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CIRCULAR ECONOMY GOOD PRACTICES IN WASTE MANAGEMENT AND PREVENTION IN THE FOOD SYSTEM

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Abstract

The food system is one of the most important sectors affecting the transition to a circular economy. Through more efficient use of resources, a circular economy in the food system can contribute to economic growth and climate change mitigation, creating new market opportunities. Food loss, waste and surplus are in fact, related to the inefficient use of resources. All these inefficiencies throughout the various phases of the food system generate impacts not only at the environmental, but also at the societal level.
This paper aims to identify strategies associated to innovative food system good practices that support more efficient food waste prevention and management and the adoption of a circular economy approach. For this purpose, 56 circular economy good practices related to the food system were analysed.
This work is based on studies carried out in Italy in the framework of the Italian Circular Economy Stakeholders Platform referring to European circular economy good practice criteria. An official definition of a circular economy good practice has not yet been worked out, but this study singled out new approaches to classifying and analysing them for future implementation of circular economy standards. Moreover, the analysis made it possible to identify gaps in the food system and the strategic actions needed to close them through a systemic and integrated approach covering the various phases of the food system.

Key words: circular economy, food system, food waste prevention, food waste reduction, good practices

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1. Introduction

According to a recent UN research, about 17% of total food available to consumers in 2019 became waste (UNEP, 2021). Such a large amount of waste in all its various forms (loss, waste, surplus) can be attributed mainly to the enormous complexity of the food system (FAO, 2019; Foran et al., 2014) which includes processes starting from different primary resources, as well as the economic, social and natural environments in which these are embedded (FAO, 2014). The greater its complexity, the greater its environmental impact in terms of resources and greenhouse gas emissions (FAO, 2015). Conversely, foods that require minimal processing, including short-chain products, impact less (Kiss et al., 2019).

Socio-economic conditions have a strong influence on food waste (FAO, 2011). In high-income regions, in fact, waste is greater in the later stages and mainly during consumption. In low-income regions, on the other hand, food waste occurs most often during post-harvest handling, aggregation and storage, and is mainly due to economic problems (FAO, 2013; Parfitt et al., 2010). Food waste is therefore a clear example of inefficient use of resources with causes differing greatly depending on the phase in which they are produced (Göbel et al., 2015). Impacts affect not only

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the environment but also, dramatically, society (Seberini, 2020).

Hence, preventing and reducing food waste requires actions during all phases of the food system, with different strategies depending on the specificities of the individual phases and the production and consumption contexts. Such an approach finds expression in the circular economy (CE) perspective, which includes waste management and prevention strategies (European Parliament, 2015; EMF, 2013). According to EU programmes (EC Communication 2020a; EC Communication 2020b), the CE provides a systemic approach to transforming waste into resources and addressing the food system comprehensively.

In Italy, food waste prevention strategies and actions were introduced by the so called "Gadda law" (GD, 2016) which contains provisions concerning "the donation and distribution of food and pharmaceutical products for the purposes of social solidarity and the limitation of waste". This law, which regulates existing norms on tax concessions, civil liabilities and procedures for hygienic-sanitary safety, introduced advantages for those who donate their surpluses (as opposed to destroying them), such as reductions in garbage tax and facilitation of administrative proceedings for donation procedures. Yet, it also promotes the recovery of food for human consumption (to avoid destruction) as a value of and the creation of a Coordination Table within the Ministry of Agriculture, Food and Forestry Policies for consultation among all those involved to counter food waste and poverty. Thanks to this law, the recovery and redistribution of food surpluses for social purposes is fostering the transition towards a circular economy while improving collaboration between food supply chain stakeholders.

In order to identify and develop effective strategies for reducing food waste, a systemic and integrated approach has to be implemented, keeping the specificities of the phases of the food system and the contingent socio-economic systems in mind. To this end, the paper aims to explore the association between 56 food waste prevention actions carried out in Italy and the circular economy pillars set down for controlling food waste.

