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Published in:

International Food and Agribusiness Management Review

DOI:

[10.22434/IFAMR2022.0006](https://doi.org/10.22434/IFAMR2022.0006)

Publication date:

2023

Document version:

Publisher's PDF, also known as Version of record

Link:

[Link to publication in PEARL](#)

Citation for published version (APA):

Zhao, G., Liu, S., Wang, Y., Lopez, C., Ong, A., & Chen, X. (2023). Reducing food waste from social innovation perspective: a review of measures, research gaps and future directions.

International Food and Agribusiness Management Review, 26(2), 199-223.

<https://doi.org/10.22434/IFAMR2022.0006>

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Reducing food waste from social innovation perspective: a review of measures, research gaps and future directions

REVIEW ARTICLE

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Abstract

Food waste (FW) has been increasingly recognized as a severe environmental, social, and economic problem. Therefore, it should be tackled innovatively by analyzing and synthesizing existing solutions. This study aims to achieve a comprehensive understanding of different social innovation measures adopted for reducing FW using a systematic literature review. After locating, collecting, evaluating, and analyzing 50 publications from four databases, we conclude that social innovation activities such as digital food-sharing platforms, social supermarkets, solidarity stores, and food rescue hubs are widely deployed in different FW reduction processes. Based on the findings, we synthesized several research gaps and proposed corresponding future research directions related to research methodology, country, food redistribution, food rescue, food donation, and food sharing. These directions include conducting research to develop suitable key performance indicators to evaluate the performance of digital food-sharing platforms, linking with specific theory to conduct empirical research on partnership analysis regarding social supermarkets, and investigating the structure of multiplex relations among different participants in the food rescue activities using social network analysis. We suggest that more keywords should be scrutinized and included when searching publications in future research as keyword selection is subjective.

Keywords: social innovation, food waste reduction, systematic literature review, agri-food supply chains
JEL code: O35, Q01, Q13

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1. Introduction

Food waste (FW) refers to food that completes various processes of the agri-food supply chain (AFSC) (e.g. farming, manufacturing, packaging, distribution, and marketing) up to a final product, of good quality and fit for human consumption, but that is discarded in the retail stage, the food service stage or the consumption stage (Food and Agriculture Organization of the United Nations (FAO), 2021). FW typically happens at the downstream stages of AFSCs, such as retail and consumption stages, whereas food loss takes place at the upstream stages of AFSCs (e.g. production, post-harvest and processing stages) and is associated with the quantity lost (Ciccullo *et al.*, 2021). Various factors can cause FW, such as food past its expiry date, over-preparation, large leftovers, large packaging, excess purchases, and contamination (Jeswani *et al.*, 2021). Globally, according to the Food Waste Index Report conducted by the United Nations Environment Programme (UNEP, 2021), approximately 931 million tons of FW was generated in 2019, which indicated that around 17% of global food production might be wasted. Moreover, 61% of FW came from households (568 million tons), 26% from food services (242 million tons), and 13% from retail (121 million tons). It is estimated that FW will increase dramatically in the next 25 years because of economic growth and the increase in the world population that is projected to reach 9.7 billion in 2050 and a further increase to 11.2 billion by 2100 (Chen *et al.*, 2017). Based on the report conducted by Deloitte (2021), the volume of wasted food can feed 2,400 million malnourished people every year.

As food production is a resource-intensive activity, FW seriously depletes natural resources and negatively impacts environmental sustainability. For example, almost 4.4 gigatons of carbon dioxide (CO₂) equivalent are generated annually by global food wastages, which is slightly lower than the contribution of total road transport emissions to global warming. Around 250 km³ of surface and groundwater resources and 1.4 billion hectares of farmland are also attributable to FW (FAO, 2015). FW not only burdens environmental sustainability but also increases threats to food insecurity. For example, FW contains many biodegradable components that may generate decay, odor, and leachate during the collection and transportation processes; therefore, it can cause transmission of communicable diseases (Socas-Rodriguez *et al.*, 2021). Considering the severe effects of FW on the environment and society at large, the United Nations proposed Sustainable Development Goals (SDGs) in 2015 for tackling climate change and ending hunger by 2030. Thus, it is necessary for us to examine, summarize, and synthesize existing literature and propose valuable directions for researchers and scholars to tackle FW in an innovative way.

FW has drawn increasing attention from academics, governments, businesses, non-profit organizations, and the public regarding FW generation, collection, reduction/minimization, quantification, and energy recovery (Chauhan *et al.*, 2021). For example, the European Commission (EC) launched a series of plans for tackling FW, such as the Circular Economy Action Plan, the European Green Deal, the Farm-to-Fork Strategy, and the European Circular Economy Stakeholder Platform (Hebinck *et al.*, 2018). From the academic perspective, increasing focus has turned to different factors responsible for FW generation (e.g. poor packaging and mishandling), various strategies for mitigating FW (e.g. operational strategies, behavioral strategies, and policy-related strategies), new technologies for FW recovery (e.g. internet-of-things, artificial intelligence, and blockchain technology), and tradeoffs with FW (e.g. costs, travel distance, and operational efficiency) (Dou and Toth, 2021; Giroto *et al.*, 2015). However, research to date seems to neglect the role of social innovation in reducing FW.

Social innovation aims to improve the welfare and wellbeing of individuals and communities through designing and implementing new concepts, products, processes or programs (Haskell *et al.*, 2021; Ukar *et al.*, 2019; Westley and Antadze, 2010). For example, the European Network for Rural Development (ENRD) was built to facilitate knowledge sharing, information exchange, and cooperation across rural Europe through engaging with anyone with an interest in the rural development of Europe (ENRD, 2014). The Social Innovation Academy is a free online training platform, which aims to equip social innovators with the requisite knowledge and skills to make their dreams a reality (Social Innovation Academy, 2022). Other examples such as food banks and food surplus entrepreneurs' network are all social innovation initiatives

that aim to deal with socio-economic problems, including FW, while contributing to economic development. Considering that more than 70% of FW is generated at the household level, this means that it is not enough to only rely on the government to set FW initiatives (UNEP, 2021). It is critical to implement strategies that cut across organizational, sectoral, or disciplinary boundaries in order to trigger the awareness of the whole society of the imperative to reduce FW. Particularly, from the social innovation perspective, initiatives such as compelling new social relationships and combining existing elements seem to be the most effective ways to reduce FW (Huang and Tsai, 2021). Recent articles (e.g. Kafa and Jaegler, 2021; Santiago *et al.*, 2019; Schanes *et al.*, 2018) on FW also show that the overwhelming focus of current research on FW is on exploring better storage facilities and extending the shelf-life of food, whereas other measures such as infrastructural measures, informational and educational support, and social innovation have not received sufficient attention. In particular, how to reduce FW through social innovation seems to have been largely forgotten by researchers until the FUSIONS (Food Use for Social Innovation by Optimizing Waste Prevention Strategies) project was funded by the EC (Cerciello *et al.*, 2019). The FUSIONS project not only provides a more accurate method for estimating FW, but also shows how social innovation contributes to solving FW (FUSIONS, 2016). To reduce FW, it is necessary to identify and implement a consistent and coherent framework that includes different approaches (e.g. technology, policy, social, and economic) across different actors.

FW management literature has been increasing in recent years; for example, systematic literature review (SLR) literature on FW in educational institutions (Kaur *et al.*, 2021), FW minimization methods (Moraes *et al.*, 2021), FW technology adoption (Aramyan *et al.*, 2021; Joubert and Jokonya, 2021), FW from AFSC practitioners' perspective (Schanes *et al.*, 2018), and FW and sustainability (Huang *et al.*, 2021). In particular, some literature review articles shed some lights on FW prevention and social innovations (Al-Obadi *et al.*, 2022; Moraes *et al.*, 2021), but social innovation was not the main role discussed in their studies. To the best of our knowledge, to date, no SLR has been conducted on reducing FW from social innovation perspective, which highlights a research gap that needs to be filled. Thus, this study conducts a SLR on social innovations and FW, highlighting the critical role of different social innovation measures for reducing FW and proposing valuable directions for future research. This study complements previous literature reviews by providing an overview of the state-of-art research on social innovation for reducing FW.

