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

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Abstract

Food waste has been increasingly recognized as a serious environmental, social, and economic problem. Therefore, it should be tackled in an innovative way through analyzing and synthesizing existing publications. This study aims to have a comprehensive understanding on different social innovation measures adopted for reducing food waste using a systematic literature review. After locating, collecting, evaluating, and analyzing 47 publications from four databases, we concluded that social innovation activities such as digital food sharing platforms, social supermarkets, solidarity stores, and food rescue hubs were widely deployed in different food waste reduction processes. Based on the findings, we synthesized several research gaps and proposed future research directions regarding research methodology, country, food redistribution, food rescue, food donation, and food sharing. For example, conduct research to develop suitable key performance indicators to evaluate the performance of digital food sharing platforms and link with specific theory to conduct empirical research on partnership analysis regarding social supermarkets. This study has a limitation on controlling publication quality due to identify more social innovation measures for reducing food waste.

1. Introduction

Food waste (FW) refers to the decrease in the quantity or quality of food resulting from decisions and actions by retailers, food service providers and consumers (Food and Agriculture Organization of the United Nations (FAO). 2021). Globally, and according to the Food Waste Index Report that conducted by the United Nations Environment Programme (UNEP) (2021), appropriately 931 million tons of FW was generated in 2019, which indicated around 17% of global food production might be wasted. Moreover, 61% of FW came from households (568 million tons), 26% from food service (242 million tons) and 13% from retail (121 million tons). It is estimated that FW will have a dramatic increase in the next 25 years because of the economic growth and the world population is projected to reach 9.7 billion in 2050 and further increase to 11.2 billion by 2100 (Chen et al. 2017). Based on the report conducted by Deloitte (2021), the wasted food can be used for feeding 2400 million people each year who are malnourished.

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 (CO_2) equivalent are generated annually by global food wastages, which is slightly lower than the contribution of global road transport emissions to global warming. Around 250 km^3 of surface and groundwater resources and 1.4 billion hectares of farmland are also attributable to FW (FAO. 2015). FW not only burdens the environmental sustainability, but also poses threats to food insecurity. For example, FW contains a large amount of 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. 2021). Considering the severe effects of FW to the environment and society at large, the United Nations proposes Sustainable Development Goals (SDGs) for tackling climate change and ending huger. It is necessary for us to examine, summarize, and synthesize existing literatures and propose valuable directions for researchers and scholars to tackle FW in an innovative way.

FW has raised an increasingly 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 Circular Economy Action Plan, European Green Deal, Farm to Fork Strategy, and the European Circular Economy Stakeholder Platform. From the academia perspective, increasing focus has been given to different factors (e.g., poor packaging and mishandling) responsible for FW generation, various strategies (e.g., operational strategies, behavioural strategies, and policy-related strategies) for mitigating FW, new technologies (e.g., internet-of-things, artificial intelligence, and blockchain technology) for FW recovery, and tradeoffs with FW (e.g., costs, travel distance, and operational efficiency) (Bernstad and la Cour Jansen. 2012; Girotto et al. 2015; Dou and Toth. 2021). However, previous research seems to neglect the role of social innovation for reducing FW.

Social innovation was defined by Westley and Antadze (2010, p. 2) as "*a complex process of introducing new products, processes or programs that profoundly change the basic routines, resource and authority flows, or beliefs of the social system in which the innovation occurs. Such successful social innovations have durability and broad impact*." Considering that more than 70% of FW is generated at the household level, this means that only relying on the government for setting FW initiatives is far from enough (UNEP. 2021). It is critical to implement strategies that cut across organizational, sectoral or disciplinary boundaries for triggering the whole society's awareness for reducing FW. In other words, from the social innovation perspective such as compelling new social relationships and combining existing elements, seems to be the most effective way for reducing FW (Huang and Tsai. 2021). Recent literature reviews (e.g., Schanes et al. 2018; Ozbuk and Coskun. 2020; Kafa and Jaegler. 2021) on FW also indicates that current research on FW is overwhelming 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 enough attention. In particular, how to reduce FW through social innovation seems to be forgotten by the researchers till the FUSIONS (Food Use for Social Innovation by Optimizing Waste Prevention Strategies) project was funded by the EC. For reducing FW, a consistent and coherent framework that includes different approaches (e.g., technology, policy, social, and economic) across different actors is necessary. Thus, the aim of this study is to conduct a systematic literature review (SLR) to review studies on social innovations and FW, highlighting the critical role of different social innovation measures for reducing FW and proposing the valuable directions for future research.

The remainder of this paper is organized as follows. In section two, SLR process is described in detail. In section three, two types of analysis of the literature is presented, descriptive and thematic analysis. In section four, we discuss the major findings of this study and propose future research directions. Finally, conclusions are drawn in section five.

2. Research methodology

An SLR was considered as the most suitable method for this study because of several reasons. *First*, an SLR is useful for synthesizing and refining scattered knowledge from existing studies, therefore, contributes to new knowledge generation and theory building (Meredith. 1993; Tranfield et al. 2003). *Second*, it helps to limit researchers' bias and errors through providing strong objective observation and the highest possible replicability (Denyer and Tranfield. 2009).

Third, SLR is a widely used method and 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 e-commerce (Zeng et al. 2017). Thus, this study adopts the five-step research methodology proposed by Denyer and Tranfield (2009) to exhaustively search relevant literatures 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 (see Figure 1).

