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# The role of food waste hierarchy in addressing policy and research: A comparative analysis

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## Abstract

The European Union is working towards reducing food waste by 30% by 2025. A pyramid of priorities to manage the food waste reduction is set by the Directive 2008/98/EC, where prevention is the first action to be implemented by the Member States. The objective of this paper is to identify the main trajectories followed so far by scientific research and two national laws against food waste, namely the Italian and the French laws. To do so, the two regulations are compared by analyzing and classifying each single measure according to the FUSIONS approach. Results are discussed with reference to the priorities expressed in the food waste pyramid. So far, it seems that the two national laws took a different direction, limiting the prevention activities to communication campaign addressed to final consumers and focusing on re-use and recovery especially at the final stages of the supply chain. Academic research shows a dominant focus on energy recovery and recycling.

2

## 3 1. Introduction

4 Food waste is recognized as a global issue and its reduction is considered a crucial element in  
5 developing a sustainable food system (UN, 2015). After the first estimation conducted by  
6 FAO in 2011 (Gustavsson et al., 2011), revealing that one-third of the food globally produced  
7 is lost during the several stages of the supply chain, other studies confirmed that the amount  
8 of food waste is very relevant (Stenmarck et al., 2016). Producing food that will never be  
9 consumed causes the waste of environmental resources (Hall et al., 2009; Kummu et al.,  
10 2012), hinders food security (Godfray, 2010) and raises social and economic problems  
11 (Mourad, 2016; Cicatiello et al., 2016). In 2014, the UN set up a target specifically addressed

to food waste within the Sustainable Development Goal (SDG) n.12 (i.e. ensure sustainable consumption and production patterns): SDG n.12.3 calls for halving per capita global food waste at the retail and consumer level and reducing food losses along the production and supply chains, including post-harvest losses, by 2030. This target is the main legal foundation of policies against food waste all over the world.

A huge effort has been done, in the last years, to search and implement solutions against food waste at different levels of the supply chain (Mourad, 2016). These solutions are supposed to follow the priorities set for waste management, thus focusing firstly on prevention, and seeking reusing and recycling solutions as secondary options (Papargyropoulou et al., 2014).

In the European Union, France and Italy approved specific laws addressing food waste, in a comprehensive normative framework addressing the overall problem with multiple acts and solutions.

This paper provides an analysis and appraisal of the measures designed by the French and Italian laws against food waste and a discussion of their consistency with the current trends of the research on food waste. The objective is to compare the trajectories followed by the legislative framework and by the academic literature, to discuss the extent to which they are able to contribute to the achievement of the targets set at the policy levels. To do so, the paper adopts a twofold approach. First, the two national regulations against food waste are analysed, by studying (i) how they are linked to the principles settled in the European regulation and to the most recent evidences provided by international literature in the field of food waste, and (ii) the type of measures implemented, to check whether there is a difference in approach and methods and if there is coherence of actions with policy and scientific agenda at global level. By doing so, the study aims to complement the work of Vaque (2017) who proposed a first comparison between the two laws, commenting on the potentiality of replication of the single sections/articles in other UE member states. Second, the occurrence of the food waste hierarchy keywords in the extant literature on food waste is studied, as well as the prevalence of studies dealing with different stages of the food chain. The results are then compared in order to discuss where the current policy and research efforts are moving. The article ends with some conclusions and suggestions to push the global agenda toward a greater application of the food waste hierarchy in the implementation of actions against food waste in Europe.

## **2. Background on food waste policies**

### *2.1 The EU approach to food waste prevention and reduction*

Latest researches state that in the EU-28, 89 million tons of food are wasted every year (Stenmarck et al., 2016), corresponding to 173 kilograms of food waste per person. Among



this, households are estimated to be responsible of 53% of the total, followed by processing (19%), public and private food service (12%), production (11%) and retail (5%) (Stenmarck et al., 2016). Although some of these figures may be under or over-estimated – e.g. in the retail sector (Cicatiello et al., 2020) and at households (Giordano et al., 2018; 2019) - the issue of food waste is cross-cutting to all phases of the chain. This requires a global policy approach to address the problem.

The EU Waste Directive encourages Member States to develop “*waste prevention programmes, concentrating on the key environmental impacts and taking into account the whole life-cycle of products and materials*” (EU, 2008; p. 312/6). A section of these waste prevention plans should be specifically focused on food waste, although this is not mandatory. Among others, Italy (PINPAS, 2013-2015), France (ANTI-GASPI, currently ongoing) and Spain (Mas Alimentos, Menos Desperdicio, currently ongoing) approved a National Plan for Food Waste Prevention and Reduction. Italy and France have also approved national comprehensive laws against food waste in 2016. Instead, in other EU countries, initiatives against food waste have been implemented through more fragmented actions, for example waste management plans at the municipal level (Austria, Czech Republic and Poland), action plans for food loss and waste reduction (Netherlands, Sweden and Scotland) or laws targeting specific issues of the food waste problem (UK, with the “Groceries Code Adjudicator Act”). Large cities across Europe<sup>1</sup> are also implementing urban policies promoting initiatives for waste reduction along the supply chain.

The focus of food waste prevention at the EU level is on reducing the resources to be used for food production and to lower the environmental impact of food production and consumption, consistently with new Circular Economy Package. Food waste is also mentioned in most

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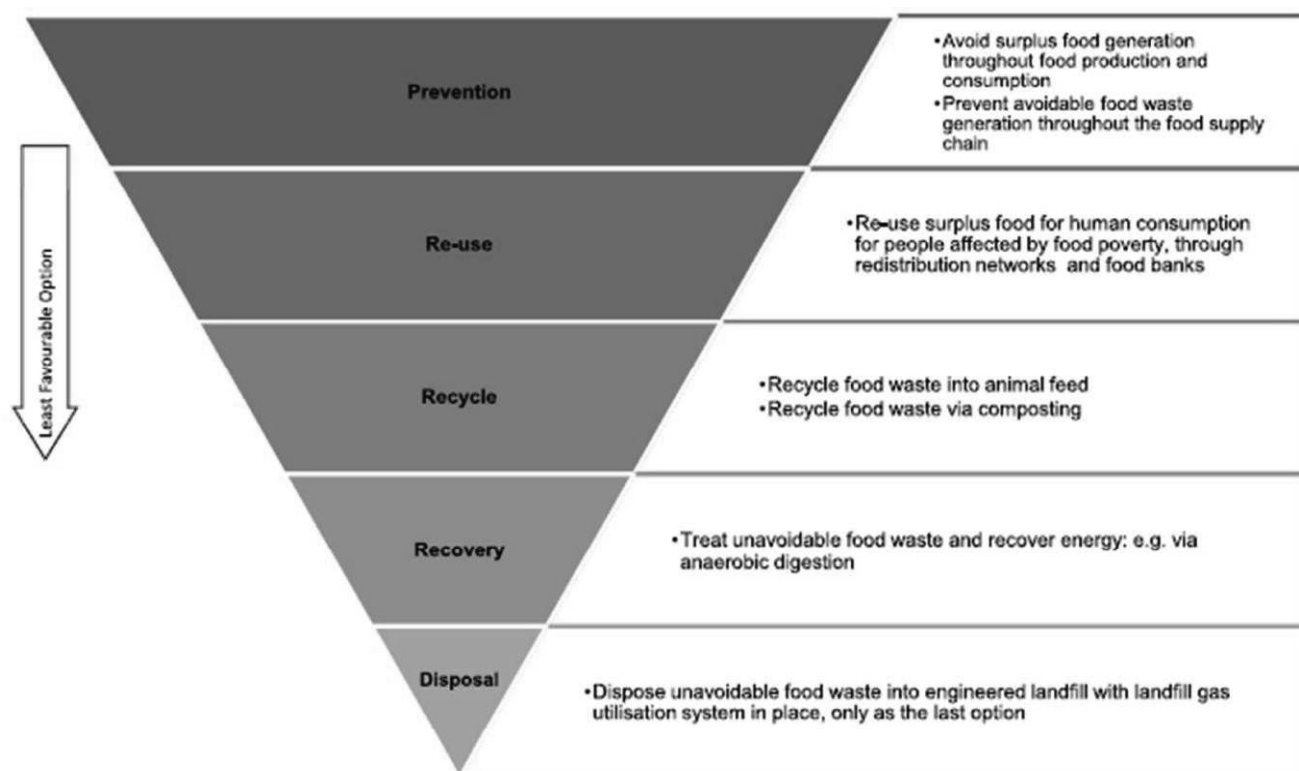
<sup>1</sup> The 2018 Eurocities Working Group Food Report counts 43 urban initiatives on food waste prevention and reduction.

recent Directive (EU) 2018/851 concerning waste management, as EU countries are requested to take action to reduce food waste at all stages of the supply chain, to monitor food waste levels and to report whether the targets are reached. An official methodology for quantification, to be used for this purpose, has been adopted by the European Commission on the 3<sup>rd</sup> of May 2019 (EC delegated decision 3211 Final).

A clear hierarchy of priorities to manage the generation of waste is set by Directive 2008/98/EC (EU, 2008): *“the following waste hierarchy shall apply as a priority order in waste prevention and management legislation and policy: (a) prevention; (b) preparing for re-use; (c) recycling; (d) other recovery, e.g. energy recovery; and (e) disposal”* (Art.4).