The remainder of this paper is organized as follows. Section two – we describe the SLR process in detail, such as how to formulate research questions and how to locate, select and evaluate, analyze, and present studies. In Section three, two types of analysis of the literature are presented – descriptive and thematic analyses. Descriptive analysis is conducted by analyzing the research methodology adopted and the distribution of publications, whereas thematic analysis is conducted by analyzing different FW reduction measures adopted from the social innovation perspective. In Section four, we discuss and synthesize the main findings of this study and propose future research directions related to methodology, food redistribution, rescue, donation, and food sharing. Finally, conclusions are drawn in Section five.

2. Materials and methods

A SLR was considered the most suitable method for this study for several reasons. First, a SLR is useful for synthesizing and refining scattered knowledge from existing studies, thereby contributing to new knowledge generation and theory building (Meredith, 1993; Tranfield *et al.*, 2003). Second, it helps to limit researchers' bias and errors by providing strong objective observation and the highest possible replicability (Denyer and Tranfield, 2009). Third, SLR is a widely used method that has been adopted in different research fields, such as food safety standards (Rao *et al.*, 2021), agri-food supply chain (AFSC) management (Fernqvist and Goransson, 2021), and social innovation (Foroudi *et al.*, 2021). Thus, this study adopts the five-step research methodology proposed by Denyer and Tranfield (2009) to exhaustively search relevant literature on social innovation and FW, detect existing gaps in the research field, and propose future research directions. These steps are described in the following sub-sections (Figure 1).

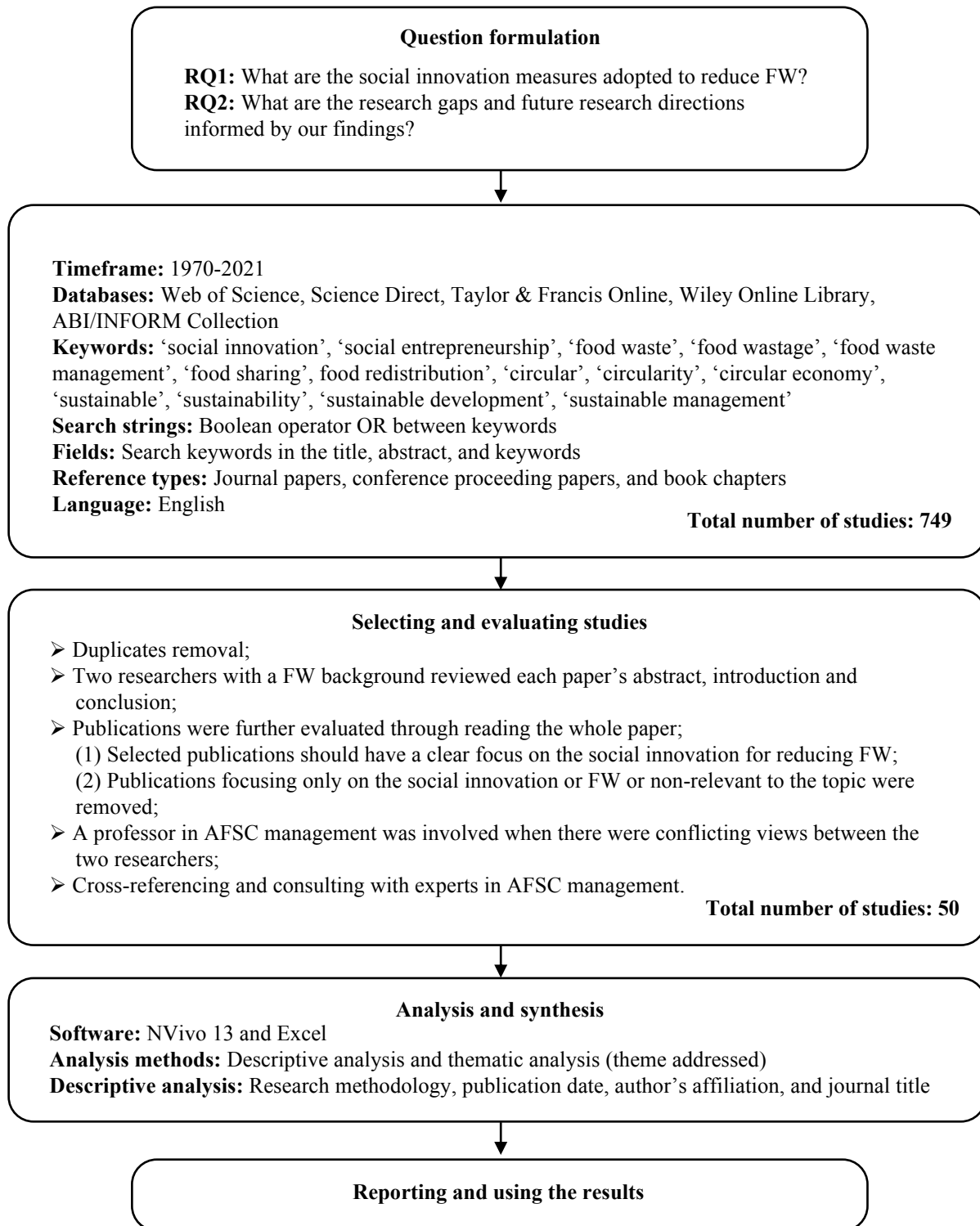


Figure 1. A summary of the systematic literature review process.

2.1 Question formulation

The first step of a SLR is to develop a clear focus of the study to avoid bias, error, and ambiguity (Light and Pillemer, 1984). Thus, specific, informative, and clearly defined research questions are formulated:

RQ1: What are the social innovation measures adopted to reduce food waste?

RQ2: What are the research gaps and future research directions informed by our findings?

2.2 Locating studies

The second step of a SLR is to create a comprehensive list of core contributions related to the review questions (Denyer and Tranfield, 2009). Thus, five databases were selected to comprehensively search relevant publications, including Web of Science, Science Direct, Taylor & Francis Online, Wiley Online Library, and ABI/INFORM Collection. These databases were selected as they are the world’s leading business research repositories, include an extensive collection of journals, books, and conference proceedings in science, social sciences, and arts and humanities, and are frequently used in literature reviews. In line with prior literature review articles on social innovation (e.g. Do Adro and Fernandes, 2019; Foroudi *et al.*, 2021) and FW (e.g. Bhattacharya *et al.*, 2021; Schanes *et al.*, 2018), several keywords were used and combined as search criteria to obtain broader coverage from the literature (Table 1). Keywords such as ‘circular economy’ and ‘sustainable management’ were also included; these were searched for in the title, abstract, and keywords. This is because social innovation activities are very heterogeneous, often experimental, and can be driven by a project, a company, and even the whole of society. For example, nine types of social innovation activities were categorized based on the degree of interaction/societal domain (Schartinger *et al.*, 2020). Thus, more relevant keywords may help us to identify more relevant literature, thereby contributing to a comprehensive understanding of different social innovation activities for reducing FW. Furthermore, experts’ recommendations and cross-referencing were all used to cover a wide range of information and sources. Two experts are consulted in this study: one is a professor in AFSC management, who has expertise in ‘FW management’, ‘food safety’ and the ‘circular economy’ and has done different projects related to AFSC and circular economy; the other one is a professor in supply chain and logistics management with a particular interest in food supply chains and has overseen projects funded by the EC and the Food Standard Agency.

We set the timeframe for searching relevant publications across five databases from 1970 to 2021, for a number of reasons. First, previous literature reviews on social innovation (e.g. Do Adro and Fernandes, 2019; Edwards-Schachter and Wallace, 2017) all set their starting point for searching relevant publications from 1970 to the present date. We chose similar timeframes to cover a wide range of studies and topics while capturing the most recent developments. Second, the concept of social innovation can be traced back to 1930 (Swift Jr, 1930), but the role of social innovation in reducing FW has received considerable attention since

Table 1. Keywords and search strings.

Keywords	‘social innovation’, ‘social entrepreneurship’, ‘food waste’, ‘food wastage’, ‘food waste management’, ‘food sharing’, food redistribution’, ‘circular’, ‘circularity’, ‘circular economy’, ‘sustainable’, ‘sustainability’, ‘sustainable development’, ‘sustainable management’
Databases	Web of Science, Science Direct, Taylor & Francis Online, Wiley Online Library
Search strings	(‘social innovation’ OR ‘social entrepreneurship’) AND (‘food waste’ OR ‘food wastage’ OR ‘food waste management’ OR ‘food sharing’ OR ‘food redistribution’ OR ‘circular’ OR ‘circularity’ OR ‘circular economy’ OR ‘sustainable’ OR ‘sustainability’ OR ‘sustainable development’ OR ‘sustainable management’)

the FUSIONS project was set up in 2016 (Lombardi and Costantino, 2020). Since then, the value of social innovation for reducing/preventing FW has been recognized by researchers, policymakers, and the society at large. Thus, capturing up-to-date publications can help us know the latest trends in this topic.