The linkage between circular economy good practices (CEGPs) and waste prevention has been explored by Cappellaro et al. (2020) through an analysis of more than 30 CEGPs in one Italian region (Emilia-Romagna), that was a first attempt at establishing criteria for the identification of CEGPs. In fact, there are still no precise criteria for the identification of CEGP. Actually, a Technical Committee on the Circular Economy was recently established in the framework of the International Standard Organisation (ISO) with the aim of developing "frameworks, guidelines, supporting tools and requirements for the implementation of activities of all involved organizations to maximize the contribution to Sustainable Development" (ISO/TC323, 2021). Similarly in Italy, the National Unification Authority (UNI) has set up a Technical Committee on the Circular Economy (UNI/CT057, 2021), which has however not yet published a standard, only some working documents.

A reference and representative criteria method for CEGP collection was recognised in the European Circular Economy Stakeholder Platform (ECESP, 2018; Cappellaro et al., 2020). The ECESP was created in 2017 by the European Economic and Social Committee (EESC) and the European Commission (EC) with it's the aim, among others, to facilitate the exchange and mapping of national, regional and local circular economy good practices, as well as examples from businesses, trade unions and civil society organizations. The Italian Circular Economy Stakeholder Platform (ICESP) is the Italian mirror initiative and one of its aims is to stimulate the collection of good circular economy practices in Italy. In 2020, more than 80 good practices were collected in the ICEGP database on the basis of ECESP criteria. ICESP outputs are also present in the ECESP, thereby introducing Italian results in Europe and contributing to the European Circular Economy Agenda. The key factors for potential transferability are based on the relationship between the Italian and European platforms, a feature that makes the model perfectly transferred to other member countries.

On the basis of these considerations, this study carried out an analysis of 56 CEGPs collected according to ECESP/ICESP.In particular, the research approach deals with the following phases:

- collection of food system CEGPs;
- classification of food system CEGPs according to the food system phases and circularity pillars;
- analysis of CEGPs frequency distribution in the food system phases and in the circularity pillars;
- identification of associations among food system phases and circularity pillars.

2. Material and methods

2.1. Collection of food system Circular Economy Good Practices

According to the ECESP (2018), "Good practices are relevant initiatives, innovative processes and 'learning from experience' examples involving companies or other relevant stakeholders such as research, academia and civil society". The circular economy good practices (CEGPs) considered in this paper were evaluated on the basis of ICESP (Italian Circular Economy Stakeholder Platform) criteria, which are similar to those of ECESP (European Circular Economy Stakeholder Platform), however the criteria of replicability was also added (Cappellaro et al., 2020).

Fifty-six CEGPs related to the Italian food system were collected in the period January-May 2020 on the basis of a study reported by the ICESP working groups on "Sustainable and circular design, production, distribution and consumption systems"

(ICESP, 2020) and "City and Territory" (ICESP, 2019).

2.2 Analysis and classification of food system Circular Economy Good Practices

The authors then classified the CEGPs found in the ICESP studies according to the food system phases in which they occur and the circular economy pillars they implement. This classification required a new definition of the state of the art of food system phases, which had to be formulated in accordance with a circular economy approach. In particular, each CEGP was associated only to the circularity pillar in which it is implemented the most. The list of CEGPs is included in the supplementary material.

2.2.1. Food system phases

To understand the importance and severity of the food waste phenomenon, circular economy good practices (CEGPs) have to refer to the whole food system not just the value chain. The value chain merely involves the profit at each stage, while the whole food system provides a wider and clearer view of each phase from primary production to consumption and post-consumption.

In the literature, food system phases differ depending on the classification method and whether it focuses more or less narrowly on production (primary and transformation) phases (FAO, 2011; Humphrey and Memedovic, 2006; TEEB, 2020). However, since food waste does not occur only in these phases, an agri-food system including the management of surpluses, among other things, is more appropriate.

