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FARMER BEHAVIOR AND PERCEPTION REGARDING FOOD WASTE AND UNSOLD FOOD

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FARMER BEHAVIOR AND PERCEPTION REGARDING FOOD WASTE AND UNSOLD FOOD

Abstract

Purpose– The purpose of this paper is to analyze farmer behavior, considering their attitude toward food waste with particular focus on their involvement in the last phase of the process, the retail phase. It assesses the different approaches applied to food waste management and its future.

Design/methodology/approach– A sample of 35 farmers in the *Porta Palazzo* market, the biggest food market in the Turin Area (North-West Italy), was identified and a survey was carried out to determine the behavior and perception of farmers regarding food waste and the management of unsold food.

Findings– Results show that there is a high level of interest on the ethical and charitable aspects of food waste and unsold food. However, awareness and knowledge of the initiatives organized by institutions are not sufficient.

Practical implications– If policy makers and institutions have an understanding of farmer behavior, they can implement ad hoc initiatives to reduce food waste and build on the work already done by farmers. Additionally, farmers can help customers to better understand the products.

Originality/value– This study analyzes the perception of the food waste phenomenon for one type of traditional operator in the food supply chain, the farmer. The originality of the paper lies in the fact that it has not only considered the perception of food waste but also the management of unsold food in a market area.

Keywords– Food waste, Unsold food, Farmers, Marketplace

Paper type - Research paper

Introduction

Food waste is a phenomenon that increasingly affects both developed and developing economies and, its relevance is linked to the negative externalities (Kummu *et al.*, 2012) it causes, such as economic, environmental, and social consequences. Economic agreements are not always in line with the true market and consumers needs and this is one of the main causes of food waste (Stuart, 2009), together with inappropriate behavior of players involved in food production as well as customers (Block *et al.*, 2016; Parfitt *et al.*, 2010). Although food waste is a well-known phenomenon, it is still difficult to define it in a uniform way and clearly identify all the processes and players involved (Garrone *et al.*, 2014).

The European Union defines food waste as foodstuffs that, although still edible, are discarded by some players of the supply chain for aesthetic reasons (EU, 2012). In line with the EU definition, Hudson and Messia (2014) focused attention on the role played by the retail and final consumption stages, indicated as the one in which food is most often discarded. Food waste takes place in all phases of the supply chain and the different characteristics of various countries affect it, for example economic and climatic conditions, productive systems, infrastructures, market, and consumption. The EU (2012) and Hudson and Messia (2014) are just some of the studies that emphasize the role of the supply chain in the analysis of food waste.

Numerous studies have analyzed the relationship between supply chain and food waste, the costs generated and the negative spin-offs. For example, food losses in the distribution phase in Austria (Lebersorger and Schneider, 2014) and in Sweden (Eriksson *et al.*, 2012), along the whole supply chain in Switzerland (Beretta *et al.*, 2013), in food service management (Engstrom and Carlsson-

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3 Katayama, 2004), the generation of food waste caused by packaging and labelling information
4 (Williams *et al.*, 2012) and different types of food products (Buzby and Hyman, 2012), the costs
5 incurred to manage household food waste in South Africa (Nahman *et al.*, 2012), and the use of
6 resources to generate food waste (Kummu *et al.*, 2012).

7 Other studies have divided the supply chain into different phases in order to have a better focus
8 on the processes therein. Cicatiello *et al.* (2016) report four phases: production and processing,
9 retail, food service, and household consumption. According to Gustavsson *et al.* (2011) and
10 Verghese *et al.* (2013) there are five phases: agricultural production, post-harvest handling and
11 storage, processing, distribution, and consumption.

12 In order to have a positive impact on the food waste phenomenon, Parfitt *et al.* (2010) argued that
13 it is fundamental to address the problem starting from farmers by making them more aware of the
14 issue. Changes in both legislation and business behavior are necessary to reduce food waste in
15 developed countries.