2.3 Study selection and evaluation

The review was limited to publications published in peer-reviewed journals, book chapters, and conference proceedings rather than only focusing on peer-reviewed journal articles. This is because although a stringent publication selection process may increase the quality of the study, it limits the creativity and innovation of the study (Easterby-Smith *et al.*, 2012). Considering that this study aims to explore the different social innovation measures that are adopted for FW reduction, more reference types are included.

The initial search with specified keywords in the selected five databases starting from 1970 generated a preliminary sample of 749 contributions (Figure 1). To select the most relevant publications, two criteria were used. First, publications had to contain ‘social innovation’ and/or ‘food waste’ in the title, abstract or keywords, since the aim of the study was to identify different social innovation measures for reducing FW. Second, publications should show the interaction between social innovation and FW. The 749 selected publications were checked for duplication with the assistance of EndNote X8 (Clarivate, Philadelphia, PA, USA). This resulted in 458 publications for further analysis. To minimize any subjective bias and enhance the validity of this study, two researchers who have a background in FW management were involved to read each paper’s title, abstract, introduction, and conclusion. In this stage, we excluded papers focusing on defining and categorizing social innovations, exploring social innovation components, and discussing general FW practices (Baptista *et al.*, 2019; Caroli *et al.*, 2018). When there was a conflicting view between the two researchers regarding inclusion or exclusion of papers, a professor of AFSC management was involved. For example, several papers titled ‘circular economy’, ‘green social innovation’, and ‘sustainable development’ do not show a clear relevance to the topic, hence their inclusion was discussed with the professor. As the outcome of this process, 75 papers were selected for full-text assessment. For example, articles that focused on other topics such as food and city sustainability, food poverty alleviation, sustainable urban development, and food assistance systems that shed light on social innovations for increasing resource efficiency/effectiveness were all included for full-text assessment. Then, each paper was read in its entirety by the two researchers to ensure that all selected publications are highly relevant to the topic. This step resulted in 45 papers. After cross-referencing and discussion with experts in FW management, an additional five publications were identified, resulted in a total sample size of 50.

2.4 Analysis and synthesis

Fifty papers were selected for descriptive and thematic analyses. Regarding the descriptive analysis, the selected publications were classified based on their characteristics, including year of publication, journal title, author’s nationality, and the research methodology adopted (e.g. theoretical and conceptual papers, case studies/interviews, surveys, modeling papers, and literature reviews) (Seuring and Muller, 2008). In this process, the relevant information from each paper was recorded in an Excel file for analysis purposes.

The thematic analysis was adopted for generating themes through analyzing, summarizing, and linking the content of papers. Thematic analysis is selected because it is frequently used in SLRs such as social media value creation (Rashid *et al.*, 2019) and knowledge management (Bornbaum *et al.*, 2015). Furthermore, thematic analysis is effective for examining the different perspectives of research articles. This study collected 50 papers for analysis, which means that these papers may provide different social innovation measures for reducing FW. The clear and well-structured process of thematic analysis provides us a useful way to consolidate and integrate the findings of multiple qualitative studies. Themes are considered to represent the fundamental concepts that describe the subject matter of each author’s article (Ryan and Bernard, 2003). In this study, we are following Nowell *et al.* (2017) for conducting thematic analysis, as their work demonstrates how to establish trustworthiness during each phase of the analysis. Thematic analysis involves four steps; these are

(1) familiarizing oneself with each paper through immersive reading; (2) coding of each paper line-by-line; (3) identifying and naming major themes; and (4) grouping articles on the basis of similarity of themes. To build a trustworthy thematic analysis, researcher triangulation is required. Thus, two researchers who were involved in the process of study selection and evaluation coded each paper. Two researchers were asked to code each paper individually with the assistance of NVivo 13 (QSR International, Burlington, MA, USA). After the two researchers finished their coding, we implemented the coding comparison query function of NVivo 13 to process kappa coefficient and percentage agreement analysis. The kappa coefficient analysis results were $k=0.79$, which means substantial agreement between two researchers (Cohen, 1960). Through checking the degree of agreement of the codes generated by the two researchers, we ensured we had codes that have been applied nonexclusively (O'Conner and Joffe, 2020). In the step of identifying and naming themes, two researchers were required to achieve consensus on themes. If there was a conflict between the two researchers, an associate professor in FW management with more than 10 years' experience in qualitative data analysis was involved. Thus, themes are drawn to represent the core ideas, arguments, and conceptual linking of expressions through an holistic understanding of each article (Linan and Fayolle, 2015).

2.5 Reporting and using the results

After the analysis results were checked, they were organized to answer the research questions. In the next section, we present the descriptive and thematic analyses results, respectively.

3. Literature analysis

In this section, we first present the descriptive analysis by demonstrating the authors' nationality, research methodology adopted, number of reviewed studies per year, and the distribution of publications. The complete list of publications is shown in Supplementary Table S1. As for the thematic analysis, different measures adopted from the social innovation perspective are classified and synthesized.

3.1 Descriptive analysis

In terms of the authors' affiliation, we found that authors affiliate to different institutions in different countries across the globe (Figure 2B). In Europe, the majority of authors affiliate to Italy ($n=11$, 22%), the United Kingdom ($n=7$, 14%), The Netherlands ($n=5$, 10%), Austria ($n=3$, 6%), and Finland ($n=3$, 6%), whereas a minority of authors affiliate to Denmark ($n=2$, 4%), Greece ($n=1$, 2%), Switzerland ($n=2$, 4%), France ($n=1$, 2%), Sweden ($n=1$, 2%), Germany ($n=1$, 2%), and Spain ($n=1$, 2%). FW is a serious problem in Australia and New Zealand; for example, nearly 300 kilograms of food per person are wasted in the average Australian household (Food Bank, 2021) and almost 79 kilograms of edible food per household are sent to landfills in New Zealand every year (Wellington City Council, 2021). However, the topic did not receive considerable attention in Australia ($n=1$, 2%) and New Zealand ($n=2$, 4%), respectively. Although China ($n=1$, 2%) and India ($n=1$, 2%) have been listed as the countries that produce the most household FW across the globe (Statista, 2021), reducing FW from the social innovation perspective has not received much attention in these two countries. Authors affiliated to other countries have also been observed, such as Canada ($n=3$, 6%), the USA ($n=1$, 2%), Brazil ($n=1$, 2%), and Turkey ($n=2$, 4%). Furthermore, we find that the publications selected in this study were produced at research institutions from Europe ($n=38$, 76%), Asia ($n=2$, 4%), Oceania ($n=5$, 10%), North America ($n=4$, 8%), and South America ($n=1$, 2%). The huge differences between Europe and other continents can be explained by the different policies, research programs, strategies, and agreements implemented by the European Union (EU) for reducing FW, as reinforced by Moraes *et al.* (2021).

