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Assessing the economic, social and environmental impact of collaborative short food supply chains: a producers' perspective

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Abstract

Short food supply chains (SFSCs) have been recently gaining increased popularity. Many are the expectations around their economic, social and environmental impacts on producers, consumers and communities. However, high heterogeneity and informality of SFSCs' initiatives, coupled to the strong interconnection between farms' multiple production processes and distribution channels, make it quite complex to assess their impacts. Indeed, few are the comprehensive analyses of SFSCs' impacts that can be found in the literature, especially with comparisons against long food supply chains (LFSCs). This work presents a qualitative methodology for the assessment of economic, social and environmental impacts of SFSCs and the results from its implementation on 13 European collaborative SFSCs, in the context of the Horizon 2020 EU-funded project "COACH". The methodology is based on actors' impacts self-assessment, implemented during wider direct in-depth interviews to producers and other relevant actors of each SFSC initiative. Results showed that producers perceive SFSCs as having an overall better impact than LFSCs on all the sustainability items analysed. Along the supply chain, farmers give a higher evaluation to the impact of SFSC on private economic aspects than processors and retailers, who in turn give a higher evaluation to the impact of SFSC on the community and the territory. Also, actors from more solidarity-oriented initiatives perceive as higher the impact of SFSC compared to actors from more market-oriented initiatives, especially on societal and territorial aspects. The self-assessment procedure imparts a transformative nature to the evaluation, enabling SFSCs operators to self-assess their performance and identify possible corrective actions, gain awareness on the impacts of their choices and activate a joint reflection within their SFSC initiatives. For future strengthening of SFSCs, practitioners and policy-makers should promote and support collaboration and collective investments between food producers, education and training, peer-to-peer skills and knowledge exchange.

Keywords: Short food supply chains, Impact assessment, Food systems, Transformative evaluation

Introduction

In recent years, short food supply chains (SFSCs) have gained significant popularity. Consumers are increasingly interested in reconnecting with the origins of their food, while farmers and small- and medium-sized enterprises seek to strengthen their position in the value chain and increase their share of value added by bypassing intermediaries. At both European and local level, the contribution of food systems to sustainable local development has been recognised, leading to an increased focus on short food chains also in EU policies and strategies (e.g. the European Green Deal and the Farm to Fork Strategy).

The sustainable transition of agrifood systems finds a privileged place for its realisation at the scale of the local territory (Lopez-Merino and Lamine 2024). Indeed, it is at this territorial level that small farmers and other stakeholders can easily collaborate through broader self-organised processes, leveraging their collective agency to reform institutions, build markets and foster innovation (Lamine et al. 2012, 2019).

The greatest potential for scaling up the impacts of SFSCs on sustainable local development lies in collaborative SFSCs. These involve farmers, consumers, other food chain actors and public institutions working together to develop solutions tailored to specific territorial contexts (Claeys et al. 2021; EIP-AGRI 2015).

Many are the expected economic, social and environmental impacts of SFSCs, both at the private (on producers and consumers) and public (on communities and territories) levels (Kneafsey et al. 2013). However, very few studies have focused on the costs and benefits to farmers and other producers of participating in collaborative SFSCs compared to selling through long food supply chains (LFSCs), and our work aims to contribute to filling this research gap. Indeed, this manuscript presents a qualitative methodology that allows producers to self-assess the economic, social and environmental impacts of SFSCs and LFSCs based on their own perceptions, and the results from its implementation in 13 European case studies, in the context of the Horizon 2020 EU-funded project "COACH".[1] The paper aims to answer the following two research questions: (I) How do producers and other actors in the food chain perceive the economic, social and environmental impacts of participating in SFSC initiatives? (II) How can collaboration and relationships enable producers and other actors in the value chain to jointly maximise the benefits and reduce the costs of SFSCs?

The study is based on in-depth qualitative semi-structured interviews with producers and key actors belonging to the collaborative SFSC initiatives in the sample, and on a self-assessment questionnaire that allowed respondents to self-evaluate their performance in the SFSC initiative and compare it with that in LFSCs. The self-assessment procedure, which is based on individual and collective perceptions from within the initiatives rather than on external measurements, gives the evaluation a transformative character (Cooper 2014; Lopez-Merino and Lamine 2024; Otieno et al. 2023). This allows SFSCs operators to reflect on their individual performance in the different distribution channels in which they are involved, and at the same time activates collective reflection

[1] COACH project—Collaborative Agri-food Chains: Driving Innovation in Territorial Food Systems and Improving Outcomes for Producers and Consumers—(https://coachproject.eu/), European Commission, Coordination and support actions, CALL H2020-RUR-2020–1, Program H2020, Project 101,000,918.

within the SFSC initiatives, leading to collective learning processes, more conscious decision-making and possibly the adoption of corrective measures to consolidate such initiatives.

In the next section, we perform a review of the main literature—first on the topic of economic, social and environmental impacts of SFSCs and then on the different methodological approaches to their assessment—that was the basis on which we built our self-assessment methodology and selected the appropriate impact indicators. We then describe the methodology designed for this study and its application to our sample of collaborative SFSC initiatives. In the following section, we present the main findings of the study and the self-assessment process. In discussion section, we draw some implications from the results in terms of critical and success factors in collaborative SFSCs, and we illustrate some good practices that actors in our sample initiatives have put in place to mitigate the risks and capture the opportunities offered by collaborative SFSCs. In conclusions, we summarise the main findings of our study and draw some policy and practice implications.

Assessing the impacts of SFSCships

The impacts of SFSCs

The sustainability of SFSCs is a strongly debated issue in the recent academic literature, especially in comparison with LFSCs, and has received increasing political attention in view of the beneficial impacts they are likely to have on the economy, the environment and the society as a whole. Indeed, the significant growth of SFSC initiatives has led to a substantial body of research, primarily focused on exploring the characteristics, structures and governance organisation of SFSCs, the potential impact of SFSCs on the economy, the society and the environment, as well as the challenges faced by different actors (Gori and Castellini 2023; Jia et al. 2024).