16 Previous studies focus on the whole supply chain (Beretta *et al.*, 2013; Mena *et al.*, 2011),
17 individuals' behavior (Lundqvist, 2009), and legislation (Aparicio Arroyo, 2015; Lissel, 2015).
18 Therefore, the authors decided to structure a preliminary analysis of farmers, since they are an
19 important part of the supply chain (Peira *et al.*, 2018), their role is indicated as fundamental to
20 influence customers (Parfitt *et al.*, 2010), which emphasizes the necessity to understand and
21 change their behavior (Parfitt *et al.*, 2010; Peira *et al.*, 2018).

22 The authors identified a large Italian market area, based in Turin, where a large number of farmers
23 sell products every day. The chosen marketplace is a daily farmers market where it is possible to
24 meet a number of farmers that are involved both at the beginning and at the end of the supply
25 chain. This allowed the authors to gather information about two different phases of the food
26 supply chain process: primary production and retail. A three-part questionnaire was developed to
27 assess farmers' attitudes toward and perception of food waste management and it was personally
28 submitted to 35 farmers.

29 Results show that there is a high level of interest in the ethical and charitable aspects of food
30 waste and unsold food. However, awareness and knowledge of the initiatives organized by
31 institutions are insufficient.

32 The contribution of the paper is twofold, it opens a new debate on farmers' behavior following the
33 guidelines of some researchers and it also provides policy makers with important indications of
34 the actual situation and farmers' current behaviors. Greater awareness of the present situation
35 provides institutions and organizations the opportunity to identify proper initiatives to reduce
36 food waste and correct wrong behaviors, starting from the supply chain.

37 ***The role of the supply chain in the food waste phenomenon***

38 The FAO data (Gustavsson *et al.*, 2011) indicate that 33% of annual world food production, which
39 accounts for about 1.3 billion tons, is lost or wasted along the food supply chain. In 2013, the
40 Institution of Mechanical Engineers (IME, 2013) estimated the total amount of food waste to be
41 1.2-2 billion tons, about 30-50% of the world food production.

42 In 2014, the European Commission estimated that food waste in agricultural production was
43 around 1.6 billion tons (EU, 2014). Supply chain efficiency and consumer behavior have been
44 reported as being the main causes of this phenomenon (Lundqvist, 2009).

45 In 2011, EU food waste amounted to 89 million tons, about 179kg per capita. This data did not
46 take losses in the agricultural production phases or fishing losses into consideration. Of the total
47 waste 42% is household waste, 60% of which is inevitable; 39% production waste, 14% foodservice
48 waste, and 5% wholesaler/retailer waste (EU, 2012). Food waste generated in the final phases of
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3 the supply chain is very common in industrialized countries and accounts for 31-39% of the total.
4 In developing countries, this percentage is only 4-16% of total food waste.

5 It has been reported that the current linear production system and related consumption seem
6 unsustainable due to the exploitation of natural resources and continuous wastage throughout the
7 various phases of the supply chain (Borrello *et al.*, 2017).

8 In this context, some studies focused their attention on food waste in the food supply chain
9 because it has been demonstrated that each stage of the food value chain generates costs and
10 negative externalities that are constantly increasing, that is, the use of resources such as
11 freshwater, cropland, and fertilizers (Kummu *et al.*, 2012). In fact, between 25% and 58% of food
12 waste is derived from the supply chain process (Green and Johnston, 2004; Nelleman *et al.*, 2009;
13 Beretta *et al.*, 2013).

14 Beretta *et al.* (2013) analyzed the different phases of the entire supply chain, agricultural
15 production, postharvest handling and trade, processing, foodservice industry, retail, and
16 households, and showed that the most avoidable food losses occurred in the household,
17 processing and agricultural production stages. Household food consumption, which can amount to
18 almost 10% of the average amount spent on food per consumer (Buzby and Hyman, 2012), can be
19 considered the major contributor to the generation of food losses (Beretta *et al.*, 2013) and can
20 generate elevated management costs (Nahman *et al.*, 2012). Moreover, food waste generated in
21 this stage can be caused by packaging and labelling information (Williams *et al.*, 2012; Newsome
22 *et al.*, 2014) and by consumers' general behavior (Aschemann-Witzel *et al.*, 2015; De Hooge *et al.*,
23 2017).