Regarding the research methodology adopted, a majority of publications adopted case studies/interviews ($n=35$, 70%), while the remaining minority adopted theoretical and conceptual papers ($n=4$, 8%), modeling ($n=3$, 6%), surveys ($n=3$, 6%), and literature review ($n=4$, 8%) (Figure 2C). Interestingly, only one publication adopted a mixed research methodology, including case studies/interviews and surveys ($n=1$, 2%). We assumed that case studies/interviews are frequently used by the researchers to investigate the topic, as it allows in-

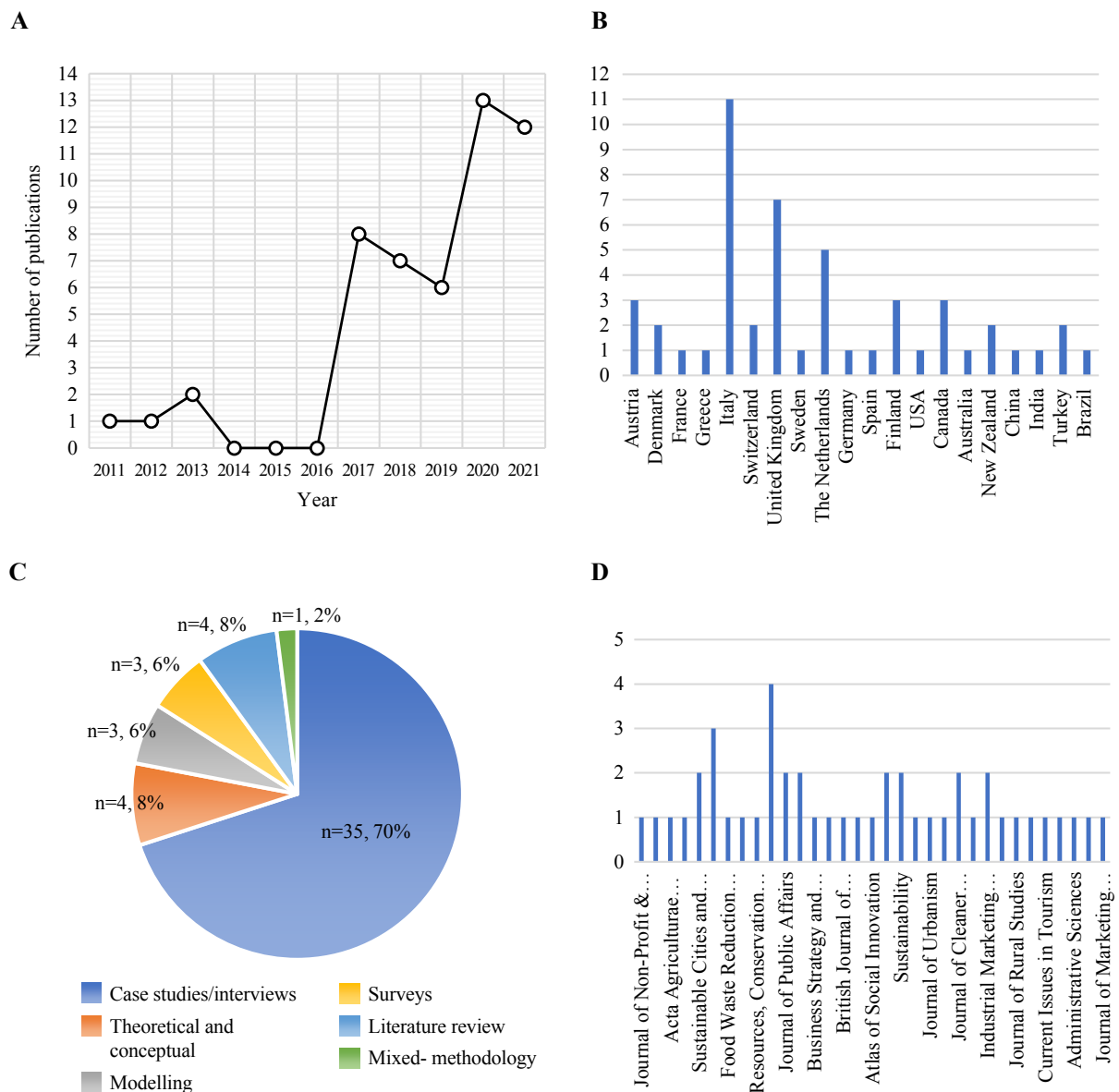


Figure 2. Descriptive analysis of the sample studies; (A) the number of publications over the years; (B) authors’ affiliation across different; (C) research methodology adopted; (D) journal/book title.

depth investigation about a specific phenomenon. Other methodologies such as modeling and surveys may achieve a more precise result, but they lack potential depth (Saunders *et al.*, 2009). In particular, investigating the role of social innovation in reducing FW is a trending topic; therefore, an in-depth investigation for achieving better knowledge/understanding is timely.

For the number of publications published per year, we find that the topic is currently being developed (Figure 2A), as an overall growing trend of publications on reducing FW from the social innovation perspective was observed in this study. In particular, a dramatic increase in publications on the topic was observed from 2016 to 2017 and from 2019 to 2020. This is for several reasons. First, researchers realized the huge potential of social innovation for reducing/preventing FW when the EC-funded FUSIONS project was set up in July 2016. This is because the FUSIONS project has made a great contribution to the European-level FW estimation, quantification, and reduction from the social innovation perspective (Vittuari *et al.*, 2017). Second, the EC

launched a set of policy initiatives (e.g. EU Green Deal) for transforming the EU into a modern, resource-efficient, and competitive economy from 2019 (European Commission, 2019a). Third, reducing FW is the key to achieving zero net emissions of greenhouse gases by 2050. We believe that there will be a continuous increase in publications related to the topic, as 10% of greenhouse gas emissions originally from the FW and rising global average temperature will lead to a widespread change in weather patterns.

Publications are dispersed across 33 different journals rather than concentrated in several journals, as shown in Figure 2D. The nine most recurring journals are: British Food Journal (n=4, 8.69%), The Design Journal (n=3, 6.52%), Sustainable Cities and Society (n=2, 4.35%), Journal of Public Affairs (n=2, 4.35%), Local Environment (n=2, 4.35%), European Planning Studies (n=2, 4.35%), Sustainability (n=2, 4.35%), Journal of Cleaner Production (n=2, 4.35%), and Industrial Marketing Management (n=2, 4.35%). We find that these journals cover a wide research area, including sustainability and environment, cleaner production, sustainable design, community relations, industrial and business-to-business markets, and waste issues. This means that reducing FW from the social innovation perspective needs inter-disciplinary collaboration that considers it from different research angles.

3.2 Thematic analysis

The thematic analysis results show that different measures have been adopted from the social innovation perspective for reducing FW, including food redistribution, food rescue, food donation, and food sharing.

■ Food redistribution

Food redistribution is ‘a process whereby surplus food that might otherwise be wasted is recovered, collected and provided to people, in particular to those in need’ (European Commission, 2019b: 5). We found that numerous studies attempt to assess the value of food redistribution activities for reducing FW from the social innovation perspective. For example, Lombardi and Costantino (2020) conducted a case study to investigate a social innovation model for reducing FW through the lens of an Italian project. Their research results indicate that the project ‘Avanzi Popolo 2.0’ implemented at Bari for activating citizens against FW was useful in three different ways, including establishing an online food-sharing community for people to exchange food directly, building connections between ‘waste places’ and ‘need places’ to redistribute food, and conducting educational programs (e.g. public events, workshops, and roadshows) to raise people’s awareness about the impacts of FW on the society, the environment, and the economy. Huang and Tsai (2021) described how social innovation activities could be used to tackle the connectivity gap between smallholder farmers and urban markets in China by creating an online market for small-scale farmers to sell their products, creating an exchange platform for farmers and consumers to increase trust and engagement, and creating a mobile application to facilitate the communication between farmers and technicians.

The key for triggering the role of social innovation for reducing FW is to formulate a community that includes a range of AFSC practitioners (e.g. producers, processors, wholesalers, retailers, and consumers) to achieve synergies through reusing and transforming FW into new materials, nutrients, and energy (Gollnhofer *et al.*, 2019; Lombardi and Costantino, 2021; Spring and Biddhph, 2020). Only when social actors have built long-term trust relationships with each other can the social innovation be activated (Simone *et al.*, 2017). Through linking with intersectoral clients (e.g. education, catering, food industry, and hospital) and collaborating with bio-companies, LoveYourWaste would have the opportunity to collect, minimize, and convert FW into biogas and organic fertilizer (Angelidou and Psaltoglou, 2017). LoveYourWaste is a start-up labeled a green-tech innovation company responsible for collecting, recovering, and reducing FW. To capture the value of FW, Mattila *et al.* (2020) stated that the value network – e.g. producer, user, and supporter networks – sustainable value propositions – e.g. economic, environmental, and social dimensions – are critical. In particular, the supporter networks, which include marketing, advertising, programming, financial, and business planning, contribute to the beneficiaries involved in the networks through scalability and attractiveness. Marchesi and Tweed (2021) similarly agreed that social innovation can significantly contribute to food redistribution

