A Hierarchical Pyramid for Food Waste Based on a Social Innovation Perspective

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Abstract: Food waste (FW) represents one of the greatest concerns facing mankind today; thus, the UN Agenda 2030 for Sustainable Development establishes that it must be halved by 2030. European Union legislators have taken part in this debate by publishing Directive 2018/851 to monitor the FW reduction goals, according to the waste hierarchical pyramid approach. At present, there are several proposed FW hierarchical pyramids, but these do not regard the associations between the level of waste-tackling strategies and social innovation (SI) models. Thus, the paper aims to build a hierarchical pyramid that considers, for each step of the food-supply chain and each level of the pyramid, all the FW social innovation models. A qualitative analysis of academic studies, institutional documents, and specific projects has been conducted. The results confirm the gap in the scientific literature and the lack of a systematic classification of SI activities to reduce FW. Furthermore, current SI practices are actually more focused on the human reuse of FW than on prevention, whereas SI models based on prevention might return the FWL issue to its systematic dimension. This information will help policymakers to reconsider the structural causes of FW inside the agro-food system, and not only its final consequences.

Keywords: food waste; food loss; surplus food; waste hierarchical pyramid; social innovation; sustainable agro-food system; circular living

1. Introduction

Food waste (FW) is currently one of main issues for human beings in terms of its ethical and social impact; this impact is linked to the unmet nutritional needs of societies, leading to food poverty, food insecurity, and hunger [1–3]. FW also has a significant economic and environmental impact due to the excessive consumption of natural resources and greenhouse gas (GHG) emissions that occur throughout the food supply chain (FSC) [4,5].

In this context, in September 2015, the United Nations (UN) launched the Agenda 2030, which includes the establishment of 17 sustainable development goals (SDGs) in order to achieve economic growth, social integration, and environmental protection [6]. Among these, SDG 12 intends to “ensure sustainable consumption and production patterns,” with target 12.3 referring specifically to the reduction in FW by 50%, which would allow a decrease of 20 to 30% of the total food-sourced GHGs [7].

Although many countries have begun making commitments to following the UN recommendations, there are still concerns about the possibility of concretely reducing FW. The first one is that there is no univocal or common definition of FW in the literature. Indeed, the concept of FW is often associated with food loss (FL) [8,9]. Food loss is the decrease in the quantity or quality of food resulting from decisions and actions by food suppliers in the chain, excluding retail, food service providers, and consumers. Food waste is the decrease in the quantity or quality of food resulting from decisions and actions by retailers, food services, and consumers [9]. Sometimes, these terms are associated also with surplus food (SF), i.e., the edible food produced, manufactured, retail, or served that has
not been consumed by humans (mainly due to socio-economic reasons), including food produced beyond nutritional needs [10]. Consequently, this has led to an overlap between FW and FL, limiting the undertaking of efficient, real quantification, and consequently limiting the adaption of targeted strategies for its prevention and reduction [11–17]. The second concern is that most of the actions applied toward this goal are more oriented towards technological innovations [18] and logistical/marketing functions than social ones, neglecting the importance of the creation or reconfiguration of social networks in food redistribution [19].

In this context, European Union (EU) legislators have taken part in the debate. In 2008, the world’s first and main reference to waste management was issued: the Waste Directive (WD) 2008/98/EC [20,21]. It provided a pyramid of priorities for managing waste reduction, encouraging member states to develop specific programs to this end. It included the following priorities: (a) prevention; (b) preparing for reuse; (c) recycling; (d) other recovery, e.g., energy recovery; (e) disposal [22]. However, this pyramid presented several issues, mainly due to an overlap between measures such as prevention and reduction, preparing for reuse, and reuse as well as the measure of reuse that was included in the definition of prevention [23]. Additionally, to date, a few countries have adopted national plans for waste prevention and reduction specifically focused on food, and many more have implemented single initiatives against FW [24]. In 2016, only two national regulations were issued in this direction, representing the current best-structured normative interventions: French Law number 138 [25] and Italian Law number 166 [26]. Both laws address only the first two levels of the FW pyramid with a strong emphasis on the second layer (e.g., re-use for human consumption). In both cases, prevention measures are weak and mainly related to communication and awareness-raising activities, not introducing any structural changes to the food system upstream to avoid the generation of FW [22,27,28].