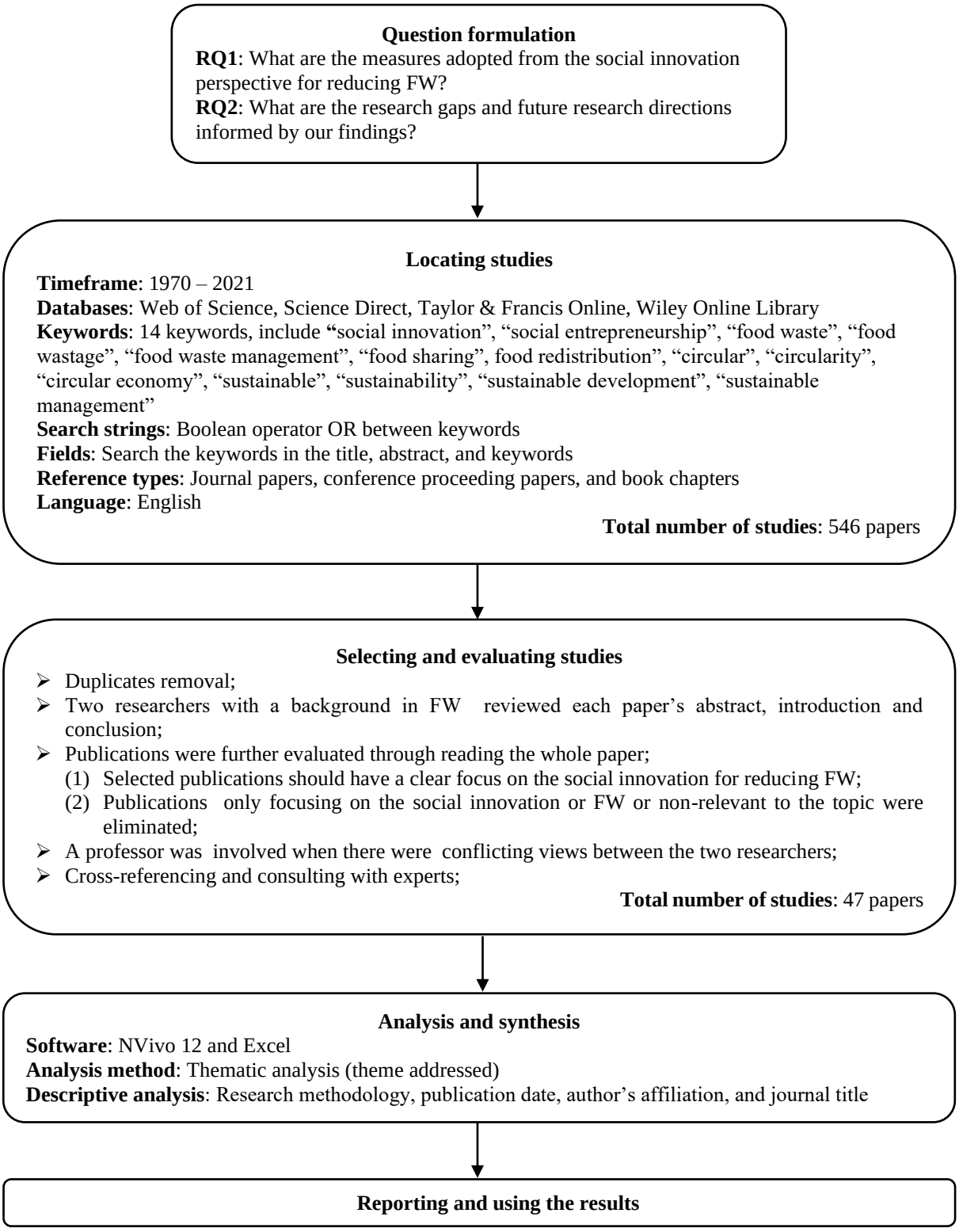

Figure 1 A summary of the SLR process

2.1 Question formulation

The first step of an 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 (Hohenstein et al. 2015):

RQ1: What are the measures that have been adopted from the social innovation perspective for reducing FW?

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

2.2 Locating studies

The second of step of SLR is to create a comprehensive list of core contributions related to the review questions (Denyer and Tranfield. 2009). Thus, four databases were selected to comprehensively search relevant publications, including Web of Science, Science Direct, Taylor & Francis Online, and Wiley Online Library. These databases were selected as they are the world's leading business research repositories, include a large collection of journals, books, and conference proceedings in science, social science, and arts and humanities, and be frequently used in literature reviews. In consistent with prior literature review articles on social innovation (do Adro and Fernandes. 2019) and FW (Schanes et al. 2018; Bhattacharya et al. 2021), several keywords were used and combined as search criteria for obtaining broader coverage from the literature (see Table 1). Keywords such as "circular economy" and "sustainable management" were also included, searching for them 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 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 literatures, therefore, contribute to a comprehensive understanding of different social innovation activities for reducing FW. Furthermore, experts' recommendations and cross-referencing were all used for covering a wide range of information and sources.

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")

We set the timeframe for searching relevant publications across four databases from 1970 to 2021. This is because of several reasons. *First*, previous literature reviews on social innovation (e.g., Edwards-Schachter and Wallace. 2017; do Adro and Fernandes. 2019) all set their starting point for searching relevant publications from 1970 and ending with up to date. We chose the similar timeframe 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 for reducing FW has received a considerable attention after the FUSIONS project was done in 2016. Then, the value of social innovation for reducing/preventing FW has been recognized by the researchers, policymakers, and the society at large. Thus, capturing the up-to-date publications can help us to know the latest trend on this topic.

2.3 Study selection and evaluation

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

adopted for reducing FW, strict quality criteria may pose threats to identify more social innovation measuremore reference types are included.

The initial search with specified keywords in the selected four databases with starting point from 1970, resulted in a preliminary sample of 546 contributions. To minimize any subjective bias and enhance validity of this study, two researchers that have a background in FW management were involved to read each paper's abstract, introduction, and conclusion, respectively. Papers only focusing on the social innovation or FW or non-relevant to the topic were eliminated. However, the articles focused on other topics such as food and city sustainability, food poverty alleviation, sustainable urban development, and food assistance systems that shed lights on social innovations for increasing resource efficiency/effectiveness were all included for further analysis. When there is a conflicting view between the two researchers regarding inclusion or exclusion of papers, a professor of FW management was involved for further analysis. For example, several papers titled "circular economy", "green social innovation", and "sustainable development" do not show a clear relevance to the topic, hence were passed to a professor for further analysis. As the outcome of this process, 75 papers were selected. Then, each paper was read entirely by the two researchers again to ensure that all selected publications are highly relevant to the topic. This step resulted in only 42 papers. After cross-referencing and discussing with experts in FW management, additional 5 publications were identified, resulted in the total sample size of 47.

2.4 Analysis and synthesis

The 47 papers were selected for descriptive analysis and thematic analysis. Regarding for the descriptive analysis, the selected publications were classified based on their characteristics, includes year of publication, journal title, author's nationality, and the research methodology adopted (e.g., theoretical and conceptual papers, case studies/interviews, surveys, modelling papers, and literature reviews) (Seuring and Muller. 2008). In this process, each paper's information was recorded in an Excel file for analysis purpose.

As for the thematic analysis, it was adopted for generating themes through analyzing, summarizing, and linking the content of papers. Thematic analysis was selected over other qualitative data analysis methods (e.g., narrative analysis, content analysis, and discourse analysis) because it is particularly useful for highlighting the differences and similarities between different data sets, therefore, deep insights regarding social innovation measures for reducing FW can be generated. Considering that we have 47 papers that need to be analyzed, therefore, NVivo 12 was used for assisting the thematic analysis process. For ensuring a high-level of credibility and reliability, two researchers that were involved in the process of study selection and evaluation coded each paper. This process ended till two researchers reached an agreement that no valuable information was missed, and additional checks were conducted.