24 Each stage of the supply chain has been studied from different points of view. Elevated levels of
25 food losses were generated in the agricultural production and postharvest handling stages. A
26 proportion of agricultural products are discarded because they cannot be used for human
27 consumption but can be safely used, for example, as animal feed (Thieme and Makkar, 2017) or to
28 produce marketable foodstuffs (Barba and Díaz-Ruiz, 2015). However, food losses can be reduced
29 if farmers pay greater attention to the harvesting process (Peira *et al.*, 2018).

30 The processing stage generates food waste and food losses. In fact, the food industry is tackling
31 such challenges in order to improve productivity by using fewer resources, increasing the
32 resilience of the food supply chain and relationships with providers and clients (Otles *et al.*, 2015;
33 Rahimifard *et al.*, 2017; Eriksson *et al.*, 2017). Some processing activities are dedicated to the
34 recycling of discarded food at different stages, for example agricultural production and retail, for
35 diverse reasons such as aesthetic standards, and to transforming it into marketable foodstuffs
36 (Barba and Díaz-Ruiz, 2015), or industrial production that collects the processing scrap, such as
37 discarded fruit and vegetables, and uses it to produce biogas (Dietrich *et al.*, 2015).

38 The retail stage was analyzed by Lebersorger and Schneider (2014) who quantified and identified
39 reasons for food loss rates for selected food products and investigated the correlation between
40 food loss rate and peculiarities of retail outlets. Eriksson *et al.* (2012) analyzed the fruits and
41 vegetables delivered to retail stores and demonstrated that pre-store waste, that is goods rejected
42 at delivery, is three times greater than in-store waste. Barco Cobalea (2015) promoted the
43 application of digital tools in order to improve the management and distribution of foodstuffs. The
44 study conducted by Aparicio Arroyo (2015) is interesting in that it underlined the limitations of
45 legislation on food donation and proposed changing EU Legislation to reduce the responsibilities
46 of users, for example non-profit organizations, regarding the state of preservation, transportation,
47 storage, and use of foods.

48 Moreover, another cause of food waste in retail stores is customer behavior regarding store
49 operations management and different product requirements (Teller *et al.*, 2018; Filimonau and
50 Gherbin, 2018).

To offer a complete overview of some of the studies on food waste and the different stages of the supply chain, some authors analyzed the foodservice sector and discovered that the largest amount of food waste is often recorded in restaurants and schools (Engstrom and Carlsson-Katayama, 2004; Von Massow and McAdams, 2015) or in hospital foodservice (Dias-Ferreira *et al.*, 2015; Zulkipli and Chik, 2015) and universities (Marais *et al.*, 2017), mainly due to serving losses, that is food remaining on the buffet and in serving bowls on the counter, and that it is most important to reduce these (Betz *et al.*, 2015). Moreover, different kinds of foodservice can provide diverse externalities in terms of environmental performance (Calderón *et al.*, 2018). However, legislation can limit the opportunity for food donation in the restaurant industry (Aparicio Arroyo, 2015; Ofei *et al.*, 2015) and therefore unsold food becomes food waste destined for landfill (Sakaguchi *et al.*, 2018).

Finally, a specific trading area where food waste can be reduced is the marketplace. Peira *et al.* (2018) emphasized that farmers pay more attention to reusing unsold food the fruit and vegetable sellers in markets, while González-Torre and Coque (2016) showed that market operators could donate more food if European regulation permitted it.