During primary production, for example, losses are generated by the incorrect timing of harvesting, inadequate harvesting and handling, inappropriate trading and climatic conditions. During post-production, significant losses are caused by inadequate storage and conservation conditions. In the processing industry, food losses and waste depend mainly on the processing efficiencies of the various stages, which vary greatly depending on the product. Overstocking, packaging, accidental damage and technical malfunctions can generate transformation losses. The post-sale phase can also produce waste, for example during catering and at home due to a lack of knowledge of daily food management and label consciousness. Table 1 gives examples of food system phase definitions cited in literature.

To improve the description of the system, other key ECESP Circular Economy areas for CEGPs were taken into consideration, such as production, consumption, secondary raw materials, waste management, and innovation and investment (ECESP, 2018). Therefore, according to the authors, the food system can be represented by the following phases in each of which waste is generated (in grey in Table 1).

• *Agricultural production* including post-harvest, handling and storage, where losses are due to mechanical damage and/or spillage, the sorting of crops, and degradation during handling, storage and transportation between farm and distribution;

• *Processing* where losses are mainly due to sorting, washing, peeling, slicing and boiling, as well as process interruptions, accidental spillage and degradation;

• *Distribution, marketing and retail* generate losses related to logistics such as incorrect stock management, meeting product quality expectations, and inefficient organization between sectors resulting in overproduction, mishaps, and/or damage;

• *Consumption* leads to waste caused by food badly cooked, not well preserved and/or not used before the expiry date. At this stage, waste is generated by a lack of awareness and ability to manage the food;

• *Secondary materials* imply the use of some agro-industrial by-products in a circular approach, as innovative and functional ingredients in value added foods;

• *Waste management* involves interdependent rather than non-alternative actions to reduce the amount of no longer recyclable waste.

Table 1. Definitions of food system phases and food system phases in authors' view (in grey)

References	***Food system phase***							
FAO (2011)			Consumption	Distribution	Processing	Post-harvest handling	Agricultural production	
TEEB (2020)			Household consumption	Distribution, marketing, and retail	Manufacturing and processing	Agriculture production		
Humphrey and Memedovic (2006)			Retail		Processing	Production	Breeding and farm equipment companies	
Nobili and Cappellaro (2021)	Waste management	Secondary materials	Consumption	Distribution, marketing and retail	Processing	Agricultural production		

According to the authors' analysis, these phases were the only ones in which good practices were found to occur; other phases with good practices were detected.

2.2.2. Circularity pillars

CEGPs were also classified with reference to five circularity pillars which, as reported in Lacy et al. (2016), are strategies that address environmental sustainability while generating opportunities in terms of innovation, competitiveness, job and value creation.

With reference to the food system, the circularity pillars for CEGPs are:

• *Sustainable inputs*, meaning use of renewable energy in the production phases and/or organic food in processing phases (Cerutti et al., 2018);

• *Life extension* relates to strategies to extend the shelf-life of food products (i.e. eco-packaging) (Guillard et al., 2018);

• *Sharing platforms* refer to web platforms for sharing surplus or exchanging by-products within communities or industrial symbiosis platforms (Cutaia et al., 2015; Sposato at al., 2017);

• *Product-as-service* in this case means, for example, ordering food online and having it delivered to one's home (Muñoz López et al., 2020);

• *End of life* means the transformation of food waste into compost and/or its valorisation for energy purposes such as biogas (Aliasgari et al., 2019).

3. Results and discussion

On the basis of the foregoing criteria, the CEGPs analysed fell into more or less all the food system phases (Fig. 1) and systematically implemented circularity pillars. In particular, the frequency distribution of the collected CEGPs refers, to varying extents, to food system phases described below:

1. *Agricultural production:* CEGPs are related to innovative agronomic practices such as the use of biodegradable mulch films and microorganism consortia to promote plant growth;

2. *Processing:* CEGPs involve innovative farming modules and hydroponic vegetable cultivation;

3. *Distribution, marketing and retail:* CEGPs refer to environmental quality labels and the digitalisation of the supply chain;

4. *Consumption and post consumption:* food surpluses are collected and distributed to people in need. This activity requires efficient logistical organisation to make the times and costs of collecting and distributing meals economically sustainable. Other CEGPs related to this phase relate to the use of compostable tableware;

5. *Secondary materials:* CEGPs illustrate the valorisation of agri-food by-products as a source of valuable bioactive compounds for producing new materials (textile fibres, packaging, food; building and biomaterials);

6. *Waste management:* CEGPs relate mainly to the regulation of separate waste collection and the conversion of waste for energy purposes.