2.5 Reporting and using the results

After the analysis results were checked, they were organized for answering the research questions. In the next section, descriptive and thematic analysis results would be presented, 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 full list of publications is available as an online supplement. 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 find that authors affiliate to different institutions of different countries across globe (see Figure 2). In Europe, a majority of authors affiliates to Italy (n = 10, 21.74%), United Kingdom (n = 7, 15.22%), The Netherlands (n = 5, 10.87%),

Austria (n = 6.52%), and Finland (n = 3, 6.52%), whereas a minority of authors affiliates to Denmark (n =1, 2.17%), Greece (n = 1, 2.17%), Switzerland (n =1, 2.17%), France (n = 1, 2.17%), Sweden (n = 1, 2.17%), Germany (n = 1, 2.17%), and Spain (n =1, 2.17%). FW is a serious problem in Australia and New Zealand, for example, nearly 300 kilograms of food per person are wasted in the household of Australia (Food Bank. 2021) and almost of 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 a considerable attention in Australia (n = 1, 2.17%) and New Zealand (n = 2, 4.35%), respectively. Although China (n = 1, 2.17%) and India (n = 1, 2.17%) have been listed as the countries that produce the most of household FW across the globe (Statista. 2021), reducing FW from the social innovation perspective has not received much attention in these two countries. Authors affiliate to other countries also have been observed, such as Canada (n = 2, 4.35%), the USA (n = 1, 2.17%), Brazil (n = 1, 2.17%), and Turkey (n = 2, 4.35%). Furthermore, we find that the publications selected in this study were produced at research institutions from Europe (n = 12, 60%), Asia (n = 3, 15%), North America (n = 2, 10%), Oceania (n = 2, 10%), and South America (n = 1, 5%). The huge differences between Europe and other continents can be explained by the different policies, research programmes, strategies, and agreements implemented by the European Union (EU) for reducing FW, as reinforced by Moraes et al (2021).

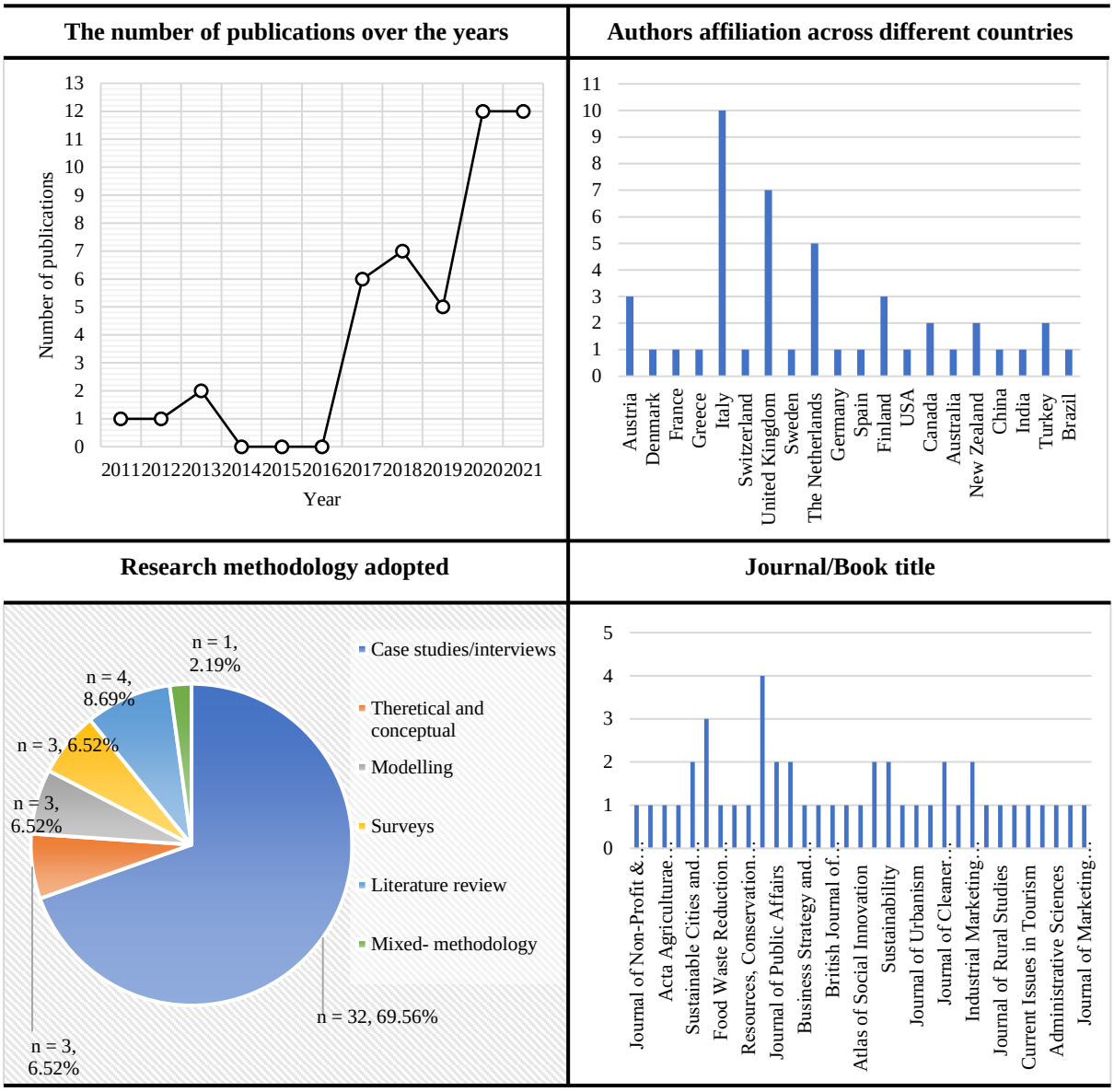

Figure 2 Descriptive analysis of the sample studies

Regarding the research methodology adopted, a majority of publications adopted case studies/interviews (n = 32, 69.56%), a minority of them adopted theoretical and conceptual papers (n = 3, 6.52%), modelling (n = 3, 6.52%), surveys (n = 3, 6.52%), and literature review (n = 4, 8.69%). It is interesting to note that only one publication adopted a mixed research methodology, including case studies/interviews and surveys (n = 1, 2.19%). We assumed that case studies/interviews are frequently used by the researchers to investigate the topic, as it allows in-depth investigation about a specific phenomenon. Other methodologies such as modelling and surveys may achieve a precise result, but they lack potential depth (Saunders et al. 2009). In particular, investigating the role of social innovation for reducing FW is a trending topic, in-depth investigation for achieving a better knowledge/understanding is necessary.

As for the number of publications published per year, we find that the topic is currently being developed (see Figure 2), 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 of publications on the topic was observed from 2016 to 2017 and from 2019 to 2020. This is because of several reasons. *First*, researchers realized the huge potential of social innovation for reducing/preventing FW when the EC funded FUSIONS project was done in

July of 2016. *Second*, 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 (EC. 2019). Thus, reducing FW is the key to achieving zero net emissions of greenhouse gases by 2050. We believe that there will be a continuous increase of publications related to the topic, as 10% of greenhouse gas emissions originally from the FW and rising global average temperature lead to a widespread change in weather patterns.

Publications are dispersed in 33 different journals rather than concentrated on several journals, as shown in Figure 2. 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 collaborations and 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.