Economic impacts

Although assessing their economic impacts can be very challenging, many studies suggest that SFSCs can be mechanisms for locally retaining value added, supporting rural development and creating new economic spaces by valorising local attributes such as terroir, traditional knowledge and landraces (Kneafsey et al. 2013; Renting et al. 2003). By reducing intermediaries, SFSCs generate multiplier effects that increase local sales, demand for services and employment (Henneberry et al. 2009; Kloczko-Gajewska et al. 2023; Kneafsey et al. 2013; Otto and Varner 2005). SFSCs such as farmers' markets attract shoppers and tourists to otherwise under-visited areas, amplifying local economic benefits (Kloczko-Gajewska et al. 2023; Kneafsey et al. 2013; Lev et al. 2003; Pearson et al. 2011).

Another commonly reported economic benefit is the increase in producers' incomes. Selling through SFSCs allows producers to bypass intermediaries, process and add value to their products themselves and capture a higher share of the profits (Pearson et al. 2011; Sage 2003).

Most producers are small- and medium-sized enterprises that are less competitive in LFSCs due to scale limits and high unit costs. For them, SFSCs represent a solution to improve profitability, benefiting from consumers' willingness to pay a price premium for

SFSC products (Aubert 2015; Malak-Rawlikowska et al. 2019; Mancini and Arfini 2018). Indeed, the higher quality and freshness of products increase the economic value for consumers too, as food lasts longer and food waste is reduced (Marino and Cicatiello 2012).

From a power dynamics perspective, SFSCs allow farmers to increase their decision-making autonomy and bargaining power by reducing their dependence on upstream and downstream intermediaries (Hinrichs 2000; Marino et al. 2013; Mastronardi et al. 2015; Van der Ploeg 2006).

Despite these potential positive effects, many studies highlight the difficulty for farmers to participate profitably in SFSCs (King et al. 2010). In fact, not all raw products can be sold directly once they are harvested or produced, and for many farmers, the costs of marketing, processing or personally attending the markets may exceed the benefits (Hardesty and Leff 2009; Kneafsey et al. 2013; Uematsu and Mishra 2011). Some authors have argued that particularly in some types of SFSCs, low profitability is "socially accepted", with farmers accepting low profits in favour of the social rewards of direct sales and community interaction, thus undervaluing their labour (Demartini et al. 2017).

As a result, many producers adopt hybrid strategies that combine SFSCs and LFSCs (LeRoux et al. 2009), in order to diversify risk, reduce sensitivity to market disruptions, better manage production surpluses and thus increase farm resilience to external shocks (Balcom et al. 2023; Lucas et al. 2024; Michel-Villarreal 2022). Indeed, many small-scale operators cannot rely solely on SFSCs and need to mix short and long chains for both their upstream (inputs) and downstream (outputs) needs (Ilbery and Maye 2005; Kneafsey et al. 2013; Sage 2003).

As highlighted by Kneafsey et al. (2013), SFSCs offer promising opportunities for some but are not feasible for all. While direct marketing avoids some of the risks of LFSCs, it introduces others and does not always improve profits. Therefore, many producers engage in SFSCs for ethical or ideological reasons, prioritising social and environmental goals over profit maximisation (Jarosz 2008; Sage 2003).

Social impacts

Among the three pillars of sustainability, the social pillar is the most agreed upon by scholars (Demartini et al. 2017). The literature usually identifies three main areas of social impact: trust and social embeddedness, sense of community, and knowledge and behavioural change (Kneafsey et al. 2013).

Building trusting relationships is crucial in SFSC. Consumers often value the friendly atmosphere of their shopping experience and the opportunity to buy directly from someone who is knowledgeable about the product, its origin and production, and who can promptly answer questions. Thus, over time, consumers' trust shifts from the product itself to the farmer (Hendrickson and Heffernan 2002; Mancini et al. 2019).

"Sense of community" is another crucial social dimension of SFSCs, which have the potential to empower and revitalise local communities, increase employment opportunities (including for young farmers and disadvantaged workers), maintain agriculture and farming in peri-urban areas and create new connections between cities and the countryside, helping to avoid food deserts in urban contexts while maintaining populations in rural areas (Aubry et al. 2008; Bullock 2000; Marino and Cicatiello 2012). In addition,

SFSCs can strengthen cultural and regional identities, fostering community pride and social cohesion (Vittersø et al. 2019; Warsaw et al. 2021). However, some studies warn that, in some cases, "alternative" food networks can reinforce social exclusion and structural inequalities, as they often cater to white, middle-class, affluent consumers (Conner et al. 2010; Guthman 2008; Hinrichs and Allen 2008; Warsaw et al. 2021).

The third social dimension affected by SFSCs concerns knowledge and behavioural change. SFSCs tend to foster cooperation across different levels of the supply chain, and small producers can benefit from collaborating with others (Belletti et al. 2024; Kurtsal et al. 2020; Mengoni et al. 2024; Stoeva et al. 2024)—for example, through shared logistics, common delivery systems, collective labelling schemes, and coordinated promotion and marketing efforts—as this helps them access markets that would otherwise remain out of reach (Bouaïcha 2023). This also favours innovation through the exchange of knowledge and practices, and technical relationships among farmers (Kneafsey et al. 2013; Mancini et al. 2019; Mastronardi et al. 2015; Vittersø et al. 2019).

The improved social relations in SFSCs also foster consumers awareness of the organoleptic and territorial characteristics of food, and of production methods, thus enabling them to understand the real cost and externalities of food production and make more sustainable food choices (Malak-Rawlikowska et al. 2019; Mastronardi et al. 2015; Vittersø et al. 2019; Warsaw et al. 2021).

Environmental impacts

The environmental impacts of SFSCs remain the most uncertain of the three pillars of sustainability. The most commonly reported effects in the literature include positive impacts on biodiversity, reduced agrochemical use and waste, and reduced food miles and carbon footprint. However, quantitative evidence on these effects is relatively scarce, due to the difficulty of measuring environmental outcomes and externalities across different types of SFSCs.

