTonFrigo	2012	France								C2C
43	Pepperplate	2011	US	×							Recipe
44	Phenix	2014	France			×			×		B2C
45	PucciFrigo	2019	Italy				×				Alert system
46	Ratatouille	2014	US					×			C2C
47	Regusto	2019	Italy			×			×		B2C
48	ResQClub	2016	Finland			×			×		B2C
49	ShareTheMeal	2015	Germany			×					C2NGO
50	SoAppli	2017	France								Stock list
51	TooGoodToGo	2016	Sweden			×			×		B2C
52	TotalCtrl Home	2017	Norway								Alert system, stock list
53	UBO	2014	Italy	×			×				Stock list
54	WasteNoFood	2011	US			×		×			B2NGO
55	WasteTraker	2019	Switzerland				×				Alert system
56	weSAVEeat	2017	Spain			×			×		B2C
57	Yonodesperdicio.org	2015	Spain					×			C2C
58	Ywaste	2011	South Africa	×						×	Education
59	ZeroGachis	2011	France			×			×		B2C
Total				*7*	*0*	*37*	*14*	*18*	*23*	*1*	

Source(s): Authors' work