In 2018, the WD was amended by the new Directive (EU) 2018/851, which established a baseline to monitor the achievement of FW reduction goals (30% by 2025 and 50% by 2030) and to facilitate the identification of the main FW flows to be valorized in a circular economy perspective [4,29]. In 2019, proceeding in the same direction, the European Commission also provided a common methodology and set minimum quality requirements for the uniform measurement of FW levels [30,31], followed by the UNEP, which, in 2021, published a methodology for countries to measure FW, at household, food service and retail level, to track national progress towards 2030 and to report on SDG 12.3 [32].

In 2020, the European Commission finally launched, inside the bigger “European Green Deal”, the “Farm to fork strategy”, which proposes measures and targets for each stage of the FSC, from production to distribution to consumption, in order to make the European food systems more sustainable [33].

Hence, it has become critical to evaluate the different models that are used by each member state of the EU in applying an FW hierarchical framework. In some models, bottom-up approaches are being adopted. These approaches are intended to involve all actors of the FSC, emphasizing the importance of formal multistakeholder collaborations and focusing on the role of different relational forms in stakeholder networks (exchange of information, sharing of resources, and development of cooperative projects) [34]. They can be transformed into social innovation (SI) models, representing a valid alternative tool for ensuring sustainable production and consumption, i.e., FW and FL reduction. SI initiatives, indeed, might engage consumers more efficiently because, as is known, they can activate relations among them, creating or reconfiguring their social networks and introducing an innovative practice with a high possibility of acceptance [35,36].

There are some existing SI models for reducing FW, mainly focused on the final phases of the FSC [19]. The FUSIONS project has completed an inventory of them and has implemented seven feasibility studies on the impact of SI on FW. Its document “Policy Brief” states, “[S]ocial innovation is an effective way of preventing food waste and [...] if these activities can be scaled up, they can make a significant impact, both environmentally and socially.” Additionally, the project developed four key recommendations directed to
EU policy makers to facilitate these kinds of activities: creating a favorable EU and national legislative framework; developing tools to identify appropriate funding; building and expanding an FS social innovation network; encouraging dialogue around FW reduction and redistribution [37]. However, to date, there has not been a direct connection between a hierarchical pyramid for waste and the SI models used for reducing FW, and there remains an academic gap in the study of SI models and related case studies, strictly associated with FW hierarchical pyramids and the FSC.

In light of the aforementioned premises, we aim to propose an FW hierarchical pyramid based on an SI perspective. To this end, we conducted a qualitative review analysis of academic studies, institutional documents, and specific projects to collect related data. We intend to build a hierarchical pyramid that considers, for each step of the FSC and each level of the pyramid, all the SI models implemented to reduce SF, FW, and FL.

The expected results might be useful both for filling the academic gap in this field and providing policy makers with a comprehensive overview of SI initiatives to tackle the aforementioned issues. This information can help them to understand which strategy of the FW hierarchical pyramid is generally most adopted and what level of success the new EU directive has attained. Furthermore, these findings could represent an aspect of the “circular living” approach, defined by Future Food Institute of Bologna (Italy) as an innovative area aiming to eliminate FW through continuous resource management [38]. Finally, they could offer valuable insight into tackling the agro-food system in a more sustainable way, in compliance with the pandemic crisis we are living in, as well as solutions to environmental problems that require behavioral change.

2. Literature Review

A very few academic studies have been published on the FW hierarchical pyramid. The authors decided to consider only those studies that strictly focus on the elaboration of proposals for an FW hierarchical pyramid that was not foreseen in Waste Directive 2008/98/EC or afterwards in Directive (EU) 2018/851. They have been reported and described as follows.

