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## **Exploring the Role of Farmers in Short Food Supply Chains: The Case of Italy**

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### **Abstract**

The aim of this paper is to explore the role of farmers in Italy who are involved in Short Food Supply Chains (SFSCs), paying particular attention to sustainability in terms of its social, economic and environmental dimensions. Research is based upon a set of indicators linked to structural and economic aspects, and also to issues relating to employment. ANOVA and MANOVA models are used to highlight farm behaviors within SFSCs about sustainability.

The analysis identified the complex nature of the relationships between farms involved in various short food supply chain schemes regarding the sustainability. While the social dimension is highly important in the case of farmers' markets and multi-chain farms, the environmental dimension is more significant for solidarity purchasing groups and farms selling directly. The economic dimension has a key role in each of the different types. Apart from these considerations, SFSCs have a fundamental place in promoting and achieving sustainability at local level.

**Keywords:** short food supply chains, sustainability, indicators, farmers, Italy.

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## Introduction

The paper focuses on the role played by farmers in Italy who are involved in Short Food Supply Chains (SFSCs), looking in particular at social, economic and environmental aspects and at differences between the markets.

A primary aim of the paper is to make a comparison between the sustainability-related performances of farms taking part in various SFSCs initiatives, in order to identify the elements that define them.

Interest in the topic of the sustainability of farming involved in SFSCs is justified by the fact that they deal with some of the most topical issues within the debate on food and, particularly, the food paradox question; the problem regarding the relationship between global change, availability of natural resources and farm production; the economic and social conflicts that emerge between various players within food chains; and the issue of interaction between cities, as places of consumption, and the countryside, as places of production. An additional factor in Italy is the recent and fast-growing expansion of SFSCs, and, despite channeling only a negligible percentage of the food products sold; they are the subjects of a lively and political scientific debate, with an increasingly knowledgeable public opinion (Marino and Franco 2012; Marino et al. 2012).

In this context, the comparative analysis of the sustainability performance of companies is useful for two reasons. The first reason is that SFSCs provide a very articulate scenery where co-exist different marketing patterns. Every SFSC has its own pattern where the social relation of exchange, as well as economic ones, and the attention on environmental issues looks different, because various are the purposes of people involved. The second reason is that comparative analysis of farms sustainability is a relevant issue for policy-makers who are going to boost the spread of these trade patterns in agricultural products, and to enhance their positive effects at local level and on the communities.

Conceptually, a SFSC can be defined as an agro-food supply chain where there are only a few intermediaries between producer and consumer and/or a short distance, geographically, between the two (Parker 2005). In agricultural markets, SFSCs are, therefore, an alternative to traditional supply chains (Aubry et al. 2008) which refer, instead, to the itinerary followed by a product within the food farming system and concerns the set of agents (businesses and public administrations), the operations that contribute to the creation and transfer of the product to its final stage of use and the relative connected flows (Malassis and Ghersi 1995), where the main players are often wholesale dealers. Literature on the subject highlights that this approach to the agro-food supply chain is based on new metrics, no longer involving mass production, but sustainable development (Morgan and Morley 2002). Indeed, “Alternative Agro-Food Networks” were so named following the refusal of food chain players to accept and adopt the defining elements of traditional supply chains, such as excessive productivity, standardization and industrial organization (Higgings et al. 2008), placing instead a greater emphasis on other aspects, such as quality, origin and the “naturalness” of agro-food production (Renting et al. 2003). In this paper, we refer to the concept of sustainability defined by the World Commission on Environment and Development (1987), which takes into account the interrelation between social,

environmental and economic issues. The short supply chain touches each of these three aspects of sustainability since it can “re-connect” agriculture to consumers (Curry 2002) whether socially, through dialogue and the sharing of information between the parties involved, or economically and environmentally, where agricultural resources are managed with a view of obtaining profits and maintaining public goods, respectively.

Studies on the effect of SFSCs on producers have primarily looked at farmers’ markets, highlighting the various associated social, economic and environmental implications. There is, however, a large amount of literature on the subject. Some studies examine the benefits of SFSCs for agricultural businesses, especially the small farms squeezed between large industries supplying raw materials, on the one side, and the world of wholesale dealers on the other, for whom selling products directly to the end user is both a sensible and a profitable solution (Christensen 1984; Singh et al. 1991; Govindasamy et al. 1998; Brown and Miller 2008). Other works concentrate on the implications of short supply lines established at a local level for consumers, who can, therefore, access fresh, high quality produce at, on balance, relatively low prices, while at the same time re-establishing social relationships with farmers and, in general, with the entire rural world (La Trobe 2001; Lyon et al. 2009). Finally, another aspect often cited in literature, especially in studies adopting a governance-related perspective, is the positive impact of SFSCs on the environment (Murdoch and Miele 1999; DEFRA 2005). Another factor is that, at least in the European Union, public policies concerning the agricultural sector seem to have taken up the challenge of adopting a new perspective for agriculture and food production (Ilbery and Maye 2005). Public policies of the last two decades support a new agricultural model that aspires towards multi-functional, diversified activity (EC 1999 2005). This means that farms must turn towards other functions apart from those typical of food production, for example, by developing ecological, cultural and social services (Henke 2004) while, at the same time, farms are encouraged to introduce economically viable diversification initiatives and agro-environmental measures, and to shift the product processing and sales phases to a local level (Banks and Marsden 2000; Gardini and Lazzarin 2007; Cicatiello and Franco 2008), so that agriculture can actively contribute towards rural development wherever it has a place (EC 1988). This situation is symptomatic of the new European approach towards rural development policies, where planned initiatives are to be extended to all rural-based players, including those not linked directly to agriculture, with a view to establishing an integrated approach throughout the territory (Lowe et al. 2002).