3.1 Food redistribution

Food redistribution was defined as "a process whereby surplus food that might otherwise be wasted is recovered, collected and provided to people, in particular to those in need" (EC. 2019, p. 5). We found that numerous studies attempt to discover 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 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, environment, and economic. Huang and Tsai (2021) described how social innovation activities could be used for tackling the connectivity gap between smallholder farmers and urban markets in China. That is, 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 technician.

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 material, nutrient, and energy (Lombardi and Costantino. 2021). Through linking with intersectoral clients (e.g., education, catering, food industry, and hospital) and collaborating with bio-companies, LoveYourWaste (https://www.loveyourwaste.com/) would have the opportunity to collect, minimize, and convert FW into biogas and organic fertilizer (Angelidou and Psaltoglou. 2017). For capturing the value of FW, Mattila et al. (2020) stated that the value network (e.g., producer, user, and supporter networks) and sustainable value propositions (e.g., economic, environmental, and social dimensions) are critical. In particular, the supporter networks that include marketing, advertising, programming, financial, and business planning, which contribute to the beneficiaries involved in the networks through scalability and attractiveness. Marchesi and Tweed (2021) hold a similar view that social

innovation can significantly contribute to the food redistribution activities, but the involvement of a wider network that includes a range of communities, food hubs, and processors is necessary. Alberio and Moralli (2021) considered that reformulating the relationships among AFSC stakeholders through 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 that grassroot community members should be involved to get additional insights, achieve cross-fertilization, and enhance the whole knowledge repository. The recent study by Penco et al. (2021) show that the organization (e.g., food bank) operates as a social network should have appropriate attitude to absorb new knowledge and adopt suitable measures to spread the knowledge to its external partners. Thus, unthinkable innovative solutions can be emerged from the iterative knowledge sharing process. Furthermore, their research also stressed the important role of strengthening/extending relationships with existing/new partners for increasing the adaptive capacity of food banks and its effectiveness. However, Karki et al. (2021) stated that various organizations participated in the food redistribution activities might hamper the efficiency of the system. Thus, they suggested a coordinator to coordinate the activities among different actors for capturing the value of surplus food. After conducting three case studies (e.g., "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.

3.2 Food rescue

Food rescue is frequently used for reducing FW and increasing food supplies in the emergency food sector (Lindberg et al. 2014). Based on its applications, food rescue has been categorized into three different groups, including traditional rescue organizations (e.g., food banks and food rescue hubs), complementary rescue organizations (e.g., services and apps), and 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 organization for reducing FW. For example, FoodCloud (https://food.cloud/) through building 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. In the UK, the widely spread food rescue hubs for collecting perfectly good food from businesses, sell rescued food to customers, reinvent rescued food into new meals and dishes, freeze suitable items for longer end life, and provide regular opportunities for the customers to learn FW knowledge, which makes rescue food, reduce FW, and reconnect people at community level is possible. In Spain, public street actions such as project Dress Rehearsal were used for rescuing food. A series of steps needs to be taken for implementing the project, including 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 the menu, reusing, and transporting), and finally is evaluating and learning from the activity (Cid. 2019). In New Zealand, governments set a number of policies and practices for encouraging 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 vacuum, which needs government facilitative practices implementing 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 accept and value opinions, all need to be done 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 for helping community tech social innovators to mater a sustainability toolkit, generate capacity, scalability the digital social innovation. Furthermore, local governments also need to continuously review their facilitative practices and provide more effective supports to citizens and communities. The pilot study conducted by Ruge and Mikkelsen (2013) also reinforced that workshops and curriculum-based interventions implemented in schools with 6th grade students, which would contribute to students' FW awareness and food literacy knowledge enhancement.

According to Avelino et al. (2020), there are six advantages for building local and trans-local social innovation networks, including (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 wider impact; (5) sharing successful & failure experience with each other to generate network resilience; and (6) local sense-making and collective identify. A more integrated network involving multiplex relations among stakeholders is confirmed effective for handling FW issues, but the outcomes depending on the relationship types and the degree of homophily among stakeholders (Ghinoi et al. 2020). For example, lower level of the degree of homophily among stakeholders with different forms of well-known organizations and different types of knowledge that is identified as desirable. In accord with Bakırlıoglu and McMahon (2021), knowledge is likely to have positive effects for facilitating sustainable transition of businesses. Therefore, a co-learning environment that involves novice designers, industry partners, and researchers/educators, as well as sustainability training programme should be conducted to make effects in real-word contexts.

Recent study conducted by Sirieix et al. (2017) on consumers' attitude towards doggy bags in restaurants show that the doggy bag could be seen as a social innovation and be useful for increasing consumers' awareness about FW, but it lacks social identification which hampering its application in restaurants. For tackling 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, doggy bag's economic, social, environmental, and ethical value could be improved. To further remove the barriers for using doggy bags, Mirosa et al. (2018) stressed that positive social norms around using doggy bags should be set and disseminated by the local governments.

3.3 Food donation

FoodCloud is actively working as bridges between local retailers and charity groups through connecting them using a smartphone app, which allowing 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 for free and then sell it to local consumers with a discount up to 70%. This kind of organization is totally different from other organization forms such as food banks and conventional supermarkets, because of its limited target groups, ultra-low food prices, and the limited offerings (up to 45% are frozen foods). Risso (2012) pointed out that the key for running the social supermarket was the involvement of large retailers and had effective and efficient logistics and sales management systems. Like the solidarity stores in France, they formed an association and formulated partnership with Carrefour and local communities. Thus, Carrefour would have an opportunity to reduce their waste management cost, enhance 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 make them more sustainable in consumption, more willing to collaborate with others, more interested in local politics, and have more concerns about social effectiveness.

Marchesi and Tweed (2021) designed a social innovation model for a circular food system based on the multiple case study analysis. In their social innovation model, five stages are involved, including design, take (material sourcing), make (growing/production and distribution/sales), use (consumption), and dispose (FW collection). They suggest that communities, retailers, and manufacturers should donate the surplus food to the sustainable food places to increase consumer awareness. Cattivelli and Rusciano (2020) conducted a case study in the province of Naples of Italy regarding social innovation and food provision during COVID-19. Their research results stressed that the collaborative efforts between local communities and volunteering association were effective for tackling food provision problems during the COVID-19. Furthermore, they also reinforced that it was necessary to connect with local food practices to achieve a better performance. Social innovation activities may facilitate food donations, but Karki et al. (2021) raised concern about how to ensure the quality and safety of food, as social innovation activities might involve different suppliers to donate food. For tackling this problem, they suggest 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.