Therefore, the directive strongly supports the concept of waste prevention as a first and necessary step for waste management, with landfilling being the least preferable option under the strong environmental perspective adopted in the directive. This hierarchy, which applies to all waste categories, has been specifically applied to the food waste issue by Papargyropoulou et al. (2014), who designed a food waste prevention pyramid (Figure 1). Here, the best option is to reduce the generation of food waste by preventing the production of surplus food (upstream in the food chain) and the disposal of avoidable food waste (downstream). When this is not possible, the reuse of surplus food for human consumption - e.g. through redistribution initiatives - is advised. The subsequent levels of the food waste hierarchy envisage the recycle and the energy recovery of food waste, with the aim to avoid landfilling, which stands as the least desirable option.

Figure 1 - Food waste prevention pyramid



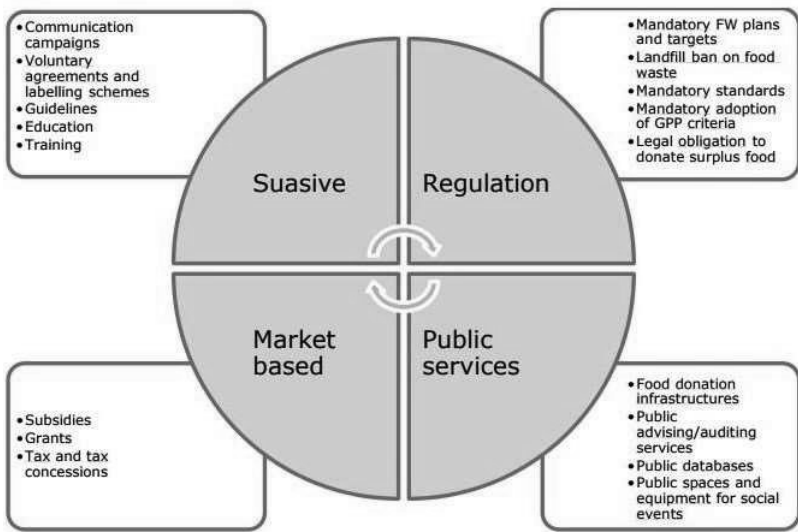
Source: Papargyropoulou et al., 2014, adapted from European Parliament Council 2008

## 2.2 Evaluations of food waste policies

Each policy initiative - aimed, in this case, to address the issue of food waste - is based on a specific policy approach, which can be more or less strong in fostering the desired behaviour by citizens, institutions and business organizations. The effectiveness of a policy depends on the mix of policy approaches used in the interventions. However, in the case of policies against food waste it is still unclear which combination of initiatives can achieve best results, as evaluations of food waste prevention policies are scarce (Thyberg & Tonjes, 2016). In FUSIONS (2016) such complexity of policy approaches is interpreted according to the classification scheme in figure 2. The policy approach is classified as suasive or regulatory, while instruments can be market based or public goods. A suasive approach encourages behavioural changes through the provision of information, while a regulatory approach

introduces penalties. Under both policy approaches, different types of instruments can be conceived. Market-based instruments encourage behavioural change through market signals rather than through traditional regulations; examples include environmentally related taxes, charges and subsidies. Instead, other instruments are characterized by the provision of public goods or services to achieve the goal.

Figure 2- FUSIONS' classification approach for the policy measures.



Source: FUSIONS, 2016, p.22

Another classification framework is proposed by Muraud (2016), basing on the evaluation of the strength of the prevention measures. In this framework, a clear distinction is made between “weak” actions, focusing on achieving a higher efficiency in food supply operations, and “strong” actions, which instead aim to push holistic changes in the food systems, e.g. reducing the levels of production and/or consumption. Under this classification, most of the measures usually included in food waste policies at different levels, namely recovering, recycling and awareness raising campaigns, have to be considered weak actions.

### 3. Methodology of the study

To discuss the trajectories of the laws against food waste in force in the EU in comparison with the most recent trends of the current research in the field of food waste, this paper uses a twofold methodology. First, an analysis and classification of the measures included in the laws against food waste are provided, according to a functional method for comparative law analysis (Michaels, 2006); second, the current scientific literature dealing with food waste reduction is systematized. Both methodologies are engaged with the layers of the food waste hierarchy, which is used as a common framework to compare the results from the two parts of the study.

#### 3.1 Methodology of the policy analysis

The policy analysis concerns the two national laws in force in EU countries:

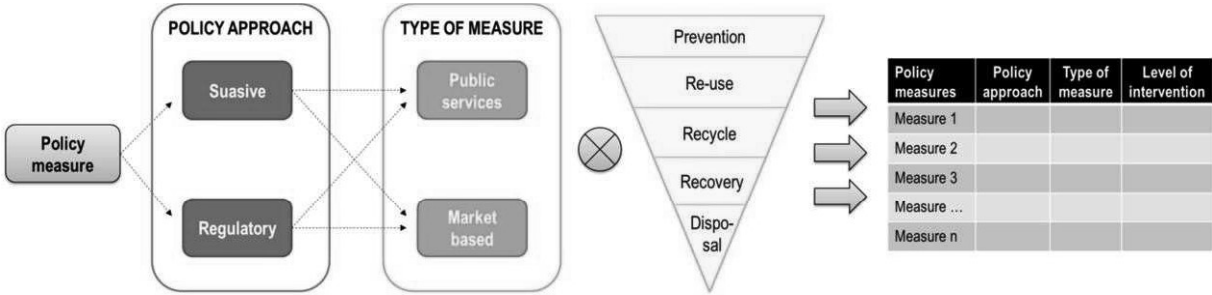
- the Italian law against food waste, number 166, passed on August 19<sup>th</sup>, 2016;
- the French law against food waste, number 138, passed on February 11<sup>th</sup>, 2016.

Both laws are analysed through a functional approach (Michaels, 2006), used as an evaluative criterion to assess their implications on the reality. Namely, this functional approach focuses not (only) on rules, rather on their effects on the society, i.e. in this case, on the way they can actually contribute to food waste prevention and reduction. The methodology is based on FUSIONS (2016), so that each measure is first classified along a 2x2 scheme, where the policy approach could be considered either *suasive* or *regulatory*, while the instruments provided could belong to the *marked based* or *public service* class type. Second, a further classification is made, based on the layers of the food waste hierarchy (Papargyropoulou et al., 2014), by specifying whether they are intended to the prevention, reuse, recycle or recovery of food waste. As a third step of the methodology, the actors addressed by the

measures and the funding provided are also noted. This further classification is inspired to stakeholders mapping and analysis tools (Eden and Ackermann 2013) and it is used to extrapolate information about: (i) the actors in charge of implementing the measure, (ii) the actors impacted by its implementation (positively or negatively), and (iii) whether the measure is financed or not. This is helpful to detect the potential effects of the measures, in line with the functional approach (Michaels, 2006).

A diagram of the resulting classification framework is represented in Figure 3.

Figure 3- Classification framework adopted for policy measures' analysis.



Source: authors' elaboration

As a result of this classification, a table is compiled for each of the laws analysed where, for each of the measures listed in the rows, the following information is reported:

1. Code of the measure: each measure was assigned a code, reporting IT for the Italian law and FR for the French law, followed by a sequence number; this code is used throughout the paper to refer to the single measure analysed.
2. Number of the article where the measure is established, as it appears in the law itself.
3. Number of the clause, as it appears in the law itself.
4. Policy approach: suasive (SUA) or regulatory (REG), as previously defined in subsection 2.2.

- 169 5. Type of measure: public service (PS) or market-based (MB), as previously defined in  
170 subsection 2.2.
- 171 6. Level of the food waste pyramid concerned.
- 172 7. Actor in charge of implementation of the measure, as it can be deduced from the text  
173 of the article.
- 174 8. Actor to whom the measure is addressed, i.e. the subject which will take advantage (or  
175 will be affected) by the implementation of the measure.
- 176 9. Financing: whether the measure is clearly financed or not, as it can be deduced from  
177 the text of the article.

178 To compare the two laws, a graphical representation is provided, with the aim to detect  
179 differences in their approaches, type of interventions and allocated resources.

### 181 3.2 Systematization of the scientific literature on food waste reduction

182 In the systematization of the literature dealing with food waste reduction, the food waste  
183 hierarchy (Papargyropoulou et al., 2014) was used as a framework to allow consistency with  
184 the methodology of the policy analysis. A search in Scopus was conducted on all journal  
185 articles that mentioned among the keywords the term “food waste” or “food loss”. The search  
186 was limited to the period 2008-present<sup>2</sup>, with most of the studies being published very  
187 recently: out of the total 2,908 papers returned by the search, 698 were published in 2018 and  
188 533 in 2017. A database containing all the documents’ information was extracted and  
189 elaborated in Microsoft Excel.

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<sup>2</sup> The search was conducted on March 29<sup>th</sup> 2019.

The analysis assessed the occurrence of the keywords related to the food waste hierarchy among the abstracts of the papers included in the database. Namely, the occurrence of the following terms related to the different layers of the food waste hierarchy was detected:

- Layer on prevention: “prevent” or “prevention” or “awareness”;
- Layer on reuse for human consumption: “reuse” or “re-use” or “redistribution” or “donation”;
- Layer on recycling: “recycling” or “recycle” or “animal feed” or “compost”;
- Layer on energy recovery: “energy” or “digestion” or “recovery”.