activities, but the involvement of a broader network that includes a range of communities, food hubs, and processors is necessary. Alberio and Moralli (2021) considered the reformulating of the relationships among AFSC stakeholders by introducing ‘co-producers’ to participate in the activities of producing, delivering, and consuming. Co-producers are a group of citizens that include a range of occupations, such as farmers and politicians. Through exchanging ideas, knowledge, and skills in the alternative food networks, FW can be reduced through redistribution activities. For maximizing the FW performance of the food networks, Fernhaber *et al.* (2019) proposed that diverse community stakeholders, particularly grassroots community members, should be involved to get additional insights, achieve cross-fertilization, and enhance the whole knowledge repository. The recent study conducted by Penco *et al.* (2021) shows that the organization (e.g. food bank) that operates as a social network should have an appropriate attitude to absorbing new knowledge and adopting suitable measures to disseminate the knowledge to its external partners. Thus, novel innovative solutions can emerge from the iterative knowledge-sharing process. Furthermore, their research also stressed the critical role of strengthening/extending relationships with existing/new partners to increase the adaptive capacity of food banks and its effectiveness. However, Karki *et al.* (2021) stated that various organizations that participated in the food redistribution activities might hamper the efficiency of the system. Thus, they suggested a coordinator to manage the activities among different actors for capturing the value of surplus food. After conducting three case studies (i.e. ‘Ekam Eco Solutions’, ‘Let’s Recycle’, and ‘Waste-Pro’) related to social innovation practices in sustainable waste management, Ambati (2019) stated that three elements are critical for food enterprises for facilitating social innovation, including professional technological knowledge for creating eco-friendly solutions, relentless social innovating, and great passion regarding social entrepreneurial.

■ *Food rescue*

Hecht and Neff (2019: 1) defined food rescue as ‘a practice of gathering rescuable food and redirecting it for human consumption’. Based on Poppendieck’s (1994) work, food rescue organizations collect unused food from restaurants, caterers and institutions’ dining halls and then distribute them to soup kitchens. This practice is frequently used for reducing FW and increasing food supplies in the emergency food sector (Dagevos and Veen, 2020; Lindberg *et al.*, 2014). Based on its applications, food rescue has been categorized into three different groups: these are (1) traditional rescue (e.g. food banks and food rescue hubs); (2) complementary rescue (e.g. services and apps); and (3) original rescue (e.g. sale strategies) (Hecht and Neff, 2019). An empirical investigation conducted by Angelidou and Psaltoglou (2017) on sustainable urban development construed the important role of complementary rescue organizations in reducing FW. For example, FoodCloud built FoodCloud Hubs to connect a range of food businesses (e.g. farmers, manufacturers, and distributors) across the whole country to rescue a large amount of surplus food and redistribute it to charities and communities. The UK has the widespread food rescue hubs for collecting food from businesses, selling rescued food to customers, reinventing rescued food into new meals and dishes, freezing suitable items for longer end life, and providing regular opportunities for the customers to learn FW knowledge, all of which makes ‘rescue food’, ‘reduce FW’, and ‘reconnect people at the community level’ possible. In Spain, public street actions such as project Dress Rehearsal were used for rescuing food. A series of steps needed to be taken to implement the project; these included building a network that involves gleaners, gardeners, and food merchants for gathering food, sharing and communicating with network partners, planning activities (e.g. gleaning, designing menus, reusing, and transporting) and, finally evaluating and learning from the activity (Cid, 2019).

In New Zealand, governments set several policies and practices to encourage retailers to build relationships with various groups (e.g. protein re-processors, local farmers, food rescue charities) to divert retail FW away from landfills (Goodman-Smith *et al.*, 2020). However, relationship building does not happen in a vacuum; it needs government facilitative practices implemented at citizen, community, and society levels. For example, financial assistance (e.g. project application and grant calls), administrative assistance, technical assistance (e.g. knowledge, skills, and technical equipment), capacity building (e.g. experience-sharing workshops and seminars), networking support, flexibility in rules, and accepting and valuing opinions, all need to be overseen by the local government (Chin and Mees, 2021). In particular, Cangiano *et al.* (2017) described a one-year

training program provided by the local government to help community tech social innovators to master a sustainability toolkit, to generate capacity and scalability for the digital social innovation. Furthermore, local governments also need to continuously review their facilitative practices and provide more effective support to citizens and communities.

Ruge and Mikkelsen (2013) conducted a pilot study to evaluate whether local food strategies are an effective social innovation method. Their research results reinforced the need for workshops and curriculum-based interventions (e.g. cooking sessions) implemented in schools with sixth-grade students. Such interventions would contribute to establishing new educational links between schools and local producers, as well as enhancing students' FW awareness and food literacy knowledge. A more integrated network involving multiplex relations among stakeholders is confirmed as effective for handling FW issues, but the outcomes depend on the relationship types and the degree of homophily among stakeholders (Ghinoi *et al.*, 2020; Soma *et al.*, 2020). For example, a lower level of homophily among stakeholders with different forms of well-known organizations and different types of knowledge are identified as desirable. In accord with Bakırhıoglu and McMahan (2021), knowledge is likely to have positive effects for facilitating the sustainable transition of businesses. Therefore, a co-learning environment should be cultivated that involves novice designers, industry partners, and researchers/educators. Moreover, a sustainability training program should be offered to make an impact in real-world contexts.

■ *Food donation*

Based on the European Economic and Social Committee (2014: 21), food donation is defined as 'holdings of food or feed for the purpose of sale, including offering for sale or any other form of transfer, whether free of charge or not, and the sale, distribution, and other forms of transfer'. FoodCloud is actively working as a bridge between local retailers and charity groups through connecting them using a smartphone app, which allows the local retailers to donate food on a daily basis (Angelidou and Psaltoglou, 2017). Holweg and Lienbacher (2011) proposed a social supermarket concept that helps the people who are in or at risk of poverty. That is, social supermarkets receive agri-food products from retailers and manufacturers free of charge and then sell them to local consumers with a discount of up to 70%. This kind of organization is different from other organization forms such as food banks and conventional supermarkets because of its limited target groups, ultra-low food prices, and limited offerings (up to 45% of goods are frozen foods). Risso (2012) pointed out that the key to running the social supermarket was the involvement of large retailers that had effective and efficient logistics and sales management systems. Like the solidarity stores in France, they formed an association and formulated partnerships with Carrefour and local communities. Thus, Carrefour had an opportunity to reduce their waste management costs, enhance their corporate brand image, and formulate new social partnerships. Other involved parties such as solidarity stores and local communities could support low-income families, improve their logistic networks, and create job opportunities for local community members. Based on the research conducted by Signori and Forno (2019), organizations or individuals participating in the solidarity group would become more sustainable in consumption, more willing to collaborate with others, more interested in local politics, and be more concerned about social effectiveness. Avelino *et al.* (2020) suggest six advantages from building local and trans-local social innovation networks: (1) creating new relations; (2) creating larger supportive contexts; (3) fostering/sharing/developing skills through hands-on experimentation and learning; (4) increasing access to resource and generating broader impact; (5) sharing success and failure experience with each other to generate network resilience; and (6) local sense-making and collective identity.

Marchesi and Tweed (2021) designed a social innovation model for a circular food system based on multiple case study analysis. Their social innovation model involves five stages: (1) design; (2) take (material sourcing); (3) make (growing/production and distribution/sales); (4) use (consumption); and (5) dispose (FW collection). They suggest that communities, retailers, and manufacturers should donate surplus food to sustainable food places to increase consumer awareness. Cattivelli and Rusciano (2020) conducted a case study in the Naples province of Italy regarding social innovation and food provision during the COVID-19 pandemic.

Their research results confirmed that the collaborative efforts between local communities and volunteering associations were effective for tackling food provision problems during the pandemic. Furthermore, they also reinforced that it was necessary to connect with local food practices to achieve better performance. Social innovation activities may facilitate food donations, but Karki *et al.* (2021) raised concern about ensuring the quality and safety of food, as social innovation activities might involve different suppliers to donate food. To tackle this problem, they suggested that a legislative framework should be built for food donations and an independent third-sector organization should be involved to test and certify the donated food.