Papargyropoulou et al., 2014, were probably the first to attempt a revision of WD 2008 and to interpret the waste hierarchy in the context of FW by considering the three dimensions of sustainability (environmental, economic, and social). Its hierarchy suggested that prevention was the most efficient possibility, followed by the distribution of SF to groups affected by food poverty and by the transformation of FW in animal feed [39].

Garcia-Garcia et al., 2017 improved on this scheme, identifying types of FW through a nine-stage categorization with a set of waste management alternatives. Both authors stressed that prevention can be associated with each level of FSC through the use of logistics and management tools or by targeting the education, behavior, and consumption habits of consumers [40].

Teigiserova et al., 2020, proposed a new revision to earlier FW pyramids after the amendment of WD 2008 by the new Directive (EU) 2018/851 [41]. The reason for this revision was that the FLW and SF framework have continued to miss the adoption of a specific separated waste hierarchy, which is necessary for increasing the efficiency of prevention and reuse in a circular economy framework. They distinguished “surplus food and a new category for material recycling, in order to reflect the future food waste biorefineries in the circular bioeconomy.” Thus, they separated the nutrient and energy recovery from FW into two categories and clarified the terms of recovery and recycling. This latter change represents material recycling that does not include the total degradation of FW as it occurs in energy and nutrient recovery, so that the resulting products can be re-introduced into the market (Figure 1).
Di Terlizzi et al., 2016, reported many other FW hierarchies proposed at the international level: the food-waste pyramid for London; the food recovery hierarchy developed by the United States Environmental Protection Agency (US-EPA); the Netherlands’ ladder of Moerman; the food waste hierarchy of the Public Waste Agency of Flanders (OVAM), and FoodDrinkEurope’s food-waste hierarchy. All of these mainly recommend the reduction of FLW at source, but they also include lists of preference for use, reuse, recycling, and waste treatment [42].

Thirapongphaiboon (2018) stressed that many studies on the FW hierarchy did not concretely suggest “the way to prevent food surplus and waste by revaluing or adding value to the unwanted food materials to become edible and preferable to the market again.” Thus, the author proposed a focus on the concrete experiences of social enterprises for more easily identifying the best level of business to tackle FW through prevention. Consequently, three new categories of practice for prevention are proposed in the FW hierarchy: repurposing, revaluing, and finding new destinations [43–46].

Therefore, on the basis of the results of the academic literature review, it is clear that there are still missing elements that are necessary to elaborate an FW hierarchical pyramid from an SI perspective. Indeed, the pyramids that we found are not often clearly supported or associated with specific SI models, or with related case studies that have been developed in recent years. Thus, we have tried to fill this gap by analyzing other references (documents, general articles and project website links) associated with SI models and real case studies for reducing FW at each level of the strategies for tracking.

3. Materials and Methods

As stressed in the introduction section, to reach our aim, we carried out a qualitative review analysis of the academic literature and the most frequently referenced case studies...
related to this issue. Snyder (2019) indeed identified different review strategies (systematic, semi-systematic, and integrated) that can use qualitative or quantitative approaches or have a mixed design, depending on the phase of the review.

In this context, we decided to use the integrative or critical review that aims “at assessing, critiquing and synthesizing the literature on a research topic in a way that enables new theoretical frameworks and perspectives to emerge” [47].

The research steps are the following:

- Definition of the system boundaries of analysis: academic papers (research articles, and review articles) and all other useful documents;
- Classification context: a classification context was selected and defined, in order to distinguish between the academic literature and the referenced case studies;
- Data evaluation: the data were examined and divided according to the classification context, for identifying the pertinent issues and interpretation of results;
- Collecting publications and delimiting the field: the qualitative review analysis was limited to English and Italian peer-reviewed articles, institutional documents and case studies of specific projects. The Internet search was carried out during August 2020 and April 2021, without a specific timespan, even if the field of application is new and recent;
- Data treatment: the data were compared, clustered according to their specific topic, and integrated in the FW hierarchical pyramid framework.