For each article, the presence of at least one term per layer of the food waste hierarchy was noted, as a proxy of the article’s link with the discussion on food waste reduction. The occurrence of terms related to each layer of the food waste pyramid was illustrated through descriptive statistics and analysed through correlations.

## **4. Results: trajectories of actions against food waste in the Italian and French laws**

### *4.1 Structure of the laws*

The Italian law against food waste (number 166 passed on August 19<sup>th</sup>, 2016) is made up of 18 articles, 15 of which deal with principles and initiatives set by the law itself, while 3 introduce modifications and/or additions to existing regulations; while the French law (number 138 passed on February 11<sup>th</sup>, 2016) is made up of 4 articles, all introducing modifications to existing regulations, namely the environmental, civil, education and commerce codes.

In article 2, the Italian law includes several definitions that are later recalled throughout the text. First, the concept of food waste is defined as “*food products discarded at different steps of the agro-food chain [...], still edible and potentially suitable for human consumption that,*



in the absence of a possible alternative use, are destined to be disposed of". This definition excludes food scraps and food industry by-products that are often included in other definitions used in the literature, under the category of "*unavoidable food waste*" (Beretta et al., 2013; Quested and Johnson, 2009; European Commission, 2019). Another relevant definition included in the Italian law against food waste concerns the so-called "*food service providers*", i.e. public or private actors involved in the food production, transformation, packaging, retailing and supply, to whom several measures of the law are specifically addressed. Instead, the French law does not include any definition of the terms and actors concerned by the initiatives against food waste, coherently with its structure which looks much more concise than the Italian one.

For what concerns the implementation of the food waste prevention hierarchy, some differences can be noted. Article 1 of the French law states that actions against food waste should be implemented along the following priority order: (1) prevention; (2) donation or transformation of food waste which is still suitable for human consumption; (3) valorisation of food waste for animal feeding purposes; (4) production of compost or energy valorisation. This recalls very closely the hierarchy of interventions of the food waste pyramid.

The Italian law, instead, does not include any direct reference to the food waste pyramid. In article 1 the main purposes of the law are established, including: fostering the collection and donation of edible food waste for human consumption purposes; reducing the negative environmental impact of food waste through recycle and reuse; improving the research on food waste and pushing awareness campaigns addressed to consumers and institutions.

#### 4.2 Trajectories of actions against food waste in the Italian law

237 The 18 articles of the Italian law against food waste address 12 different measures that were  
238 considered in the analysis. Indeed, not all the articles concern specific interventions against  
239 food waste; rather some of them state general principles or amendments to previous laws.  
240 General principles include the list of priorities to be considered for the food donation (human  
241 consumption, only whether food does not pass the expiration date; use for animal feeding, as  
242 a second option; composting as last option). They also specify that *gleaning* is allowed, and  
243 sanitary issues related to the collection are responsibility of the charities themselves.

244 Among the interventions provided by the Italian law, several concern food donations. Food  
245 donation is defined as a “voluntary” act. As written in the article 3 of the law, clauses 1, 2, 3  
246 and 4, food “can be” donated (1), for free (2), and whether it does not fit the sanitary  
247 standards for human consumption, it can be donated for animal feeding or composting (3);  
248 food products showing irregularities in labelling can be donated for human consumption as  
249 well (4).

250 Much effort is put on measures targeting awareness- raising and communication campaigns.  
251 Article 9, clauses 1, 2 and 3, proposes three types of communication campaigns: the first  
252 (coded as measure IT01) to be broadcasted to the general public through the three national TV  
253 channels. Public funding has been foreseen to accomplish the target. On the other side,  
254 clauses 2 and 3 invite the ministries of Environment, Agriculture and Work (measure IT02)  
255 and Health (measure IT03) to divulgate data on food waste and promote awareness campaigns  
256 specifically addressed to promote the use of doggy bag at restaurant. No funding has been  
257 foreseen for such activities, at this stage. Finally, Ministries of Education, Environment,  
258 Health and Agriculture are invited to formulate awareness raising initiatives both for food  
259 waste and inequality in food access; the awareness raising initiatives are addressed to primary  
260 and secondary schools; however, no funding has been foreseen for such activities either. All

261 these measures have been therefore classified as suasive initiatives, to be implemented  
262 through public services.

263 In article 9, clause 4 (measure IT04), Regions are invited to stipulate agreements with  
264 packaging operators in order to provide restaurants with sustainable doggy bag (realized in  
265 recyclable material). Also, the article invites Municipalities to promote such a measure in  
266 their web-sites. Given the absence of obligations and the involvement of regional institutions  
267 for the implementation of the measure, it has been classified as SUA/PS as well. The measure  
268 is financed; specifically, packaging company associations have been invited to propose  
269 innovative solutions for doggy bag.

270 Article 9, clause 5 (IT05) foresees the development of an education programme for schools  
271 with reference to food sustainability, even included food waste. The programme should be  
272 developed by the four ministries of School and University, Health, Agriculture and  
273 Environment. The measure is not financed.

274 Measure IT06 concerns the invitation to the Ministry of Health to produce guidelines to  
275 reduce food waste and foster donations in public food services, especially school canteens.  
276 This is a suasive and public service measure, with no funding foreseen in the law.

277 Art 17 (measure IT07) allows Municipalities to establish tax exemptions for those subjects  
278 who donate food - the tax exemption is granted prior to certification of donated food and is  
279 proportional to the quantity donated. This measure does not foresee any obligation and  
280 therefore it is classified under the suasive approach. Although no direct financing for this  
281 measure is foreseen by the law, its implementation requires an indirect fiscal support,  
282 sustained by the Municipalities (in charge of setting up rules and collecting the waste tax) and  
283 affects retailers' business with a potential gain, due to the reduced waste tax; considering the  
284 mentioned reasons, the approach to this measure was classified as market-based.

285 The law also establishes a stakeholders' committee on food waste (article 8) that will meet  
286 under the coordination of the Ministry of Agriculture. Such committee has many functions.  
287 This committee actually inherits the functions of the working group that drew the National  
288 Plan for Waste. The functions are: proposing projects to be financed by the specific fund for  
289 food donation; proposing improvements for the normative system of food donation;  
290 monitoring of food waste and food donation; enhancing cooperation among actors that are  
291 dealing with food donation. The committee is composed of representatives of the government  
292 and the civil society. Governmental stakeholders are representative of the Ministries of:  
293 Agriculture, Work and Social Affairs, Economy, Environment (of which, one part of the  
294 National Plan for Waste Prevention committee) and Economic Development. Furthermore,  
295 the following stakeholders are foreseen: civil society representatives' part of retail  
296 associations, associations recorded as "recipient" from the AGEA granting (AGEA is the  
297 Italian governmental agency in charge of distribution of funding in Agriculture, even included  
298 Common Agricultural Policy funding), food transformation associations, catering and  
299 restaurant services, agricultural associations, autonomous regions and municipalities, National  
300 Association of Italian Municipalities (ANCI), major wholesale companies and agricultural  
301 cooperation. Representatives of the potential beneficiaries of campaigns against food waste -  
302 such as charities or consumers - are not included in the committee. The institution of this  
303 committee is classified as measure IT08, but it cannot be recognized as having neither a  
304 suasive nor a regulatory approach; rather, it represents an implementing measure (IP), i.e. it  
305 establishes how other measures have to be implemented. Activities implemented by the  
306 committee will be reported to the Parliament annually. No funding has been foreseen for such  
307 an activity either.

308 The first fund “Refinancing of fund foreseen by Article 58 paragraph 1, 22 June Decree 83 of  
 309 2012, refinanced 2 million euro for 2016” is not clearly addressed to a specific activity  
 310 (IT11).

311 The second fund is granted in order to improve food packaging and increasing the shelf life of  
 312 fresh products (“Funding of projects aimed at improving packaging and shelf-life of products,  
 313 1 million euros per year (2016, 2017, 2018”). The third fund is granted to foster initiatives  
 314 aimed at promoting the use of doggy bag (“Funding granted by art. 2 clause 323 law 24  
 315 December 2007 n.244 addressed to reduce waste will be incremented of 1 million euro per  
 316 year (2017 and 2018), in order to include initiatives to promote the use of doggy bag at  
 317 restaurants”). This fund is originally financed with 20 million euros per year (IT09 e IT10).

318 Clauses 1-7, article 16, define the exact procedures for the donation of food products at fiscal  
 319 and bureaucratic level. These measures are coded as IT12 and classified as implementing  
 320 provisions as well.

321 The final classification of the measures included in the Italian law against food waste is  
 322 reported in Table 1.