■ Food sharing

Food sharing is a collaborative practice where individuals or groups of people make a commitment to ensure that food is shared rather than wasted (Michellini *et al.*, 2018). There are three different business models of food-sharing platforms; these are (1) sharing of food at the community level through peer-to-peer mechanisms – ‘sharing for the community’; (2) consumers buy agri-food products close to the expiry date from suppliers at a discounted price – ‘sharing for money’; and (3) suppliers provide surplus food for free to non-profit organizations – ‘sharing for charity’ (Gollnhofer, 2017; Michellini *et al.*, 2018). Several initiatives and start-ups (e.g. SHARECITY) have been implemented across Europe to promote the food-sharing economy and collaborative consumption models involving the distribution of excess food from retailers and consumers (Falcone and Imbert, 2017). SHARECITY is a project funded by the Horizon 2020 Programme to assess the practice and sustainability potential of city-based food-sharing economies (European Commission, 2015). There are different advantages in facilitating food sharing, including reducing FW, increasing food accessibility, and further helping to achieve zero hunger and responsible consumption and production (Bugge *et al.*, 2019).

Previously, people facilitated food sharing and reconnected people to tackle food poverty and food inequality through ‘community-garden initiatives’, ‘community-kitchen initiatives’, and ‘eco-villages’ (Sedlacko *et al.*, 2013). To alter social relations and empower the community in food-sharing activities like community-garden initiatives, five enablers are necessary; these are (1) clear purposes and motivations; (2) diversification of garden resources; (3) experimental knowledge processes; (4) effective internal support and strong recognition; and (5) implementation place-based practices (Ulug and Horlings, 2019). With the rising of digital technologies, the way people share food is changing (Jaeggi and Gurven, 2013). The reason for integrating digital technologies with community engagement, bottom-up approaches, and co-creation strategies is to create a digital social innovation for tackling society needs (Cangiano *et al.*, 2017). In other words, tackling the society needs such as FW, requires efforts from the whole society perspective, rather than only relying on the centralized proprietary solutions provided by several companies. The wide application of food sharing websites and mobile applications (e.g. VizEat, S-food exchange, Next door help, Last minute market) can potentially coordinate different consumers and eradicate FW. For example, Harvey *et al.* (2020) conducted a social network analysis based on the data collected from the free food sharing mobile application – OLIO. Their research results show that, in the last 10 months, there were 54,913 instances of food sharing among 9,540 people. Insights into the food-sharing experience show that social interaction, novelty, authenticity, and awe are considered to be the most important factors that attract people to participate in the food-sharing activities (Atsız *et al.*, 2021). Graham-Rowe *et al.* (2014) noted that most people have an interest in food sharing because of its capacity for connecting, informing, protecting, mobilizing, integrating, and measuring in recovering FW along with the AFSC, rather than environmental concerns. Therefore, a better understanding of the economic, social, and environmental benefits of food-sharing practices should be conducted and mobilized with consumers (Ciulli *et al.*, 2020). Michellini *et al.* (2020) hold a similar view that the value of food-sharing platforms on FW recovery, prevention, and eradication of poverty can only be identified when the impacts of food-sharing platforms on the economic, environmental, societal, and political contexts are properly assessed. Although the application of digital technology improves the food-sharing experience and extends the social interactions of the users, problems may emerge from the food-sharing process; for example, food quality and food safety cannot be guaranteed, strict hygiene requirements may not be applied, and it may be difficult to monitor the food-sharing process (Angelidou and Psaltoglou, 2017). D’Ambrosi (2018) construed that digital platforms’ application promotes food sharing activities, facilitates local communities’

participation, and strengthens collaborative economic practices. However, knowledge of the barriers that exist (e.g. cultural and human behavior) in applying digital platforms is lacking, which impedes our further understanding.

The emergence of ‘doggy bags’ has also facilitated food sharing. A doggy bag is a container or bag for leftovers that customers of restaurants or cafes can take home (Merriam-Webster, 2022). A recent study conducted by Sirieix *et al.* (2017) on consumers’ attitudes towards doggy bags in restaurants showed that although the doggy bag could be seen as a social innovation and help to increase consumers’ awareness about FW, it lacks social identification which hampers its application in restaurants. To tackle the social identification problem of doggy bags, Bozzola *et al.* (2017) suggested that cross-disciplinary teams should be involved in designing doggy bags, including academic, cultural, commercial, and social teams. Thus, the doggy bag’s economic, social, environmental, and ethical value could be improved. To further remove the barriers to using doggy bags, Miroso *et al.* (2018) stressed that positive social norms around using doggy bags should be set and disseminated by the local governments.

4. Discussion and future research directions

This section aims to reveal some of the issues that currently remain comparatively unexplored and to propose valuable future research directions that can significantly expand the knowledge in this research area. Thus, we begin with methodological considerations by extensively discussing contributions and offering useful recommendations for the research methodology to be used in future research. Then, we refresh our minds in how FW can be reduced through embedding social innovation activities into food redistribution, food rescue, food donation, and food sharing is conducted. Thereafter, through synthesizing the findings of this study, we build a conceptual framework in terms of social innovations for reducing FW. Last, this section provides recommendations that may facilitate the development of all the research themes addressed in this study.

4.1 Methodological considerations

A noticeable methodological trend is observed in this study – that is, case studies/interviews account for 70% of the research methodology used. In contrast, other research methodologies (e.g. theoretical and conceptual papers, modeling, surveys, and literature reviews) only account for 30% of the methodologies. Case studies/interviews are prevalent because reducing FW from the social innovation perspective is a relatively new topic, so researchers have attempted to understand this social phenomenon or have sought to interpret its meaning through the study of targeted people or places. Although existing studies have assisted our initial understanding of how social innovation activities (e.g. network building and doggy bag) can be used for reducing FW, limited application of research methodologies has impeded further understanding. Thus, we encourage scholars to use different research methodologies or a mixed research methodology approach to investigating the topic. As for the theoretical and conceptual papers, we suggest two future research directions. First, scholars are encouraged to synthesize existing knowledge from previous work to propose new conceptual frameworks regarding the application of the social innovation model for reducing FW. For example, Lombardi and Costantini (2021) proposed a conceptual framework that integrated social innovation (e.g. community composting, alternative food networks, animal feeding campaigns, and awareness campaigns), FW prevention/recovery strategies (e.g. prevention, re-use, material recycling, nutrient recovery, energy recovery, and disposal), and different stages of AFSCs to transform our understanding of how to combine FW with the social innovation. Second, scholars are encouraged to use different social network theories (e.g. action theory, the theory of weak ties, and the theory of diffusion of innovations) to see how social networks are formulated and developed, as developing relationships and integrating different resources are fundamental to social innovation. Concerning the research methodology of modeling, we suggest that it can be used to model the degree of homophily of different stakeholders to achieve the best FW performance. Furthermore, prioritizing the enablers/barriers of social innovation for reducing FW through modeling is also a feasible future research direction. Regarding surveys, existing studies focus on investigating consumers’ attitudes/practices toward food sharing, social media, and doggy bags, and their role in facilitating social

innovation (Miroso *et al.*, 2018; Signori and Forno, 2019; Young *et al.*, 2017). However, studies that investigate stakeholders', policymakers', community leaders', and volunteers' attitudes towards different social innovation activities for reducing FW are lacking. Thus, we suggest that scholars could take this opportunity to conduct research with stakeholders, policymakers, community leaders, and volunteers using questionnaires/surveys to gain a comprehensive understanding. Also, we observed that a literature review was rarely used to review existing social innovation activities for reducing FW. Thus, we suggested that scholars could review several topics that may facilitate the development of this research area, including the role of digital technologies for transforming social innovation activities to reduce FW, how social networks are developed to reduce FW, different social innovation products, and the role of doggy bags in reducing FW. Finally, we suggest that a longitudinal strategy could be used to see the effects of social innovation for reducing FW in the longer term, as a cross-section strategy was prevalent.

Besides, we find that existing research is primarily conducted in European countries, particularly in Italy, the United Kingdom, and the Netherlands. However, limited research was observed from countries of Asia, Oceania, South America, and North America. There are several reasons for this. First, the EU contains 27 member states, which represents the highest cultural diversity in this world. Thus, it offers fertile soil in which to foster social innovation activities. Second, demographic changes, the climate crisis, and technological changes all impose pressures on the existing system, which force researchers, policymakers, and industrial practitioners to tackle these societal challenges from the social innovation perspective. Third, the EU set a target to achieve a 55% net emissions reduction by 2030. Thus, reducing FW from the social innovation perspective contributes significantly to the carbon reduction activities (European Commission, 2020). Conducting research only in the European countries may hamper our understanding, as we cannot know context-specific, context-bounded, and context-embedded factors that may facilitate/impede social innovation activities for reducing FW. Based on the above discussions, a promising research area is to investigate social innovation activities for reducing FW in other countries that are located in Asia, Oceania, North America, and South America to enrich the findings. Another area of investigation is conducting cross-country empirical research on the topic to generalize the research findings and generate a broader impact, including comparative analysis between European countries and comparative analysis between European countries and other countries from other continents.