From an environmental point of view, farms that adopt forms of SFSCs tend to implement more sustainable production methods, which in turn have a positive impact on biodiversity, the landscape and the natural resources of the territory (Battershill and Gilg 1998; Cicatiello and Franco 2012). The necessity of diversifying production to meet the consumers’ demand for variety has pushed farmers towards the most diverse farming practices, with the result that they do not specialize in one or two products, but offer, instead, a wide range of different goods. This often leads to rediscovering traditional vegetables, ancient fruit cultivations and dairy products made from the milk of indigenous breeds. The reorganization of production systems can also cover the decision to introduce production methods with lower environmental impact, such as organic farming or integrated agriculture (Bullock 2000). A SFSC, being based on the relationship between farmer and consumer at a local level, can greatly reduce the distance that food has to travel from where it is produced to where it is consumed, and, therefore, limit

external negative factors linked to its transport, such as CO<sub>2</sub> emissions, air pollution, traffic, accidents and noise pollution (DEFRA 2005).

Looking at social reasons, local markets generate a net profit in terms of employment (Bullock 2000). SFSCs present young farmers with the opportunity of developing their activity, while pensioners can earn additional income by taking up farming (Hilchey et al. 1995). In addition, the expansion of sales-related initiatives may require employing workers outside the family to cover the increased need for labor, creating further employment opportunities for people living in rural areas, and promoting in this way a virtuous circle that benefits everyone in the territory (Marino et al. 2013).

Local markets, where relationships are easily made on a personal level and are linked to this shared space (Lyson and Green 1999; Hinrichs 2000), provide the ideal opportunity for exchanging information and opinions about production techniques, the specific characteristics of a product and, more in general, countryside knowledge (Renting et al. 2003). Following these considerations, we could even interpret the spreading of new supply chain forms as a political tool, used to back the will of certain public administrations of retaining agriculture and farming in the areas surrounding towns instead of transforming previously farmed land into urban areas (Aubry et al. 2008).

Economically, farmers taking part in SFSCs can make a significant profit (Brown 2002). They have a direct input on price, which can be determined in a totally autonomous way (Cicatiello and Franco 2008). This allows farmers to regain control over decisions about what to produce (Hinrichs 2000), and so escape from the vicious circle typical of traditional markets. This also means that they can avoid the so-called squeeze on agriculture (Van der Ploeg 2006), namely, the situation whereby farmers are pressed on the one side by their suppliers and on the other by the wholesalers to whom they sell their products, so that they gradually lose their decision-making autonomy. Producers taking part in SFSCs have enhanced entrepreneurial skills in aspects such as customer relationships, marketing and business self-confidence (Feenstra et al. 2003). A further economic advantage is that of immediate financial gain (Vaupel 1989). Through SFSCs, farmers can sell their products during periods of the year when offer exceeds demand (Hardesty and Leff 2009), while, at the same time, continuing to use traditional marketing channels. In this way, placing products without creating a surplus allows farmers to sell their produce for more than they would have obtained from a wholesaler, while consumers can pay less than normal retail prices (Tropp 2008).

This literature review of the influence of SFSCs over producers has highlighted many aspects relating to sustainability and this determined the choice of variables and indicators that were used in our analysis (Battershill and Gilg 1998; Ilbery and Maye 2005; DEFRA 2005; Aubry et al. 2008).

In this context, the first contribution of our paper is to highlight the Italian situation regarding SFSCs. This is important in economic terms, not least for the major role they can play in promoting and spreading the principles of sustainability that are at their core, and as a consequence expanding our knowledge and helping to outline a framework to be used when defining any legislation to regulate and promote these complex realities. A second contribution is

to initiate a thought process about which indicators can be used to evaluate the sustainability of these supply chains.

## Methods

The data used were gathered by means of a direct survey. The first phase of the research involved identifying the variables to be used for evaluating SFSCs and their impact on the territory, in terms of both farming and communities. Focus groups were employed to identify the territorial cases (cities), types of SFSCs and farms. Two focus groups were set up, the first involving the supply chain stakeholders and the second scholars and academics. The survey took in consumers, producers and possible organizers, and included face-to-face, in-depth and mail-based interviews. Regarding the interviews conducted with farmers, in order to ensure that it was possible to compare data that had emerged from different forms of short supply chain, we prepared a questionnaire organized into a number of phases. First, we carried out a survey to identify the knowledge acquired from previous surveys, derived in part from the joint experience of the research group in organizing and managing similar surveys. Keeping in mind the objectives of the survey, we then organized the sections of the questionnaire as follows: a) a first series of questions about the “story” and the reasons linking producers to the short supply chain about which they were being interviewed; b) a second series of questions about their perception of the social, environmental and economic effects resulting from their involvement in that specific short supply chain; c) a final section going into further detail about their farm and its operations, asking information about the farmers themselves and the structure of their farm. The final version of the questionnaire containing 11 questions is the result of complex fine-tuning work to the previous versions that were tested on the focus groups to ensure their functionality. The direct survey involved 226 producers<sup>1</sup>, selected according to territorial distribution and to the typology of short chain (Table 1). The sampling was random. Of these, 203 were sent to the producers directly, while the others were compiled electronically using the NRN INEA program.<sup>2</sup>

In Italy, there are now 270.497 farms that sell directly to consumers, representing 26% of the total number of farms (up from 22.1% in 2007, and 5% more than in 2000), with 1.367 *Farmers' Markets*, which increased by 44% over the past two years and 890 *Solidarity-Based Purchasing Groups* (Marino and Cicatiello 2012).