Quantitatively, the analysis showed that the phases most frequently represented were, equally: "consumption and post consumption", "secondary materials" and "waste management". Instead, only a few CEGPs were related to "agricultural production", "processing" and "distribution". In particular, the new strategies that emerged for food waste management and prevention in accordance with a circular economy approach promote:

• innovation in agronomic practices to make agriculture more sustainable;

• designing production so that it is more sustainable and circular, using waste from other productions;

• establishing criteria, methods and applications that develop an approach to waste prevention and raise the awareness of industrial and (hotel, restaurant and café - ho.re.ca.) operators;

• bringing about changes in culture and behaviour, by raising consumer awareness of purchases and consumption through the dissemination of information and events, and the adoption of new urban models of circular communities (co-housing, collective purchases, short supply chains from organic agriculture, to fair trade, etc.);

• the use of by-products in a circular approach often promoting industrial symbiosis for the health and well-being of consumers and the environment;

• communicating actions, including information on the specifications and innovations of the services, and teaching the public about the correct separation and disposal of waste and the potential of wet waste compost and biogas.

Classifying CEGPs according to the circularity pillars revealed that the pillar by far most frequently represented is "Sharing, use and consumption", while the least represented were "Product as a service" and "product end of life" (Fig. 2). Looking at the distribution of circularity pillars in CEGPs suggests that the following strategies would create some advantages and make it possible to overcome the unsustainability of the current food system:

• sharing platforms optimise food system costs and favour resource-efficient use in consumption phases

• sustainable inputs reduce the environmental footprint of food systems

• life extension prevents food waste.

• product-as-a-service significantly reduces environmental impact and fosters innovation in the distribution, marketing and retail phases

• extending products' end-of-life improves the sustainability of waste management phases.

The evaluation of good practices with respect to both phases and pillars, which may suggest further strategic actions for the management and prevention of food waste within the food system, can be summarized as given in Table 2.