4.2 Food redistribution, rescue, donation, and sharing-related recommendations

Regarding the role of social innovation in food redistribution activities, we identified several future research directions, as shown in Supplementary Table S2. First, existing studies (Huang and Tsai, 2021; Lombardi and Costantino, 2020; Sutinen and Narvanen, 2021) realized that the key to maximizing the performance of food redistribution activities is to build connections between the 'wasted places' and the 'needed places' through deploying different social innovation measures, such as online markets and online food-sharing communities. However, the performance of the measures adopted to tackle the connectivity gaps appears to have been largely ignored by the extant literature (De los Mozos *et al.*, 2020). Thus, we suggest that comparative empirical analysis is conducted across different measures that are adopted to tackle the connectivity gaps using a longitudinal strategy to identify the most effective measure for building connections among stakeholders, community members, and policymakers. Second, extending food redistribution networks and involving more people to participate is still a research trend, including scaling-up community action, mobile applications and involving 'co-producers' (Alberio and Moralli, 2021; Harvey *et al.*, 2020; Shaw *et al.*, 2018). This means that researchers are considering the diversity of the networks, while seemingly neglecting the management issues. For example, the coordinator has the responsibility to manage the volunteers, run the apps/websites, reconfigure the resources, and establish relationships with others. Therefore, its influential role is critical for food redistribution activities. A remaining question is who (e.g. grassroots community members, policymakers, or volunteers) can be the coordinator to activate the best performance of social innovation activities in the food redistribution networks. Third, we observed that several studies focus on knowledge sharing activities (Ambati, 2019; Penco *et al.*, 2021), as knowledge is the foundation of social innovation. We reinforce the importance of knowledge-sharing/educational programs among different

stakeholders to raise their FW awareness and achieve synergies. Thus, we suggest exploring knowledge boundaries and boundary-crossing mechanisms in social innovation activities of food redistribution. Finally, digital technologies' application facilitates circulation of surplus food, strengthens civic participation and accelerates knowledge mobilization, but use of digital platforms for exchanging surplus food is still low (D'Ambrosi, 2018). This may be due to cultural resistance, or because we are reluctant to share food with somebody unknown. Thus, we suggest that scholars and policymakers investigate several research topics related to digital technology or smart platforms: (1) users' segmentation – who are currently using these digital platforms; (2) brand awareness – the impact of digital platform features on dissemination practices; (3) potential market exploitation – who are reluctant to use these platforms and why; and (4) performance measurement of digital platforms. This last topic can be measured by various key performance indicators (KPIs) such as new charities' engagement, volunteers' engagement, quantity of surplus food collected, recovery of food value, new consumers' engagement, operation cost reduction, and the quantity of hungry people fed.

Regarding food rescue, several research gaps emerged from our study, including rarity of studies that evaluated the food assistance practices provided by the government and the lack of studies that investigated the homophily issues in the food rescue networks. Limited funds, spaces and resources have been listed as some of the top barriers to the development of food rescue (Hecht and Neff, 2019). Although some governments provide different food assistance practices to facilitate citizens to participate in food rescue activities, the effectiveness of these practices is unknown (Chin and Mees, 2021). Thus, it is better to conduct empirical research regarding the food assistance practices provided by the government to develop a consistent protocol to evaluate/assess the outcomes of these programs. For example, several feasible KPIs can be considered such as equipment received, knowledge acquired (e.g. seminars, conferences, and webinars), network developed (e.g. contact information acquired), community entrepreneurs fostered, and funding received from the government (Van Meerkerk *et al.*, 2018). Another concern is the homophily issue among the members in the food rescue activities. In the network theory, homophily was defined as two actors having a relationship because of their similar characteristics (Lazega *et al.*, 2012). A high level of homophily among the members of food rescue activities may not be good for knowledge cross-fertilization, which will further hamper social innovation. Thus, we suggest that researchers investigate the structure of multiplex relations among different members who participate in the food rescue activities using social network analysis. Based on the analysis results, we propose that potential interested members that have different characteristics from existing participants to participate in the food rescue activities to maximize the performance of knowledge sharing in the network. We expect this to be one of the most fruitful areas in the social innovation for food rescue activities.

Beyond the typical call for conducting research using a longitudinal strategy, challenges remain in raising researchers' concern in the social innovation activities for facilitating food donation. First, limited studies have conducted empirical research regarding social supermarkets. The scarcity of empirical research in the scientific literature is due to a lack of data (Schneider, 2013). With the idea of social supermarkets taking root around the world, different countries have built social supermarkets or similar non-profit organizations to tackle food donations; for example, Feeding America in the USA, European food banks, SOMA social supermarkets in Australia, solidarity stores in France, and food banks in Columbia (Herbst, 2019). The massive implementation of social supermarkets in different countries provides researchers with excellent opportunities to conduct cross-country empirical research regarding the enablers/barriers for implementing social supermarkets, performance measurement of social supermarkets, and network analysis of social supermarkets. Second, extant studies have stressed that different partnerships among profit organizations, non-profit organizations, public institutions, and governments are critical for the success of the sustainable development of social supermarkets (Brehmer *et al.*, 2018; Risso, 2012). However, limited research has conducted empirical research on how a social supermarket builds partnerships with other institutions (e.g. big supermarkets and governments) through the lens of a theory to gain a deeper understanding. A promising research area can be through using the 'theory of change' as a lens to investigate how and why social supermarkets want to build relationships with big supermarkets (e.g. Carrefour of France and Tesco of the UK) to achieve sustainable development. Third, a prevalent problem that exists in different countries is the trust problem between donors and social supermarkets that has resulted from the fragmented nature

of small social supermarkets, lack of food safety knowledge of volunteers, and lack of suitable refrigerated facilities (Boeck *et al.*, 2017). To tackle this problem, we suggest conducting empirical research from different practitioners' perspectives to acquire a comprehensive understanding of this issue. The practitioners include but are not limited to social supermarkets, regulators, volunteers, donor enterprises, and transporters.

Finally, in investigating the social innovation in food-sharing activities, several studies have carefully considered the enablers for a successful digital food-sharing platform (D'Ambrosi, 2018; Mazzucchelli *et al.*, 2021) from the consumer perspective, as the primary role of the platform is to share discount information between local retail stores and their customers. However, gaining an in-depth understanding of the barriers to applying a digital food-sharing platform is essentially ignored. Clearly, successfully run digital food-sharing platforms not only rely on the retail stores, but also depend on other practitioners such as monitors, restaurants, regulators, and consumers. Thus, an empirical analysis of the barriers to applying digital food-sharing platforms from different practitioners' perspectives is necessary. Besides, we identified that food-sharing business models and the characteristics of food sharing platforms both have received considerable attention from academia (Ciulli *et al.*, 2020; Micheli *et al.*, 2018), but research that has conducted a comparative analysis across different digital food-sharing platforms regarding its applicability, characteristics, usefulness, and educational attributes is lacking. A recent study conducted by Cane and Parra (2020) summarized different websites, blogs, and mobile applications that have been used in the fight against FW and provided a novel typology of food-sharing platforms. However, the work only provides a simplistic description of different platforms, which lacks a systematic analysis of commonalities and differences across various digital platforms. This may prevent us from acquiring further and more in-depth understanding of how these platforms tackle FW. Thus, this will be a promising future research area. Furthermore, while a handful of studies deal with digital food-sharing platforms (Nica-Avram *et al.*, 2021; Rombach and Bitsch, 2015), the question of how to monitor the food-sharing process to provide safe food to consumers still remains. Emerging technologies such as blockchain technology and machine learning may solve this problem. Finally, this study also suggests the value of identifying suitable KPIs to evaluate the performance of different digital food sharing platforms.