Among the different types of supply chain, the largest category is represented by *Farmers' Markets* (FMs) with 137 producers being surveyed, followed by *Solidarity Purchasing Groups* (SPGs) (37 farmers) and by the category of *Farms Selling Directly* (FSD) (30 farmers). A decidedly smaller number of producers were detected for the *Box Schemes* (BS) and *Community Supported Agriculture* (CSA) categories (8 and 4 units, respectively). In addition, there is a special category defined as *Multi-Chain Farms* (MCFs) (10 farms), which identifies producers participating indistinctly in several markets.

<sup>1</sup>The survey was carried out within the framework of a project financed by the Italian Ministry of Agriculture, Food and Forestry, and coordinated by CURSA, the Inter-university Consortium for Socio-economic Research.

<sup>2</sup> The NRN INEA programme is Italy's contribution to the larger European project (the European Network for Rural Development ENRD), which studies and integrates all activities linked to the development of rural areas in the period between 2007 and 2013.

**Table 1.** Number of farmers involved in the analysis.

Type of Market	Definition	Cities						Total
		Lecce	Pisa	Rome	Turin	Trento	Other	
Box Schemes	Sales method whereby the farmer sends produce directly to the homes of participating consumers.			6	1	1		8
Community Supported Agriculture	Commercial partnership between one or more farmers and a network community of supporters/consumers			2		2		4
Farmers' Markets	Markets where farmers sell their produce directly exclusively to end users.	26	6	68	20	15	2	137
Solidarity Purchasing Groups	Consumers meeting to purchase farm produce from farmers and then distribute it among the group.	2	8	18	3	4	2	37
Farm Selling Directly	Sales taking place within the farm buildings and typically involving one or two products in which the farm specializes.	5	6	9	2	2	6	30
Multi-Chain Farms	Farms that sell simultaneously through various short supply chains						10	10
<b>Total</b>		<b>33</b>	<b>20</b>	<b>103</b>	<b>26</b>	<b>24</b>	<b>20</b>	<b>226</b>

At the territorial level, most farmers were interviewed in the markets of Rome (103 units), while in the remaining markets, significantly fewer farmers were detected, varying between a minimum of 20 interviewed in Pisa to a maximum of 33 in Lecce. About 45% of the surveyed farms, the production methods adopted have a low environmental impact<sup>3</sup> and for almost 40% of them, a significant share of areas in permanent meadows and pastures are included within their cropping systems, while the farms with land falling within areas of ecological interest or with wooded areas are significantly less (17% and 20%, respectively). The average age of the farmers being interviewed is quite low (41 years old) and as many as 67% of the farms are run by young entrepreneurs, most of whom are male. The average size of farms is quite large (about 25 hectares) and more than half of those surveyed cover around 17 hectares. The farms with meadows and pastures are larger (about 52 hectares), while farms with orchards or fruit-bearing trees are much smaller (about 7 hectares). Farm produce mainly concerns fruit and vegetables, while other significant products include processed fruit and vegetables and olive oil, produced by about one-quarter of the farms, and dairy products. Livestock, however, plays a decidedly minor role compared to plant crops. Among the surveyed farms, many are deeply involved in activity seen as complementary to agriculture in a stricter sense. The sustainability analysis was carried out by first comparing the performance of the surveyed farms with that of all farms nationally in relation to the indicators used, and then the differences between markets.

<sup>3</sup> The low environmental impact production method is an indirect evaluation approach to identify farms that respect the EU agri-food measures, referred to biological production (Regulation no. 834/2007).

The research is based upon a set of indicators relating to structural, employment and economic aspects. Despite not considering all the issues included within the definition of sustainability, this set of indicators should include a combination of the three spheres of sustainability. According to the United Nations Department of Policy Coordination and Sustainable Development UN DPSCD (1996), environmental sustainability is the capacity of retaining the quality and capability of reproduction of natural resources; social sustainability is the capacity of ensuring equally distributed human comfort (in relation to class and gender); and economic sustainability is the capacity of generating income and employment to support the population.

The indicators chosen for the study are those most frequently used in studies on sustainability. The many attempts to measure sustainable development can be classified into four types (Zezza 2013): 1) Set of dashboard indicators; 2) Composite indices; 3) “Corrected” GDP measures; 4) Indices concentrating of measuring over-consumption of resources.

The indicators used in the paper are dashboard indicators and were chosen by adopting as main references the most frequently cited examples in the literature on short supply chains in terms of the environmental, social and economic impact (Battershill and Gilg 1998; Ilbery and Maye 2005; DEFRA 2005; Aubry et al. 2008; Marino et al. 2013). During the literature review phase, several hundred indicators relating to the themes of analysis outlined previously were initially taken into consideration. These were subsequently analysed and classified, until a manageable set of indicators was obtained.

The environmental themes were associated with the natural resources to be assessed in terms of sustainability. The general objective of this group of indicators was above all to evaluate the availability and use of a natural resource, linking this to farming activity. Environmental sustainability takes into account the way farmland is cultivated, farmland falling within protected areas and distance from city centres.

In terms of social sustainability, we considered the impact that the production system has on the life of people and their organization. The starting point was the farm and therefore the farmer and the farmer’s family, then extending the field of observation to aspects linked to sustainability in order to identify and, as far as possible, measure, the impact on the various social players. The indicators used to measure the social sustainability of SFSCs focus on employment and, in particular, they look at the number of young employees, female workers and entrepreneurs, family workers, employees with disabilities and pensioners.

The sustainable behaviour of agricultural entrepreneurs can be evaluated through the group of economic indicators, verifying, on the one hand, that short supply chains entail a different pathway of development for the farm and, on the other, that the ensuing value is not simply ethical but also economic. Economic sustainability is given by several indicators, which refer to standard output<sup>4</sup> (standard output vegetables, standard output olive trees and grapevines, standard output fruit-bearing trees, etc.), multiplied by the use of farmland.