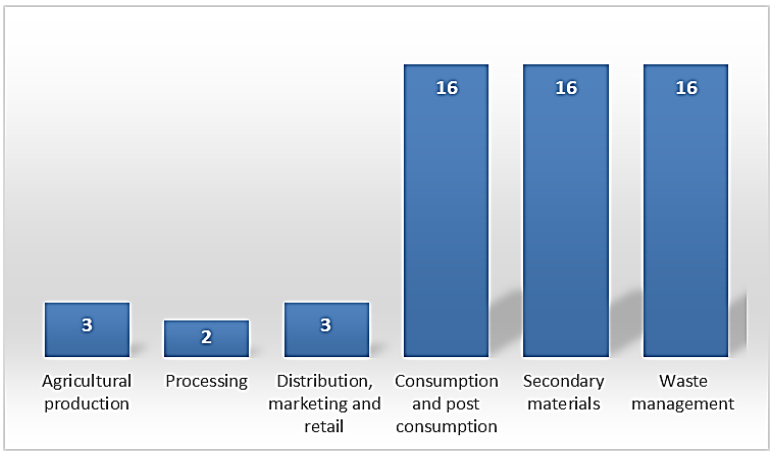

Fig. 1. Frequency distribution of CEGPs in food system phases

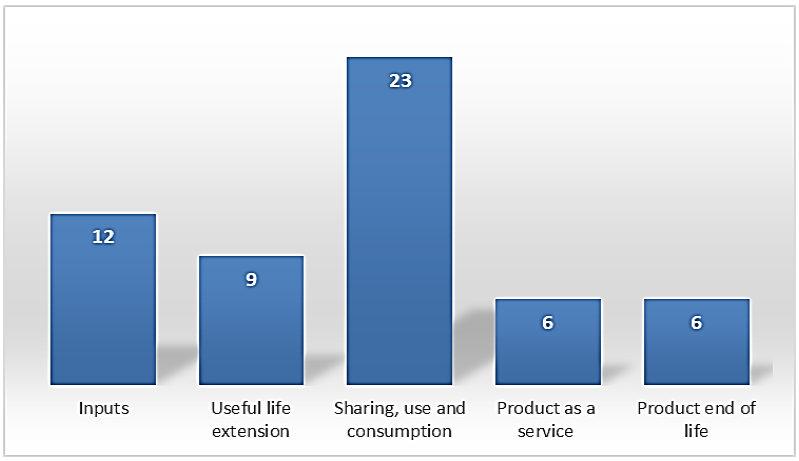

Fig. 2. Frequency of the distribution of CEGPs in the circularity pillars

Figures displayed in the "circularity pillars" Table refer to the CEGPs listed in the supplementary material. Each CEGP was considered only once in Table 2 depending on the main pillar it implements. The Table shows that the most frequent associations include surplus distribution to optimise food system costs and resource-efficient use in consumption phases; the use of agri-food by-products as innovative value-added ingredients; and new technologies and materials for preventing and reducing crop losses as inputs for primary production.

The first association points out that synergies established between different users reduce the production of waste; improve its quality, collection, transformation and reuse; and monitor actions relating to the quality and quantity of the organic residue collected (Saha et al., 2010). As described in the Introductory paragraph, this approach, particularly in Italy, is encouraged by the so called "Gadda law" (GD, 2016).

The second association, related to the use of by-products, is in line with what is emerging from the third "Italian circular economy report" (Circular Economy Network, 2021). The report points out that Italy is in second place behind France for the circular use of materials (19.3%). The recycling of secondary raw materials is, then, a way to redirect the system towards a circularity perspective that leads to a decrease in the impact (of food waste) and towards climate neutrality. Efforts must be concentrated on the creation of products designed to last longer, especially in a context characterized by intense use in a short period of time or by a second life immediately following the first (Fifield and Medkova, 2016).

Finally, another association concerns new technologies and materials as inputs for agriculture production. Important directions on this issue arise from the new European Farm to Fork paradigms, the new action plan (EC Communication, 2020a) for the circular economy and biodiversity strategy for the agri-food sector. An enormous effort is being made to enhance sustainable agriculture, organic production, agroecology and other innovative management forms allowing for the reduction of the use of pesticides without compromising the fertility and microbial richness of soils so as to guarantee the safety and healthfulness of foods and thereby protect human health. Noteworthy is that the majority of CEGPs analyzed referred to the downstream phases of the food system, contributing to defining strategies aimed at sharing surpluses through web platforms and charity networks or via industrial symbiosis platforms, while fewer CEGPs referred to the upstream phases of the food system.

Table 2. Associations of the different phases of the food system and circularity pillars. Figures represent CEGPs as listed in the supplementary materials