The entire supply chain plays an important role in the food waste phenomenon and each stage produces both food waste and negative externalities, but there are opportunities to reduce it by working on the behavior of the main players involved. As suggest by Parfitt *et al.* (2010), farmers can be considered a good starting point to influence customer behavior.

Inside the supply chain: farmers from different perspectives

There are numerous studies dedicated to farmers and their activities and they have recently covered various questions including food safety (Yu *et al.*, 2017; Bovay, 2017; Zhang *et al.*, 2017; Ayedun *et al.*, 2017), food security (Corsi *et al.*, 2017; Hulbrock *et al.*, 2017), the public's willingness to pay for local food (Berg and Preston, 2017), crops (Ayedun *et al.*, 2017), genetic improvements (Tindano *et al.*, 2017), or commercialization of waste-based organic fertilizers (Danso *et al.*, 2017). Moreover, some studies analyzed farmers' perception of the effect of climate change (Lee, 2017; Otieno *et al.*, 2017; Boansi *et al.*, 2017), policy implementation at a local level (Pradhan *et al.*, 2017), and rice production (Islam *et al.*, 2017; Nonvide *et al.*, 2017).

Beausang *et al.* (2017) report that most farmers are not interested in the food waste phenomenon and do not consider food waste an issue of primary concern. Indeed, they are of the opinion that food waste "is a necessary evil and do not even note how much they waste." Therefore, data on estimates for food waste and losses is lacking. Other farmers have expressed an interest putting waste to use on their farms to produce energy through anaerobic digestion, even if they did highlight several barriers to this.

Other studies have concentrated on the comparison between farmers markets and food waste. Some of these referred to food recovery programs and their efficacy in reducing food insecurity by taking advantage of the food left-over in markets (Sisson, 2016). Others report on the farmers' perception of food waste (Beausang *et al.*, 2017; Peira *et al.*, 2018).

Peira *et al.* (2018) analyzing the role of farmers, market traders and the so called "hybrid," underlined an important point that individuals have different behaviors according to their understanding of food waste and it is important to increase the level of awareness in order to reduce the phenomenon at each stage of the supply chain. This is in line with Parfitt *et al.* (2010) who reported the necessity to start to work on farmers in order to obtain positive results from all individuals.

Based on this point of view, some authors analyzed feasible solutions to the problem such as reducing food options and plate size, removing food trays and providing information and education on food waste (Miroso *et al.*, 2016; Gonzalez-Torre and Coque, 2016; Qi and Roe, 2017;

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3 Marais *et al.*, 2017). In particular, the work of Gonzalez-Torre and Coque (2016) analyzed
4 marketplaces in Spain and the findings demonstrated that it is possible to better manage unsold
5 food, for example via donations to food banks.

6 Finally, since the phenomenon of food waste is constantly increasing and there are a lot of players
7 involved in each stage of the supply chain, it is important to understand the awareness and
8 behavior of those involved (Peira *et al.*, 2018), starting from the farmers (Parfitt *et al.*, 2010). Few
9 studies analyzed a group of farmers in order to understand their level of awareness and attitude
10 toward food waste.

11 For this reason, the research was orientated toward the analysis of farmer behavior, considering
12 their attitude toward food waste with focus on their involvement in the last phase of the process,
13 the retail phase. In particular, the objectives of the paper are to investigate the relevance of the
14 food waste concept for farmers and understand how they manage the unsold food.
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19 **Study area and methods**

20 This study aimed at obtaining more information on farmers' perception of food waste
21 management in a specific market area, Porta Palazzo market in Turin, Italy (Gilli and Ferrari, 2017;
22 Alfiero *et al.*, 2017). The city hosts two famous slow food events, the *Salone del Gusto* and *Terra*
23 *Madre* (Parkins and Craig, 2009; Black, 2012; Myers, 2013; Hendriks *et al.*, 2017), and Eataly
24 (Massa and Testa, 2012; Sebastiani *et al.*, 2013; Bertoldi *et al.*, 2015; D'Ippolito and Timpano,
25 2016; Di Gregorio, 2017), the only Italian distribution chain of national high quality foodstuffs with
26 supermarkets all over the world.