4.3 Synthesis of existing findings and framework development

This study identified various social innovation measures for reducing FW, such as doggy bags, community of gardens, eco-villages, community kitchens, social supermarkets and solidarity stores. Besides, various participants have participated in these activities, such as manufacturers, charities, restaurants and cafes, policy-makers and volunteers. Based on our findings, we propose a framework, which is introduced in Figure 3. The framework contains four sections, these are resources, potential social innovation participants, social innovation measures, and FW reduction. This gives us an excellent opportunity to re-examine our work, synthesize existing findings, and propose valuable future research directions. After seeing the whole picture of our work, three questions emerged, which may open new avenues for future research. First, resources are critical for activating social innovation, such as financial, human and physical resources, which are widely defined by scholars (Foroudi *et al.*, 2021; Wilson and Millman, 2003). Other resources such as network resources and government support mechanisms are also both essential (Chin and Mees, 2021). However, there is a vagueness around how to combine these resources to activate and deliver superior value of social innovation for reducing FW, which is reinforced by two review articles on social innovation (Foroudi *et al.*, 2021; Short *et al.*, 2009). To achieve a comprehensive understanding, a promising future research direction is to investigate resources and their possible combination for activating social innovation to reduce FW. Second, knowledge has been recognized as one of the most valuable resources to individuals, companies, and nations (Drucker, 1998). In the context of social innovation for reducing FW, knowledge has been mobilized among different participants to generate new ideas, raise FW awareness, and achieve competitive advantage (Lombardi and Costantino, 2020; Ruge and Mikkelsen, 2013). However, considerably fewer scholars have conducted studies on the types of knowledge that should be mobilized and measures for facilitating knowledge mobilization in terms of social innovation to reduce FW. Future studies should investigate this kind of issue via the use of different methodologies. Finally, it is obvious that participants can support FW reduction by implementing various social innovation measures. However, a potential barrier that may impede

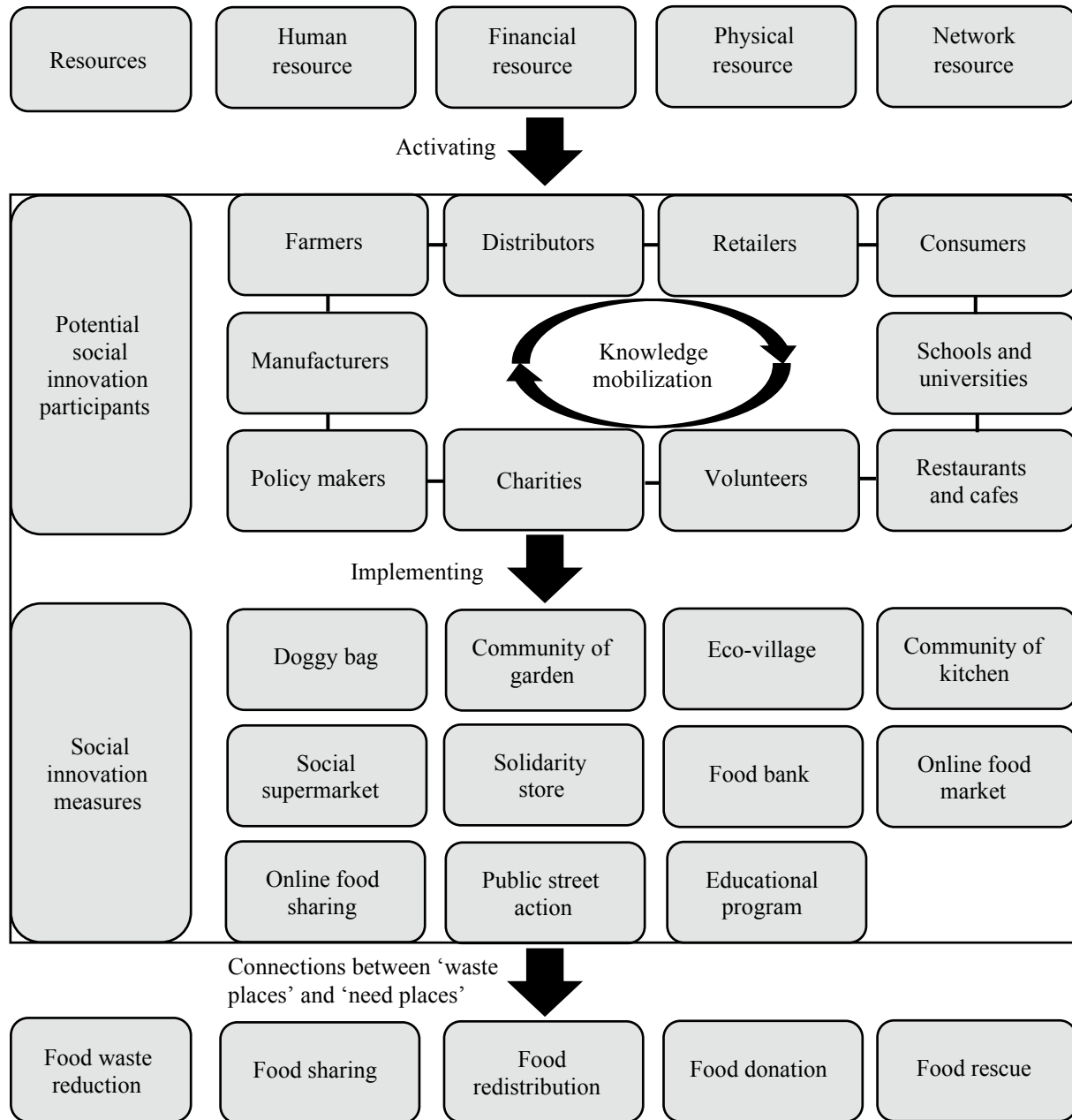


Figure 3. The interpretative framework of social innovation for reducing food waste.

our understanding is whether other benefits may emerge from the process, such as economic, social and sustainable values. Based on the social innovation framework proposed by Foroudi *et al.* (2021), there are three opportunities for social innovation participants – these are technology transfer, business formation, and problem solving. In this context, FW reduction can be considered as problem solving. But what about the other two benefits? This is a valuable direction for further exploration.

5. Conclusions

This study carefully reviewed the accumulated knowledge on social innovation for reducing FW from 1970 to 2021. As a result, 50 publications were extracted from five databases, various social innovation measures were identified, an interpretative framework of social innovation for reducing FW was built, and valuable future research directions were proposed. For example, this study identified 11 social innovation

measures that have been applied in food redistribution, food sharing, food donation, and food rescue, such as doggy bag, community of garden, eco-village, community of kitchen, social supermarket, solidarity store, food bank, online food market, online food sharing, public street action, and educational program. Based on the findings, we built an interpretative framework to describe the whole picture of social innovation for reducing FW. Finally, we proposed research directions that may open avenues for future research. For example, from the research methodology perspective, we suggest integrating different social network theories to see how social networks are formulated and developed, modeling the degree of homophily of stakeholders that participated in social innovation activities to achieve best FW reduction performance, and conducting empirical research using a longitudinal strategy. From the country perspective, we suggest conducting cross-country comparative analysis on the topic to generalize the findings. For the different social innovation measures used in FW reduction, we suggest various fruitful future research directions, such as investigating who can be the coordinator of food redistribution activities for achieving the highest efficiency and effectiveness, assessing different assistance practices provided by government, linking with specific theory to conduct empirical research on partnership analysis regarding social supermarkets, and investigating suitable KPIs to evaluate the performance of food-sharing platforms. Other valuable future research directions emerged from our research, including resources for activating social innovation activities, knowledge types for mobilizing among social innovation partners, and other benefits that can be achieved through implementing social innovation.

We believe that our study follows the rigorous steps required to conduct the SLR, highlights different social innovation activities in FW reduction processes, reveals different research gaps, and elicits different future research directions. However, our research still has limitations. For example, we used different keywords to search publications in four databases, which resulted in 50 publications. This is an issue that can be problematic as keyword selection is totally subjective. Although we are confident that we have reviewed the majority of studies in this research area, some publications that are relevant to the topic may have been excluded from the analysis due to keywords selection. To alleviate this problem, we suggest that more keywords can be scrutinized and included when searching publications in the future research. For example, keywords related to ‘social movement’, and ‘alternative food practices’, and ‘social entrepreneurship’, ‘social housing’ and ‘resource efficiency’ can all be added in future literature reviews.

Supplementary material

Supplementary material can be found online at <https://doi.org/10.22434/IFAMR2022.0006>

Table S1. Literature analysis.

Table S2. Research gaps and future research directions based on the literature review.

Acknowledgements

With the support of the Marie Curie Alumni Association

Conflict of interest

The authors declare no conflict of interest.

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