SFSCs are likely to have a positive impact on agrobiodiversity. To meet consumer demand for variety—typically offered by supermarkets—producers tend to diversify their production rather than specialise in one or two crops. This often leads to the rediscovery of heritage and traditional varieties and breeds, and a shift towards organic or low-input practices (Bullock 2000; Marino et al. 2013; Mastronardi et al. 2015; Ušča and Aļeksējeva 2023). This is also facilitated by the increased flow of information between producers and consumers, the smaller production scale and the limited logistical complexity that characterise SFSCs.

In SFSCs, farmers tend to adopt more sustainable practices aimed at reducing the negative externalities of agriculture on the environment, such as avoiding the use of pesticides and agrochemicals, preventing water pollution and land degradation, protecting natural habitats, minimising packaging, contributing to the reduction in food waste by selling fresh and high-quality products, and paying attention to animal welfare (Marino and Cicatiello 2012).

One of the most frequently cited positive environmental aspects of SFSCs is the reduced distance between the place of food production and consumption (i.e. "food miles"), which allows to reduce energy consumption and emissions of CO_2 and other

pollutants, improving the environmental performance of food distribution systems (Mancini et al. 2019; Marino et al. 2013; Mastronardi et al. 2015).

Nevertheless, this point remains controversial in the literature. Indeed, many consumers driving small energy-inefficient vehicles to and from local retail outlets to purchase small quantities of food may generate more carbon emissions per kilogram of product than conventional shopping with its large, energy-efficient, fully loaded trucks (DEFRA 2005; Mancini et al. 2019; Vittersø et al. 2019). Furthermore, food miles do not account for other emissions associated with production, processing and storage, which are still part of the food production and distribution system. Similarly, while the term "local" appeals to consumers and may be interpreted as a proxy for reduced transportation emissions, local producers may still rely on non-local inputs, conventional farming or environmentally harmful processing methods (Kneafsey et al. 2013).

Methodologies to assess the impacts of SFSCs

The high diversity and informality of SFSC initiatives, the small size of agricultural enterprises participating in SFSCs and the interconnected nature of their production processes and distribution channels, make it difficult to collect data and information and thus to assess and quantify the impacts of SFSCs. In fact, there are few comprehensive analyses of the impacts of SFSCs in the literature, particularly comparing the costs and benefits to farmers and other producers of participating in SFSCs compared to LFSCs (Table 1).

Academics and experts have tried, in many projects, to define some general frameworks, methodologies and guidelines for assessing the impact and sustainability of SFSCs, proposing more or less extensive lists of impact indicators, usually mainly qualitative, with sometimes also some quantitative indicators to measure specific aspects especially related to economic or environmental sustainability. Several frameworks assess the sustainability of SFSCs through qualitative or mixed sets of indicators in environmental, economic and social domains (Bellassen et al. 2016; Marino and Cicatiello 2012; Zasada et al. 2014), sometimes based on previous literature, while some others identified through participatory approaches involving key experts, informants and/or supply chain actors (Borsotto et al. 2023).

These different frameworks may involve both sides of the supply chains (producers and consumers) and sometimes also integrate the perspective of producer and/or consumer associations, managers of SFSC initiatives, academic experts and other relevant stakeholders.

In empirical impact assessment studies, most of the works employ qualitative methods (Aguado-Gragera et al. 2024; Demartini et al. 2017; Mancini et al. 2019), sometimes based on actors' perceptions or self-assessment of impacts and performance (Doernberg et al. 2022; Schmutz et al. 2017; Vittersø et al. 2019), which are considered more appropriate and able to capture the full complexity and interconnectedness of SFSCs impacts.

Instead, some works use quantitative methods (Floriš et al. 2022; Hardesty and Leff 2009) or employ mixed methods to deepen insights by linking metrics on economic performance and costs with subjective assessment of other aspects (Malak-Rawlikowska et al. 2019; Marino et al. 2013; Verhaegen and Van Huylenbroeck 2001).

Table 1 Methodologies to assess the impacts of SFSCs in literature. *Source*: authors' own elaboration

Scientific article	Actors involved	Method proposed/implemented
Methodological studies		
Zasada et al. (2014)	Producers	Qualitative: sustainability impacts assessment of SFSCs, with 15 impact areas, belonging to three dimensions (environment, economy and society), to which correspond performance indicators
Bellassen et al. (2016)	Producers	Mixed: three areas of sustainability (economic, social, environmental), 150 variables, grouped in 23 indicators
Borsotto et al. (2023)	Experts and relevant stakeholders	Mixed: participatory identification of 47 economic, social, and environmental indicators to assess the sustainability of SFSCs and setting up of a decision-making tool for producers
Marino and Cicatiello (2012)	Producers, consumers and relevant stakeholders	Mixed: three areas of sustainability (economic, social, environmental), 12 areas of impact, each one containing some sub-areas of impact
Empirical studies		
Aguado-Gragera et al. (2024)	Producers and consumers	Qualitative: focus groups including consumers and producers on consumer awareness and use of SFSCs, and issues and challenges faced by producers in SFSCs
Demartini et al. (2017)	Producers	Qualitative: analysis of producer's motivations and their perceived effects of participating in SFSCs
Doernberg et al. (2022)	Producers, consumers and relevant stakeholders	Qualitative: rapid sustainability self-assessment of SFSCs based on performance indicators, grouped into 15 impact areas, belonging to three dimensions (environment, economy and society)
Mancini et al. (2019)	Producers and consumers	Qualitative: analysis of producers' and consumers' perceptions of the economic, social and environmental sustainability of SFSCs
Schmutz et al. (2017)	Producers	Qualitative: participatory sustainability impact assessment with local food system stakeholders based on perceived their impact of different SFSCs compared with LFSCs according to a list of 15 sustainability indicators
Vittersø et al. (2019)	Producers and consumers	Qualitative: self-assessment of producers and consumers' perceptions and motivations for participating in SFSCs
Floriš et al. (2022)	Producers	Quantitative: assessment of farmers' performance in SFSCs, evaluating selected economic indicators and estimating the relation between farmers' performance and their participation or non-participation in SFSC
Hardesty and Leff (2009)	Producers	Quantitative: analysis and measurement of marketing costs and profitability in alternative marketing channels