3.4 Food sharing

Food sharing is a cooperative practice where individuals or groups of people make a commitment to ensure that food is shared rather than wasted (Michelini et al. 2018). There are three different business models of food sharing platforms, including (1) sharing of food at the community level through peer-to-peer mechanisms, which named as "sharing for the community"; (2) consumers buy agri-food products close to the expiry date from suppliers at a discounted price, which is entitled as "sharing for money"; and (3) suppliers provide surplus food for free to non-profit organizations, which means "sharing for charity" (Michelini et al. 2018). Several initiatives and start-ups (e.g., SHARECIRTY) are implemented across Europe to promote the food sharing economy and collaborative consumption models involving the use of the excess of food from retailers and consumers (Falcone and Imbert. 2017). There are different advantages for 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 for tackling food poverty and food inequality through "community-garden initiatives", "community-kitchen initiatives", and "eco-village" (Sedlacko et al. 2013). For altering social relations and empowering community in food sharing activities like community-garden, five enablers are necessary including (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 of people sharing 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 digital social innovation for tackling the 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) have the potential to 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 54,913 instances food sharing between 9,540 people were observed in the last ten months. Insights into food sharing experience shown that social interaction, novelty, authenticity, and awe are considered to be the most important factors that attracting people to participate in the food sharing activities (Atsız et al. 2021). Graham Rowe et al. (2014) noted that most people have interest about food sharing because of its capacity for connecting, informing, protecting, mobilizing, integrating, and measuring in recovering FW along the AFSC, rather than environmental concerns. Therefore, a better understanding on the economic, social, and environment benefits of food sharing practices should be conducted and mobilized with consumers (Ciulli et al. 2020). Michelini et al. (2020) hold a similar view that only the impact of food sharing platforms on the economic, environmental, societal, and political be properly assessed, the value of food sharing platforms on FW recovery, prevention, and eradication poverty can be identified. Although the application of digital technology improves the food sharing experience and extends the social interactions of the users, problems may emerge from the process, such as food quality and food safety cannot be guaranteed, strict hygiene requirements may not be applied, and 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, a lack of knowledge still exists on the barriers (e.g., cultural and human behavior) impeding the application of digital platforms.

4. Discussion and future research directions

This section aims to reveal some of the issues that currently remain comparatively unexplored and propose valuable future research directions that can make significant contributions to 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 the future research. Then, a focus on refreshing our mind of how FW can be reduced through embedding social innovation activities into food redistribution, food rescue, food donation, and food sharing is conducted. The section ends with providing generic recommendations that may facilitate development of all research themes of this study.

4.1 Methodological considerations

A noticeable methodological trend is observed in this study, that is, case studies/interviews account for appropriately 70% of the research methodology used, whereas other research methodologies (e.g., theoretical and conceptual papers, modelling, surveys, and literature reviews) only account for 30%. Case studies/interviews are prevalent because reducing FW from the social innovation perspective is a relatively new topic, researchers attempted to understand this social phenomenon or seek to interpret the meaning through the study of targeted people or places. Although initial understanding on how social innovation activities (e.g., network building and doggy bag) can be used for reducing FW has been learned from existing studies, limited application of research methodologies impeding the further understandings. 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 social innovation model for reducing FW. For example, Lombardi and Costantion (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 of social innovation. As for the research methodology of modelling, we suggest that it can be used for modelling the degree of homophily of different stakeholders to achieve the best FW performance. Furthermore, prioritization of the enablers/barriers of social innovation for reducing FW through modelling methodology is also a feasible future research direction. Regarding surveys, existing studies are focusing on investigating consumers' attitudes/practices toward food sharing, social media, doggy bags, and their role for facilitating social innovation (Young et al. 2017; Mirosa et al. 2018; Signori and Forno. 2019). However, a lack of studies to investigate stakeholders', policymakers', community leaders', and volunteers' attitudes towards different social innovation activities for reducing FW. Thus, we suggest that scholars could take this opportunity to conduct research with stakeholders, policymakers, community leaders, and volunteers using questionnaires/surveys to have a comprehensive understanding. Also, we observed that literature review was rarely used to review existing social innovation activities for reducing FW. Thus, it is 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 for reducing FW, how social networks are developed for reducing FW, different social innovation products, and the role of doggy bags for reducing FW. Finally, we suggest that longitudinal strategy could be used to see the effects of social innovation for reducing FW in a longer-term, as cross-section strategy was prevalent.

Besides, we find that existing research is mostly conducted in the countries of Europe, particularly in Italy, United Kingdom, and The Netherlands. However, very rare related research was observed from countries of Asia, Oceania, South America, and North America. This is because of several reasons. *First*, EU contains 27 member states, which represents the highest cultural diversity in this world. Thus, it can be a good soil to foster social innovation activities. *Second*, demographic changes, climate crisis, and technological changes all pose pressures to 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 55% net emissions reduction by 2030. Thus, reducing FW from the social innovation perspective contributes significantly to the carbon reduction activities (EC. 2020). Conducting research only in the Europe 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 conduct research on social innovation activities for reducing FW in other countries that locates in Asia, Oceania, North America, and South America to enrich the findings. Also, conduct cross-country empirical research on the topic to generalize the research findings and generate a wider impact, including comparative analysis between Europe countries and comparative analysis between Europe countries and other countries from other continents.

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

As for the role of social innovation in food redistribution activities, we identified several future research directions, as shown in table 2. *First*, existing studies (Lombardi and Costantino. 2020; Huang and Tsai. 2021) realized that the key for 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 market and online food sharing community. However, the performance of the measures adopted for tackling the connectivity gaps, which seems largely ignored by the extant literature (de los

Mozos et al. 2020). Thus, we suggest that conducting comparative empirical analysis across different measures that are adopted for tackling the connectivity gaps using longitudinal strategy, to see which is 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 domain research area, including scaling up community action, mobile applications, and involve "co-producers" (Shaw et al. 2018; Harvey et al. 2020; Alberio and Moralli. 2021). This means that researchers are considering the diversity of the networks, whereas the management issues seem to be neglected by them. For example, coordinator has the responsibility to manage the volunteers, run the apps/websites, reconfigure the resources, and establish the relationships with others. Therefore, its effective role is critical for the food redistribution activities. A remaining question is who (e.g., grassroot community members or policymakers or volunteers) can be the coordinator to activate the best performance of social innovation activities in the food redistribution networks. *Finally*, we observed that several studies focusing on the 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 that exploring knowledge boundaries and boundary-crossing mechanisms in social innovation activities of food redistribution.