323

324 Table 1 - Table of measure of the Italian law against food waste<sup>3</sup>  
 325

Cod e	Article	Comma	Policy approach	Type of measure	Food waste pyramid	Actor in charge	Actor addressed	Funding
IT01	9	1	SUA	PS	Prevention	National Tv Channel	General public	Yes
IT02	9	2	SUA	PS	Prevention	Ministries of Env, Agr and Work	General public	No
IT03	9	3	SUA	PS	Prevention	Ministries of ENV, AGR and HEALTH	General public	No
IT04	9	4	SUA	PS	Prevention	Regional authorities and Municipalities, packaging producers	Restaurants	Yes

IT05	9	5	SUA	PS	Prevention	Ministries of	Primary and	No
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<sup>3</sup>IP is the acronym for Implementing Provisions; SUA refers to suasive measure; REG stands for regulatory; MB means Market Based.

						education, environment, health, agriculture	secondary schools	
IT06	10	1	SUA	PS	Re-use	Ministry of health	Canteens	No
IT07	17	1	SUA	MB	Re-use	Municipalities	Retailers, canteens	No
IT08	8	1-3	IP		Prevention	Ministry of agricultu re	Selected food- chain stakeholders	No
IT09	11	2	IP		Prevention	Ministry of Environment	-	Yes
IT10	12	1-2	IP		Prevention	Ministry of Environment	-	Yes
IT11	11	1	IP		-	Government	-	Yes
IT12	16	1-7	IP		Re-use	Retail sector	Recipients (NGO, charities)	No

*Source: authors' elaboration*

### 4.3 Trajectories of actions against food waste in the French law

The 4 articles included in the French law against food waste concern 9 measures to be implemented at different levels. Most of them concern the setting of a regulatory framework on food donations by retailers, while others concern awareness and education campaigns addressed to different recipients.

Namely, article 1 foresees the insertion of an additional sub-section in the Environmental Code. This sub-section starts with measure FR01, setting of a clear prioritization among interventions against food waste, recalling the food waste pyramid. This measure is addressed to all actors of the supply chain, which are recommended to follow the prevention - donation - reuse for animal feeding - composting and energy recovery hierarchy while taking actions against food waste. Since no obligation is foreseen, this is classified as a suasive measure, while public services are in charge of pushing food chain actors to follow such prioritization. Another article is added to the Environmental Code, specifically addressed to retailers. This is coded as measure FR02, where retailers are called to recover the value of the food they are not able to sell following the priority hierarchy set in measure FR01. The following measure

343 FR03 establishes that no contracts or agreements between retailers and their suppliers can



prevent the application of strategies against food waste. In the same article, measure FR04 establishes that all supermarkets larger than 400 m<sup>2</sup> have to sign an agreement with a charity where the donation of the edible food which remains unsold is foreseen. All these measures - FR02, FR03 and FR04 - include the setting of obligation and regulatory standards for retailers, so they are classified under a regulatory approach. As fines are foreseen for retailers which do not apply these provisions, these measures are subsequently classified as market based. Indeed, although no incentives are provided to retailers to foster the application of the measures, fines can harm their businesses.

The following measure FR05 describes the structure and timing of the agreements that supermarkets have to sign with charities to start donating the edible food, which remains unsold in their shelves. Such agreement has to be signed within one year from the approval of the law, or one year after their opening. Fines are foreseen for those who fail to fulfil this obligation. It is therefore clear that this measure has to be classified as a regulatory/market-based action as well as the previous ones.

More details about the structure and the content of the agreement between supermarkets and charities are included in a decree - approved few months after the French law against food waste - that has become part of the provisions settled by the law itself. In our study, such provisions are classified under measure FR06, which assumes again a regulatory approach to define how products intended for donation to charities can be identified and treated within supermarkets and within charities. The main indications to this regard concern: the timing of donation, which should be completed at least 2 days before the expiration date (with some exceptions); the exclusion of unpacked meat and unpacked animal products in general, for safety reasons; the responsibility of charities in accepting or not the products offered by

supermarkets; the traceability of donated food products through transport documents and related invoices; the safety issues to be fulfilled in the taking and transport of products.

Article 2 of the French law against food waste concerns the definition of the responsibility of retailers in the donation of food products. Indeed, by introducing a new article in the Civil Code, retailers are compared to producers when they donate own-brand products. This is classified as measure FR07, still with a regulatory approach.

The subsequent measure, classified as FR08, concerns the insertion of a new article in the French Education Code, where the inclusion of nutrition and food waste related information in school programs is foreseen. This is a suasive measure, since it aims to increase pupils' awareness on the issue of food waste. Public services - schools in this case - are the instruments foreseen by the law to apply this measure.

The fourth article of the law concerns the modification of one article in the Commercial Code, where actions against food waste are listed among the information that firms can provide in their social reporting, thus informing stakeholders on the way they address the social and environmental challenges arising from their commercial behaviour. This measure (coded as FR09) has a clear suasive approach, and is classified under the MB category, as social reporting can improve the image of businesses, thus potentially generating higher revenues on the market.

All the four articles of the French law do not explicitly foresee direct funding to implement the measures established. Moreover, it should be noted that few of them charge institutions to implement the measures, rather most of them are addressed to private actors of the food chain.

The final classification of the measures included in the French law against food waste is reported in Table 2.

Table 2 - Table of measure of the French law against food waste<sup>4</sup>

Cod e	Article	Insertion <sup>5</sup>	Policy approach	Type of measure	Food waste pyramid	Actor in charge	Actor addressed	Funding
FR01	1	Code Environnement 541-15-4	SUA	PS	Prevention	Ministry of Environment	Producers, food industry, retailers, consumers, charities	No
FR02	1	Code Environnement 541-15-5	REG	MB	Prevention	Retailers	Retailers	No
FR03	1	Code Environnement 541-15-5	REG	MB	Re-use	Retailers	Retailers, charities	No
FR04	1	Code Environnement 541-15-5	REG	MB	Re-use	Retailers	Retailers, charities	No
FR05	1	Code Environnement 541-15-6	REG	MB	Re-use	Retailers	Retailers, charities	No
FR06	1	Code Environnement 543-306/7	IP		Re-use	Retailers, charities	Retailers, charities	No
FR07	2	Code Civil 1386-6	IP		Re-use	Retailers	Retailers	No
FR08	3	Code Education 312-17-3	SUA	PS	Prevention	Ministry of Education, Schools	Pupils	No
FR09	4	Code Commerce 225-102-1	SUA	MB	Prevention	Businesses in general	Businesses in general	No

392

*Source: authors' elaboration*

393

394 **5. Results: trajectories of food waste scientific research**

395 The search of the terms related to the layers of the food waste hierarchy was positive for

396 1,752 documents dealing with the topic of food waste (60.2% of the total papers), showing at

397 least one of the selected terms in the abstract. Figure 4 shows the distribution of these

398 documents according to the occurrence in the abstract of terms related to one, two or more

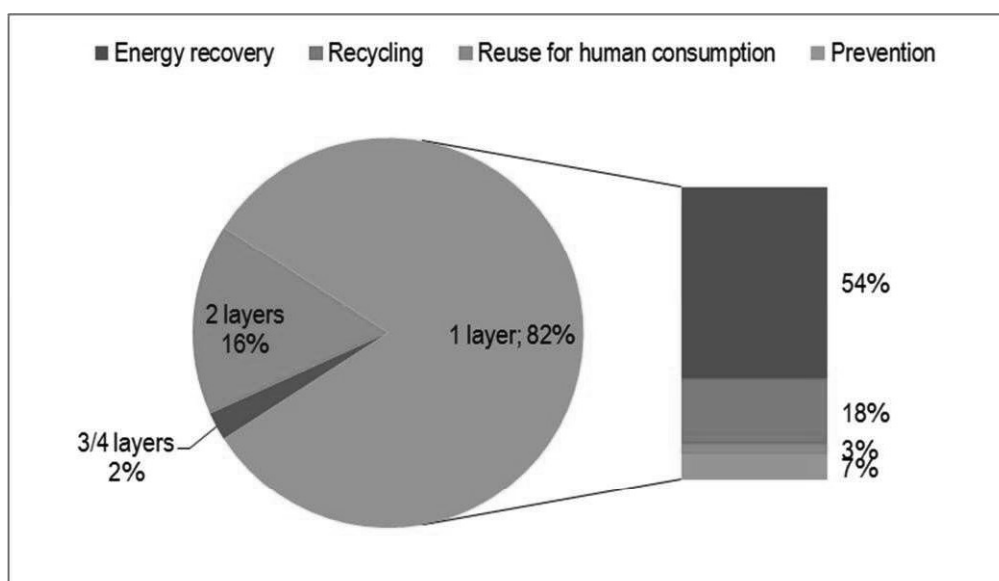
399 layers of the food waste pyramid.

400 Figure 4 - Occurrence of keywords related to the food waste hierarchy (N=1,752)

---

<sup>4</sup>IP is the acronym for Implementing Provisions; SUA refers to suasive measures; REG stands for regulatory; MB means Market Based.

<sup>5</sup>For each measure, the number of the article of the French law 2016-138 and the corresponding number of the new articles inserted in the concerned codes are reported.



*Source: authors' elaboration*

Most of the documents showed in the abstract terms related to only one layer of the pyramid, most often related to energy recovery and, to a lesser extent, to recycling.

Terms related to energy recovery were detected in nearly 70% of the documents, and this topic was by far the most common in the literature on food waste. The occurrence of terms related to food waste recycling and composting was also rather common, being found in 31.79% of the documents, while many less documents cited terms related to prevention and, especially, reuse of food waste for human consumption purposes (Table 3).