<sup>4</sup> Standard output is the economic principle at the basis of the European classification of farms, and is known as the Community typology for farms. The purpose of the Community typology is to provide a classification format to analyse farms within the Community in terms of economic criteria and to make a comparison between farms belonging to different classes and between the economic results achieved over time and in different member States and their regions.

The analytical system first examined the specific characteristics of the surveyed farms in comparison to all Italian farms, followed by a comparison between farms within the short supply chain.

The methodology made use of ANOVA and MANOVA models/CVA (Canonical Variable Analysis). The Analysis of Variance (ANOVA) is a statistical inferential type procedure used to evaluate the differences between two or more groups by comparing the variability within the groups (Variance Within) with the external variability or with the variability between groups (Variance Between).

In the study at issue, the ANOVA was mainly used to evaluate differences within groups or between the specific variables of each group, while the multivariate version (MANOVA) was used to evaluate differences between groups, investigating the relations between variables and groups. The scatter-plot CVA was used to represent the elements of each group on the main components plane, highlighting the associations between the distribution of the groups in space and the orientation of the variables with regard to the main axes.

This made it possible to explain the differences observed between groups in the MANOVA analysis, highlighting the correlations with the most important variables according to the weight (cumulative variance) of the axis, ignoring the non-significant associations. To avoid the analysis being affected by the non-uniform distribution of the respondents, the least representative chains in terms of farms, specifically Box Schemes and CSA, were merged into a single category called BS-CSA, meaning that the statistical significance of the elaboration is increased. The comparison between the two levels of analysis (multivariate and group level) then was both the inspiration and the basis for explaining the farmers' participation in short chains according to the aspects being examined (environmental, social and economic).

The ANOVA and MANOVA models were used to highlight the differences between farms within the short supply chain; however, the lack of a statistical basis of comparison meant that it was not possible to use the same method to compare the characteristics of the farms being surveyed with all farms nationally.

## **Farmers and Sustainability**

Before illustrating the differences between the environmental, social and economic performance of farms participating in SFSCs, it makes sense to try and understand whether there are differences between the farms surveyed and the universe of farms at a national level<sup>5</sup>, in the light of the indicators used. Useful information could emerge about the specific aspects of the farms being surveyed, in relation to the topic being covered.

First, a key issue is that the indicators used for the analysis of sustainability record higher values for the surveyed farms compared to the equivalent values recorded for the farms at national level.

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<sup>5</sup> The information relating to national farms has been extracted from the 6<sup>th</sup> General Census of Italian Agriculture by ISTAT (2010).

From an environmental point of view, the value of the index of evenness<sup>6</sup> (equal to 0.5) highlights that the surveyed farms show a good level of crop diversification. About 75% of the areas produce at least three different types of crop (against 28% nationally) and as a result, there is less use of monoculture practices and probably an improvement in overall biodiversity. In terms of UAA (Utilized Agricultural Area), 40% of the areas are cultivated using organic methods, a value well above the national average (9%), and this is probably determined by the demand on the part of consumers for SFSCs that focus on quality products, while observing with increasing interest the principles of organic and ecological farming. In addition, the areas with permanent meadows and pastures are even more substantial (67% of the total), which is higher than the national value (27%), confirming that, in this circumstance, agri-environmental policies relating to the conservation of semi-natural areas in the territories where the surveyed farms are located are indeed effective. These policies are important because they improve the environment where farming takes place. Forest areas, on the other hand, affect the surveyed areas less (29% of the total), but this is still significant compared to the national scene (18%). Similarly, farmland falling within protected areas is even less (13% of UAA), but still more than the national value (8.6%). Despite benefitting from the spread of protected areas in the suburban belt surrounding some cities, this figure indicates a positive impact on the relationship between farming and environmental protection, especially when considering that the persistence of agricultural production processes is positive for the environment and biodiversity in these areas. The farms are located near main markets, and the average distance from the market is about 25 km. According to these data, there may be a framework in which farms that join forms of SFSCs tend to develop more environmentally sustainable practices, which in turn have a positive impact on biodiversity, landscape and the natural resources of the land. In this sense, SFSCs provide an opportunity to reduce the negative external factors of agriculture.

In terms of social sustainability, the surveyed farms employ, on average, six people, including two family members and two female workers. The WU/UAA ratio (Utilized Agricultural Area to Working Unit) shows relatively low values, due to the high incidence of labour-intensive crops in the production system, such as fruit and vegetables, as well as complementary activities, in particular food processing, which is highly labour-intensive. Family workers and women are 34% and 35% of the labour force, respectively. The proportion of young workers, despite being at lower levels (25% of the total) is still quite significant, while the percentage of disabled workers and pensioners is rather marginal. Compared to the employment structure overall in Italian farms, the number of women employed within business operations taking part in SFSCs is not particularly high. The presence of young people, traditionally fairly rare within the agricultural sector nationally, seems instead more widespread here. The data may indicate that these innovative forms of marketing are chosen and implemented mainly by new generation

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<sup>6</sup>The index of equipartition is a statistical index deriving from the Shannon Weiner Diversity index denoted by  $H'$ , which measures the diversity of a population with a finite number of elements, where  $p_i$  is the proportion of the  $i$ th species ( $\sum p_i = 1$ ) and  $R$  is the number of species. In the article under examination, the species or element is represented by the relation (proportion) between the area covered by cultivation and the utilized agricultural area (UAA) of the farm.