27 The Torino Market network has a total of 42 markets in the urban area of the Commune di Torino.
28 The biggest of these markets is *Porta Palazzo*, which is the largest market in Europe covering an
29 area of about 50,000 square meters with over 1,000 commercial operators. The *Porta Palazzo*
30 market is open from 7.00 am to 2.00 pm Monday to Friday and from 7.00 am to 7.00 pm on
31 Saturdays. This market dates back to 1835 when it was transferred from the sites of the original
32 medieval market, the "*Piazza delle Erbe*" and "*Corpus Domini*." *Porta Palazzo* is an alternative
33 system compared to the conventional distribution system due to the numerous commodities
34 offered, that is food and other commodities, such as fabric, threads, wool, clothing, shoes,
35 household goods as well as flowers and plants. About 100,000 customers visit it per week and
36 most of them go on Saturdays (25,000); it is also a tourist attraction (Gilli and Ferrari, 2017).

37 Food is sold at the *Porta Palazzo* market in various sections: the "Fruit and Vegetable Market" in
38 an open space, with 278 market traders, the covered "IV Food Market", also named "the Clock
39 Market", with 78 market traders, which sells a mixture of food products, including meat, the
40 covered "V Food Market", with 40 market traders that sells more or less the same products as the
41 IV market, the covered "Fish Market" with 15 market traders and the Farmers' Market, also known
42 as the "Farmers' Canopy", with 69 farmers, who sell their locally produced fruit, vegetables, eggs,
43 and cheeses. According to the zero-kilometer philosophy, most of the farms are located no more
44 than 30 km away (77%) and all of them are either in the province of Torino itself (81%) or in close
45 proximity (19%).

46 In line with the objectives set by this research, the largest farmers' market in Turin was chosen as
47 it has the highest concentration of farmers in one place. A three-part questionnaire was developed
48 to assess the farmers' attitudes toward and perception of food waste management. The first part
49 collected the interviewees' demographic, social, educational and personal information, that is
50 gender, age, residence, nationality, qualification, education and their market activities: license and
51 number of market days per year. The second part collected information about the farmers'
52 attitude toward food waste, going into detail as to how concerned they are, or not, about it, the
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3 positive implications food waste reduction may have in terms of the environment, society and the
4 economy, the feasible activities to reduce and manage unsold food and how much they know
5 about the initiatives aimed at food waste reduction already operating in Turin.

6 The third part of the questionnaire asked the farmers to evaluate the way in which unsold food
7 products are managed. It collected detailed information about the quantity of the unsold food per
8 day, the kind of products that remain unsold, the influence the season has on them, the
9 management of products in the *pre-sale* phases, that is, the harvest and the *post-sale* phases, that
10 is, the management of unsold food. The last part of the questionnaire collected information about
11 the farmers' attitude toward donating their unsold food, or a part of it for social reuse, such as
12 food for the homeless.
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14 A preliminary version of the questionnaire was tested on 10 farmers in a *Campagna Amica*
15 *Market*, a Sunday farmers' markets organized by *Coldiretti* (a direct farmers' organization), to
16 detect any mistakes and to assess any structural weaknesses (Vecchio and Annunziata, 2013;
17 Clonan *et al.*, 2009). After making some adjustments, the final version was determined.