Regarding food rescue, several research gaps were emerged from our study, including rarity of studies to evaluate the food assistance practices provided by the government and lack of studies to investigate the homophily issues in the food rescue networks. Limited funds, spaces and resources have been listed as some of top barriers for hampering the development of food rescue (Hecht and Neff. 2019). Although some government provided different food assistance practices to facilitate citizens to participate in the 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 (Key performance indicators) 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 problem also raised our concern is the homophily issue among the members in the food rescue activities. In the network theory, homophily was defined as two actors have a relation 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 investigating the structure of multiplex relations among different members participated in the food rescue activities using social network analysis. Based on the analysis results, inviting potential interested members that have different characteristics to participate in the food rescue activities for maximizing 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*, very rare studies have conducted empirical research regarding social supermarkets. The scarcity of empirical research in scientific literature due to a lack of data (Schneider. 2013). With the idea of social supermarkets spread to all over the world, different countries have built social supermarkets or similar non-profit organizations to tackle food donations. For example, Feeding America in USA, European food banks, SOMA social supermarket in Australia, solidarity stores in France, and food banks in Columbia. The massive

implementation of social supermarkets in different countries provide 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 organization, non-profit organization, public institutions, and governments is critical for the success of sustainable developments of social supermarkets (Risso. 2012; Brehmer et al. 2018). However, rare studies have conducted empirical research on how a social supermarket builds partnership with other institutions (e.g., big supermarkets and governments) through the lens of a theory for gaining a deep 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 UK) to achieve a sustainable development. *Third*, a prevalent problem that existing in different countries is the trust problem between doner and social supermarkets that resulted from fragmented nature of small social supermarkets, lack of food safety knowledge of volunteers, and lack of suitable refrigerated facilities (Boeck et al. 2017). For tackling this problem, we suggest to conduct empirical research from different practitioners' perspectives to have a comprehensive understanding. The practitioners include but no limited to social supermarkets, regulators, volunteers, doner enterprises, and transporters.

Finally, in studying 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 basic role of the platform is to share discount information between local retail stores and their customers. However, an in-depth understanding on the barriers for applying digital food sharing platform is essentially ignored. Clearly, the successfully running 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 on the barriers for 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 has received a considerable attention from the academia (Michelini et al. 2018; Ciulli et al. 2020), but a lack of study to conduct a comparative analysis across different digital food sharing platforms regarding its applicability, characteristics, usefulness, and educational attribute. Recent study conducted by Cane and Parra (2020) summarized different websites, blogs, and mobile applications that have been used for fighting against FW and provided a novel typology of food sharing platforms. However, the work just provides a simple description of different platforms, which lacks a systematically analysis such as commonalities and differences across different digital platforms. This poses a threat for us to have a further understanding on how these platforms fight against FW. Thus, this will be a promising future research area. Furthermore, while a handful of studies dealing with digital food sharing platforms (Rombach and Bitsch. 2015; Nica-Avram et al. 2021), a question still remaining is that how to monitor the food sharing process to provide safe food to consumers. The emerging technologies such as blockchain technology and machine learning may provide a solution for this problem. Finally, this study also suggests that identifying suitable KPIs to evaluate the performance of different digital food sharing platforms is essential.

Table 2 Research gaps and future research directions based on the literature

	Established findings	Research gaps	Suggestions for future research
Research methodology	▪ A majority of publications adopted case studies/interviews as a research methodology (n = 32, 69.56%), whereas a minority of them adopted theoretical and conceptual paper (n = 3, 6.52%), modelling (n = 3, 6.52%), surveys (n = 3, 6.52%), and literature review (n = 4, 8.69%) ▪ All of the studies adopted a cross-sectional strategy	➢ Lack of studies to conduct research on the role of social innovation for reducing FW through using theoretical and conceptual studies, modelling, surveys, and literature review ➢ Lack of studies to conduct research using a longitudinal strategy	✓ Theoretical and conceptual – (1) synthesize existing knowledge and propose new conceptual frameworks to transform our understanding; (2) integrate different social network theories to see how social networks are formulated and developed ✓ Modelling – (1) modelling the degree of homophily of stakeholders; (2) modelling enablers/barriers of social innovation for reducing FW ✓ Surveys – employing questionnaires/surveys not only from the consumers perspective, but also from stakeholders', policymakers', community leaders', and volunteers' perspectives to have a comprehensive understanding ✓ Literature reviews – several topics were suggested, including the role of digital technologies for transforming social innovation activities for reducing FW, how social networks are developed for reducing FW, different social innovation products, and the role of doggy bags for reducing FW ✓ Conduct research using longitudinal strategy
Country	▪ Appropriate 60% of studies are conducted by the research institutions of Europe ▪ The Italy, United Kingdom, and the Netherlands are received the highest attention ▪ All studies are conducted from a single country perspective	➢ Lack of studies to conduct cross-country empirical research on the social innovation activities for reducing FW ➢ Lack of studies to conduct research in other countries, such countries in Asia, Oceania, North America, and South America	✓ Conduct cross-country empirical research on the research topic to generalize the findings ✓ Conduct research on social innovation activities in other countries that locates in Asia, Oceania, North America, and South America to enrich the findings
Food redistribution	▪ Tackling connectivity gap between the "wasted places" and the "needed places" through using different measures, such as online food sharing community and online market ▪ Involving more people (e.g., AFSC stakeholders and	➢ Lack of studies to investigate the performance of different measures for tackling the connectivity gap ➢ Lack of studies to investigate who should coordinate the food redistribution network to achieve the best performance ➢ Lack of studies to investigate different knowledge boundaries and boundary-	✓ Conduct comparative empirical analysis using longitudinal strategy to see which measure is effective for tackling the connectivity gap ✓ Investigate who can be the coordinator of food distribution activities for achieving the highest efficiency and effectiveness ✓ Investigate knowledge boundaries and boundary-crossing mechanisms that exist in the food redistribution activities

	community grassroot community members) to participate in the food redistribution networks ▪ Investigating the role of knowledge sharing for facilitating food redistribution activities	crossing mechanisms in the food redistribution networks	
Food rescue	▪ Different assistance practices were implemented by the government for helping food rescue activities ▪ Homophily issues in the food rescue networks	➢ Rare of studies conducting research to evaluate the food assistance activities provided by the government ➢ Lack of studies to investigate the homophily issues in the food rescue networks	✓ Assessment different assistance practices provided by the government through building a protocol ✓ Investigate the structure of multiplex relations among different members participated in the food rescue activities to maximize the knowledge sharing performance in the network
Food donation	▪ Social innovations such as social supermarkets and solidarity stores have received a considerable attention ▪ Partnership's formulation is critical for food donation ▪ Food safety issues in food donation	➢ Lack of studies to conduct empirical research on the social innovations such as social supermarkets and solidarity stores ➢ Lack of research to describe how a social supermarket to formulate partnerships with other institutions linking with a theory ➢ Rare of studies to conduct a comprehensive analysis not only from the social supermarket perspective, but also from the regulator, donor, acceptor, and transporter perspective	✓ Conduct cross-country comparative analysis on the social supermarkets to generalize the findings and gain a deep understanding on this phenomenon ✓ Link with specific theory to conduct empirical research on partnership analysis regarding social supermarkets ✓ Conduct empirical analysis from different practitioners' perspectives to gain a comprehensive understanding
Food sharing	▪ Integrating food sharing activities with digital technologies to expand food sharing networks, empower community capacities, and facilitate knowledge mobilization	➢ Lack of studies to conduct empirical research on the barriers of applying food sharing platforms ➢ Lack of studies to conduct empirical research on monitoring food sharing process in the digital era ➢ Lack of studies to systematically summarize and compare different digital food sharing platforms ➢ Lack of studies to conduct performance measurement of food sharing platforms	✓ Conduct empirical research on the barriers for applying digital food sharing platforms not only from consumer perspective, but also from government, restaurant, and other stakeholders' perspectives ✓ Investigate the possibility for monitoring the food sharing process through using different digital technologies, such as blockchain technology and machine learning ✓ Conduct comparative analysis across different forms of digital food sharing platforms regarding their characteristics, accessibility, and usefulness ✓ Investigate suitable KPIs to evaluate the performance of food sharing platforms