Table 3 - Number of journal articles with terms related to the food waste hierarchy (N=1,752)

Layer of the food waste hierarchy	Number of articles with related terms	% of articles with related terms (N=1,752)
Prevention	227	12,96%
Reuse for human consumption	108	6,16%
Recycling	557	31,79%
Energy recovery	1223	69,80%

*Source: authors' elaboration*

Table 4 shows the correlation matrix on the presence of the terms related to each layer of the food waste hierarchy. The presence in the abstract of terms related with energy recovery is negatively correlated with all the other variables, while the study of prevention strategies is positively correlated with the discussion on the possibility to reuse food waste for human consumption. The same is true, although to a lesser extent, for the correlation reuse-recycling.

Table 4- Correlation matrix of the occurrences (N=2,908)

Variables	Prevention	Reuse for human consumption	Recycling	Energy recovery
Prevention	1	0,051	0,005	-0,064
Reuse for human consumption	0,051	1	0,043	-0,009
Recycling	0,005	0,043	1	-0,052
Energy recovery	-0,064	-0,009	-0,052	1

*Source: authors' elaboration*

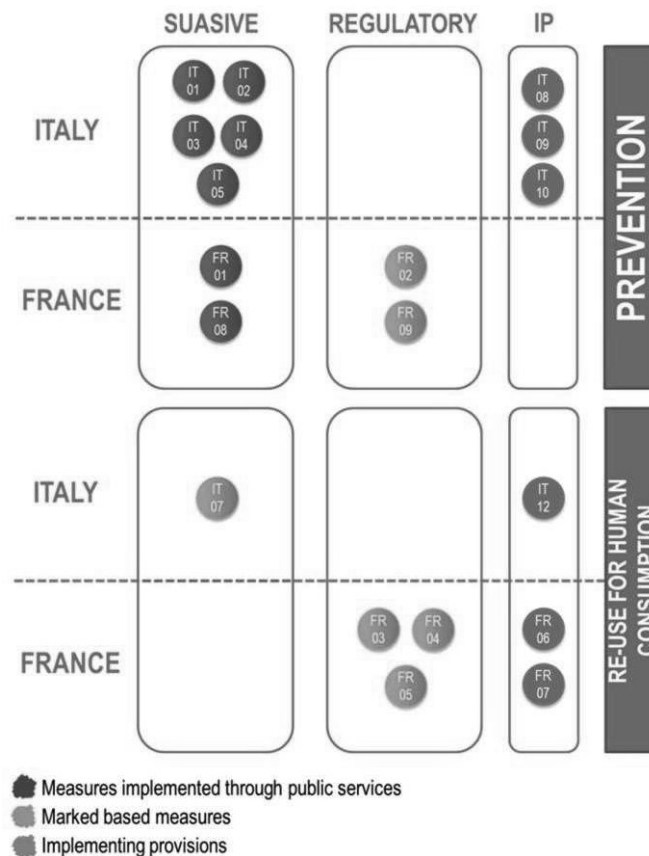
## 6. Discussion

### 6.1 Comparing the Italian and French laws

Solutions against food waste, as identified in the Italian and French laws, belong to the first two levels of the food waste pyramid - prevention and re-use for human consumption. No direct mention is made to other levels of intervention in the law, suggesting that solutions at different levels may compete with one another and can therefore be hardly addressed together in the same legal framework (Mourad, 2016).

The classification of the measures from the Italian and French laws against food waste was transferred in a graphical representation (Figure 5), with the aim to highlight the similarities and differences among the two.

Figure 5 - Graphical representation of the measures in the Italian and French law



*Source: authors' elaboration*

The Italian law's general provisions (Clauses 1, 2, 3, 4 of art. 3) clearly state the willing to follow the waste prevention pyramid proposed by the European Commission, just as the French regulation does in article 1. However, the two laws show many discrepancies in applying this framework. As pointed out by the synthesis in Figure 6, a huge difference concerns the policy approach adopted by the regulations: indeed, while the Italian law is mainly based on a suasive approach, the French one is much more focused on regulatory measures. It is also evident that the Italian law put more efforts in trying to enhance prevention by awareness raising campaigns, whilst the French law mostly call food chain actors - especially supermarkets - in taking action against food waste.

Another difference concerns funding to the measures settled in the two laws. In the Italian law, only few measures are supported with financial instruments. The many actions foreseen

448 on communication and awareness raising are not specifically financed, although they are  
449 supposed to be addressed to many actors, ranging from schools to general public. Only  
450 measure IT01 - awareness raising campaign broadcasted through TV and radio - has been  
451 specifically financed. Similarly, interventions aimed at increasing pupils' education are  
452 neither mandatory for school, nor financed. In the Italian law, improving the shelf-life of food  
453 products (measure IT04) seems to be at the top of priorities, being mentioned in more than  
454 one article and financed (300.000 out of 1.000.000 euros granted COMIECO, the consortium  
455 for recycling in Italy). In the French law, no specific funding is foreseen for measures against  
456 food waste; however, the regulatory measures included in the law provide market-based  
457 instruments - namely, fines to actors who do not fulfil the provisions stated by the law - to  
458 assure that the measures are correctly applied by the concerned actors.

459 Regarding food donations, many differences arise between the two laws. First, most of the  
460 effort of the French law is on donation by supermarkets, while actions aimed to prevention  
461 have much less importance. This appears to be in contrast with the priorities set by the  
462 European Commission - and by the French law itself - concerning the food waste prevention  
463 hierarchy, where avoiding the production of surplus food should be regarded as a primary  
464 objective, and donations should be used only in case this is not possible. Another essential  
465 difference is that food donation is mandatory in the French law, while only encouraged and  
466 supported in the Italian regulation. To this respect, it seems that in Italy much effort has been  
467 put on harmonizing and simplifying existing normative on food donation at retail's level, thus  
468 making donation easier and more feasible for businesses, whilst in France all the  
469 responsibility is charged to retailers, who are forced to set agreements with charities if they  
470 want to avoid fines. The Italian law also shows a potentially wider application, as the  
471 donation process is supported in different stages of the supply chain (restaurants) and includes



non-food products. The definition of the potential beneficiaries has been accurately detailed in the Italian law, thus limiting in the practice the number of people who can benefit from the donations process (Vaque, 2017).

Market based instruments have been found in several measures of the French law, while they are used to a lesser extent in the Italian regulation. The fines foreseen in the French law for retailers that do not fulfil the prescriptions about the setting of agreements with charities, as well as the publication of the names of these retailers so as consumers can get to know who fails to comply, are probably set with the aim of encouraging retailers to start donations (Vaque, 2017). Instead, in the Italian law, market based instruments are much weaker, and only concern the possibility for municipalities to propose reduction of the waste tax to supermarkets that donate food (measure IT07).

The results of the policy analysis suggest that neither the Italian nor the French laws tackle the issue of food waste with a “*strong prevention*” approach (Mourad, 2016: 469), i.e. no structural changes have been foreseen in the food system to avoid the generation of food waste but communication to consumers have been privileged. Rather, the Italian law provides examples of “*weak prevention*” initiatives, (Mourad, 2016: 468), but evidently both regulations focus their attention on recovery strategies to re-use food waste for human consumption. In both cases, most of interventions have not been foreseen in the manufacturing and distribution phases but at retail/consumption. This is consistent with the tendency of “blaming the consumer” (Evans, 2011) for the generation of food waste. Post-consumption actions may then be seen as the main tool to manage food waste, instead of targeting the production system as a whole to find where and how the generation of food waste can be avoided.

## 6.2 Comparing the trajectories of the research with the policy actions

The systematization of the scientific articles dealing with initiatives against food waste shows very clearly that the frequency of the topics analysed in the research does not reflect the priorities of the food waste hierarchy settled by the European directive. Indeed, most scientific research is focused on the energy recovery of food waste, which is the least desirable option before disposal (Papargyropoulou et al., 2014). The possibility to recover part of the energy of the food wasted at the end of the chain captures much more attention than other possible ways to prevent or reduce the generation of food waste (see Xiong et L., 2019). This result is consistent with Mourad (2016), who remarked that the relative importance of the fields of research tackled by the literature is the opposite with respect to the priorities set in the food waste hierarchy. However, it should be noted that energy recovery has been very often studied in relation to the management of municipal organic waste, i.e. at the last steps of the food chain (household consumption and private/public food service). Given that consumption is the phase of the food chain where most of the food waste is produced, this might show a good awareness of how this phase of the chain is crucial in the generation of food waste.

The policy analysis shows a great attention of regulations to re-use as a main way to reduce food waste. However, similarly to the tendency observed in scientific articles, this is not consistent with the priorities set by the food waste hierarchy. Moreover, especially in the French regulation, the focus of measures against food waste is on retail, disregarding the fact that this phase of the food chain is responsible for the generation of only about 5% of the total food waste (Stenmarck et al., 2016). An argument to explain the choice of this trajectory in the design of policies against food waste may be that donation, besides saving the environmental resources used to produce the food, is also an example of socially and

economically sustainable solution (Schneider, 2013b). On the contrary, it is also possible to speculate that privileging food donations, while not questioning the strong unbalance in the current food production system and its negative externalities (included food waste), lies under a sort of “philatroc capitalist” (Bishop and Green, 2009) approach that shifts a problem of unbalanced distribution of resources and waste production to a philanthropic solution. Indeed, donating food is somehow easier than taking measures against over-production/supply and it can have direct, positive implications for the society, intervening in the market failure that produces unequal food access. What should be further questioned is the role of national states in committing public resources to encourage private subjects in food waste donation and preventing them to pay for the externalities of their economic activities, as in the case of Italy. Indeed, it is important to point out that a consistent analysis of the impact of food donation to reduce food poverty is missing in the existing scientific literature. So far, the extent to which food donation alleviates food poverty is unknown, as well as how it may be effective (if donated food is always nutritious, for instance, or effectively consumed or just thrown away elsewhere). At a pure theoretical level, an analysis of such an approach in terms of food and environmental justice would be recommended. Borrowing the words of Arcuri (2019) and applying them to both the laws examined in this article “[...] *it is difficult not to agree with the principle that, in the face of excess food and hungry people, the right thing to be done is to give them that food rather than wasting it. This rationale appeals to the moral obligation of feeding the poor and translates into a deeply rooted ethic, shared by many churches and secular institutions (Bane et al. 2000). The strength of Gadda law lies in the capacity to refer to such principle, reconcile different positions and bring actors together around a short term objective*”.