18 Semi-structured interviews (Alvesson, 2003) were conducted during the Autumn of 2016 with 35
19 farmers registered at the market (Leiper and Clarke-Sather, 2017) over a two-hour period; 34/69
20 declined to participate in the survey. The order of the individual questions in the interview was
21 changed in line with other authors (Pitrone, 1984; Fideli and Marradi, 1996). Each interview lasted
22 around 25 minutes and the interviewer asked the questions according to the interview guide,
23 recorded the answers and noted the main topics. The authors then analyzed the interview results
24 individually so as not to influence one another (Atkinson and Shaffir, 1998). Lastly, the results of
25 each author's analysis were compared, and the fundamental elements identified.
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29 **Sample and results**

30 The study group was comprised of 35 farmers, with an average age of 48; the youngest farmer was
31 21, the oldest 69. A total of 34 farmers were Italian and 1 was Romanian; 24 farmers were male
32 and 11 female. Education levels varied: 17 farmers had an Italian High School diploma and 18 had
33 finished compulsory education schemes (the older ones only up to the age of 11) without
34 diplomas. In order to be able to sell on markets in Italy, market traders must have one of two
35 types of license, either a permanent place on the market, which 28 farmers had, or one allocated
36 on a daily basis, which the other 7 farmers had. The number of market days per year was
37 distributed as follows: 8 farmers over 200 days per year, 11 over 160 days per year, 8 over 120
38 days per year, 5 over 80 days per year, 2 over 40 days per year and 1 under 40 days per year. Most
39 of the farms are located in the Province of Torino (25), Cuneo (5), Vercelli (3), Asti (1) and Verbanò
40 Cusio Ossola (1). A total of 27/35 farms were located less than 30 km from the *Porta Palazzo*
41 *Market* and only 3 farms were located over 50 km away (Table 1).
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48 **Table 1. Description of the Sample**

53 *Perception of Food waste*

54 The second part of questionnaire, which follows the sample characteristics, investigates the
55 farmers' perception of food waste. The first question defined how concerned they were about
56 food waste using a ten-point Likert scale with 1 being the lowest score and 10 the highest. Results
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3 showed that the farmers are quite concerned about this issue (median value of 6, even if the
4 evaluations differed greatly). Indeed, the level of concern seems have an inverse correlation with
5 age, that is the younger farmers were more sensitive to the question than the older ones (Table 2).
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10 **Table 2. Concern regarding Food Waste**

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14 All respondents agreed that each initiative implemented to reduce food waste is useful. In fact,
15 they even suggested further initiatives, such as the collection of unsold produce at the end of day
16 (23 out of 35), the improvement of market logistics (12 out of 35), generic waste prevention (11
17 out of 35), waste prevention with control systems in different phases of the supply chain (4 out of
18 35), or through awareness campaigns (3 out of 35).
19

20 The farmers were asked to score some prospective feasible positive implications of food waste
21 reduction, assuming that better management of unsold produce had been applied. They took into
22 consideration how food waste reduction might lead to several advantages: economic, that is
23 general reduction of costs, environmental, that is an overall reduction in the quantity of waste,
24 and ethical, that is improvements in the distribution/use of unsold foodstuffs. The same Likert
25 scale was used for each type of advantage, where 1 was no positive implication, up to a maximum
26 of 10 for positive implications and the respondents assigned higher scores to ethical implications.
27 Farmers over 59 years old are more interested in the environmental advantages (median value 10)
28 and ethical implications (median value 10) (Table 3).
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34 **Table 3. Better Food Waste Management and Its Potential Advantages**

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38 However, the resulting data showed that the farmers did not know very much about food waste
39 management initiatives. In fact, 19 out of 35 had no knowledge of farmers' initiatives dedicated to
40 reducing food waste; of the remaining 16, 11 knew about the set-up of a food stall for
41 redistribution amongst the poor, three knew about the Last Minute Market, where some
42 perishable products are sold for less, and two knew about swapping activities, where one farmer
43 exchanged goods with another.
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46 *Unsold Food Management*