Dividing  $H'$  by the maximum possible value  $H'_{\max} = \log(s)$ , we obtain an index between 0 and 1 called evenness or index of equipartition, where the maximum value (1) is linked to an area dominated by a single type of cultivation and the minimum value (0) to an area where all types of cultivation are equally represented.

farmers. The short chain thus offers good opportunities for young entrepreneurs to develop their activities and leads to the employment of people outside their immediate family to cover the increased need for labour, creating more job opportunities for residents of rural areas. There is, however, the problem that SFSCs seem less capable of providing additional income to pensioners involved in agriculture or employment opportunities for the weaker elements of the workforce, such as people with disabilities, and this definitely limits their social impact in terms of the employment of weaker sections of the population.

From the perspective of economic sustainability, the farms being surveyed show higher average values in terms of produce ready for consumption, such as horticultural crops (€144,845), and to a lesser degree, fruit-bearing trees (€35,154) and oil and wine products (€31,387). Other types of crops show considerably lower values, with the exception of beef products. Compared to the national picture, farms specializing in horticultural products that sell through short supply chains reveal a higher standard output than that recorded for the horticultural sector nationally (€81,137). These data are repeated for animal-based products, in particular beef (€17,637 against €6,402) and sheep (€5,782 against €1,487). On the contrary, farms specializing in oil and wine products show lower values than the national level (€43,487). There is no appreciable difference for the other farm produce.

With regards to the comparison between the chains, our analysis suggests that there is a substantially varied situation, which changes according to the various aspects of sustainability.

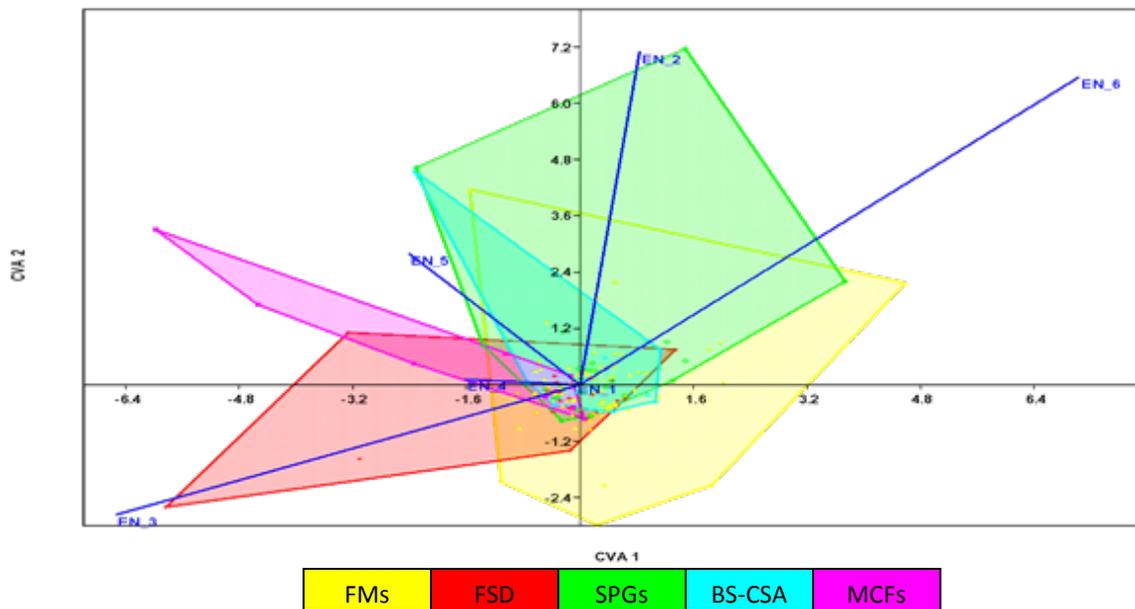
Table 2 (see Appendix 1) shows the synthetic results of the surveyed farms involved in SFSCs. The descriptive statistics highlight a relatively heterogeneous situation regarding sustainability in the surveyed farms. In this respect, in terms of environment, the index of farm diversification EN\_1 shows that the sample of farms presents, on average, a high level of horticultural diversification and that this value is more representative than other indicators of environmental sustainability based upon the observed relative variability. The indicators EN\_3 and EN\_4, instead, show the greatest variability within the sample. With regards to the social dimension, the most representative indicators are those that refer to female entrepreneurs SO\_4 and to family workers SO\_5, while the indicator SO\_7 is the least significant. The indicator that refers to female employment SO\_6 shows a certain level of variability. In terms of the economic dimension, all the indicators considered are greater than one and, as a consequence, there is a reasonably high level of variability.

Going on to the comparison between the farms surveyed<sup>7</sup>, in environmental terms, first there is a clear high variability between most of the surveyed markets (Table 3, see Appendix 2): all markets (except BS-CSA) have well-defined characteristics and their averages are significantly different from one another<sup>8</sup>.

<sup>7</sup> Below are the results of the MANOVA analysis, while for the result of ANOVA analysis the readers are invited to contact the Authors.

<sup>8</sup> Significance values (Hotelling's p-values) are referred to the whole set of indicators reported in the first row of each table, under section a).