However, the results of this study confirm that both research and policies are far from a full implementation of the food waste hierarchy, suggesting that the EU will struggle to meet the objective of reducing by 30% the quantity of food waste by 2025.

## **7. Conclusions**

After the recognition of food waste as a main environmental problem at the global level, in 2014 the EU set a clear objective against food waste and called countries to adopt regulations on this topic. The hierarchy provided by the waste regulation in force should guide actions and research in tackling the issue of food waste, therefore maximum priority should be given to prevention measures. Here, the trajectories of research and policies on this issue are analysed.

The two laws examined only partially reflect the priorities suggested by the hierarchy. The distance between the principles stated by the Directive, the intent of the two national laws and the types of regulated measures suggest that, in the transition from the general guidelines to the actions, the hierarchical structure of the priorities and the logic of the principles underlying the European legislation have partially been lost. Moreover, the focus on the distribution phase of the food chain (especially in the French regulation) is somewhat in contrast with the evidence that only a little part of the total food waste is produced at supermarkets, although its recoverability is higher than in any other step of the food chain.

The systematization of the literature showed that in the scientific debate there is a clear overturning of the priorities of the food waste hierarchy, with most of the research focused on energy recovery of municipal organic waste. This reflects the tendency of focusing on post-consumption actions to manage food waste, instead of targeting the whole production system to find where and how the generation of food waste can be avoided.

Results shall however be intended as a first attempt to study the path undertaken by national governments and research institutions. The present study did not consider all the measures included in the waste laws or other normative frameworks existing in the EU countries out of Italy and France- and the latest review of all policy actions undertaken in Europe is dated 2015, even before the two laws were adopted. Moreover, while underlying the weakness of a prevention approach in the two laws, the present article does not suggest possible prevention actions to be privileged instead of recovery measures. Further studies are recommended to show the prevention approach undertaken by other laws. Last, the attention of the present article was focused on European Union, yet other experiences of food waste prevention ruled by national laws exist and should be taken in consideration in future analyses. An implication of the present study should be the need to verify the impact, in terms of food poverty reduction and avoided waste, of food donation as well as of the communication campaigns. To pursue this stream of research, further studies are envisaged, tackling the assessment of the impact of policy measures against food waste on the actual quantity of food discarded at the different steps of the chain. This would be very useful to set informed policies in the many EU countries that still do not have taken action against food waste.

## **References**

- Arcuri, S. (2019) Food poverty, food waste and the consensus frame on charitable food redistribution in Italy. *Agriculture and Human Values*, Preprint. DOI: 10.1007/s10460-019-09918-1
- Beretta, C., Stoessel, F., Baier, U., & Hellweg, S. (2013). Quantifying food losses and the potential for reduction in Switzerland. *Waste management*, 33(3), 764-773.

590 Callan, S., & Thomas, J. (1997). The Impact of State and Local Policies on the Recycling  
 591 Effort. *Eastern Economic Journal*, 23(4), 411-423.

592 Cicatiello, C., Franco, S., Pancino, B., & Blasi, E. (2016). The value of food waste: An  
 593 exploratory study on retailing. *Journal of Retailing and Consumer Services*, 30, 96-104.

594 Cicatiello, C., Franco, S., Pancino, B., Blasi, E., & Falasconi, L. (2017). The dark side of  
 595 retail food waste: Evidences from in-store data. *Resources, Conservation and Recycling*, 125,  
 596 273-281.

597 Cicatiello, C., & Franco, S. (2020). Disclosure and assessment of unrecorded food waste at  
 598 retail stores. *Journal of Retailing and Consumer Services*, 52, 101932.

599 Directive 2008/98/EC of the European Parliament and of the Council of 19 November 2008  
 600 On Waste And Repealing Certain Directives, available at: [http://eur-lex.europa.eu/legal-](http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=celex:32008L0098)  
 601 [content/EN/TXT/?uri=celex:32008L0098](http://eur-lex.europa.eu/legal-content/EN/TXT/?uri=celex:32008L0098)

602 EC COM 2014 398, Communication from the Commission to the European Parliament, the  
 603 Council, the European economic and social Committee and the committee of the regions  
 604 “towards a circular economy: a zero waste program for Europe”. Available at:  
 605 <http://ec.europa.eu/transparency/regdoc/rep/1/2014/EN/1-2014-398-EN-F2-1.Pdf>

606 EC Delegated decision C (2019) 3211 Final and Annex. Supplementing Directive 2008/98/EC  
 607 of the European Parliament and of the Council as regards a common methodology and  
 608 minimum quality requirements for the uniform measurement of levels of food waste.  
 609 Available at: [http://ec.europa.eu/transparency/regdoc/rep/3/2019/EN/C-2019-3211-F1-EN-](http://ec.europa.eu/transparency/regdoc/rep/3/2019/EN/C-2019-3211-F1-EN-MAIN-PART-1.PDF)  
 610 [MAIN-PART-1.PDF](http://ec.europa.eu/transparency/regdoc/rep/3/2019/EN/C-2019-3211-F1-EN-MAIN-PART-1.PDF) Last accessed 27.06.2019

611 Eden, C.; Ackermann, F. (2013). Making Strategy: The Journey of Strategic Management.  
 612 SAGE. p. 123. ISBN 9781446265192.

613 Evans, D. (2011). Blaming the consumer—once again: the social and material contexts of  
 614 everyday food waste practices in some English households. *Critical Public Health*, 21(4), 429-  
 615 440.

616 Fiore, M., Contò, F., & Pellegrini, G. (2015). Reducing Food Losses: A (Dis)-Opportunity  
 617 Cost Model. *Rivista di Studi sulla Sostenibilità*, 1/2015.

618 FUSIONS (2016). Recommendations and guidelines for a common European food waste  
 619 policy framework. Report of the WP3, Task 3.4, Deliverable 3.5. DOI:  
 620 <http://dx.doi.org/10.18174/392296>

621 Giordano, C., Piras, S., Boschini, M., & Falasconi, L. (2018). Are questionnaires a reliable  
 622 method to measure food waste? A pilot study on Italian households. *British Food Journal*,  
 623 120(12), 2885-2897.

624 Giordano, C.; Alboni, F.; Falasconi, L. Quantities, Determinants, and Awareness of  
 625 Households' Food Waste in Italy: A Comparison between Diary and Questionnaires  
 626 Quantities. *Sustainability* **2019**, *11*, 3381

627 Godfray, H. C. J., Beddington, J. R., Crute, I. R., Haddad, L., Lawrence, D., Muir, J. F.,  
 628 Pretty, J., Robinson, S., Thomas, S.M., & Toulmin, C. (2010). Food security: the challenge of  
 629 feeding 9 billion people. *Science*, 327(5967), 812-818.

630 Gustavsson J., Cederberg, C., Sonesson, U., Van Otterdijk, R., & Meybeck, A. (2011). Global  
 631 food losses and food waste: extent, causes and prevention. Rome: FAO

632 Hall, K. D., Guo, J., Dore, M., & Chow, C. C. (2009). The progressive increase of food waste  
 633 in America and its environmental impact. *PloS one*, 4(11), e7940.

634 Liu C., Hotta Y., Santo A., Hengesbaugh M., Watabe A., Totoki Y., Allen D., Bengtsson M.,  
 635 (2016) Food waste in Japan: Trends, current practices and key challenges, *Journal of Cleaner*  
 636 *Production*, Volume 133, p 557-564, <https://doi.org/10.1016/j.jclepro.2016.06.026>

637 Marra F., (2013) Food Loss and Waste in Japan, Master thesis, available at:  
638 [https://www.academia.edu/8853973/Fighting\\_Food\\_Loss\\_and\\_Food\\_Waste\\_in\\_Japan](https://www.academia.edu/8853973/Fighting_Food_Loss_and_Food_Waste_in_Japan) last  
639 accessed on 27 June 2019

640 Michaels Ralfs, 'The Functional Method of Comparative Law', in: M. Reimann & R.  
641 Zimmerman (eds.), *Oxford Handbook of Comparative law* 2006.