47 The farmers were asked to comment on how often (in days) they had unsold produce that could
48 not be sold the day after. A total of five out of 35 reported having unsold produce every day, 14
49 out of 35, 50% of the time, 16 out of 35 only occasionally; none of the farmers reported having no
50 waste at all. Thirteen of the farmers estimated their unsold produce and seven reported waste of
51 < 7 kg, three reported waste between 10 and 20 kg and another three >20 kg *per waste day*.
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53 A high percentage of the farmers were not worried about their unsold produce and did not pay
54 attention to the pre-sale phase (22 out of 35). The remaining 13 calculated how much food to take
55 to the market every day on the basis of their personal experience on that particular day (Monday
56 or Saturday), the season and affluence of potential customers also on the basis of nearby events.
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3 The management of the post-sale phase differed, and some farmers also applied more than one
4 solution. The unsold food was donated directly on site to the needy at the end of the market day
5 by 24 farmers and 19 reported sharing their unsold produce with members of their family. A price
6 reduction was made at the end of the market day by 23 of the farmers before they tried other
7 solutions, so as to reduce the unsold risk as a whole.

8 The farmers were then asked if they would be willing to donate all their unsold produce, or if they
9 would do so for a small incentive, such as a reduction in the cost of the market space, waste
10 collection, electricity and so on. Vague replies were given by 11 farmers, four said they would be
11 willing to donate their waste produce, four preferred to sell for a lower price or use it themselves.
12 Almost 50% stated they would be willing to apply waste management improvement strategies if
13 the incentives and/or subsidies were to be implemented. The respondents scored the incentives
14 on a ten-point Likert scale with 1 being not interested and 10 very interested. A reduction in the
15 market space fee and lower waste collection costs were considered the most important incentives
16 in the Porta Palazzo area, whilst the electricity bill scored less (median value 9) (Table 4).
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22 **Table 4. Farmers' Preferences for Proposed Incentives**

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27 Moreover, 27 out of 35 farmers pointed out that their willingness to donate would depend on
28 such donations being managed by accredited public institutions.
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30 **Discussion and Conclusions**

31 The sample varies in terms of age, gender, and education. Most of the farmers lived in the Turin
32 area and highlighted the importance of farmers' markets in urban areas, both in terms of social
33 sustainability through maintaining agricultural activities and environmental sustainability through
34 local agricultural production.
35

36 The survey demonstrated that not only is the food waste phenomenon present in this market
37 area, but also the phenomenon of unsold food. All of which does cause some concern, especially
38 among younger farmers (those under 40). There is a strong awareness of the ethical aspects
39 connected to the redistribution and use of unsold food. This generates a positive result in the form
40 of donations or the consumption of food amongst family members/friends. However, it also
41 revealed a lack of knowledge as to initiatives dedicated to waste food reduction in Turin. Less than
42 half of the farmers included in the study knew anything about the most widely implemented food
43 waste reduction initiative, the *Banco Alimentare* project. Some farmers place importance on the
44 implementation of early control activities related to the management of food waste during the
45 harvest phase. However, they were exceptions and most of the farmers considered the
46 management of unsold food a priority only at the end of market day and all of them have some
47 kind of *personal strategy* to reduce the amount of unsold produce, even if this is mainly for
48 economic reasons. Moreover, the farmers did not consider waste collection to be a means of
49 reducing the amount of unsold produce. This behavior shows that the farmers have an *in situ*
50 behavior to manage the "fruits of the land."
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53 It was also noted that the farmers would appreciate incentives if they were to donate their unsold
54 food. In fact, they were interested in obtaining a reduction in the cost of market space and/or
55 waste collection. However, this question was answered by only two thirds of the farmers
56 participating in the study. Therefore, the results are only partial, mainly due to the fact that they
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were not sure that these donation activities would be carried out by trustworthy bodies and they do not really believe that these initiatives are feasible.

In conclusion, following the suggestion of Parfitt *et al.* (2010), the aim of the paper was to understand whether the farmers are aware of the concept of food waste and how they usually manage it and their unsold food. In line with what was observed in Beausang *et al.*'s (2017) study, most farmers are not worried about food waste/unsold food and have difficulty in providing estimates. Moreover, they have little or no knowledge of initiatives dedicated to fighting these phenomena. Nevertheless, these data showed that the farmers implemented different "tailor-made" unsold food management systems, that even managed to reach a zero-waste goal. This behavior demonstrated that farmers have a sensitive attitude to the question and pay unconscious attention to food products in order to limit waste to a minimum.