5. Conclusions

This study carefully reviewed the accumulated knowledge in the intersection area of social innovation and FW from 1970 to 2021. Through locating, collecting, evaluating, and analyzing sample articles from different databases, this study identifies 47 publications that contribute significantly to the role of social innovation for reducing FW across AFSCs. Objectively, the rise of digital technologies and climate crisis are accelerating the process for organizations and communities to collaborate and communicate with each other to tackle the societal emergency – FW. In fact, we have observed that different social innovation activities such as digital food sharing platforms, solidarity stores, social supermarkets, and food banks are all deployed in different countries for facilitating food redistribution, food rescue, food donation, and food sharing. Despite the literature on reducing FW from the social innovation perspective has a rapid growth in the last five years (2016-2021), the fragmented nature and the lack of empirical study indicate that this area still needs further investigation. Thus, we proposed various future research directions based on the research methodology adopted, country involved, and social innovation activities in different FW reduction processes (e.g., food redistribution, food rescue, food donation, and food sharing). In particular, conduct research to develop suitable KPIs to evaluate the performance of digital food sharing platforms and link with specific theory to conduct empirical research on partnership analysis regarding social supermarkets.

We believe that our study follows the rigorous steps to conduct 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 included different conference proceedings and book chapters in our SLR in order to reveal more social innovation activities, this posed threats on the quality of this study. We hope future studies can conquer this problem to achieve better quality.

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Appendix 1 Literature analysis

Studies	Focus of investigation	Research methodology	Author's affiliation	Journal/Book title	Social innovation measures
Holweg and Lienbacher (2011)	Social marketing innovation	Case studies/ interview	Austria	Journal of Nonprofit & Public Sector Marketing	(1) Social supermarkets sell food and consumer goods that they receive free from retailers and manufacturers for a discount of up to 70% to people who are in or at risk of poverty
Risso (2012)	Exploring partnerships for social innovation	Case studies/ interviews	Italy	Emerging Issues in Management	(1) the case of solidarity stores in France is an example of emerging innovation through communication
Ruge and Mikkelsen (2013)	Local public food strategies as a social innovation	Case studies/ interviews	Denmark	Acta Agriculturae Scandinavica, Section B – Soil & Plant Science	(1) Local food strategies help to establish new educational links between schools and local producers and thereby contribute to food waste management
Sedlacko et al. (2013)	Sustainable food consumption through bridging the science-policy gap	Theoretical and conceptual papers	Austria	Sustainability: Science, Practice and Policy	(1) The role of social innovation in tackling food poverty and reconnecting people with food and where it comes from
Angelidou and Psaltoglou (2017)	Social innovation initiatives for sustainable urban development	Case studies/ interviews	Greece	Sustainable Cities and Society	(1) Offer goods & services no longer needed and exchange them with ones that are redundant to others; (2) create a business that makes more efficient use of resources and is socially inclusive; (3) participate in open communities to interact with others who share common concerns;
Bozzola et al. (2017)	Develop products for reducing post-consumption food waste in public areas	Case studies/ interviews	Italy	The Design Journal	(1) Doggy bags increase meaningfulness and value perception of food resources, raising public awareness on the food waste reduction
Cangiano et al. (2017)	Digital social innovation	Case studies/ interviews	Switzerland	The Design Journal	(1) Digital technologies, community engagement and collaboration are all effective social innovation measures for addressing societal needs
Falcone and Imbert (2017)	Highlight how food sharing is frequently undermined by social factors and that to make it effective specific skills are needed	Theoretical and conceptual papers	Italy	Food Waste Reduction and Valorization	(1) Food sharing through a variety of forms such as web food networks, underground restaurants, public refrigerators or simply private initiatives within specific households consisting of nonrelated people like students
Sirieix et al. (2017)	Consumers' attitude towards doggy bags	Case studies/ interviews	France	Journal of Retailing and Consumer Services	(1) Doggy bags are effective for handling leftovers and useful for increasing awareness of food waste

Young et al. (2017)	The role of social media for reducing food consumers' food waste	Surveys	United Kingdom	Resources, Conservation and Recycling	(1) Facebook, digital magazine and e-newsletter are all effective for reducing food waste
D's Ambrosi (2018)	To gauge consumer attitudes to food sharing practices in Italy and to assess the support that digital technologies can offer to promote more responsible consumption	Surveys	Italy	British Food Journal	(1) Digital technologies for exchanging surplus food or goods are still poorly used in Italy
Fernhaber et al. (2018)	Engaging diverse community stakeholders for reducing food waste	Case studies/ interviews	United States of America	Journal of Public Affairs	(1) Open innovation online platform for connecting people directly through live community sessions
Hebinck et al. (2018)	Food assistance practices for transforming food system	Case studies/ interviews	Sweden	Local Environment	(1) The food assistance system in Tuscany, the Dutch "Vereniging Nederlandse Voedselbanken", and the Irish "Food Cloud Hubs" are all examples of social innovation in food assistance initiatives
Herbst (2018)	The role of niche marketing and coopetition in social enterprises for facilitating sustainable development	Case studies/ interviews	Australia	Business Strategy and Development	(1) The organizations leverage relationships across their horizontal and vertical value chains to enhance their own resources and capabilities while advancing wider social and environmental interests
Mirosa et al. (2018)	Consumers' behaviors and attitudes toward Doggy bags	Case studies/interviews Surveys	New Zealand	Journal of Food Products Marketing	(1) Doggy bags have positive effects for avoiding food waste, saving time/effort, and consuming good food a second time
Santiago et al. (2018)	Increasing knowledge of food deserts in Brazil	Case studies/ interviews	Brazil	Journal of Public Affairs	(1) The importance of digital and interactive mosaic to tackle the sustainability challenges
Shaw et al. (2018)	Scaling up community action for tackling climate change	Case studies/ interviews	United Kingdom	British Journal of Management	(1) Connecting communities to broader sustainability agenda and have positive effects for tackling food waste
Ambati (2019)	Social innovation practices for facilitating sustainable food waste management	Case studies/ interviews	India	International Journal of Scientific & Technology Research	Three concepts are very important for social enterprises for reducing food waste: (1) technological knowledge for creating solutions; (2) relentless social innovating; (3) social entrepreneurial passion
Cid (2019)	Investigate how ephemeral design can showcase and promote environmental change	Case studies/ interviews	United Kingdom	The Design Journal	(1) Public street action would activate connections between people and communities committed to defending and developing more sustainable ways of living and nourishing themselves
Signori and Forno (2019)	Consumer groups as grassroots social innovation niches	Surveys	Italy	British Food Journal	(1) Participation in GAS not only makes individuals more responsible towards their consumption choices lifestyles,