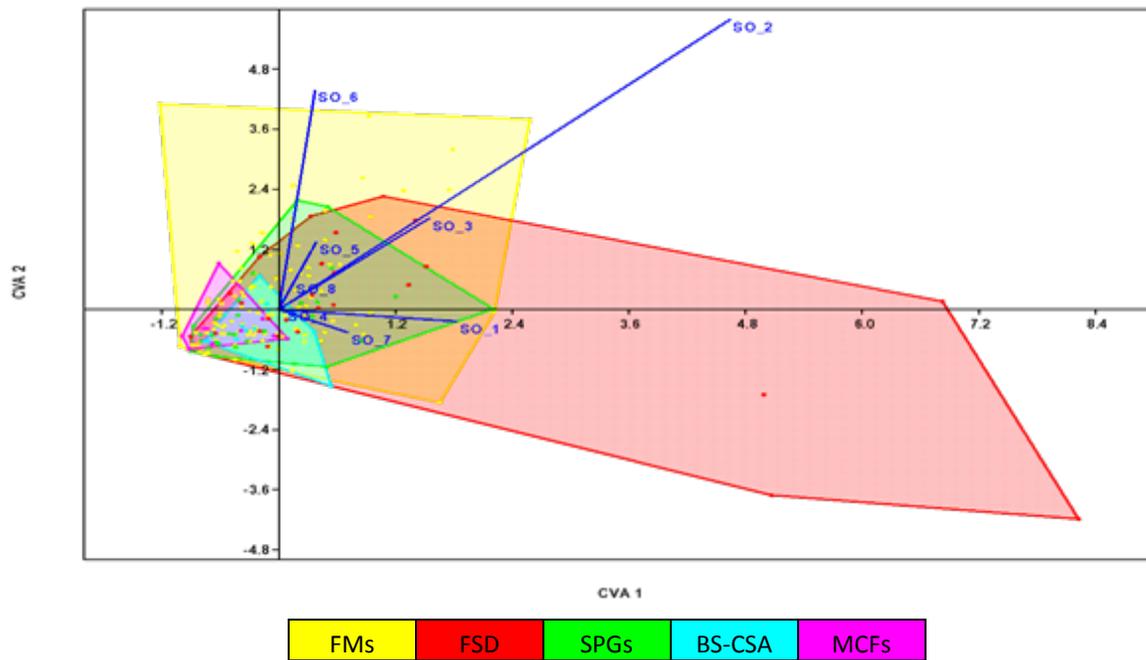
As seen in Figure 1, most of the farms have relatively low values (proximity to the centre of the axes) and only a few others show very high values that determine the direction of the polygons. Both the axes have a significant weight and globally explain around 86% of the observed variability. However, the indicators show a relatively good capacity in selecting the groups, as there is highly specific correspondence between the supply chain schemes and the most closely associated variabilities, specifically, FMs with EN\_6, EN\_2, FSD with EN\_3, SPGs with EN\_2 and EN\_6, BS\_CSA with EN\_5, MCFs with EN\_4 and EN. The group of FM producers is, on average, correlated with the variable that refers to the distance from outlet markets EN\_6, so that it may be assumed that this type has the great ability to attract farms located further from the market. Among the farms with the largest areas cultivated organically EN\_2, some elements belonging to the SPGs stand out, while the farms with the largest crop areas falling within protected areas EN\_3 are included in types FSD and MCFs, with the latter also including some farms with areas of meadows, pastures and woods EN\_4. The indicator EN\_1 does not define any category. Among the supply chains, some variability is shown in groups FMs and SPGs between variables EN\_6 and variables EN\_1, EN\_3, EN\_5, leading us to suppose that farms further from the markets have a higher environmental value than those located nearby.



**Figure 1.** Scatter-plot of environmental sustainability indicators

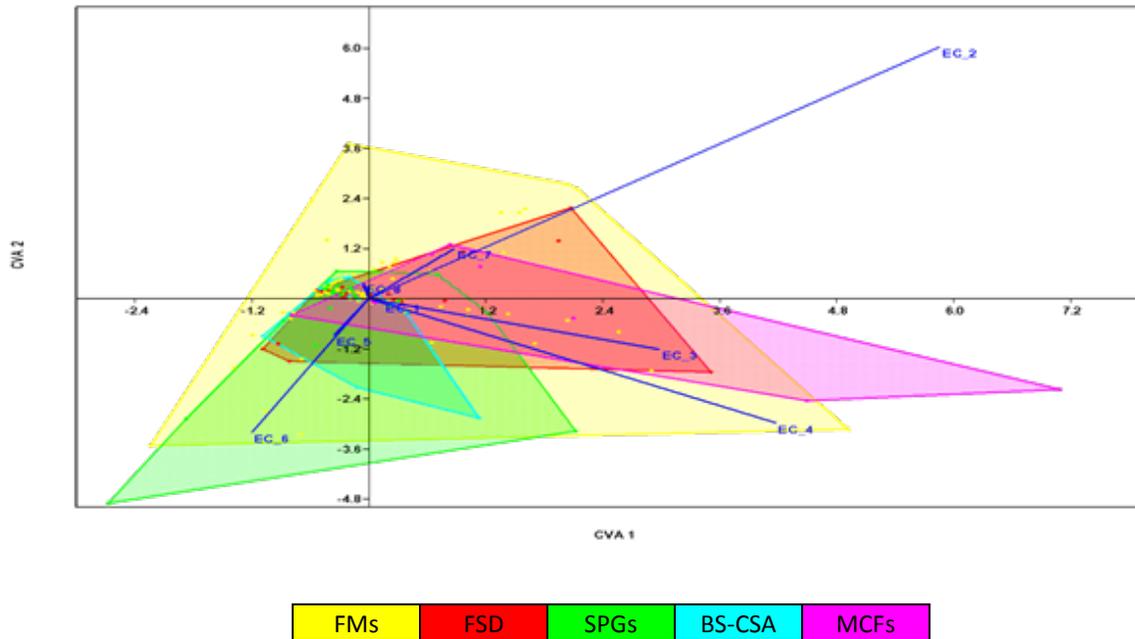
Concerning social sustainability, the data highlight that there is certain heterogeneity between the various types of supply chain. Categories FSD and FMs show average values that are significantly different to each other (Table 4, see Appendix 3). This are associated to a more readily available workforce SO\_2 for the first group and a higher female employment SO\_6 for the second (Figure 2). Between the two correlations, the first is significantly more important, as it is associated mainly to the first horizontal axis, explaining great part of the variance observed (78%). After the size of the workforce, the other significant variables are SO\_3, which refers to the number of entrepreneurs and young workers, and SO\_1, which refers to the relationship

between workforce units and utilized agricultural area. Both variables are associated positively to types SPGs and FSD, although the latter shows some outliers that determine higher average values compared to the former. The ANOVA analysis also highlights significant differences between the workforce (SO\_2) and the other variables within types FMs, FSD, SPGs and BS\_CSA, confirming the priority of this indicator within the framework of reference. The situation within the MCFs is more complex, and here there is more variability among the indicators, except for the indicator SO\_2.



**Figure 2.** Scatter-plot of social sustainability indicators

In terms of economic sustainability, the differences between the markets are limited and only the MCFs recorded substantially different average values than those of the FMs and SPGs (Table 5, see Appendix 4). From Figure 3, it is clear that the first principle axis explains nearly two thirds of the total variance observed and is linked to not very significant averages that confirm a substantially similar situation. FMs are, in any case, the most coherent group according to the measure adopted. MCFs, however, record higher standard output values for two groups, horticultural (EC\_2) and fruit (EC\_4) crops, and for oil and wine production (EC\_3). FMs and SPGs show, on the other hand, output values that are on average higher for livestock (EC\_6). Within the supply chains, among the FMs there a significant variation between the variable EC\_2, with the highest values, and the other variables, while among the SPGs there are differences between the indicators relating to livestock, and specifically the variable EC\_6, that has a higher than average difference from EC\_8.



**Figure 3.** Scatter-plot of economic sustainability indicators

## Conclusions

The analysis carried out in this paper provides the means to reflect upon the very real possibility that SFSCs promote the spreading of the most sustainable production models and, if this is indeed the case, also upon the most effective policies to support these initiatives, or, on the contrary, upon those that are most useful in strengthening this aspect. The continued great interest in the expansion of SFSCs, not just in Italy, lies in the analytical possibilities that are opened when addressing them. Detangling the short supply chains includes discussions about food and nutrition, producers and consumers, the environment and social relationships. It basically involves addressing a series of complex inter-related topics that are concerned with the economic, environmental and social spheres. This becomes even more important at the point when expressions such as “short supply chain” or “zero miles” become part of everyday language, or are used by business and institutions that often apply them in a simplified way which may be effective within their own specific contexts but are, in general, partial and used without sufficient thought.

It should be further emphasized that this paper does not pretend to set out a categorical measurement system of sustainability but, on the basis of the indicators used, it only attempts to highlight the most significant differences between farms that take part in the various short supply chain schemes, in function of the three main aspects of sustainability.

From the analysis, a clear difference emerges between farms that participate in the various short supply chain schemes when various aspects of sustainability are taken into consideration. While the role played by the social dimension is important for initiatives regarding *Farmers’ Markets* and *Multi-Chain Farms*, the environmental aspect is higher for *Solidarity-Based Purchasing Groups* and in *Farms Selling Directly*. In addition, the economic dimension – particularly at a

farm level – plays a key role in each of the different typologies. SPG farmers in particular show a clear preference for almost all the dimensions of sustainability, placing special attention on the size of the areas cultivated using organic production methods, the intensity of the work, the presence of young farmers and a young workforce and income from livestock. FM farms are defined by the number of family workers and, to a lesser extent, by a slight economic vitality, as shown by the income from the livestock sector. Farms with direct sales pay more attention to the environmental aspects relating to the amount of farmland falling within protected areas and to employment. MCF farms are defined, from an environmental point of view, by the farmland falling within protected areas, as well as by the presence of meadows, pastures and woods. From an economic point, these farms stand out for the value of their fruit and vegetable production and for that of their oil and wine. Nevertheless, SFSCs are fundamental in promoting and achieving sustainability at a local level.

In wishing to point out the limits of this study, first, it was not possible to carry out a rigorous comparative analysis at the provincial level, as there was no statistical data available to make a comparison with the data gathered in our survey. It was not possible to use our indicators to measure sustainability through a points system and it was also not possible to understand whether the farms surveyed can be considered sustainable or not under the three aspects of sustainability. We also still seek to understand whether participating in a short supply chain scheme is a key factor of sustainability, but this could be assessed by making a comparison between the performance of farms operating with short supply chains and those selling through traditional channels.

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## Appendix 1

**Table 2.** Sustainability indicator values (descriptive statistics)

Dimensions of sustainability	Indicator	Description	Mean	Median	Standard dev.	Coefficient of variation
Environmental dimension	EN_1	Diversified farmland	0.55	0.65	0.39	0.70
	EN_2	Farmland cultivated using organic production methods (hectares)	23.06	0.00	57.93	2.51
	EN_3	Farmland falling within protected areas (hectares)	6.03	0.00	27.16	4.50
	EN_4	Farmland occupied by meadows and pastures (hectares)	13.40	0.00	72.62	5.42
	EN_5	Farm land planted to forest (hectares)	5.77	0.00	9.14	1.58
	EN_6	Distance from the city centre (kilometres)	24.79	14.50	30.33	1.22
Social dimension	SO_1	WU/UAA ratio	0.43	0.23	2.79	6.44
	SO_2	Total number of employees	6.00	3.00	14.75	2.46
	SO_3	Number of young farmers and young employees	2.00	1.00	3.47	1.74
	SO_4	Number of female farmers	0.54	1.00	0.49	0.90
	SO_5	Number of family employees	2.00	2.00	1.84	0.92
	SO_6	Number of female employees	1.54	1.00	9.49	6.16
	SO_7	Number of employees with disabilities	0.08	0.00	0.95	11.20
	SO_8	Number of employed pensioners	0.14	0.00	0.63	4.63
Economic dimension	EC_1	Standard Output Cereals (value in €)	6,695	0.00	28,024	4.19
	EC_2	Standard Output Vegetables (value in €)	144,850	8,567	293,743	2.03
	EC_3	Standard Output Olive trees/Grapevine (value in €)	31,387	0.00	61,330	1.95
	EC_4	Standard Output Fruit-Bearing Trees (value in €)	35,154	0.00	83,075	2.36
	EC_5	Standard Output Meadows/Pastures (value in €)	10,067	0.00	54,446	5.41
	EC_6	Standard Output Cattle (value in €)	17,636	0.00	54,810	3.11
	EC_7	Standard Output Sheep (value in €)	5,782	0.00	38,760	6.70
	EC_8	Standard Output Poultry (value in €)	1,842	0.00	14,026	7.61

## Appendix 2

**Table 3.** Indicators of environmental sustainability

**a) Mean Values**

	EN_1	EN_2	EN_3	EN_4	EN_5	EN_6
Farmers' Markets	0.45	12.92	3.64	13.83	1.27	32
Farms Selling Directly	0.56	26.05	17.78	27.45	3.17	21
Solidarity Purchasing Groups	0.58	28.99	1.70	23.96	4.41	28
Box Schemes and Community Supported Agriculture	0.42	22.13	2.34	25.40	3.84	22
Multi-Chain Farms	0.51	12.27	21.10	42.96	12.30	12

**b) Values of significance (Hotelling's p-values)**

	Farmers Selling Directly	Solidarity Purchasing Groups	Box Schemes and Community Supported Agriculture	Multi-Chain Farms
Farmers' Markets	0.0657	0.0352	0.6906	0.0002
Farms Selling Directly		0.0122	0.4272	0.0479
Solidarity Purchasing Groups			0.8319	0.0042
Box Schemes and Community Supported Agriculture				0.1468
Multi-Chain Farms				

**Note.**

EN\_1 \_Diversified farmland

EN\_2 \_Farmland cultivated using organic production methods

EN\_3 \_Farmland falling within protected areas

EN\_4 \_Farmland occupied by meadows and pastures

EN\_5 \_Farmland planted to forest

EN\_6 \_Distance from the city center

Level of significance ( $\alpha \leq 0.05$ )

### Appendix 3

**Table 4.** Indicators of social sustainability

		SO_1	WU/UA	SO_2	SO_3	SO_4	SO_5	SO_6	SO_7	SO_8
<b>a) Mean Values</b>										
Farmers' Markets		0.5		6.2	1.2	0.23	2.3	2.5	0.3	0.0
Farms Selling Directly		2.1		9.3	2.8	0.30	2.4	2.2	0.4	0.7
Solidarity Purchasing Groups		0.5		4.9	1.7	0.22	1.9	1.3	0.2	0.1
Box Schemes and Community Supported Agriculture		0.3		4.3	0.9	0.25	2.0	0.9	0.0	0.3
Multi-Chain Farms		0.2		1.8	0.5	0.30	1.3	0.7	0.1	0.0
<b>b) Values of significance (Hotelling's p-values)</b>										
	<b>Farmers Markets</b>									
Farmers' Markets				0.0005	0.8345	0.8440	0.7094			
Farms Selling Directly					0.0252	0.1897	0.0654			
Solidarity Purchasing Groups						0.9858	0.9381			
Box Schemes and Community Supported Agriculture							0.9708			
Multi-Chain Farms										
<b>Note.</b>										
SO_1_WU/UA										
SO_2_Total number of employees										
SO_3_Number of young farmers and young employees										
SO_4_Number of female farmers										
SO_5_Number of family employees										
SO_6_Number of female employees										
SO_7_Number of employees with disabilities										
SO_8_Number of employed pensioners										

**Table 5.** Indicators of economic sustainability  
**a) Mean Values**

	EC_1	EC_2	EC_3	EC_4	EC_5	EC_6	EC_7	EC_8
Multi-Chain Farms	10,196	176,228	82,317	110,913	7,904	4,518	21,967	300
Box Schemes and Community Supported Agriculture	5,308	32,368	7,617	33,709	25,395	28,073	0	1,126
Farmers' Markets	7,117	92,214	20,206	20,002	10,961	12,446	10,826	3,025
Solidarity Purchasing Groups	9,567	39,783	21,949	18,597	19,450	38,456	3,557	587
Farms Selling Directly	19,635	61,040	18,294	22,927	29,465	22,297	19,993	296

**b) Values of significance (Hotelling's p-values)**

	Farmers Markets	Famers Selling Directly	Solidarity Purchasing Groups	Box Schemes and Community Supported Agriculture	Multi-Chain Farms
Farmers' Markets		0.5737	0.4628	0.8513	0.0059
Farms Selling Directly			0.5365	0.8266	0.0948
Solidarity Purchasing Groups				0.9948	0.0250
Box Schemes and Community Supported Agriculture					0.2794
Multi-Chain Farms					

**Note.**

- EC\_1\_Standard Output Cereals
  - EC\_2\_Standard Output Vegetables
  - EC\_3\_Standard Output Olive trees/Grapevines
  - EC\_4\_Standard Output Fruit-bearing trees
  - EC\_5\_Standard Output Meadows/Pastures
  - EC\_6\_Standard Output Cattle
  - EC\_7\_Standard Output Sheep
  - EC\_8\_Standard Output Poultry
- Level of significance ( $\alpha \leq 0.05$ )