Implications, limitations, and future research

Current literature on food waste and farmers' activities remains scant, with various aspects still to be assessed. Indeed, this study showed that the farmers themselves implemented personal unsold food management systems aimed at reducing food waste.

From an academic point of view, this study contributes to a more in-depth understanding of one of the most important players the food supply chain, farmers. Following the suggestion of Parfitt *et al.* (2010) and the study of Peira *et al.* (2018) the research gives some insight into the behavior and attitude of farmers and the food waste phenomenon with particular reference to marketplace, which is still an under investigated perspective.

From a managerial point of view there are two main contributions: the first one is in terms of policy makers and institutions, while the second one involves the customers. Policy makers and institutions that understand the behavior of farmers can implement ad hoc initiatives to reduce food waste and assist the work already done by farmers. On the other hand, customers can be helped by farmers in understanding products better and using them in a more efficient way, thereby also reducing food waste.

However, the study does have some limitations such as the fact that the sample was limited to the farmers operating in the Porta Palazzo Market. The information analyzed is limited to only certain aspects of foodstuff waste management and selling processes, for example the uncertainty of daily unsold produce or the fact that no comparison was made between farmers and market traders in the selling phase, making it impossible to identify whether or not their attitude toward the management of unsold food differed.

Although this is a preliminary study, it was based on lengthy research and reported on one of the largest European open markets.

Further studies are ongoing to clarify whether or not farmers and market traders have a different attitude to this phenomenon. Such studies will focus on the analysis of market traders and farmers in numerous markets involving a larger geographical area. Moreover, the second part of the research will investigate the point of view of customers in the same market areas according to the perception of food waste and service quality since some studies go into depth in understanding the point of view of customers as well as the relationships between their emotions and the perception of service quality (Kashif *et al.*, 2015).

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Table 1. Description of the Sample

	No.	Min	Max		No.	Min	Max
SAMPLE	35			MARKET DAYS PER YEAR		0	35
				> 200	8		
AGE		21	69	161-200	11		
< 40	6			121-160	8		
40 - 49	10			81-120	5		
50 - 59	12			41-80	2		
> 59	7			< 40	1		
AVG	48.77			PROVINCE OF RESIDENCE		0	35
NATIONALITY		0	35	Torino	25		
Italian	34			Asti	1		
Rumanian	1			Cuneo	5		
GENDER		0	35	Vercelli	3		
Male	24			Verbano Cusio Ossola	1		
Female	11			DISTANCE (km)		0	35
EDUCATION		0	35	< 10	2		
Compulsory Education	18			10-19	19		
High School	17			20-29	6		
LICENSE		0	35	30-39	2		
Permanent Position	28			40-49	3		
Daily Space	7			> 50	3		

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Table 2. Concern regarding Food Waste

	Min	Max	Median value
Whole sample	1	10	6
< 40	5	9	7
40-49	1	10	5,5
50-59	1	10	5,5
> 59	1	10	2

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Table 3. Better Food Waste Management and Its Potential Advantages

	Age	Min	Max	Median Value
Economic		1	10	8
	< 40	1	10	9
	40-49	1	10	8,5
	50-59	1	10	8
	> 59	1	10	9
Environmental		1	10	8
	< 40	5	10	9
	40-49	1	10	7,5
	50-59	1	10	7
	> 59	5	10	10
Ethical		1	10	8
	< 40	5	10	8
	40-49	5	10	9
	50-59	1	10	8
	> 59	5	10	10

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Table 4. Farmers' Preferences for Proposed Incentives

	Min	Max	Median value
Market Place Fee	5	10	10
Waste Collection Fee	5	10	10
Electricity Bill	1	10	9

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