642 Mourad, Marie (2015), Thinking Outside the Bin: Is there a better way to fight food waste?  
643 *Berkeley Journal of Sociology*, [http://berkeleyjournal.org/2015/11/thinking-outside-the-bin-is-](http://berkeleyjournal.org/2015/11/thinking-outside-the-bin-is-there-a-better-way-to-fight-food-waste/)  
644 [there-a-better-way-to-fight-food-waste/](http://berkeleyjournal.org/2015/11/thinking-outside-the-bin-is-there-a-better-way-to-fight-food-waste/), last access 30/01/2018

645 Mourad, Marie (2016), Recycling, recovering and preventing "food waste": competing  
646 solutions for food systems sustainability in the United States and France. *Journal of Cleaner*  
647 *Production*. <http://dx.doi.org/10.1016/j.jclepro.2016.03.084>

648 Papargyropoulou, E., Lozano, R., Steinberger, J. K., Wright, N., & bin Ujang, Z. (2014). The  
649 food waste hierarchy as a framework for the management of food surplus and food waste.  
650 *Journal of Cleaner Production*, 76, 106-115.

651 Quested, T., & Johnson, H. (2009). Household food and drink waste in the UK. *Wastes &*  
652 *Resources Action Programme (WRAP)*. Available at:  
653 [http://www.wrap.org.uk/sites/files/wrap/Household\\_food\\_and\\_drink\\_waste\\_in\\_the\\_UK\\_-](http://www.wrap.org.uk/sites/files/wrap/Household_food_and_drink_waste_in_the_UK_-_report.pdf)  
654 [\\_report.pdf](http://www.wrap.org.uk/sites/files/wrap/Household_food_and_drink_waste_in_the_UK_-_report.pdf)

655 Schneider, F. (2013a). The evolution of food donation with respect to waste prevention.  
656 *Waste Management*, 33(3), 755-763.

657 Schneider, F. (2013b). Review of food waste prevention on an international level. In  
658 *Proceedings of the Institution of Civil Engineers-Waste and Resource Management* (Vol. 166,  
659 No. 4, pp. 187-203). ICE Publishing.



660 Stenmarck, A., Jensen, C., Quested, T., Moates, G., 2016. Estimates of European Food Waste  
 661 Levels. Publication of the FUSIONS Project. European Commission (FP7). Coordination and  
 662 Support Action–CSA. Available at: [https://www.eu-](https://www.fusions.org/phocadownload/Publications/Estimates%20of%20European%20food%20waste%20levels.pdf)  
 663 [fusions.org/phocadownload/Publications/Estimates%20of%20European%20food%20waste%](https://www.fusions.org/phocadownload/Publications/Estimates%20of%20European%20food%20waste%20levels.pdf)  
 664 [20levels.pdf](https://www.fusions.org/phocadownload/Publications/Estimates%20of%20European%20food%20waste%20levels.pdf)  
 665 Thyberg, K. L., & Tonjes, D. J. (2016). Drivers of food waste and their implications for  
 666 sustainable policy development. *Resources, Conservation and Recycling*, 106, 110-123.  
 667 UN (2015), Sustainable Development Goals. Responsible Consumption and production. Target  
 668 12. <http://www.un.org/sustainabledevelopment/sustainable-consumption-production/>  
 669 Vaqué, L. G. (2017). La legislación francesa e italiana sobre el desperdicio alimentario:¿ Un  
 670 ejemplo a seguir por otros Estados miembros de la UE?. *Revista Aranzadi Unión Europea*,  
 671 31-49.  
 672 Vittuari et al. (2015) Review of EU legislation and policies with implications on food waste,  
 673 Final report, FUSIONS, 15 June 2015. Link: [https://www.eu-](https://www.fusions.org/index.php/publications/267-analysing-food-waste-policies-across-the-eu-28)  
 674 [fusions.org/index.php/publications/267-analysing-food-waste-policies-across-the-eu-28](https://www.fusions.org/index.php/publications/267-analysing-food-waste-policies-across-the-eu-28) last  
 675 [accessed 27.02.2019](https://www.fusions.org/index.php/publications/267-analysing-food-waste-policies-across-the-eu-28)  
 676 Xiong X., Yu I., Tsang D.C.W., Bolan N.S., Ok Y.S., Igalavithana A.D., Kirkham M.B., Kim  
 677 K., Vikrant K., Value-added chemicals from food supply chain wastes: State-of-the-art review  
 678 and future prospects, *Chemical Engineering Journal*, Volume 375, 2019, 121983,  
 679 <https://doi.org/10.1016/j.cej.2019.121983>

## Tables

*Table 1 - Table of measure of the Italian law against food waste<sup>1</sup>*

<b>Cod e</b>	<b>Article</b>	<b>Comma</b>	<b>Policy approach</b>	<b>Type of measure</b>	<b>Food waste pyramid</b>	<b>Actor in charge</b>	<b>Actor addressed</b>	<b>Funding</b>
IT01	9	1	SUA	PS	Prevention	National Tv Channel	General public	Yes
IT02	9	2	SUA	PS	Prevention	Ministries of Env, Agr and Work	General public	No
IT03	9	3	SUA	PS	Prevention	Ministries of ENV, AGR and HEALTH	General public	No
IT04	9	4	SUA	PS	Prevention	Regional authorities and Municipalities, packaging producers	Restaurants	Yes
IT05	9	5	SUA	PS	Prevention	Ministries of education, environment, health, agriculture	Primary and secondary schools	No
IT06	10	1	SUA	PS	Re-use	Ministry of health	Canteens	No
IT07	17	1	SUA	MB	Re-use	Municipalities	Retailers, canteens	No
IT08	8	1-3	IP		Prevention	Ministry of agriculture	Selected food-chain stakeholders	No
IT09	11	2	IP		Prevention	Ministry of Environment	-	Yes
IT10	12	1-2	IP		Prevention	Ministry of Environment	-	Yes
IT11	11	1	IP		-	Government	-	Yes
IT12	16	1-7	IP		Re-use	Retail sector	Recipients (NGO, charities)	No

*Source: authors' elaboration*

<sup>1</sup> IP is the acronym for Implementing Provisions; SUA refers to suasive measure; REG stands for regulatory; MB means Market Based.

*Table 2 - Table of measure of the French law against food waste<sup>2</sup>*

<b>Cod e</b>	<b>Article</b>	<b>Insertion<sup>3</sup></b>	<b>Policy approach</b>	<b>Type of measure</b>	<b>Food waste pyramid</b>	<b>Actor in charge</b>	<b>Actor addressed</b>	<b>Funding</b>
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FR02	1	Code Environnement 541-15-5	REG	MB	Prevention	Retailers	Retailers	No
FR03	1	Code Environnement 541-15-5	REG	MB	Re-use	Retailers	Retailers, charities	No
FR04	1	Code Environnement 541-15-5	REG	MB	Re-use	Retailers	Retailers, charities	No
FR05	1	Code Environnement 541-15-6	REG	MB	Re-use	Retailers	Retailers, charities	No
FR06	1	Code Environnement 543-306/7	IP		Re-use	Retailers, charities	Retailers, charities	No
FR07	2	Code Civil 1386-6	IP		Re-use	Retailers	Retailers	No
FR08	3	Code Education 312-17-3	SUA	PS	Prevention	Ministry of Education, Schools	Pupils	No
FR09	4	Code Commerce 225-102-1	SUA	MB	Prevention	Businesses in general	Businesses in general	No

*Source: authors' elaboration*

<sup>2</sup> IP is the acronym for Implementing Provisions; SUA refers to suasive measures; REG stands for regulatory; MB means Market Based.

<sup>3</sup> For each measure, the number of the article of the French law 2016-138 and the corresponding number of the new

articles inserted in the concerned codes are reported.

Table 3 - Number of journal articles with terms related to the food waste hierarchy (N=1,752)

Layer of the food waste hierarchy	Number of articles with related terms	% of articles with related terms (N=1,752)
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Recycling	557	31,79%
Energy recovery	1223	69,80%