					but also makes consumers more willing to collaborate with others
Ukar et al. (2019)	Social innovations for tackling food waste	Theoretical and conceptual papers	Germany	Atlas of Social Innovation	(1) Social-digital innovations for preventing food waste; (2) food redistribution; (3) create communication platforms
Ulug and Horlings (2019)	Explore the role of community gardens for reducing waste	Case studies/ interviews	The Netherlands	Local Environment	Main enablers for altering social relations and community empowerment were identified: (1) clear goals and motivations; (2) diversity in garden resources; (3) experimental knowledge processes; (4) strong internal support and recognition; and (5) place-based practices
Avelino et al. (2020)	Social innovation networks	Case studies/ interviews	The Netherlands	European Planning Studies	(1) People are empowered through the transnational networking while also zooming in on the dynamics in local initiatives
Cattivelli and Rusciano (2020)	Social innovation and food provisioning during COVID-19	Case studies/ interviews	Italy	Sustainability	(1) The importance of the combined commitment of local communities and volunteering association as a reaction to food provisioning problems in the time of COVID-19, as well as an increasing interest in reconnecting with local food practices
Chin and Mees (2020)	Waste reduction from the government perspective with social innovation measures	Case studies/ interviews	The Netherlands	Environment Policy and Governance	(1) Government's support on common practices may facilitate social innovations
Dagevos and Veen (2020)	Meal sharing	Case studies/ interviews	The Netherlands	Journal of Urbanism	(1) The online meal sharing platform is a good example to improve urban experience by engaging in peer-to-peer interactions
de los Mozos et al. (2020)	A review of sustainable consumption by reducing food waste	Literature review	Spain	Procedia Manufacturing	(1) Charity redistribution; (2) animal feed; (3) composting; (4) Anaerobic digestion; (5) wastewater treatment plant; (6) incineration with energy recovery; (7) landfilling
Ghinoi et al. (2020)	From a network perspective to reduce food waste	Modelling	Finland	Journal of Cleaner Production	(1) Multiple interactions across dyadic relationships in stakeholder networks are effective for reducing food waste
Goodman-Smith et al. (2020)	To quantify retail food waste in New Zealand and identify key drivers for food waste reduction	Case studies/ interviews	New Zealand	Food Policy	(1) Establish relationships with various groups that divert retail food waste away from landfill
Harvey et al. (2020)	Food sharing, redistribution, and waste management via mobile applications	Modelling	United Kingdom	Industrial Marketing Management	(1) Social relations formed through mobile phones have positive effects for food sharing, redistribution, and waste reduction

Mattila et al. (2020)	The role of platform-based business models for reducing food waste	Case studies/ interviews	Finland	International Journal of Entrepreneurship and Innovation Management	(1) Network (user, producer, and support networks) is effective for addressing sustainability in platform-based businesses
Michelini et al. (2020)	The potential impact of food sharing platform business models	Case studies/ interviews	Italy	British Food Journal	(1) The need for the platform to manage the multifaced tensions of food waste recovery vs prevention and the benefits of food recovery to helping hungry people vs the actual need to eradicate poverty by addressing social injustices and inequalities
Schartinger et al. (2020)	A typology on social innovation	Literature review	Austria	European Planning Studies	(1) Company-based social innovation; (2) entrepreneurial social innovation; (3) disruptive social innovation; (4) temporary niche; (4) community-based social innovation; (5) global movement-based social innovation; (6) experimental social innovation; (7) Embedded social innovation; (8) top-down social innovations
Spring and Biddulph (2020)	Examine two surplus food redistribution initiatives from a self-organization perspective to identify ways contribute to sustainable transitions in the future	Case studies/ interviews	Canada	Sustainability	(1) The interplay of organizational agency and institutional structures affecting the growth and characteristics of surplus food distribution
Alberio and Moralli (2021)	Social innovation in alternative food networks	Case studies/ interviews	Canada	Journal of Rural Studies	(1) rearrangement and networking of the producer-consumer relation and interaction for reducing food waste
Aramyan et al. (2021)	A review on food waste reduction in supply chains through innovations	Literature review	The Netherlands	Measuring Business Excellence	(1) Innovative smart phones can be used to promote sales of products nearing their expiration dates
Atsiz et al. (2021)	Exploring the components of meal-sharing experience with local foods	Case studies/ interviews	Turkey	Current Issues in Tourism	Seven components of meal-sharing experiences with local foods: (1) authenticity; (2) social interaction; (3) local hospitality; (4) awe; (5) local culture; (6) novelty; and (7) service escape
Bakırlıoğlu and McMahon (2021)	Co-learning environment design for facilitating circular economy	Case studies/ interviews	Turkey	Journal of Cleaner Production	(1) Co-learning activity for novice designers, industry partners and educators to formulate a productive co-learning environment can address real-life challenges to circularity and facilitate productive exchanges of knowledge

Huang and Tsai (2021)	Social innovation for food security and tourism poverty alleviation	Case studies/ interviews	China	Frontiers in Psychology	(1) Increasing smallholder farmers' connectivity gap with urban markets; (2) digital social innovation and e-agriculture; (3) the community-supported agriculture model
Karki et al. (2021)	Reducing food waste through surplus food distribution	Case studies/ interviews	United Kingdom	Industrial Marketing Management	(1) The need for a coordinated effort between actors as an essential arrangement to capture the value of surplus food
Lombardi and Costantino (2021)	To improve understanding about how social innovation models can enhance food waste reduction	Case studies/ interviews	Italy	Administrative Sciences	(1) Building new relations inside the stakeholders network, and improving new actors usually not actively participating
Lombardi and Costantino (2021)	Food waste reduction from the social innovation perspectives	Literature review	Italy	Sustainability	(1) Awareness and education campaigns; (2) food recovery activities;(3) surplus food retail, processing & service; (4) food sharing; (5) social campaigns for animal feeding; (6) composting communities; (7) community Anaerobic Digestion;
Lucas et al. (2021)	Quantifying the efficacy of volunteer-based community activation for start-ups	Modelling	United Kingdom	Research policy	(1) A sharing-economy app designed to facilitate peer-to-peer food sharing and redistribution
Marianna and Tweed (2021)	Social innovation for a circular economy in social housing	Case studies/ interviews	United Kingdom	Sustainable Cities and Society	(1) Do-it-together citizens, sharing citizens, and do-it-yourself citizens are all effective for reducing food waste
Penco et al. (2021)	Open social innovation for surplus food recovery and aid during COVID-19	Case studies/ interviews	Italy	British Food Journal	(1) COVID-19 has stimulated the adaptation of open social innovation practices to innovate the food bank behavior
Sutinen and Narvanen (2021)	The role of social media for reducing food waste	Case studies/ interviews	Finland	Journal of Marketing Management	(1) The identified discourses of explanation, exhibition and appeal each have a different type of potential to steer changes in different actors' food waste-related practices