The data from the scientific literature were generated through a combination of: (a) database searches (cross-discipline platform of Elsevier (www.sciencedirect.com, accessed on 20 August 2020 and on 8 April 2021) and Scopus (www.scopus.com, accessed on 20 August 2020 and on 8 April 2021); and (b) the screening of references to studies retrieved under (a). Consequently, we used the following keywords in our searches: “food waste hierarchical pyramid” associated with “social innovation”. Through a search of titles and a scan of abstracts, articles that did not focus on an FW hierarchical pyramid with this element were excluded.

On the contrary, we used the Google search engine to collect other relevant institutional documents and case studies of specific projects, using the keywords “FW and social innovation”. In this way, real case studies of SI initiatives, compliant with each phase of the FW hierarchical pyramid and the FSC, were integrated. Concerning the different SI models for FW reduction, we utilized our previous research, published in an international open-access journal [19].

4. Results

The results of the qualitative review analysis are reported in Table 1. From this, we developed a graphical representation of the new FW hierarchical pyramid, based on the SI perspective (Figure 2). This elaboration derived from the systemization of a SI activities’ classification against FL and FW, on the basis of the FSWL hierarchical pyramid provided by Teigiserova et al., 2020, and the relevant FSC stage [41].

FSWL pyramid stages are located on the y-axis, while FSC phases are indicated on the x-axis. Each SI initiative is represented by a black dot at the intersection between the line corresponding to its strategy for tackling FW from prevention to disposal, and the line corresponding to the FSC phase where it intervenes to save:

- Food from becoming SF (prevention);
- SF from becoming FW (human reuse);
- FW from becoming FL (animal reuse, material recycling, nutrient recovery, energy recovery).
The SF, FW, and FL definitions used by Teigiserova et al., 2020, are recalled here in a social perspective where “FW is defined as SF that is not used for feeding people” [48], while “FL only refers to the streams that are truly lost, whether because [they are] not accounted for or disappearing from the accounting” [41].

The SI initiatives considered here have the central roles played by the community or the individual in common, whereas they are not included in more traditional or top-down approaches. SI is not involved when a solution is linked to regulatory interventions under public authority or to merely technical and technological innovations. Due to this latter consideration, SI initiatives are quite rare or null at the processing, packaging, and transportation levels of the FSC, whereas they are more concentrated at the extremities of the FSC, especially at the consumption level.

5. Discussion

The results are explained and discussed according to the different stages of the FSWL hierarchical pyramid.

5.1. Prevention

In the prevention stage, SI activities can mainly be directed to primary producers or final consumers. Regarding the first target, we refer to a number of different experiences connecting producers and consumers in more local, direct ways as a response to the contradictions of the unsustainable industrial food system, often referred to as alternative food networks (AFNs) [48] or short food supply chains [49,50]. AFNs, which can assume the shape of farmers’ markets, community-supported agriculture, box schemes, solidarity purchasing groups [51], etc., are based on the creation of a relationship between producers and consumers, sometimes even called “co-producers” [52], through either direct or mediated interaction between the two [53]. This tight relationship allows producers to estimate demand more accurately, both in quantity and quality, and sometimes to pre-sell their production, consequently reducing or eliminating FL and SF. This is also the case of the Farmer Producer Organizations (FPO) in India [54].

In terms of prevention, and following FUSIONS’ approach [55], awareness and educational campaigns directed to final consumers can also be considered SI activities when they
lead to direct engagement. Moraes et al., 2021, present a compilation and categorization of prevention methods found in the scientific literature, differentiating between education and awareness, communication, training and conscious consumption [56].

According to Reynolds et al., 2019, this type of FW preventative intervention has shown a high level of effectiveness, as revealed in their review of the global academic literature from 2006 to 2017 [57]. An example is provided by the campaign Love Food Hate Waste [58], which offers people the opportunity to use new tools (FW diaries, cooking recipes, etc.), sign petitions, set up groups, and engage in their communities. Another good example is the Stop Wasting Food Movement, which began in Denmark in 2008 and succeeded in establishing cooperation among the national government to end the practice of bulk-buy offers in retailing and to raise the awareness of the Danish people about FW issues [59]. Amicarelli et al., 2021, also stress the importance of the educational role. They investigated current attitudes, perceptions and behavioral patterns related to FW reduction in households in the Apulia region (Italy). For them, the development of educational programs “should become more incisive, making evident what hides beyond thrown-away food in terms of resources (e.g., financial costs, natural resources, water) and highlighting wastage-related consequences (e.g., food security, malnutrition, hunger)” [60].

5.2. Human Reuse

The vast majority of SI activities are concentrated on the human reuse stage. The reuse of SF for human consumption is also known in the literature by the term food rescue [61,62], with a large heterogeneity in approaches (monetary and non-monetary) and organizational models. One example is provided by food redistribution activities (FRAs). These interventions “include various types of organizations and initiatives that distribute edible food that is about to be wasted, directly or indirectly to food insecure people” [5,63]. Scherhaufer et al., 2018, on the basis of an extended literature review, include food banks in this definition, but also food pantries, soup kitchens, shelters, and mixed forms. In Europe, the European Federation of Food Banks, which includes 421 Food Banks and branches in 24 countries, reports that, in 2018, it redistributed 781,000 tons of food, equivalent to 4.3 million daily meals, in cooperation with 45,700 charities, assisting 9.3 million deprived people [64,65]. In consideration of the consolidated role that they have developed in the last 50 years, and in line with the approach taken by FUSIONS, traditional food banks are not considered here to be proper SI actors, whereas we mainly refer to new models of food redistribution that share similar goals in innovative ways. This is the case, for example, of Magazzini Sociali in Italy, a community-led food bank that operates to build a social economy local circuit, aiming to transform the local food system [66].

In these new approaches, an SI feature may also involve, for example, a specialization in SF supply channels, such as those realized by Recup and Ecomori in Italy, to recover SF from city markets, or by Equoevento, which recovers leftovers from catering events [67–69]; it may also concern the management system for a recovery network, such as the one provided by Refood in Portugal, which operates with a particular focus on community-building and citizen participation at a local level [70], or by Avanzi Popolo 2.0 in Italy, which works to create new connections between heterogeneous stakeholders [19]. Food recovery governance can also take the form of public–private networks, as occurs in Genoa (Italy) with Ricibo, a social platform involving non-profit organizations, the local Municipality and traditional businesses cooperating in SF recovery as a circular business model [71].

FRAs usually target retailers, but they can also address processors and primary producers. It is worth mentioning a particular kind of FRA, which addresses the possibility of donating food after the best-before date (BBD), as was recently introduced in Italian law. Busetti (2019) highlights the strengths of this approach, but also draws attention to some weaknesses, mainly in terms of reputational risk for producers and low acceptance by charities [72].

Other economic activities are involved in the reuse stage. These activities are often run by social businesses that use SF as an input in their value chain, thereby creating economic
and social value through FL and FW reduction. We refer to this category as **surplus food retail, processing and service**, and we divide these activities among three sectors: SF retailers, value-added preparation, and SF service. In the case of SF retailers, recovered food is directly sold to final consumers at a lower price in shops dedicated to disadvantaged people, following the so-called bottom-of-the-pyramid approach [73], such as social supermarkets [74], or, alternatively, to any consumer motivated by environmental or social concerns, such as Fruta Feia in Portugal, a cooperative selling **ugly fruits** at 12 delivery points around the country [75]. Value-added preparation includes social enterprises that use SF as a raw material to make new products. An example of this is Toast Ale in England, a beer made using surplus bread in place of virgin barley, with profits donated to charities [76]; another example is RecuperAle in Italy, which uses the same method, but involves detainees in the production [77]. A similar method is used to make many other products (jams, chutneys, juices, etc.). The last group consists of many different forms of food service using SF as a source. As with SF retailers, these initiatives can be directed to people, either in need or not; they may utilize the **pay-as-you-feel** system adopted, for example, by Surplus Cafés [78] and The Real Junk Food Project in the United Kingdom (UK) [79]. In this category, social initiatives may belong to the so-called **wastecooking** movement. Examples include Food Not Bombs and disco soups or disco salads, events where anti-waste volunteers collect, chop, cook, and distribute leftover food to anyone, regardless of need, while dancing and partying. The main goal of these events is to raise awareness about FW [80].

At the consumer level, the most important SI reuse practice is surely represented by **food-sharing**. This term does not refer to the general human tendency to eat together and share food, which has been studied by anthropologists as a distinguishing feature with a unique complexity [81]; rather, it refers to a particular implementation of the sharing economy that allows people to connect, interact, and exchange food, usually through the use of ICT [82–86]. Michelini et al., 2017, provide a taxonomy of food sharing models differentiated on the basis of a number of variables (organization profile, type of technology, delivery model, type of donor, type of beneficiary, type of transaction, social impact, management feature). They categorize sharing activities into three purposes: for money, for charity, and for community [65]. The first group includes for-profit organizations that use web platforms or mobile apps through which food operators (retailers or producers) can post their offers and consumers can buy online or reserve products at discounted prices, as in the case, for example, of the mobile app Too Good to Go [87].

The second purpose consists of non-profit organizations that use web platforms to connect food operators and charities. This model is considered distinct from FRA only when it allows consumers to play a direct role as donor or beneficiary. The third purpose includes profit and non-profit organizations operating P2P platforms where food is collected from consumers and shared free of charge with other consumers in the same community [65]. From the SI perspective, this is also the most interesting cluster, with experiences like the platform OLIO in UK, which features a multiple configuration of stakeholders; consumers can directly exchange food among them, purchase from a retailer, or mediate as volunteers between a retailer and a final beneficiary [84,88]. Another well-known initiative is the German community foodsharing.de, which enables many kinds of stakeholders—consumers, farmers, organizations, retailers—to interact in an effort to save food from being wasted, thereby also promoting community-building against FW [89].

In this last category, it is also possible to include a particular off-line food sharing practice born in Germany and developed in the UK, Spain, and France: **social or community fridges**. These are refrigerators open to anybody who wants to store or take food. They are usually located in public spaces and are often grouped in networks at the local or national level [57,90,91].

A very particular form of food sharing is **dumpster-diving**, a practice that is illegal in many countries, but consists of direct recovery of still-edible food from dumpsters, either to consume or share, thereby avoiding waste at the very last moment. This activity could be considered SI, as it is often organized in groups using social networks to exchange infor-
mation and help each other. Moreover, activists motivated by political and environmental causes often practice it for reasons other than economic concerns [92].

At the opposite end of FSC, we also consider gleaning to be an SI reuse’s initiative. This term was originally used in the Hebrew Torah, where it is said that farmers should leave a part of their field unharvested in order to benefit poor people, strangers, widows, and orphans, who were allowed to glean this surplus harvest. This use, also recognized under law in many European countries, survived until the 18th century. Nowadays, there are gleaning communities or networks composed of volunteers who rescue SF from willing farms and use it directly for themselves or to the advantage of people in need [16].

5.3. Animal Reuse

The last four stages of the FW pyramid present more difficulty in matching SI features; they concern food no longer fit for human consumption. An example of SI applied to animal reuse may be represented by social campaigns for animal feeding such as The Pig Idea in the UK, promoted by the anti-FW organization Feedback, which aims to remove the legal ban on the use of FW to feed pigs; it employs a processing method based on heat treatment and acidification to eliminate safety risks [93].

5.4. Material Recycling

Material recycling is a new category introduced by Teigiserova et al., 2020, in the FSWL hierarchy referring to the extraction from FW of valuable bio-molecules leading to such high-value compounds as bio-based organic acids, bioplastics, bio-based colorants, bio-based enzymes, proteins, and other molecules [41,94,95]. The authors are not aware of SI initiatives regarding FW material recycling, probably due to the early stage in the development of this sector and to the need for heavy processing; moreover, the social acceptability of biorefineries by communities is an issue that may need to be addressed through SI management models.

5.5. Nutrient Recovery

Another interesting practice is performed by composting communities, groups that collect/receive and compost material, run education campaigns, promote home composting, and facilitate others to develop/promote community composting [96]. It can take place at many levels—in backyards, on blocks, in neighborhoods, schoolyards, extending to larger communities and regions—and in urban, suburban, and rural areas. In community composting programs, resources are recognized and managed as community assets. These programs are typically characterized by local control and community access, but not necessarily by community ownership [97]. An example is provided by the village of Layang-Layang, Johor province, Malaysia, located within the Iskandar Malaysia development corridor. It is also located within a palm oil plantation and is part of a project of the Malaysia Rural Transformation Center, where a community-composting pilot plant was successfully established in 2016 [98]. Within this community-based FW composting program, launched by Regional Development Malaysia as part of its Low Carbon Society Blueprint for Iskandar Malaysia 2025, volunteers were selected and trained to manage daily composting operation. FW containers were gathered and transformed into compost. The project showed significant utility as it turned waste into valuable products with potential for commercialization and benefits for the same community. However, in order to facilitate the process scale-up, it was necessary to expand the number of participants and volunteers for developing a sustainable business model, and for the product commercialization and marketing phases [99].

5.6. Energy Recovery

A similar idea is also practiced at the recovery level through community anaerobic digesters. Anaerobic digestion (AD) is a biological process that uses microorganisms to break down organic matter, producing both fertilizers and biogas; it may be considered as
both a nutrient recovery and an energy recovery process [100]. Following the approach proposed by Teigiserova et al., 2020, “The intended service of AD (energy or nutrient), i.e., the one that justifies why AD takes place, should be the one determining to which category AD belongs” [41].

Although the process requires much larger, more complex facilities, some community-based projects already exist, especially in developing countries where small-scale digesters prevail over larger ones, as well as in domestic digesters. Leow et al., 2019, starting from the success of the Layang-Layang composting community, carried out an interesting analysis on the environmental and economic performance of the community-composting project [98]. For this purpose, they considered different scenarios for the upgrading of the project; among these, one scenario considered the treatment of municipal wastes from 3000 residents to generate biogas via AD, where the digestate was used for composting. Results showed that this solution was not attractive for investment if compared with the possibility of continuing to produce compost with the same engagement of residents. Thus, this SI option for FW reduction is not yet feasible for the community. Moreover, this type of intervention is also not widely practiced in developed countries, where the FW issue is more relevant [101]. Generally, the main technologies applied in energy communities for self-production and self-distribution are those involving photovoltaic plants and wind farms, which are more easily manageable through a bottom-up approach [102–104].

| Stages of Hierarchical Pyramid | SI Models | SI Activities (Case Studies) | References |
|-------------------------------|-----------|-------------------------------|------------|
| Prevention                    | Alternative Food Networks (AFNs)/Short Food Supply Chains (SFSCs) | Solidarity Purchasing Groups Farmer Producer Organization | [48–54] |
|                               | Awareness and education campaigns | Love Food Hate Waste Stop Wasting Food Movement | [55–60] |
|                               | Food Recovery Activities (FRAs) | Avanzi Popolo 2.0 Food Banks Fratelli Sociali Recup Ecomori Equoevento Refood Ricibo Donating after the BBD | [5,19,61–72] |
| Human Re-Use                  | Surplus Food Retail, Processing & Service | Social Supermarkets Fruta Feia Toast Ale RecuperAle Surplus Café The Real Junk Food Project Wastecooking | [73,80] |
|                               | Food sharing | Olio Too good to go Foodsharing.do | [57,65,81–91] |
|                               | Dumpster-diving | - | [92] |
|                               | Gleaning | - | [16] |
| Animal Re-Use                 | Social Campaigns for Animal Feeding | The Pig Idea | [93] |
| Material Recycling            | Social Campaigns for Animal Feeding | The Pig Idea | [94,95] |
| Nutrient Recovery             | Composting Communities | Layang-Layang Jbhor | [96,99] |
| Energy Recovery               | Community Anaerobic Digestion (AD) | Layang-Layang Academy of Champions for Energy | [41,98,100,105] |

The National Energy Foundation in the UK, however, as part of the Academy of Champions for Energy project (a sustainable energy initiative operating in the UK, Ireland, France, Belgium, and the Netherlands and funded by the INTERREG IVB NWE program), has developed practical suggestions and inspirations for establishing an AD
community [105]. This was an attempt to promote AD community initiatives, providing guidelines to help communities in setting up sustainable energy projects.

5.7. Final Considerations

From this analysis, we have observed that most SI practices are still concentrated in the human reuse stage, and they are coherent with the role usually played by social organizations using SF as an input for their social purposes. This is particularly evident in traditional organizations such as food banks, but often also effective for more innovative models. It is much more difficult to find SI practices applied at the lower stages of the pyramid, such as the Nutrient recovery, where, although a high amount of FW is generated, technical and technological solutions are highly prevalent compared to social ones.

The role played by SI actors is subject to two types of criticism in the academic literature. On one hand, as highlighted by Arcuri (2019), the institutionalization of SI actors risks hiding the responsibilities of the state in SF management and, more generally, in the provision of welfare services [106]. In this sense, it should be kept in mind that the role of SI can be more highly valued, but it cannot replace public intervention. On the other hand, SI models are not exempt from the so-called “prevention paradox” [107]—that is, the contradiction between the publicly proclaimed preference for prevention in the FW hierarchical pyramid and the effective responses, which are mainly focused upon managing rather than preventing. This paradox unveils a potential conflict of interest as FW management per se implies the need for FW, whereas avoiding FW insurgence at all would eliminate any need for management and, consequently, for many of the practices analyzed here.

Answering these criticisms requires moving upward and to the left along the FW hierarchical pyramid in order to intensify preventative actions and to move interventions up to the first stages of the FSC, thereby increasing the environmental benefits. Consequently, social organizations confronting FW are called to work more in partnership with primary producers acting as socially and environmentally oriented intermediaries toward final consumers. In fulfilling this role, SI models may help return the FW issue to its systematic dimension, stimulating a complete reconsideration of FW structural causes inside the agro-food system, and not only its final consequences.

6. Conclusions

FW reduction is undoubtedly a field where the effectiveness of SI models can be analyzed and evaluated. The results of the qualitative review analysis confirmed the lack of specific studies on an FW hierarchical pyramid with an SI perspective. On the other hand, our analysis has revealed a wide set of documents related to many heterogeneous SI practices at use in confronting FW, FL, and SF. This means that the role of social organizations as key actors in networks for FW reduction is clearly recognized and considered in the most recent national regulations against FW. Thus, we systematized a classification of these SI practices, locating them in the FW hierarchical pyramid, to provide a useful tool for evaluating the effectiveness of SI practices according to the hierarchical stage to which they belong. Clear evidence is that the current SI practices are actually more focused on the human reuse of FW than on prevention. Consequently, we believe that this research may help public authorities to make the preference for the first stages rather than the last stages more explicit in their legislation, reevaluating the fundamental causes of FW generated into the agro-food system.

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