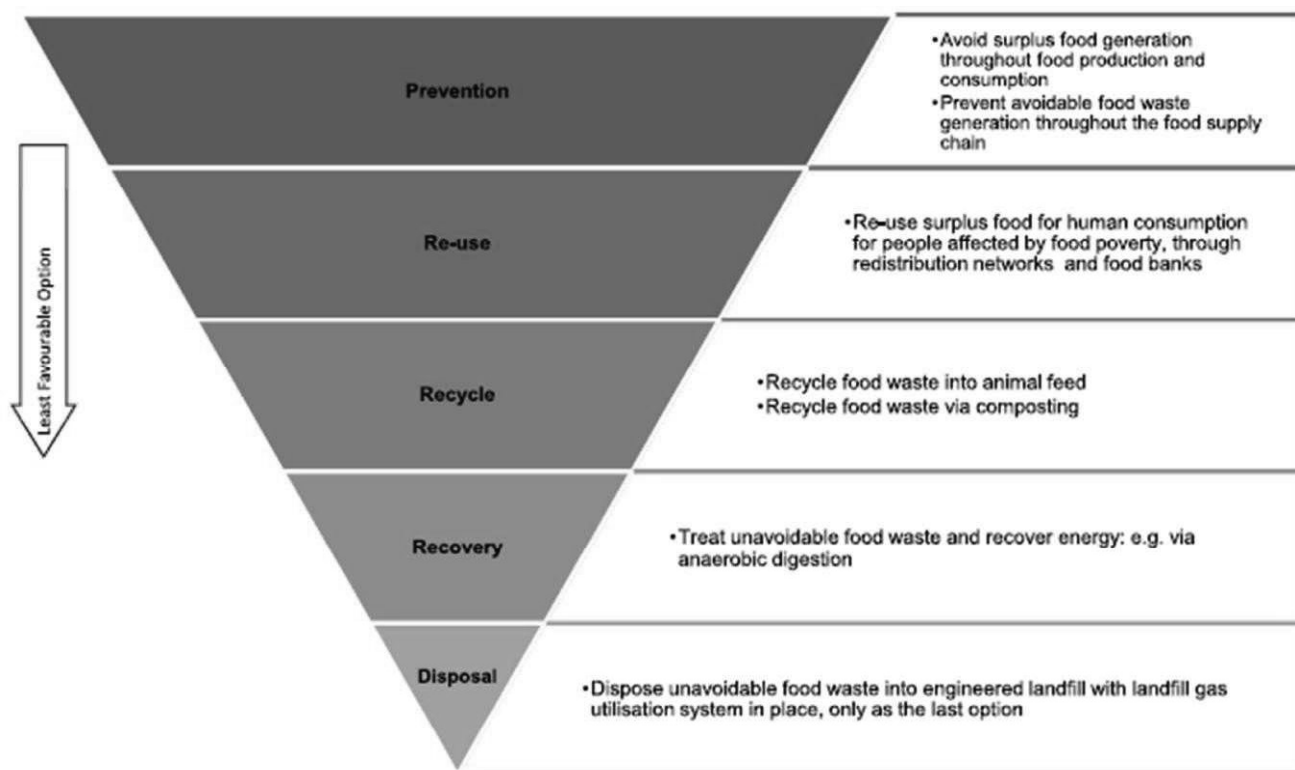
*Source: authors' elaboration*

consumption				
Prevention	<b>1</b>	<b>0,051</b>	0,005	<b>-0,064</b>
Reuse for human	<b>0,051</b>	<b>1</b>	<b>0,043</b>	-0,009
Recycling	0,005	<b>0,043</b>	<b>1</b>	<b>-0,052</b>
Energy recovery	<b>-0,064</b>	-0,009	<b>-0,052</b>	<b>1</b>

*Source: authors' elaboration*

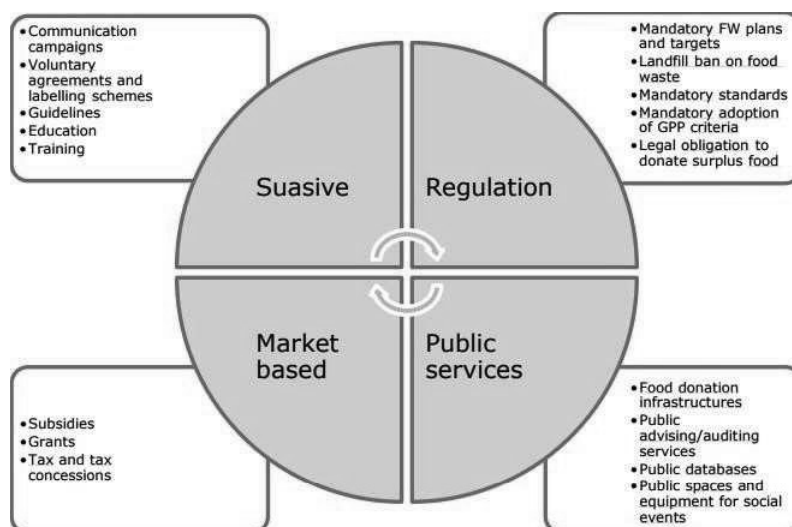
## Figures

Figure 1 - Food waste prevention pyramid



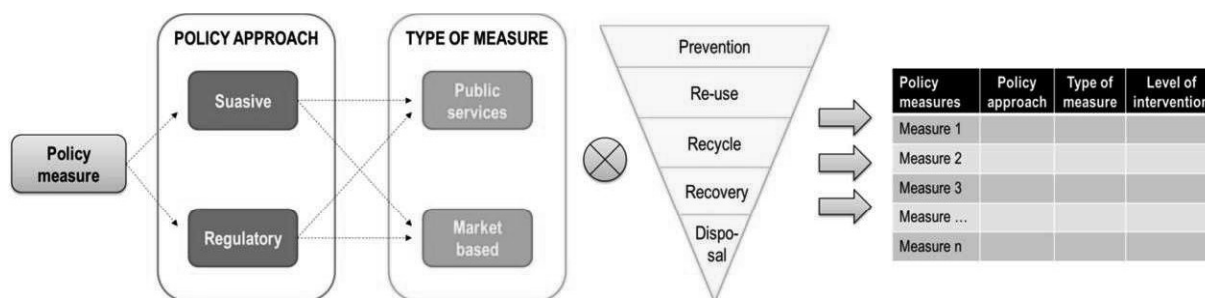
Source: Papargyropoulou et al., 2014, adapted from European Parliament Council 2008

Figure 2- FUSIONS' classification approach for the policy measures.



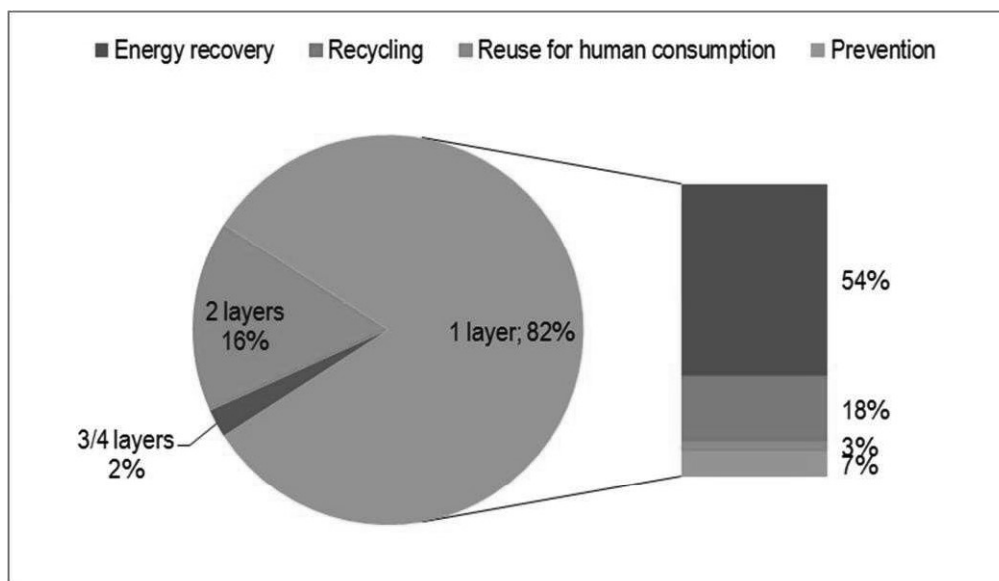
Source: FUSIONS, 2016, p.22

Figure 3- Classification framework adopted for policy measures' analysis.



Source: authors' elaboration

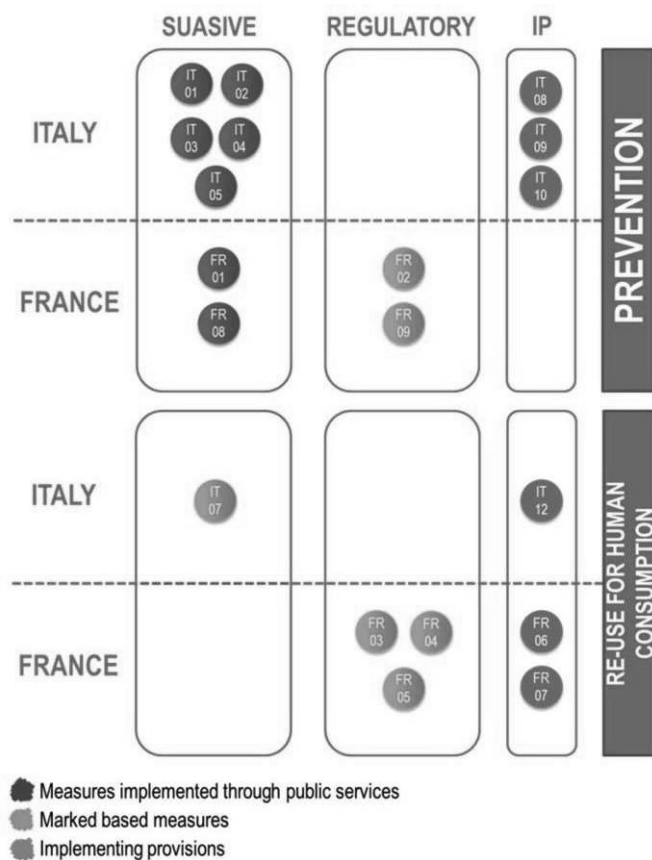
Figure 4 - Occurrence of keywords related to the food waste hierarchy (N=1,752)



Source: authors' elaboration



Figure 5 - Graphical representation of the measures in the Italian and French law



Source: authors' elaboration

## Highlights

Priorities expressed by the food waste hierarchy are only partially addressed

The French law adopts a regulatory approach while the Italian law is primarily suasive

The Italian and French laws against food waste mostly target food donation

The prevention is mainly practiced through the awareness raising campaign

Academic research focus attention on energy recovery and household's stage

**Declaration of interests**

☒ The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

☐ The authors declare the following financial interests/personal relationships which may be considered as potential competing interests: