Chapter 15
Grassroots Innovations and the Transition Towards Sustainability: Tackling the Food Waste Challenge

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Abstract The need for innovative approaches to tackle food waste problem is widely recognized, given its tight links with agriculture, food security, trade, energy, deforestation, and climate change challenges. As a matter of fact, an emerging branch of literature is drawing attention to the value of food waste, reporting both technological aspects of food waste valorisation (by means of case studies and/or pilot-scale laboratory experiences), and how such innovative pathways may contribute to the transition towards sustainable production and consumption systems and a more sustainable waste regime. However, little research efforts have been invested so far in relation to the development and diffusion of innovative approaches addressing the food waste problem and the role of grassroots innovations. Thus, our chapter aims at contributing to this strand of literature, by addressing two main issues:

- how do grassroots movements act and how effective are they in catalysing innovation in the food waste field?
- what are the specific roles that grassroots innovations may play in the transition towards sustainable production and consumption systems and a more sustainable waste regime?

Our investigation draws on the analysis of several case studies of grassroots innovations from European countries, and builds on the multi-level perspective (MLP) approach.

The specific findings of our study could support decision makers in developing tailored strategies to minimize the amount of food wasted along the supply chain and to unlock the enormous potential of food waste that is being landfilled, and also to instil some further investigations related to this strand of food waste literature.

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P. Morone et al. (eds.), *Food Waste Reduction and Valorisation*,
DOI 10.1007/978-3-319-50088-1_15

Keywords Food waste · Grassroots innovations · Transition towards sustainability · MLP

15.1 Introduction

Food waste is an environmental, socio-economic, and ethical problem that connects with the most critical societal challenges: food security, poverty, energy, deforestation, and climate change. The need to find a sustainable and economically viable way of managing food waste is a main driver behind many recent waste valorisation practices around the world (Ki Lin et al. 2013). Furthermore, there is a general consensus that food waste constitutes a largely underexploited reservoir from which a variety of valuable resources—from chemicals to energy—can be derived (Clark and Luque 2013). As a matter of fact, an emerging branch of literature is drawing attention to the value of food waste, reporting both technological aspects of food waste valorisation (by means of case studies and/or pilot-scale laboratory experiences), and how such innovative pathways may contribute to the transition towards sustainable production and consumption systems and a more sustainable waste regime.

The exact causes of food waste are very much dependent on the specific conditions and local context in a given country (Gustavsson et al. 2011: 1); for instance, 40% of food losses in developing countries occur at the farmer-producer stage of the supply chain, mainly due to an inefficient harvesting, an inadequate local transportation and poor infrastructures, while in developed countries, over 40% of food is wasted at the consumers' level, due to 'a culture which places little value on food, making it "easier" to throw it away and buy more from the overstocked supermarkets' (IIED 2013).

In view of this, grassroots innovations emerge as a suitable option to address the food waste problem, as they may provide answers which are different from mainstream innovations (Monaghan 2009), focusing on the local context, the associated interests and the values of the communities involved (Seyfang and Smith 2007; De Keersmaecker et al. 2012), and seeking 'innovation processes that are socially inclusive towards local communities in terms of the knowledge, processes and outcomes involved' (Smith et al. 2014; cited in Pansera and Sarkar 2016: 2). Furthermore, it is widely acknowledged that grassroots innovations can act as incubators of the social change that is needed to respond to the current societal challenges and the transition towards sustainability (see among others, Feola and Nunes 2014; Smith et al. 2014, 2015; Seyfang and Smith 2007).

However, little research efforts have been devoted so far in relation to the development and diffusion of innovative approaches to address the food waste problem and the role of grassroots innovations. In this respect, we can recall the focus on:

- How recent mobilizations impact the way surplus food is actually managed with respect to sustainable production and consumption (Mourad 2016)
- Potential of food redistribution, in terms of: market opportunities for surplus food (O' Donell et al. 2015), sustainability of retail food recovery (Phillips et al. 2013; Cicatiello et al. 2016), economic and environmental assessment of food rescue operations (Reynolds et al. 2015), the evolution of food donation with respect to waste prevention (Schneider 2013; Priefer et al. 2016)
- The diffusion across space of solidarity purchasing groups (Feola and Butt 2015)
- The mobilisation of values in collaborative consumption (Martin and Upham 2015)
- Grassroots innovations and the sharing economy (see among others Martin et al. 2015; Avelino et al. 2015)
- Civil society roles in transition towards sustainable food (Durrant 2012)
- Dynamics of networks of social economy and civil society actors (Vergragt et al. 2014).

This chapter adds to the existing literature on grassroots innovations and food waste, by addressing two main research questions:

– How do grassroots movements act and how effective are they in catalysing innovation in the food waste system?
– What are the specific roles played by grassroots innovations in the transition towards sustainable production and consumption systems and a more sustainable waste regime?

Our investigation draws on the analysis of several case studies of grassroots innovations from European countries, and builds on the multi-level perspective (MLP) approach. Accordingly, our chapter is structured as follows. In Sect. 15.2, the food waste challenge is depicted using the lenses of the multi-level perspective (MLP) approach. In Sect. 15.3, the multiple forms that grassroots innovation embrace in respect to food waste are introduced, and their effectiveness is assessed. In Sect. 15.4 the many roles that grassroots innovations may play in the transition towards a more sustainable waste regime are discussed. Finally the concluding remarks are highlighted in Sect. 15.5.

15.2 Food Waste and the Transition Towards a Sustainable Waste Regime

It is widely acknowledged that food waste is a dynamic category that needs to be understood in relation to multiple domains (social, economic, environmental), which acts at various levels (local and global contexts) and bears a high degree of complexity in its semantics (i.e. meanings attributed to it) (Evans et al. 2013). In this section, we aim at contributing to this endeavour by using the lenses of the

multi-level perspective (MLP) approach and thereby enhancing the understanding about the 'food waste momentum'—that unveiled 'the consequences of a long trajectory of economic expansion, unsustainable resource use and/or "out of control consumerism", and that also holds "the promise of a game-changing", reorientation of our practices, institutions, and policies of resource management' (Evans et al. 2013: 11).

This attempt is divided into two steps. First, we provide a brief overview on the historical phases of food waste dynamics; subsequently, we put the 'food waste momentum' into the multi-level perspective framework.

15.2.1 Food Waste Dynamics—Historical Phases

The food waste dynamics has varied significantly throughout the centuries. According to Evans et al. (2013), we may distinguish between three different historical phases, namely:

(i) *The relative visibility of food waste*—specific for the mid-nineteenth to mid-twentieth century
(ii) *The ubiquitous invisibility*—associated with the post-World War II decades
(iii) *The heightened visibility*—specific for the contemporary period.

A brief summary of these phases is presented in Fig. 15.1.[1] As emphasized in Fig. 15.1, the societal interest on food waste, especially in terms of value of preventing food waste, that characterized the mid-nineteenth and the first half of the twentieth century is replaced by an ubiquitous invisibility of food waste in the decades following the World War II, as a result of the transition towards a new food regime—triggered by a shift in production practices and technologies, farming approaches, food policies[2] and global trading. The all-pervading invisibility is overthrown (starting with mid 2000s) by complex dynamics, such as: the financial crisis, the global food crisis, energy security challenge, corporate land-grabbing phenomenon, deforestation, climate change challenges, etc.—that have brought back the food waste both on the agenda of food policy, and on the social and environmental debates, transforming it into a compelling, critical issue (heightened visibility phase).

The latter dynamics and the 'food waste momentum' are discussed in more details in the next subsection.

[1]For a comprehensive overview, please see Evans et al. (2013).

[2]For instance, food security has been formally turned into a policy matter, that legitimized massive investments into agricultural and food production technologies, and hence, food became abundant and also very cheap.

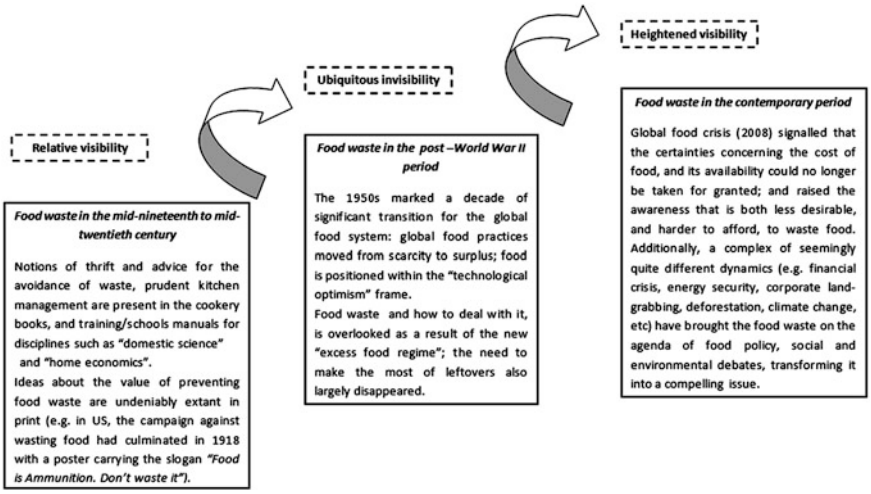

Fig. 15.1 Food waste dynamics—historical phases (after Evans et al. 2013)

15.2.2 Food Waste in the Multi-level Perspective Framework

This subsection aims at laying the ground for *food waste—grassroots innovations* nexus, by enhancing the understanding about the shift towards the heightened visibility phase and furthermore towards sustainable production and consumption systems and a more sustainable waste regime. Thus, we use the lenses of the multi-level perspective approach (MLP), as MLP enables the analysis of complex and non-linear phenomena such as historical and structural changes, including technological transitions, using a multidisciplinary and multidimensional perspective. Therefore, MLP is not just about economics or competing technologies; it involves many other areas of investigation placing the transition process in a well-defined societal space and historical context.

As our investigation is entrenched in a well-established theoretical setting (i.e. sustainability transition; see for instance, Geels and Schot 2007; Markard et al. 2012), before putting the 'food waste momentum' into the multi-level perspective (MLP) framework, we provide next, a very brief overview on MLP.

15.2.2.1 MLP—A Snapshot

The MLP is a heuristic framework, which covers three levels of analysis: the landscape (macro-level), the socio-technical regime (meso-level) and the niche (micro-level). Technological transitions can be explained through the interaction among these three levels as the transition basically entails a shift from an incumbent

socio-technical regime to a new one, which is nurtured in the technological niche and prompted at the landscape level. Landscape and niches are derived concepts 'because they are defined in relation to the regime, namely as practices or technologies that deviate substantially from the existing regime, and as external environment that influences interactions between niche(s) and regime' (Geels 2011: 26–27).

In this model, transition occurs whenever a pressure at landscape level destabilizes the regime, thus creating a window of opportunity for pioneering niche-innovations to enter in the mainstream market. In the food waste context the niches innovations could take various forms stretching from the development of new technologies (e.g. smart packaging) to behavioural changes (e.g. new consumption models). This reflects the multivariate nature of the phenomenon under scrutiny, which involves changes occurring at various levels (social, economical, environmental, contextual) all concurring to complete the transition. However, when considering grassroots movements all niches innovations have in common that 'change must spring from below, outside the existing institutions. Social movements should develop alternative structures (cooperatives, communes, ecovillages) and hope that the majority will be influenced by the power of the example' (Geels 2011: 33).

In this framework, niches are the locus of innovation. A niche is like an incubation room in which new and emerging technologies can have a space, which protects them from competition and pressures of the selective process taking place in mainstream markets. Usually rules and procedures in the niches are flexible and not formalized in order to facilitate the emergence of innovation. At the same time, the niches space is highly unstable and characterized by the co-existence of several (and often alternative) niches, which usually lack coordination between them and are in competition among each other. However, not every niche can survive for a long time and only few of them will get to a point where they will really challenge the incumbent sociotechnical regime. A niche should be sufficiently developed and mature in order for this to happen.

As introduced in Sect. 15.2.1, the shift from the ubiquitous invisibility phase to the heightened visibility phase, has been triggered by different and complex dynamics. Following the MLP framework, (depicted above) we can roughly group these complex dynamics, into (see Fig. 15.2[3]):

(i) Events affecting the socio-technical landscape
(ii) Events affecting the socio-technical regime
(iii) Events (movements) influencing the niches—innovations.

In the first category, we can mention, for instance, the *global food crisis* (2008), which signalled that the certainties concerning the cost of food, and its availability could no longer be taken for granted. This, in turn, raised the awareness on waste of food being both less desirable and harder to afford. As a matter of fact, 'since 2008,

[3]Figure 15.2 should be taken as an academic exercise, aimed at illustrating the diversity of events (exerting pressure at different levels), influencing the transition towards a more sustainable food waste regime; a far more systematic content analysis is needed to depict thoroughly, in more details this transition.

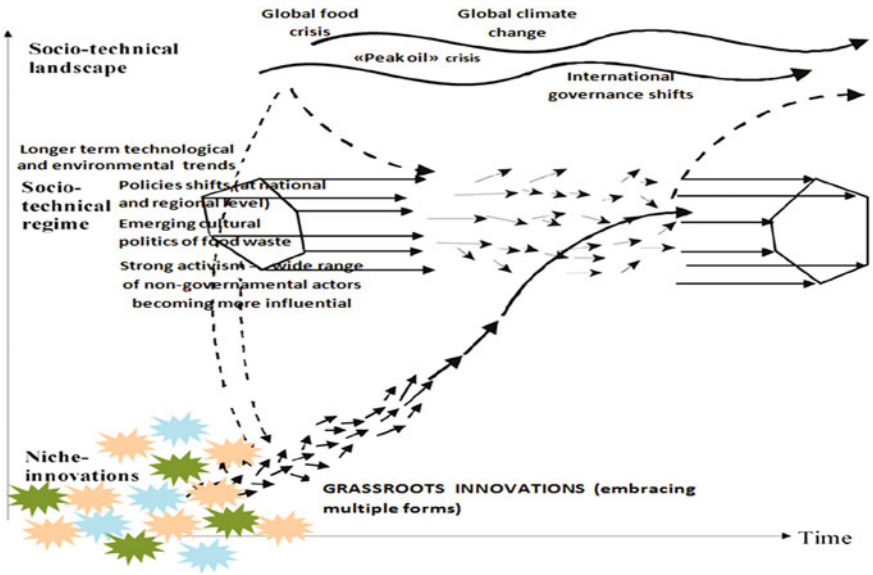

Fig. 15.2 Transition towards a sustainable waste regime. A multi-level perspective (adapted from Geels 2002)

food prices have begun to increase cyclically, and have created an environment where the relative cost of food has become a matter of consumer and public concern' (Evans et al. 2013: 16). Another event affecting the *socio*-technical landscape level is the *global climate change* associated with the level of carbon dioxide (CO_2) released into the Earth's atmosphere. The sharp increase occurred since the beginning of the industrial era,[4] lead (among other things) to severe changes in the world's weather patterns (heat-waves, cyclones, extreme floods, droughts) threatening in this way the food supply chains. However, to date, around a third of all food produced for human consumption is lost or wasted; these food losses and wastes account for about 4.4 gigatonnes of greenhouse gas emissions per year, generating more than four times as much annual greenhouse gas emissions as aviation, and being comparable to total emissions from road transports. As observed by the World Resource Institute, 'to put this in perspective, if food loss and waste were its own country, it would be the world's third-largest emitter—surpassed only by China and the United States' (Hanson et al. 2015).

As for the second group of events, we can recall the various *policies shifts* occurred both at national and regional levels. First and foremost, the EU waste policy set two ambitious targets: reducing biodegradable waste[5] to 35% of 1995 levels by 2016 (or by 2020 for some countries); halving current volumes of food

[4]Carbon dioxide levels are now approximately 40% higher than they were at the start of the Industrial Revolution.

[5]Category under which falls also food waste.

waste by 2025. Indeed, these kinds of targets exert a huge pressure on incumbent industries. Along policy shifts also the *strong activism of a wide range of non-governmental actors* should be mentioned. As these actors become more influential, we can recall two significant contributions, namely: the 2009 landmark tour of Tristram Stuart, promoting the book—*Waste: Uncovering the Global Food Scandal*; soon after followed by the first *Feeding the 5000* event in London's Trafalgar Square (in December 2009). With the extensive media outreach and public support, his endeavour had an immediate impact on government and business policy, promoting the activities and messages of partner organisations, including FareShare, This is Rubbish, ActionAid and Save the Children. Since 2009 Tristram and his team (Feedback NGO) played a central role in catalysing the food waste movement around the world, reshaping the world agenda around food waste.[6] A similar action was launched in the USA in 2011, by Jonathan Bloom, who wrote *American Wasteland: Why America Throws Away Nearly Half Its Food (and What We Can Do About it)*. Bloom gathered statistics and highlighted the extent of the food waste problem in a crowd-pleasing and accessible way, triggering the development of several initiatives across US. Since then similar initiatives have been promoted by non-governmental actors at national level worldwide.

Finally, for the third category, we can distinguish between multiple forms of grassroots innovations tackling food waste problem. In the following section we will investigate, by means of comparative case studies, how grassroots innovations evolved in the context of food waste.

15.3 Grassroots Innovations (GRI) Tackling the Food Waste Challenge

Before exploring how grassroots innovations are addressing the food waste challenge, we shall first provide a general overview of this concept as it emerged in the literature.

Hence, in the '70s 'the analysis of grassroots initiatives and social movements has traditionally been centred around political activism and the mobilization of a group of individuals that share personal grievances and deprivation' (McCarthy and Zald 1977 cited in Grabs et al. 2015: 3). Since then the concept has evolved in the academic discourses, and has been associated with various frames, such as: cultural theories (e.g. Bordieu 1984), social capital (e.g. Putnam 1995), open source innovation (e.g. Raymond 1997), collective active frames (e.g. Benford and Snow 2000), new social movement theories (e.g. Touraine 2002), autonomous geographies (e.g. Pickerill and Chatterton 2006), environmental movement (e.g. Curry 2011), social innovation (Howaldt et al. 2013), governance and participation (e.g. Stirling 2011), etc.

[6] http://feedbackglobal.org/about-us/.

To date, the most diffused definition in the emerging literature on grassroots innovations for sustainability, belongs to Seyfang and Smith (2007), that used the lenses of New Economics and Socio-Technical Transitions, and defined the concept of 'grassroots innovations' as 'networks of activists and organizations generating novel bottom-up solutions for sustainable development; solutions that respond to the local situation and the interests and values of the communities involved. In contrast to mainstream business greening, grassroots initiatives operate in civil society arenas and involve committed activists experimenting with social innovations as well as using greener technologies' (Seyfang and Smith 2007: 585).

For the purpose of this chapter, we adopt the broader definition of Smith et al. (2014) which includes in grassroots innovations also 'people and organisations coming from outside local communities, such as engineers and designers, but who engage the grassroots in innovation processes, in their ideas from the outset, and put local knowledge and communities in the lead in the framing of a collaborative innovation activity' (Smith et al. 2014: 114).

In order to address our two research questions—(1) how do grassroots movements act and how effective they are in catalysing innovation in the food waste system?; and (2) what are the specific roles played by grassroots innovations in the transition towards a sustainable food waste regime?—we performed a meticulous analysis of several case studies of grassroots innovations addressing the food waste problem in different European countries.

From this analysis emerged the fact that, when it comes to food waste, grassroots innovations embrace multiple forms, which can be roughly grouped into three categories,[7] namely:

(i) Prevention
(ii) Reduction and Reuse
(iii) Valorisation.

As mapping and discussing all the existing grassroots worldwide is beyond the purpose of our study, we briefly depict next, for each category, some of the most renowned ones–as they are empirically well documented.

15.3.1 GRI—Prevention

Grassroots initiatives belonging to this category are aiming at preventing and raising awareness about food waste, by promoting behavioural changes.

[7]In making this distinction, we followed the European Waste hierarchy, and we considered the primary goal of the grassroots. However, many of the grassroots innovations are tackling more than one aspect, and all of them directly or indirectly and in different extents, contribute to awareness raising; therefore this classification should be taken as an academic exercise, aimed at illustrating the diversity of grassroots innovations in respect to food waste.

Feeding the 5000 is one of the *Feedback*'s[8] flagship events aimed at raising awareness on the global food waste problem, and at catalysing the global movement against food waste. At each event, dishes prepared out of food that would have been wasted are served for 5000 people. Furthermore, as part of this event, local communities are encouraged to become involved (either by volunteering or attending in support), while the public is also invited to sign up to the Food Waste Pledge, committing themselves to reduce the amount of food waste they produce and to ask businesses and governments to do the same. The first Feeding the 5000 event has been held in London in 2009, and since then similar events have been organized worldwide (Paris, Sydney, Brussels, Amsterdam, Dublin, etc.).

Disco Soup, is an international grassroots movement that sets off action on food waste, works to 'fill bellies not bins' and to raise awareness about the unconceivable quantity of food that is wasted around the world, by empowering the public to recognize positive solutions to this global challenge. The first Disco Soup event was organized in Germany in 2012 (*Schnippel Disko*) by the Slow Food Youth Network and gathered 300 volunteers that came together to wash, peel, chop and cook fresh but unwanted fruits and vegetables that would otherwise have been discarded, on the music of two DJ's. This event was followed by a larger-scale Disco Soup event, staged in Paris in October 2012. In a span of few months this anti-food waste initiative spread to more than 14 cities in France. Since then, similar events have been held across the globe: Belgium, Colombia, Canada, US, South Korea, Holland, etc.

Wastecooking[9] is a movement aimed at protesting against food waste and serving up a critical stance on consumerism. It was initiated in 2012 (as an art project) by David Groß, an Austrian trained chef, filmmaker and activist, but soon after became a movement, which regularly organizes cook-ins and performances in public spaces, such as: film, music and art festivals and museums. As part of this movement, David Groß organized a Wastecooking tour in 5 European countries (Austria, Belgium, France, Germany and Netherlands) in which only cooked up what others threw out. Along the way, he received support from other activist groups, chefs and scientists. The tour was captured on a film as a five-part television series and an evening-filling documentary film.

Gleaning Network is a grassroots movement initiated in 2012 in UK[10] by Feedback, that became international, involving gleaning activities in countries such as France, Belgium, Greece and Spain. Foremost, this initiative, aims at raising

[8]Is an environmental organisation that campaigns to end food waste at every level of the food system. To date governs 5 movements: Feeding the 5000, Gleaning Network, The Pig Idea, Stop Dumping and the FSE Network. For a comprehensive overview, see http://feedbackglobal.org/.

[9]http://www.wastecooking.com/en/#home.

[10]From its start in 2012 to the end of 2015, the Gleaning Network UK gleaned over 188 t of produce (apples, pears, plums, strawberries, cauliflower, cabbages, lettuces, pumpkins and parsnips), equal to over 2 million portions of fruits and vegetables, with over 1000 volunteers across 99 gleaning days. http://feedbackglobal.org/campaigns/gleaning-network/.

awareness about the causes of food waste that occurs at the farm level, and argues for the change of retailers' policies and consumers' perceptions in respect to this type of food waste, by providing practical and implementable solutions to the problems encountered at this stage of the supply chain. Specifically, Gleaning Network coordinates volunteers, farmers and food redistribution charities to save thousands of tonnes of fresh fruit and vegetables that are wasted on farms every year, in order to direct this fresh, nutritious food to people in need.

15.3.2 GRI—Reduction and Reuse

Grassroots innovations belonging to the second category are aiming at reducing the amount of wasted food and at changing the incumbent processes across different stages of the value chain.

Anti-Gaspi (Stop Food Waste) is a grassroots movement initiated by Arash Derambarsh, a local councillor of Courbevoie (France). In December 2014, Derambarsh, joined by volunteers and friends, run a 'field experiment'—an anti-poverty and anti-food waste campaign—in Courbevoie, by recovering unsold supermarket food and distributing it to needy people, including the homeless. This 'field experiment' led to a petition—on Change.org—calling for action against food waste and change of the food retailers policies. The petition sparked the concern of many French citizens, with over 210,000 people signing it and several French celebrities endorsing the cause. Arash's tireless efforts to integrate social action, public and political mood have made its grassroots initiative, swift and effective, contributing substantially to the 'momentum creation' for the adoption of the first anti-food waste law in France. Adopted on first reading at the National Assembly on 9 December 2015 and the first reading in the Senate on February 3, 2016, in each case unanimously, the French law sets a four-step hierarchy to be implemented to limit the loss of food, that prioritizes prevention of food waste, followed by donation or reprocessing of unsold food for human consumption, recovery for animal feed and, finally, use as compost in agriculture or energy recovery, such as biomethane. It requires food retail businesses whose sales area exceeding 400 m^2 to sign a grant agreement with one or more associations of food aid. The law also prohibits any contractual provision that constitutes an obstacle to the gift of food sold under private label, and includes the fight against food waste in the school curriculum and in social and environmental responsibility, feeding into France's plan to reduce food waste by 50% by 2025. All the food retail businesses have to comply with the law by July 2016 in order to avoid penalties, which include both fines and up to two years in jail (Ministère de l'Environnement, de l'énergie et de la Mer 2016).

Given the successful outcome of the grassroots movement in France, the initiative has been taken further, pushing for anti-food laws throughout Europe, and for a European directive concerning the issue. To date, a petition entitled: *Mettons*

fin au gâchis alimentaire en Europe! #StopFoodWaste[11] is on Change.org, calling for such legislation to be enacted at the EU level. The petition was launched simultaneously in six European countries: Belgium (by Frédéric Daerden), Greece (by Nikos Aliagas), Italy (by Daniele Messina), Spain (by Manuel Bruscas), Germany (by Claudia Ruthner) and UK (by Tristram Stuart) and overall, has reached so far, over 773,000 signatures in support.

Gueules Cassées[12] (Ugly Mugs) in 2014 a Provencal entrepreneur, Nicolas Chabanne together with a group of fruit and vegetable producers, gave birth to a trademark that promotes 'ugly' fruits and vegetables (damaged, deformed or too small) among consumers to limit food waste.[13] This idea emerged when one of his friends, producer of quality apricots saw them systematically rejected by supermarkets because they were not 'calibrated'—when you see an apricot that provides optimal taste qualities but is thrown because it is too round, not large enough or not of the right colour, it hurts the heart (Chabanne, cited in Fougier 2016). In order to reassert the value of some of these products among consumers, a label which reads 'What's wrong with me? Fruits and Vegetables, less pretty but delicious!' was created to promote these substandard products and to allow them to be sold in the so-called 'classic' distribution chains. The idea led to several professionals contacting them—'We were in fruit and vegetables, but confectioners, butchers and bakers, rang to tell us "we also have our own *gueules cassées*"' (Chabanne, cited in Fougier 2016)–thus, soon after, the *Ugly Mugs* anti-food waste brand was created to raise awareness all around the world on this perfectly good food, and to save it from being senselessly wasted.

The initiative is open to all food producers or craftsmen who want to market products with minor flaws or retailers and shopkeepers who want to get the most from products with short shelf lives. Furthermore, the anti-food waste brand, offers three distinct labels:[14]

- *A label that identifies fruits and vegetables with minor aesthetic flaws*—this allows to value and sell products with small defects in shape, appearance or size
- *A label for products approaching their use-by date*—this −50 or −30% anti-food waste label can be used by any retailer or shopkeeper carrying products with short shelf-lives or products approaching their use-by date
- *A 30% discount anti-food waste label*—for a range of products with small defects in size, shape, or colour (e.g. cheese with slightly irregular edges and cereals, which seemed to have no abnormalities at a glance, but when looked at

[11] https://www.change.org/p/mettons-fin-au-g%C3%A2chis-alimentaire-en-europe-stopfoodwaste?source_location=trending_petitions_home_page&algorithm=curated_trending.

[12] *Première marque mondiale antigaspi*–The first anti-waste brand worldwide.

[13] Each year, 17 million tons of perfectly edible produce is not consumed for purely aesthetic reasons (Chabanne 2014).

[14] http://www.lesgueulescassees.org/#!solutions/b0jes.

meticulously do not fulfil the norms). To date, thanks to a sturdy and international mobilization effort, the initiative is being developed globally.[15]

Along with the above noteworthy initiatives, we can recall also the innovative web and mobile applications that encourage and allow consumers to reduce the amount of wasted food. In this sense, we can mention initiatives, such as: *Share your Meal*—a grassroots movement that encourages consumers to share the home cooking with neighbours and/or acquaintances, and to reduce in this way the amount of food thrown away. To date is promoted through online platforms in: Belgium (Thuisafgehaald), Italy (Cucina e condividi), Portugal (Acomida da vizinha), Spain (Comparto plato), Great Britain (Dinner Time), Germany (Teildeinessen), Netherlands (Thuisafgehaald), UK (Share your Meal), Slovakia (Ktominavari); *Bring Food* (Italy)—crowdsourcing web/mobile application that allows consumers, donors, to seamlessly publish offers and easily coordinate collections; *Zéro-Gâchis*[16] (France)—web and mobile platform that allows French consumers to find food products near them at a significant discount (30–70% off) that need to be consumed rapidly (as nearing their sell-by date); *Partage ton frigo (Share your Fridge) App*[17]—allows French consumers to take a picture of what they cannot eat, to name it, and share it on the app's database. After the completion of this step, consumers have just to wait for neighbours to select their leftovers, and arrange for pick-up.

Another type of grassroots initiatives that falls under this category refers to those that connect structures that have surplus food with charities and/or the neediest (FSE Network 2016). For instance: *FoodWe* (Belgium)—allows food professionals to provide, through its online platform,[18] supplies of unsold but still edible food to charitable or civic associations. On this platform, food surplus can be sold at a reduced price; *Taste Before You Waste* (Netherlands)—Collects food that otherwise would be discarded and brings it to different charities; *Foodcloud* (Ireland)—by using the app, or through the website, businesses who have registered with Foodcloud, can upload details of their surplus food and the time period in which the food can be collected; *Neighbourly Food* (Great Britain)–connects professionals (distributors, manufacturers, etc.) having surplus food with charities.

15.3.3 GRI—Valorisation

In this sub-section we focus on those grassroots innovations that have as outcome innovative products derived from food waste valorisation, that generate added value and enable the diverting of waste from landfill. Given the fact that innovative

[15]The US Investment Fund—Global Emerging Markets decided to invest in the development of this concept in US and the Middle East.

[16]https://zero-gachis.com/.

[17]http://www.partagetonfrigo.fr/.

[18]https://www.foodwe.be/.

products may find themselves in different stages of the innovation lifecycle, we report and we discuss next examples that correspond to the various stages: ideation–validation (Agridust), product development—pilot scale (Orange Fiber) and manufacturing (GroCycle and RecoFunghi).

15.3.3.1 Agridust—How Can We 3-D-Print with Food Waste

Main motivation of the grassroots entrepreneur(s)[19] The idea of reusing this type of waste was born because of a present problem in our society: waste, which can be either food or also the raw material used for constructing objects destined to end up in landfill. Inspired by the basic concept of the book *Cradle to cradle*, that is the creation of a new system where there is no longer the concept of waste, Marina Ceccolini, an Industrial Designer, has created Agridust—a biodegradable and atoxic material.[20]

Innovative idea in a nutshell The material consists of 64.5% of waste fruit and vegetables (coffee grounds, peanuts shells, husk tomato, bean pod, orange waste and lemon waste), and the remaining 35.5% of a potato starch-based binder. 'The choice of this binder was not random, as from the beginning I wanted to search a natural binder to create a non-toxic material in all its creation and processing stages' (Chiocchia 2015). Thanks to the latter feature of the material, the processing phase can be distinguished from that of other polymeric materials such as plastics (derived from petroleum processing, which causes serious damage to the ecosystem), as environmental friendly.

For this reason AgriDust is excellent as a substitute of the plastic materials for the production of plant pots and other elements dedicated to the nursery sector, it can also be used to create containers and packaging. Furthermore by controlling its viscosity is suitable as a material (a fine powder) that can be used as 'ink' for the 3D printers, taking advantage of the cold technology (LDM), where the extruder is replaced by a syringe.

Impact 'Considering how many first prints are just tests anyway, and how many prototypes makers—especially novices—often send through the 3D printer before reaching the desired shape and effect, Agridust offers a way to test and enjoy more 3D printing without worrying about the environment—the only concern is that the 3D printed items will not last indefinitely and are considered disposable' (Butler Millsaps 2015).

If taken to a higher level (up-scaling at industrial level) Agridust may facilitate the development of a sustainable 3D Printing industry, by reducing the use of plastics in 3D printing worldwide—'by 2020, experts estimate that we may be using as much as 1.4 million barrels of oil in 3-D printing' (Peters 2015), and thus decreasing the costs required for its treatment or landfilling. Additionally, AgriDust

[19]Industrial Design Student (Marina Ceccolini−Università degli studi di San Marino).

[20]Outcome of Marina Ceccolini's project work (progetto di tesi).

besides giving a second life to the chosen vegetables waste is a biodegradable material, which in turn will never become waste, because it is born with the intent to return the biological nutrients to the nature, revealing itself as advantageous for both human activities and the environment (Ceccolini 2015 cited in Chiocchia 2015).

15.3.3.2 Orange Fiber—Innovative Yarns and Fabrics from Citrus Wastes

Main motives of the grassroots entrepreneur(s)[21] Passion for textiles and attachment to Sicily, their native region, drove them to investigate if they could produce a fabric using the wastes of citrus; and thus provide a possible solution of a problem that in Sicily is a very debated one: disposal of the citrus waste derived from the processing industry (which amounted to over 700 thousand tons per year).

Innovative idea in a nutshell In 2011, from the passion for textiles, and the challenging situation of the Sicilian citrus processing industry, derives the idea of producing innovative yarns and fabrics from citrus waste. From the residues, that is all that remains after the pressing and processing of citrus, is extracted cellulose suitable for the spinning. Using nanotechnology, are produced innovative yarns and fabrics, releasing vitamin A, C and E with beneficial effects on the skin.

From the feasibility study conducted by Politecnico di Milano (Polytechnic University of Milan) develops the patent,[22] (Rubino 2014) which is registered in Italy (2012) and extended internationally. In February 2014 is established Orange Fiber, a startup based in Catania and Trentino,[23] with the goal of creating sustainable fabrics that respond to the innovation need of the fashion brands, by tackling in the same time a challenging issue in Sicily: the disposal of citrus wastes. To do that, the two young entrepreneurs planned to reuse more 700,000 tons of waste that the Italian citrus processing industry produces annually. In September 2014 it is presented the first fabric derived from citrus in the world, consisting of acetate by citrus and silk in two variants: solid satin and lace combined.

In December 2015, thanks to the Smart and Start funding of Invitalia, the first pilot plant for the extraction of cellulose from citrus wastes was opened. Currently, the first lot of fabric has been produced and proposals of top fashion brands to enter the market are undergoing an evaluation process. Furthermore, the two young entrepreneurs plan to build a production plant in Sicily, focusing on creating business partnerships (Orange Fiber, 2015, 2016).

[21]Two young entrepreneurs: Adriana Santanocito−background in fashion design and innovative materials and Enrica Arena−background in communication.

[22]For the first fabrics from citrus wastes in the world, consisting of acetate by citrus and silk.

[23]Two Business Angel, a lawyer and Trentino Development have funded the project.

Impact Orange Fiber is facilitating the development of a sustainable recovery chain of citrus, one of the most problematic waste streams in Sicily, in the Mediterranean region and not only. This will most likely have a positive impact also on other sensitive social aspects of the region, such as unemployment.

15.3.3.3 Growing Mushrooms from Waste Coffee Grounds

To get valuable insights into the up-scaling process of the grassroots innovations (which is still an aspect under-investigated in the literature) and gain a better understanding of the relevance of contextual elements (such as local constraints and web of relations) on innovation diffusion pathways, we decided to perform a comparative analysis between two cases, which are reporting the same type of innovative product, namely: *mushrooms from waste coffee grounds*. Hence, we have selected the Grocycle (England) and the RecoFunghi (Italy).

15.3.3.4 GroCycle (England)

Main motives of the grassroots entrepreneur(s)[24] 'Worldwide more than 1.6 billion cups of coffee are drunk each day and in the UK alone this figure is around 80 million every day. A cup of coffee is at the end of a process where less than 1% of the coffee plant is used. Coffee drinkers only value the beans, and after the brewing process most of the coffee grounds end up in landfill sites. This is a problem that's likely to increase as the UK already has more than 15,000 coffee shops and this number is set to keep on growing.

Taking this waste and turning it into local food is such a simple solution and a huge opportunity. Not only are there sustainability benefits, but it can change people's attitudes and create other opportunities in the process. Although most of the UK's food is consumed in cities, virtually none of it is grown there. Mushrooms are one crop ideally suited to urban agriculture, where both waste and demand are highest. They can be grown in empty spaces and add to urban food security'[25] (GroCycle 2016a).

Innovative idea in a nutshell The idea came out in 2009, as a hobby 'foraging for wild mushrooms'[26] of Adam Sayner (one of founders) and evolved along the years, the entrepreneurs being inspired by the 'scale of opportunity' to study thoroughly the chemical, sensorial, economical and sustainability aspects of their innovative idea. Traditional mushroom cultivation requires an energy intensive process to sterilise the substrate. By using coffee grounds, the two entrepreneurs reuse the energy that has already gone into the brewing process. Each week,

[24]Fungi Futures CIC, an innovative social enterprise based in Devon, UK.

[25]GroCycle (2016a), Mushrooms from Coffee Grounds?

[26]http://www.fungi-futures.co.uk/our-story/.

hundreds of kilos of coffee grounds are collected from city cafes and used to grow the Oyster mushrooms (a gourmet sortiment), that subsequently, are delivered to the best restaurants and food outlets in the South West of England.

The GroCycle innovative process delivers mushrooms and fertile compost, diverting tonnes of coffee grounds from landfill. The two entrepreneurs have been growing Oyster mushrooms from waste coffee grounds since 2011, and developed further the innovative idea, by creating the *GroCycle Urban Mushroom Farm*[27]—in order to test new ideas, and designing an user friendly Mushroom Grow Kit–to enable other people to cultivate their own mushrooms at home, by recycling their waste coffee grounds.

Additionally, they provide an online course and people from over 40 countries around the world have been trained so far.

Impact Since the first year of activity, tonnes of coffee grounds[28] have been diverted from landfill. Thanks to GroCycle the collection and recovery of coffee grounds has been shed into a new light, leading to a win-win business model for the region and to an increased environmental awareness.

15.3.3.5 RecoFunghi (Italy)

Main motives of the grassroots entrepreneur(s)[29] 'La sostenibilità, la nostra passione!'—'Sustainability, our passion!'—Concerned about environmental issues, after years of studies, research and testing in the field they managed to create a procedure to recover what, until few years ago, was considered a waste: the coffee grounds, by setting up the first company of this type in Italy (Basilicata Region, South of Italy).

Innovative idea in a nutshell The innovation journey starts in 2010 with the collection of coffee grounds from bars managed by friends, and also from unusual production places such as cellars and attics, followed by the participation with the project *'Recoffee'–mushrooms from coffee grounds*—in the call for tender N.I.D.I. —Nuove Idee di Impresa Innovative (New Ideas of Innovative Enterprises) organized by a special agency of the Chamber of Commerce of Potenza.

In 2011 their business plan was successful and, subsequently the young family of entrepreneurs got a voucher spendable in technical consulting and feasibility studies. This voucher (financial support) allowed them to study thoroughly the chemical and sensorial aspects of the products (the various types of mushrooms) and the economic possibilities for setting up a small scale company, with low environmental impact, that delivers sustainable products. During this phase they discovered that their idea

[27]They have converted an unused office building into an urban mushroom farm right in the heart of the city of Exeter (UK) (GroCycle 2016b).

[28]'5 tonnes have been collected in Plymouth and diverted only in the first year' (GroCycle 2016c).

[29]Young family of entrepreneurs with background in Enzymology (Daniele Gioia e Annarita Marchionna–Basilicata Region, South Italy).

of producing mushrooms out of coffee grounds is not that new, but they didn't get discouraged and decided to work towards the development of a manufacturing process that allows the valorisation of the expresso coffee grounds (widespread and typical in Italy) and the production of a variety of highly appreciated mushrooms in the region and all around in South of Italy, namely *cardoncello*.

The results obtained, in all respects have been satisfactory, so they decided to set up a small company, despite the times of crisis. Among all the challenges they had to confront with, the young family of entrepreneurs retains as critical as the one related to the financing of the whole activity. Fortunately, in their case, one credit bank[30] decided to finance almost the entire project. Thus, in January 2013, they could start their activity. Currently, they are producing many varieties of Pleurotus ostreatus and Eryngii (*cardoncello*). The goal, by the end of 2017, is to recover all the coffee grounds produced by the bars in the capital city of the Basilicata region and also to increase the sale of kits (RecoKit) for the production of ultra-fresh mushrooms at home or in the coffee grounds restaurants (RecoFunghi 2016).

Impact RecoFunghi has facilitated the development of a new and sustainable agro-food value chain in the region, by establishing stable partnerships with different commercial actors in the area. Thanks to RecoFunghi the collection and recovery of coffee grounds has been shed into a new light, leading to a win-win business model for the region and to an increased environmental awareness.

15.3.4 Grassroots Channels of Actions and Effectiveness in Catalysing Innovation in the Food Waste System

As depicted above, the range of grassroots innovations in the food waste field is very diverse in terms of goals, scale, space, diffusion pathways, typology of movement brokers and grassroots entrepreneurs. Furthermore, the analysis of several empirical case-studies allowed identifying some distinctive features of the grassroots innovations tackling the food waste problem.

Going back to the first research question of our study (*how GRI act and how effective they are in catalysing innovation*), the empirical evidence collected and presented above allow us to argue that grassroots innovations addressing food waste mostly are:

- Both need-generated and need-oriented
- Tackling mostly overlooked collective needs and concerns
- Aiming at delivering solutions that can be easily customized to the various contexts and settings worldwide—in this sense, most of the reported GRIs were able to articulate their own agenda and vision (e.g. *Anti-Gaspi*, *Gleaning Network*, *Gueules Cassées* etc.).

[30]La Banca di Credito Cooperativo di Laurenzana e Novasiri.

Another important aspect to note is that, in spite of the lack of knowledge and capabilities required for scaling-up the innovation, the grassroots entrepreneurs showed willingness to cooperate with other actors in managing their innovation; aimed at improving local productivity, and overall at strengthening the regional economy over the long term because of their strong attachment to the local community (see for instance the Orange Fiber case).

When considering GRI effectiveness in catalysing innovation activities and policy design, certainly the success of the French grassroots movement (which contributed substantially to the adoption of an anti-food waste law), shed a new light on the grassroots developments, from an overlooked site for innovation, to a visible hub in the realms of food policy and regulation, and emerging cultural politics of food waste, with huge potential in the transition towards a more sustainable waste regime.

From the analysis of the case studies, also emerged the fact that grassroots innovations addressing food waste problem, can act as incubators of the social change needed to respond to the current global challenges—as food waste connects with the most critical societal challenges: food security, poverty, energy, deforestation, and climate change. This remark is in line with the other findings from the grassroots innovations for sustainability literature (see among others, Feola and Nunes 2014; Smith et al. 2014, 2015; Seyfang and Smith 2007).

15.4 Grassroots Innovations Roles in the Transition Towards a Sustainable Waste Regime

In this section we make an effort to reconcile the cases examined above with the MLP framework, attempting to address the second research question on *the specific roles played by grassroots innovations in the transition towards a sustainable food waste regime*.

In all three groups of cases-studies (*Prevention, Reduction and Reuse, and Valorisation*) GRI act primarily at the niche level, creating however also the condition for enhancing landscape pressure aiming at the opening up of windows of opportunities. In fact, in all case-studies investigated, GRI can be seen as emerging and evolving socio-technical niche configurations, as they described at various levels: new arrangements of technologies, new competencies creations, alternative social practices design and development. At the same time, GRI exerts lobbing pressure on policy makers and societal groups at various levels, setting out viable and alternative models of development–e.g. food growing using waste residues on urban micro-sites (GroCycle); new forms of production based on food waste valorisation (Orange Fiber, Agridust); alternative ways of distribution and retail (*Gueules Cassées*, Gleaning Network); mobilising peoples' support for sustainable alternatives through public events, campaigns, online petitions (*Anti-Gaspi*, Wastecooking), etc.—and challenging in this way also the incumbent regime.

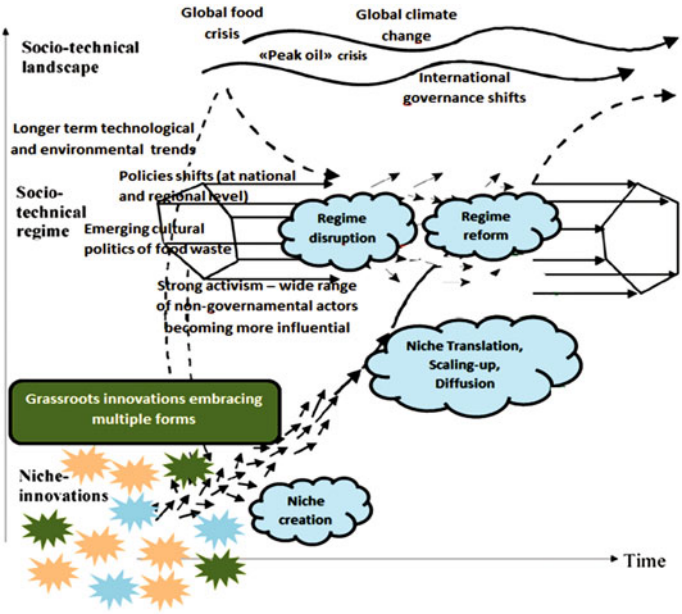

Fig. 15.3 Grassroots innovations roles in the transition towards a sustainable waste regime. A multi-level perspective (adapted from Geels 2002; Durrant 2012)

Given the specific nature of these niches innovations we shall propose a development pattern of GRI niches which differs from standard niches development process (as it was described, for instance, in Lopolito et al. 2013). The proposed path towards niche maturity articulates into four subsequent steps (see Fig. 15.3):

(1) *Niche creation* Grassroots movements can play a role in several core processes of the niche creation—in terms of network formation, learning and *competence building, but also in shielding, nurturing and empowering niche innovations—by providing legitimacy and linking them to broader societal discourses* (Ornetzeder and Rohracher 2013). *We can recall, in this sense, mainly the GRIs reported in* Sect. 15.3.2 *(GRI—Reduction and Reuse) and* Sect. 15.3.3 *(GRI—Valorisation).*

(2) *Niche translation scaling-up and diffusion* By actively contesting unsustainable incumbent arrangements and re-framing debates, GRIs pressure incumbent industries to respond; By lobbying policymakers, staging direct actions and protests, engaging in framing struggles in the media, GRIs mobilize resources and supporters (Durrant 2012). Both GRIs reported in Sect. 15.3.1 (GRI—prevention) and Sect. 15.3.2. (GRI—Reduction and Reuse) have proven to play a significant role in this phase, by advocating specific policy changes, lobbying decision makers, educating and influencing people's behaviour, promoting good practices (e.g. promoting substandard products

—'ugly mugs', and allowing them to be sold in the so-called 'classic' distribution chains).

(3) *Regime disruption* Furthermore, through this mix of strategies, GRIs 'can at times create the initial conditions required for the destabilization of incumbent industrial regimes and their replacement with more sustainable configurations' (Turnheim and Geels 2012; cited in Durrant 2012: 3). When considering GRIs potential contribution to regime disruption phase, certainly the success of the *Anti-Gaspi*—French grassroots movement (which contributed substantially to the adoption of an anti-food waste law), is encouraging, providing a piece of evidence that GRIs can undermine existing unsustainable practices, acting as incubators of the social change needed to respond to the current global societal challenges (food security, poverty, energy, deforestation, and climate change).

(4) *Regime reform* GRIs may encourage the regime actors 'to adopt and embed more sustainable configurations of technologies, practices and organizational arrangements, thus leading to the reform and re-orientation of the incumbent regime' (Durrant 2012: 4). As reported in Sect. 15.3, many of the grassroots innovations are tackling more than one aspect, and all of them directly or indirectly and in different extents, contribute to the regime reform.

15.5 Concluding Remarks

In this chapter we aimed at contributing to an emerging strand of food waste literature, namely, the development and diffusion of innovative approaches to address the food waste problem and the role of grassroots innovations. Specifically, we assessed the role of grassroots movements in catalysing innovation in the food waste system and promoting a transition towards a more sustainable waste regime. We did so by means of an in-depth case studies analysis embedded in the MLP framework. Building on the original definition of grassroots innovations provided by Seyfang and Smith (2007) and extended by Smith et al. (2014), allowed us to define grassroots innovations as networks of activists and organizations generating novel bottom-up solutions for sustainable development, including also people and organisations coming from outside local communities (e.g. engineers and designers) and engaged in the innovation processes from the onset.

From our in-depth analysis of several case-studies of grassroots innovations addressing the food waste problem in different European countries, emerged the fact that grassroots innovations dealing with food waste embrace multiple forms, which we grouped into three categories:

(i) Prevention
(ii) Reduction and Reuse
(iii) Valorisation.

In making this distinction, we followed the European waste hierarchy, and considered the primary goal of grassroots organisations. Indeed, this categorisation should not be considered as a clear-cut as many grassroots innovations are tackling more than one aspect, and all of them directly or indirectly and in different extents, contribute to awareness raising; therefore this classification should be taken as an academic exercise, aimed at illustrating the diversity of grassroots innovations in respect to food waste, and in terms of goals, scale, space, diffusion pathways, typology of movement brokers and grassroots entrepreneurs.

Regardless of these categories, however, all grassroots innovations addressing food waste appeared as both need-generated and need-oriented, tackling mostly overlooked collective needs and concerns, and aimed at delivering viable solutions that could be customized in various contexts and settings worldwide. Their effectiveness in catalysing innovation activities proved to be high, especially when it came to steer policy actions. Certainly, the success of the *Anti-Gaspi*—French grassroots movement (which contributed substantially to the adoption in France of an anti-food waste law), shed a new light on the grassroots developments, from an overlooked site for innovation, to a visible hub in the realms of food policy and regulation, and emerging cultural politics of food waste, with huge potential in the transition towards a more sustainable waste regime.[31]

Our investigation also showed how grassroots innovations can act as incubators of the social change needed to respond to the current global societal challenges, such as: food security, poverty, energy, deforestation, and climate change.

Based on the empirical evidence gathered, we can argue that grassroots innovations addressing food waste, can play a key role in several core processes (niche creation; niche translation, scaling-up and diffusion; regime disruption; regime reform) of the transition towards sustainable production and consumption systems and a more sustainable waste regime.

Furthermore, GRIs configured mostly as niches innovation are able to respond to the societal challenges and at creating the conditions for enhancing landscape pressure. These combined effects could determine the opening up of windows of opportunities which would eventually result in the hoped for sustainable transition.

The findings of our study add to the existing literature on grassroots innovations and food waste, extending the current understanding on how grassroots innovations addressing food waste challenge could support decision makers in developing

[31]Note that the French law is setting an example in Europe and similar bills are being adopted also in other countries. Italy, for example, passed a law in august 2016, which makes it easier for companies and farmers to donate food to charities and is encouraging greater use of 'doggy bags' at restaurants as part of a legislative push to curb the epidemic of food waste. The new anti-food waste Italian law has essentially relaxed regulations that made food donations cumbersome. It has clarified that food may still be donated even if it is past its sell-by date, and allows farmers to transfer produce to charities at no extra cost if it has not been sold. The law also opens the door for companies to donate food that has been mislabelled as long as it does not pose a safety risk. (see: https://www.theguardian.com/world/2016/aug/03/italy-food-waste-law-donate-food—last accessed 22-08-2016).

tailored strategies to minimize the amount of food wasted along the supply chain, and to unlock the enormous potential of food waste that is being landfilled.

Acknowledgements This work was carried out partially under the project "Sustainable path creation for innovative value chains for organic waste products" (SusValueWaste), funded by the Research Programme on Sustainable Innovation in Food and Bio-based Industries (BIONÆR) under the Research Council of Norway.

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