Food waste management and prevention strategies	***Food system phases***	***Circularity pillars***				
		Inputs	***Useful life extension***	***Sharing, use and consumption***	***Product as a service***	***Product end of life***
Technologies and materials for preventing and reducing crop losses through soilless cultivation	Agricultural production	1, 2, 3, 4, 14, 25, 42				
Agreements with wholesale markets and large-scale distributors to limit waste and the rejection of non-uniform products, and promote the sale of products in bulk	Agricultural production, processing, distribution, marketing and retail		6, 9, 12, 55			
Communication and awareness-raising campaigns to change consumers' concepts of the quality of agricultural products; direct sales from farms	Agricultural production, Consumption and post consumption		7			
Communication and awareness-raising campaigns to change consumers' ideas of food value and the need to reduce food waste in the family, company canteens and at the catering level	Consumption and post consumption, Waste management		11, 13, 38			
Communication and awareness-raising campaigns to bring about a cultural change in consumers about conscious purchases, short supply chains, and local e-commerce	Distribution, marketing and retail, Consumption and post consumption, Waste management		10			
Creation of circular communities for collective food purchases through purchasing groups	Distribution, marketing and retail, Consumption and post consumption, Waste management			8		
Linkage between places where food surpluses originate (company and school canteens, neighbourhood markets, food stores, events) and charity associations for the needy	Distribution, marketing and retail Consumption and post consumption,			15, 16, 17, 18, 19, 20, 21, 22, 23, 24, 25		
Treatment of inedible food waste for producing compost and biogas	Waste management				29, 33, 41, 43, 53, 54	
Treatments of inedible food waste for producing secondary materials	Processing, Waste management					45
Systems to optimize the collection of organic waste for compost and biogas production (e.g. use of compostable tableware in collective catering, use of bioplastic bags in neighbourhood and wholesale markets)	Waste management					34, 35, 26, 36, 37
Valorisation of agri-food by-products by extracting valuable bioactive compounds	Processing, Secondary materials			39, 40, 49, 52		
Use of agri-food by-products for producing new materials (textiles fibres, packaging, wasted bread medium paper; building materials; biomaterials)	Processing, Secondary materials			5, 27, 31, 46, 47, 48, 50		
Secondary materials for producing new products	Processing, Waste management	30, 32, 44, 51, 56				

To fill this gap, the development of additional GPs concerning the upstream phases of the system (i.e. primary agriculture production, processing and distribution) must be encouraged. Some proposals along these lines emerged in the working groups studies of the ICESP platform:

• soil care, that is rethinking the economic system involving land in an integrated way, taking the opportunity to transform soil vulnerability into a driving force for a truly sustainable recovery through the promotion of agro-ecological infrastructures;

• digitalization of the agri-food chain from primary production to the processing industry, as well as logistics in favor of product traceability;

• design and development of new technologies, including new forms of eco-packaging, that increase the shelf-life of food, thus reducing waste and improving the sustainability of agri-food production.

Future perspectives for making food products compliant with the principles of circularity and resource-efficiency have been provided by the European Commission, which has proposed measures that will expand the Ecodesign Directive. This

approach is even more important since up to 80 percent of the environmental impact of products is determined in the design phase (EC Communication, 2020a), Ecological redesign of the food system starting from the early phases will favour sustainability, which has to take into consideration socio-economic aspects, especially in the current context to support the food and nutritional needs of a growing and increasingly urbanized population

4. Conclusions

The central role of food not only for our survival but in many other areas of personal and public life is widely recognised. Indeed, food plays an important role in economic, ecological, social and political terms. It is of essential value for human health, well-being and prosperity. Yet, the waste produced by the current food system is an enormous problem, considering that every year around 1.3 tons of food are not consumed worldwide, while a billion people suffer from and millions die of hunger. For years, efforts have been made to tackle the problem in its various aspects, so that a large number of good practices related to reducing food waste and losses in every phase of the food system, from primary production to consumption, have been identified.

In this study, 56 circular economy good practices, considered in relation to food system phases and circularity pillars, were collected from the ICESP platform, established much like the ECESP and representative at Italian level of a large variety of circular economy stakeholders from public institutions, firms and industry associations, universities and research organizations, citizens and third sector. Moreover, based on agreements between ICESP and the corresponding European platform (ECESP), the CEGPs collected by ICESP are being evaluated for inclusion in the ECESP database. Consequently, CEGPs are not only relevant nationally, but can also be taken as a reference in a European context.

The CEGPs collection and classification method used in this study was based on ICESP/ECESP criteria and can be seen as a first attempt to identify universal criteria that can be used for the implementation of international standards such as ISO or UNI.

The selection and analysis methodology of circular economy good practices carried out in this paper has made it possible to identify the gaps in the Italian food system and propose strategic actions to implement new circular approaches to controlling food waste in all the food system phases.

In particular, this study has confirmed that CEGPs can provide important examples for managing and preventing waste. Nevertheless, it appears that most of the Italian good practices currently refer to the downstream phases of the food system, in association with circularity strategies aimed at reducing food waste and relating mainly to the sharing of food surpluses with needy people and reusing and enhancing by-products for consideration as second raw materials. As a final consideration, more work needs to be done on prevention in the upstream phases of the food system supply chain. This could be favoured by policies and action plans (EC Communication, 2020a) promoting the adoption of eco-innovation in soil care and throughout the agri-food chain in accordance with life cycle thinking.

Finally, the introduction in the food system of eco-design strategies could drive food waste reduction and ensure that prevention progressively become the norm throughout the food system phases.

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Appendix

Table 3. CEGPs analyzed in the paper. The CEGPs are available for consultation in Italian language on https://www.icesp.it/buone-pratiche and in ICESP, (2020) at the following web site: https://www.icesp.it/sites/default/files/DocsGdL/L%27economia%20circolare%20nelle%20filiere%20industriali%20i%20casi%20Costruzione%26Demolizione%20e%20Agrifood.pdf

No	GP TITLE	TOPIC	FOOD SYSTEM PHASE	CIRCULARITY PILLAR
1	NOVAMONT/ MATERBI MULCH FILMS	Biodegradable mulch films for agricultural production	Agricultural production	Inputs
2	RHIZOSPHERIC INTERACTIONS	Agronomic practices for the reduction of external inputs in organic horticulture	Agricultural production	Inputs
3	BIOFECTOR/ SUPRAHUMIC	Composted agricultural waste with and without selected microorganisms as soil conditioner	Agricultural production	Inputs
4	FRESHGURU GREEN HOUSE	Hydroponic cultivation for fruit and vegetable production	Processing	Inputs
5	EDIZERO	Conversion of surplus and recovered materials into high-tech biomaterial	Secondary materials	Sharing, use and consumption
6	BRESCIA MUNICIPALITY AGREEMENT	Conventions and / or agreements with large retailers for the reduction of food waste and packaging	Distribution, marketing and retail	Useful life extension
7	LA POLVERIERA	Urban regeneration project	Consumption and post consumption	Useful life extension
8	SOLIDARIA	Solidarity co-housing	Consumption and post consumption	Sharing, use and consumption
9	RISTORAZIONE SOSTENIBILE 360	Sustainable catering	Waste management	Useful life extension
10	BISOS	Responsible tourism	Consumption and post consumption	Useful life extension
11	PACCOZERO	Communication and awareness-raising campaign	Consumption and post consumption	Useful life extension
12	TRENTO ECO PROVINCIA	Local authority environmental quality branding	Distribution, marketing and retail	Useful life extension
13	LIFE FOSTER	Training, education and communication to reduce food waste in the food service industry	Distribution, marketing and retail	Useful life extension
14	COLTIVARE INLANA	Wool for soilless cultivation	Processing	Inputs
15	AVANZI POPOLO PROJECT	Food surplus sharing	Consumption and post consumption	Sharing, use and consumption
16	CIBOAMICO	Food surplus sharing	Consumption and post consumption	Sharing, use and consumption
17	POPP PROJECT	Waste management	Waste management	Sharing, use and consumption
18	LASTMINUTE MARKET	Food surplus sharing	Consumption and post consumption	Sharing, use and consumption
19	MAGAZZINI SOCIALI	Food surplus sharing	Consumption and post consumption	Sharing, use and consumption
20	FOOD BUSTERS	Food surplus sharing	Consumption and post consumption	Sharing, use and consumption
21	SIR EMILIA-ROMAGNA	Food surplus sharing	Consumption and post consumption	Sharing, use and consumption
22	DISCO SOUPE FIRENZE	Communication and awareness raising campaigns	Consumption and post consumption	Sharing, use and consumption
23	LADISPOLI NONSPRECA	Food surplus sharing	Consumption and post consumption	Sharing, use and consumption
24	FONDAZIONE BANCO ALIMENTARE	Food surplus sharing	Consumption and post consumption	Sharing, use and consumption
25	BANCOBUILDING, BANCO INFORMATICO, BANCO FARMACEUTICO	Surplus sharing	Consumption and post consumption	Sharing, use and consumption
26	TORINO CITY LAB	Food surplus sharing	Consumption and post consumption	Product end of life
27	VALLE FIORITA PROJECT	Valorisation of wasted bread as by-products	Secondary materials	Sharing, use and consumption
28	BIOINAGRO	Valorisation of by-products	Secondary materials	Inputs
29	FATTORIA DELLA PIANA	Valorisation of dairy by-products	Waste management	Product as a service
30	FUNGHI ESPRESSO	Valorisation of cafè as by-products	Secondary materials	Inputs
31	CARTACRUSCA	Valorisation of straw as by-products	Secondary materials	Sharing, use and consumption
32	PRESPAGLIA	Primary production by-product reuse	Secondary materials	Inputs
33	PROGEVA S.R.L.	Non-hazardous organic waste recycling	Waste management	Product as a service

34	NOVAMONT AMSA	Eco-friendly separate waste collection in Milan	Waste management	Product end of life
35	NOVAMONT MATERBI	Compostable tableware for better management of organic waste	Waste management	Product end of life
36	NOVAMONT COMPOST	Use of compost from organic waste	Waste management	Product end of life
37	LES OASIS DE EL OIDANE	Composting site creation	Waste management	Product end of life
38	URBANWINS	Communication and awareness raising campaigns	Consumption and post consumption	Useful life extension
39	ENEA-SVILUPPUMBRIA	Added value biomolecule production from agro-industrial waste	Secondary materials	Sharing, use and consumption
40	VALORIBIO	Enhancement of organic waste for agricultural biomaterials	Waste management	Sharing, use and consumption
41	LACITTAVERDE	Compost and biofuel from waste	Waste management	Product as a service
42	BIOXPLOSION	Transformation of organic waste and animal waste into organic humus	Waste management	Inputs
43	OLTRECAFÈ	Collection and transformation of coffee grounds into pellets	Waste management	Product as a service
44	RI-DETERSIVO	Transformation of exhausted oils into surfactant for ecological detergents	Secondary materials	Inputs
45	ADRIATICA OLI	Transformation of exhausted oils into new resources	Waste management	Product end of life
46	PIGMENTO NATURALE	Natural dyes made from agricultural and alimentary discards	Secondary materials	Sharing, use and consumption
47	VEGEA	Transformation of biomass and agro-industrial residues into new materials	Secondary materials	Sharing, use and consumption
48	RICE HOUSE	Primary production rice waste transformed into architectural materials	Secondary materials	Sharing, use and consumption
49	LAVANDULA	Valorization of lavender waste as by-product	Secondary materials	Sharing, use and consumption
50	ORANGEFIBER	Transformation of orange processing by-products into textile materials	Secondary materials	Sharing, use and consumption
51	FUNGOBOX	Reuse of coffee grounds as substrate for mushroom cultivation	Secondary materials	Inputs
52	PACKTIN	Valorization of primary production plant waste to obtain value added molecules	Secondary materials	Sharing, use and consumption
53	COMPOST COMMUNITY	Creation of community composting plant	Waste management	Product as a service
54	LIFE DOP - FERTILIZERS	Enhancement of livestock waste to produce renewable energy	Waste management	Product as a service
55	ENABLING	Use of biomass on biobased product sharing platform	Waste management	Useful life extension
56	VENICE UNIVERSITY PROJECT	Clean energy from wine waste	Secondary materials	Inputs