Table 1 (continued)

Scientific article	Actors involved	Method proposed/implemented
Malak-Rawlikowska et al. (2019)	Producers	Mixed: assessment of sustainability of SFSCs and LFSCs, mixing quantitatively measured indicators and some qualitative indicators self-assessed by producers
Marino et al. (2013)	Producers and consumers	Mixed: sustainability assessment of SFSCs through a system of explanatory variables, grouped into sub-indicators and indicators, then used to generate a quantitative Environmental, Social and Economic Sustainability Indexes (ESI, SSI, and CSI), and a total Farm Sustainability Index (FSI)
Verhaegen and Van Huylenbroeck (2001)	Producers	Mixed: analysis of extra benefits and costs for farmers participating in SFSCs and LFSCs, combining quantitative data (costs, prices and revenues) and qualitative information

The table is divided into methodological and empirical studies. Within each section, the articles are sorted by the method proposed/used (qualitative, quantitative, mixed) and then alphabetically

All these methodologically diverse studies (qualitative, quantitative and mixed) involve both sides of the supply chains (producers and consumers), depending on the objective of the study, and sometimes also include the perspective of other relevant stakeholders, such as managers of SFSC initiatives.

Material and methods

In this study, we implemented a qualitative methodology based on actors' impacts self-assessment guided by an interviewer, complemented by in-depth semi-structured interviews. This choice was due to two main reasons. First, a qualitative methodology made it possible to collect data in a situation where the strong interconnection between various activities and production processes in the firms analysed, the high level of informality and/or the lack of existing quantitative records (including accounting records) and the small size of the firms would have made the collection of quantitative data too difficult, costly and unattainable within the scope of this article. Secondly, as the study was carried out within the framework of the COACH European-funded coordination and support action project, the qualitative methodology was more in line with the objectives of the project, i.e. to provide a user-friendly tool[2] for SFSCs producers to activate processes of transformative self-evaluation (Cooper 2014; Lopez-Merino and Lamine 2024; Otieno et al. 2023), allowing for more conscious individual and collective decision-making, and generating results that are easily usable for external accountability purposes and communicable to a wide audience (e.g. consumers, practitioners, policy-makers). In addition, the qualitative evidence generated in this study can be used as a preliminary step

[2] The methodology of the present study was used to feed into a Sustainability Self-Assessment App (https://hub.urgenci.net/costs-benefits/how-to-assess-costs-benefits/) contained in a Learning Module on Costs & Benefits (https://hub.urgenci.net/costs-benefits/) realised within the COACH project, available with open access on the project *Communication, Learning and Innovation Platform* (CLIP).

Table 2 13 case studies participating to the analysis. *Source*: authors' own elaboration

SFSC Initiative	Country	Typology	Description	Types of actors interviewed
Adamah Biohof	Austria	Market-oriented	Online sales platform	Farmers, retailer
Elkana	Georgia	Market-oriented	Grain network	Farmers, millers/retailers, baker
Grain Network	Hungary	Market-oriented	Grain network	Baker
ConServe	Italy	Market-oriented	Processing initiative	Farmers/processors
GranPrato	Italy	Market-oriented	Grain network	Farmers, miller, baker
Bizkaigane Elkartea	Spain	Market-oriented	Dairy cooperative	Farmers, retailer
Feldon Forest Farm	UK	Market-oriented	Horticultural and breeding farm	Farmer
Pipers Farm	UK	Market-oriented	Meat-focussed online sales platform	Farmer (breeder), butcher/retailer
Tamar Grow Local	UK	Market-oriented	Food hub	Retailer
Les Paniers Marseillais	France	Solidarity-oriented	Community-supported agriculture network	Farmers
Netwerk Solidarische Landwirtschaft	Germany	Solidarity-oriented	Community-supported agriculture network	Farmers, breeder
Nyíregyházi Kosár Közösség	Hungary	Solidarity-oriented	Solidarity purchasing group	Retailer
Tierra Papel Tijera	Spain	Solidarity-oriented	Community-supported agriculture initiative	Farmers

The initiatives are sorted by "Typology", then alphabetically by "Country", and last alphabetically by "SFSC initiative"

to identify specific aspects that can be further explored in future studies with ad hoc quantitative methods.

Although this methodology mainly captures the opinions and perceptions of operators, the mediation by an interviewer and the comparison between SFSCs and LFSCs helped to minimise misinterpretation of the questions and inconsistencies in the answers, thus ensuring data reliability. In addition, the research did not aim to evaluate which distribution channel is more sustainable, but rather to explore which sustainability aspects are most valued by producers and how they perceive SFSCs and LFSCs in terms of sustainability.

The sample of our study consists of 13 case studies,[3] that is, 13 collaborative SFSC initiatives of different typologies, from various countries participating in the COACH project (Table 2), for a total of 34 actors interviewed.

The initiatives in the sample are very diverse in terms of typology of SFSC, types of products sold, geographical location, typologies of producers and companies involved. This heterogeneity is inherited from the COACH project, since we selected our study sample among the SFSC initiatives participating in the project. The 13 initiatives were selected based on three main criteria: (I) diversity of SFSCs (the selected case studies had to be representative of the diversity of existing SFSC typologies), (II) availability of minimum data and willingness of actors to participate in the study and (III) availability

[3] In the Living Library (https://hub.urgenci.net/living-library/) hosted in the project CLIP platform, a detailed description of the 13 sample's initiatives (among the other participating in the COACH project) can be accessed by clicking on their respective pins and names on the map.

of a real comparative LFSC benchmark or possibility to identify a known and potentially usable artificial LFSC benchmark.

The selected initiatives, as shown in Table 1, come from eight different European countries and include some more market-oriented initiatives, where the aim of finding a suitable and profitable marketing channel for agrifood products is predominant (e.g. online sales platforms, SFSC networks, processing initiatives, etc.), and some other more solidarity-oriented initiatives, which also have a strong social aim and solidarity component (e.g. community-supported agriculture initiatives and solidarity purchasing groups).

For each SFSC initiative, we interviewed a spokesperson and, where relevant, other stakeholders (producers, processors, retailers, etc.), trying to best represent the structure of the initiative at the different Levels of the value chain. In-person interviews were conducted between June and December 2021 following a common format and with the support of the other COACH project's partners. Further data and information on the SFSC initiatives analysed were collected during *campfire*-style meetings, which were held online or in person with the collaboration of other project partners, to present and discuss the preliminary results of the analysis with the interviewed actors within each initiative. All participants in the case studies were fully informed about the aims of the project and the study, their role and rights, and the data management procedures and were asked to give their informed consent prior to data collection. During the interviews, we sought to create a comfortable and respectful environment that allowed interviewees to express their opinions freely. We also sought to ensure a diversity of perspectives by selecting a diverse sample of participants. In group meetings, we sought to minimise power imbalances by including participants with different roles and positions within the initiative and the value chain being analysed, and by encouraging open and inclusive dialogue. Confidentiality was rigorously maintained by anonymising responses and securely storing data in our university databases as well as in the other project partners' databases, and only aggregated or anonymised data were published.

To account for the high diversity in the sample, for each selected SFSC initiatives we tried to reconstruct the supply chain structure as much as possible by interviewing some relevant actors at each step of the supply chain (i.e. farming, processing, retailing, etc.), always including the coordinator or representative of the initiative. A preliminary desk research phase was necessary to gather information on the characteristics, structure and composition of each initiative in order to identify and select the relevant actors to be interviewed in the following phases.

In-person interviews were conducted with all the identified actors, following a semi-structured format consisting of an introductory section with in-depth open-ended questions to collect descriptive information about the company interviewed (e.g. history and evolution, structure, activities, marketing channels used, role in the SFSC initiative, etc.), and a core section dedicated to the impact self-assessment, always supported by a guiding interviewer.

The impact self-assessment consisted of a two-part questionnaire. First, actors were asked to rate on a 5-point Likert scale (from *"much more important"*=5 to *"much less important"*=1), through a series of pairwise comparisons, the importance of a list of seven relevant criteria (Table 3) that they usually consider when making decisions about their company's production activities and marketing channels. In the pairwise

Table 3 Description of the 7 decision-making criteria. *Source*: authors' own elaboration

Decision-making criteria	Description
Income increase	The potential of a decision to lead to an overall increase in producers' income
Income security and stability	The potential of a decision to protect producers against economic uncertainties and ensure a steady stream of income
Fairness and social justice	The potential of a decision to promote equitable treatment and opportunities, reduce disparities and foster inclusivity and fairness for all individuals, regardless of their background or circumstances
Support local community	The potential of a decision to generate positive externalities on the local community and contribute to the overall community's well-being and development
Consumers' satisfaction	The potential of a decision to improve the ability of meeting the needs and expectations of consumers on products and/or services offered
Reduction in pollution	The potential of a decision to reduce environmental pollution
Preserving local resources	The potential of a decision to contribute to the preservation of material and immaterial resources, e.g. endemic animal breeds and plant varieties, culture, traditions, knowledge and skills, etc

	A	B	C	D	E	F	G	H	I	J
1		1) Income Increase	2) Income security and stability	3) Fairness and social justice	4) Support local community	5) Consumers' satisfaction	6) Reduction of pollution	7) Preserving local resources (culture, traditional resources, know-how)	**Scores (row sum)**	**Weights (scores/total score)**
2	1) Income Increase		(1;...;5)	...	...	...	...	...	= SUM (B2:H2)	= I2 / I9
3	2) Income security and stability	(6-C2)		(1;...;5)	...	...	...	...	...	= I3 / I9
4	3) Fairness and social justice	...	(6-D3)		...	...	...	...	...	...
5	4) Support local community	...	...	...		...	...	...	...	...
6	5) Consumers' satisfaction	...	...	...	...		...	...	...	...
7	6) Reduction of pollution	...	...	...	...	...		...	...	...
8	7) Preserving local resources (culture, traditional resources, know-how)	...	...	...	...	...	...		...	...
9	TOTAL								**TOTAL SUM OF SCORES [= SUM (I2:I8)]**	1

Fig. 1 Pairwise comparison matrix of decision-making criteria. The weights can take values from 0,048 to 0,238, due to the calculation procedure. *Source*: authors' own elaboration

comparisons, each of the seven criteria was compared with all the others, and then, using a matrix (Fig. 1), the score obtained for each criterion (column I) was divided by the total sum of the scores for the seven criteria, generating the weights (column J) that were used to weigh the sustainability impact items as described below.

Second, through a series of closed-ended questions, actors were asked to rate on a 5-point Likert scale (from "*very positive*" = +2 to "*very negative*" = − 2), the impact of the SFSC initiative and of a long distribution channel (taken as a "comparative benchmark", actually used or hypothetically usable by the interviewed company) on a set of 31 economic, social and environmental aspects (Table 4). The distribution channel used as comparative benchmark was chosen by each one of the interviewees from among the LFSCs that they actually use to market their products or, in the case of companies selling only in SFSCs, from among the existing usable channels where they could potentially decide to sell their products. This means that each of the interviewed actors compared the SFSC initiative to which he/she belongs with a customised benchmark channel. The choice to differentiate the "benchmark" was made

Table 4 Correspondence between the impact items, their labels used in the figures, and the decision-making criteria. *Source*: authors' own elaboration

Economic impact items	Chart labels	Decision-making criteria
EC1) Sale price level	EC1) PRICE LEVEL	Income increase
EC2) Income level/capacity to remunerate work	EC2) INCOME LEVEL	Income increase
EC3) Stability of sold volumes	EC3) SALES STABILITY	Income security and stability
EC4) Bargaining power and decision-making autonomy	EC4) POWER AND AUTONOMY	Fairness and social justice
EC5) Possibility to diversify sold products	EC5) PRODUCTS DIVERSIFICATION	Income security and stability
EC6) Possibility to sell products not fit for other distribution channels	EC6) UNFIT PRODUCTS	Income security and stability
EC7) Possibility to obtain shorter and surer payment terms	EC7) FAVOURABLE PAYMENT TERMS	Income security and stability
EC8) Possibility to share risk with other producers, customers/consumers, other actors (NGOs, public organisations, etc.)	EC8) RISK SHARING	Income security and stability
EC9) Equitable distribution of the value added along the value chain	EC9) DISTRIBUTIVE EQUITY	Fairness and social justice
EC10) Local economy growth	EC10) LOCAL GROWTH	Support local community
EC11) Consumers/customers' satisfaction (freshness, quality, variety, value for money)	EC11) CONSUMERS' SATISFACTION	Consumers' satisfaction
EC12) Resilience to value chain disruption due to Covid-19 pandemic	EC12) COVID RESILIENCE	Income security and stability
SOCIAL IMPACT ITEMS		
SC13) Trust and social relationships between producers and consumers/customers	SC13) TRUST	Support local community
SC14) Cooperation among producers	SC14) COOPERATION	Support local community
SC15) Job creation and/or preservation	SC15) JOB	Support local community
SC16) Work opportunities for marginalised groups (people with disabilities, under detention, with gambling/substance use disorders, etc.)	SC16) MARGINALISED WORKERS	Fairness and social justice
SC17) Quality of work and personal well-being (e.g. self-esteem, proudness, etc.)	SC17) PRODUCERS' WELL-BEING	Fairness and social justice
SC18) Women empowerment	SC18) FEMALE EMPOWERMENT	Fairness and social justice
SC19) Empowerment, viability and social cohesion of local communities	SC19) COMMUNITY	Support local community
SC20) Strengthening cultural and regional identities and preservation of traditional knowledge	SC20) LOCAL IDENTITY & KNOWLEDGE	Preserving local resources
SC21) Consumers' food awareness and knowledge	SC21) CONSUMERS' AWARENESS	Consumers' satisfaction
SC22) Affordability by low-income consumers	SC22) AFFORDABILITY FOR CONSUMERS	Consumers' satisfaction
SC23) Capacity to keep employment during the Covid-19 pandemic	SC23) COVID & JOB	Support local community
ENVIRONMENTAL IMPACT ITEMS		
EN24) Reduction in pollution due to transport	EN24) TRANSPORT POLLUTION	Reduction in pollution
EN25) Reduction in pollution due to packaging	EN25) PACKAGING POLLUTION	Reduction in pollution
EN26) Food waste	EN26) FOOD WASTE	Fairness and social justice

Table 4 (continued)

Economic impact items	Chart labels	Decision-making criteria
EN27) Use of pesticides, agrochemicals, preservatives and other chemical inputs	EN27) PESTICIDES	Reduction in pollution
EN28) Agrobiodiversity (e.g. producing traditional varieties, diversifying farm products)	EN28) AGROBIODIVERSITY	Preserving local resources
EN29) Animal welfare	EN29) ANIMAL WELFARE	Fairness and social justice
EN31) Environmental effects of the Covid-19 pandemic	EN30) RESOURCES REGENERATION	Reduction in pollution
EN30) Preservation of natural resources and landscapes	EN31) COVID & ENVIRONMENT	Preserving local resources

in order to ensure that the actors could compare actual and real situations (used or known), distribution channels (long and short) of which they knew the functioning and the actual or potential impact on their business in terms of organisational and economic arrangements required to participate, as well as on social and environmental dimensions.

After data collection, each of the 31 sustainability impact items was associated with one of the seven decision-making criteria (as shown in Table 4). The weights generated from the pairwise comparisons of the criteria (Fig. 1) were used to weigh the matching impacts by multiplying the score of each impact item by the weight of the associated decision-making criterion, thus generating some "weighted impacts". This procedure allowed to capture not only the perceived impact (by the actors) of the SFSC and the LFSC on the economic, social, and environmental aspects considered, but also the relative importance of each aspect for the actors in their decision-making process.

The two sets of decision-making criteria and economic, social and environmental items (Tables 3, 4) were co-constructed with the COACH project's partners, starting from a literature review, then discussed, refined, and agreed upon within the project consortium, and finally tested with a first pilot interview with one SFSC producer (out of the study sample) before delving into the actual field analysis.

The data collected during the interviews using qualitative Likert scales were converted into numbers, and each impact item was matched with a decision-making criterion, to generate the weighted impacts (as explained above). We then performed a series of elaborations on the weighted impacts to analyse the perceptions of the interviewed actors on the sustainability impacts of the SFSC initiatives in the sample and of the LFSCs. Since the number of interviewees differs in each case study (see Table 2), we standardised the weighted impacts by calculating, for each impact item, its average within each case study. Therefore, we performed all the following elaborations on these "standardised" average weighted impacts.

First, we compared the average performance of SFSC initiatives with the average performance of LFSCs, in all the economic, social, and environmental impact items. Second, we compared the answers on SFSC initiatives from farmers with those from other types of actors (e.g. processors, retailers, etc.), to highlight potential differences in sustainability perceptions. Third, we compared the average performance of market-oriented initiatives with the average performance of solidarity-oriented initiatives.

The results section presents the findings from the impact self-assessment. The findings from the in-depth semi-structured qualitative interviews are used in the discussion section, together with some examples of good practices from the sample initiatives, to contextualise and interpret the self-assessment results and to discuss critical and success factors in SFSCs.

Results

The results showed that, on average, SFSCs are perceived to have a better impact than LFSCs on all the aspects analysed (Fig. 2).

Figure 2 shows that SFSCs are perceived to have a very positive impact on all the aspects analysed, in all the three sustainability dimensions (economic, social and environmental). On the contrary, LFSCs seem to have a negative perceived impact on most of the aspects considered. In the economic sphere, the perceived impact of the SFSC, as well as the difference between the two channels, is particularly high for aspects dealing with economic autonomy (EC4), diversification of sales (EC5, EC6), risk sharing and risk management (EC7, EC8), and equitable distribution of economic benefits (EC9, EC10).

In the social area, the SFSC is widely perceived to perform particularly better than the long one in aspects related to trust, cooperation and social relations among stakeholders (SC13, SC14), personal/community empowerment and well-being (SC17, SC18, SC19), preservation and sharing of traditions and knowledge (SC20, SC21). The difference between the SFSCs and LFSCs is smaller (but still positive for the SFSC) for aspects such as job creation and maintenance (SC15, SC16, SC23), and affordability for low-income consumers (SC22).

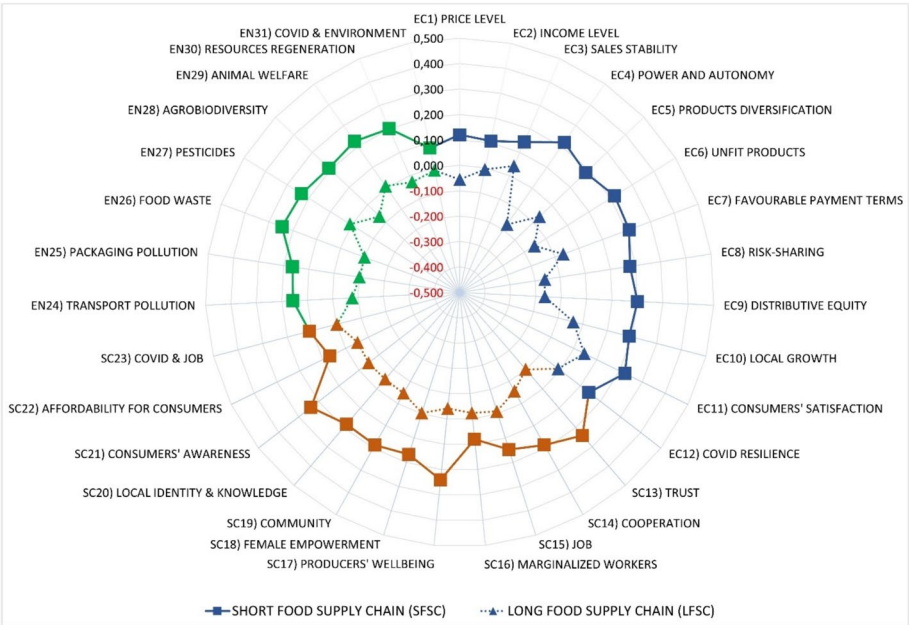

Fig. 2 Sustainability impacts of SFSCs vs. LFSCs. The figure shows the average weighted economic (EC, in blue), social (SC, in brown) and environmental (EN, in green) impacts of SFSCs and LFSCs (average of all case studies). Values can range from − 0,47,619 to + 0,47,619, due to the weighted impacts computation procedure. *Source*: authors' own elaboration

In the environmental dimension, the impact of the SFSC is perceived to be much better than that of LFSCs in all aspects considered, especially in terms of reducing pollution and food waste (EN24, EN25, EN26).

With regard to the Covid-19 pandemic, the SFSC seems to be perceived as more socially and economically resilient than LFSCs, but the difference is not as pronounced and the long chain also has a positive impact on this aspect (EN12, EN23, EN31).

Figure 3 shows the average weighted impacts of SFSC initiatives only, as perceived by the actors interviewed, distinguishing between "farmers" and "other types of actors" (i.e. processors, retailers, etc.).

Both types of actors have a similar positive perception of the impact of SFSCs on all the three dimensions. However, it is interesting to note that "farmers" give a higher evaluation than "other actors" to the impact of SFSCs on private economic aspects: price and income levels (EC1, EC2), stability of volumes sold (EC3), sale of unfit products (EC6), risk sharing and coping (EC7, EC8). On the other hand, "other actors" give the community and the territorial impacts of SFSCs a higher evaluation than farmers: equitable distribution of value added (EC9), local economic growth (EC10), community empowerment and social cohesion (SC19), preservation of traditional identities and knowledge (SC20), reduction in pollution (EN24, EN25, EN27), preservation of rural areas (EN28, EN30). This difference in perception could partly reflect a real difference in the impact of SFSCs on the two types of actors, but it probably also reflects a "perceptual difference". In fact, downstream actors in the value chain (e.g. retailers) are closer to consumers and more in a position to perceive societal and territorial impacts than farmers and, in general, upstream actors in the value chain.

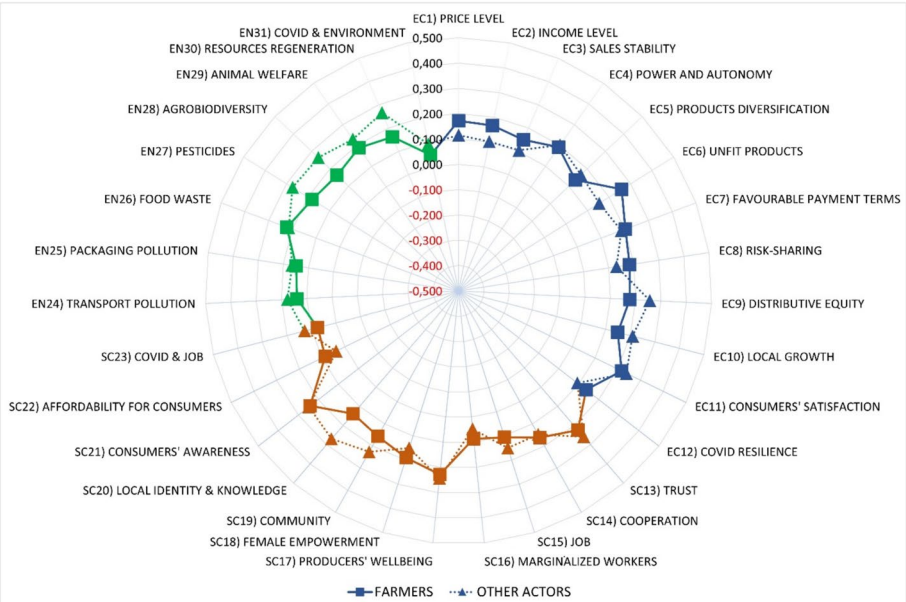

Fig. 3 Sustainability impacts of farmers vs. other actors. The figure shows the average weighted economic (EC, in blue), social (SC, in brown) and environmental (EN, in green) impacts of SFSCs (average of all case studies), as assessed by farmers vs. other actors. Values can range from − 0,47,619 to + 0,47,619, due to the weighted impacts computation procedure. *Source*: authors' own elaboration

Figure 4 shows the average weighted perceived impacts of market-oriented and solidarity-oriented SFSC initiatives.

From the graphic, we can see that actors from solidarity-oriented initiatives perceive the impact of SFSCs to be higher on most aspects across the three dimensions (economic, social and environmental), compared to actors from market-oriented initiatives. Indeed, in solidarity-oriented SFSCs, sharing and collaboration mechanisms seem to be stronger, and this positively affects aspects such as stability, decision-making autonomy and risk management (EC3, EC4, EC6, EC7, EC8), quality of work, well-being and people empowerment (SC17, SC18, SC19).

This overall higher satisfaction of actors from solidarity-oriented initiatives with the impact of SFSCs probably reflects a lower market orientation of such initiatives, which often experience a more proactive role of consumers and civil society components. This could explain why the perception of societal, territorial and environmental aspects is higher—e.g. aspects such as reduction in pollution and animal welfare (EN24, EN25, EN29)—and, more generally, why the satisfaction with the impact of SFSCs is higher, as these types of initiatives are precisely built to decouple producers and agriculture from global markets and to tie them to local territories and communities. Moreover, solidarity-oriented initiatives often involve small-scale producers, for whom SFSCs are a fundamental and sometimes the only way to access the market. Conversely, some of the market-oriented initiatives we analysed are led by medium-sized producers, already well established in local markets, for whom SFSCs may be less vital, although still very important.

In fact, when comparing the 13 initiatives, although the variability of producers' responses across the different items in many case studies is quite low, in some items such

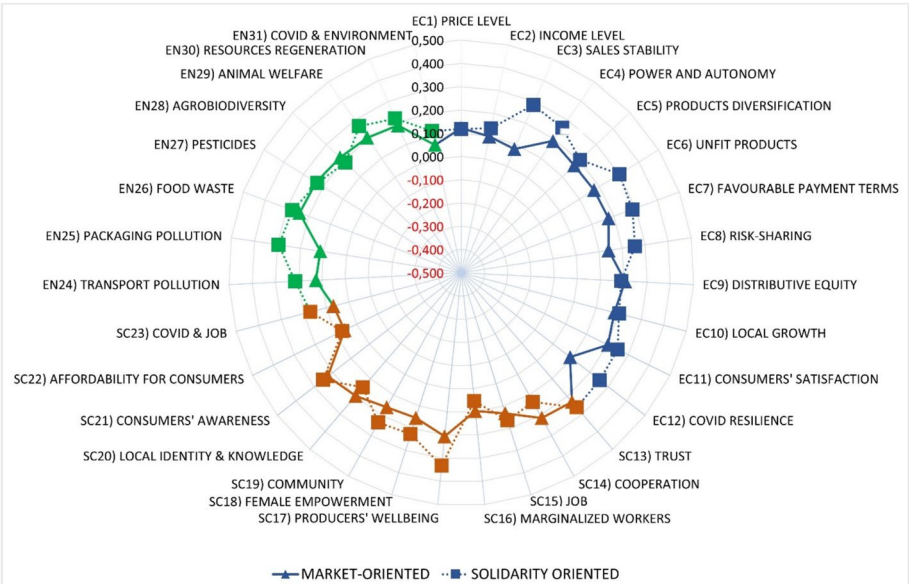

Fig. 4 Sustainability impacts of market-oriented vs. solidarity-oriented SFSCs. The figure shows the average weighted economic (EC, in blue), social (SC, in brown) and environmental (EN, in green) impacts of market-oriented vs. solidarity-oriented SFSCs (average of all case studies). Values can range from − 0,47,619 to + 0,47,619, due to the weighted impacts computation procedure. *Source*: authors' own elaboration

as stability of sales (EC3) and affordability for low-income consumers (SC10), there are some initiatives where LFSCs are perceived as performing better than SFSCs. These happens precisely in some market-oriented initiatives, where producers are more likely to benefit from stable contracts in long channels (therefore being less dependent on short channels) and to obtain higher prices (less affordable for consumers).

Another interesting difference is related to the perception of the economic and social resilience of SFSCs to the Covid-19 pandemic (EC12, SC23), which is higher in solidarity-oriented than in market-oriented initiatives. On the one hand, this can be explained by the fact that actors from the former perceived the resilient effect of SFSCs during the pandemic more strongly, due to their weaker position in long marketing channels. On the other hand, these types of initiatives are themselves characterised by stronger solidarity relationships among the actors involved than market-oriented ones, and their importance was strongly perceived during the pandemic.

Discussion

The implementation of the methodology with the 13 case studies allowed us to collect evidence on the economic, social and environmental impacts of the collaborative SFSC initiatives compared to LFSC channels. In this way, the methodology made it possible to examine to the extent to which producers at different stages of the value chain perceive the different aspects of sustainability and the impact of the two different distribution channels (short and long). Based on the results, in this section we draw some implications in terms of critical and success factors in collaborative SFSCs that emerge from the case studies, and we illustrate some good practices that actors in our sample's initiatives have put in place to mitigate the risks and seize the opportunities offered by collaborative SFSCs.

Strengthening economic impacts of SFSCs

The results show that, on average, in economic terms, collaborative SFSCs are perceived to perform better than the selected LFSC benchmarks (Fig. 2). Prices for producers are often higher, as producers can act as "price makers", whereas in LFSCs they are more likely to act as "price takers" (EC1, EC4). SFSCs also show greater stability of incomes and market sales (EC2, EC3), thanks to more stable and direct relationships with customers and/or end consumers. Indeed, in SFSCs, the establishment of long-term producer–consumer relationships favours the consolidation of trust between actors (SC13), which allows producers to know in advance the quantity and type of products to be delivered or, in some other cases, to be sure of marketing all the products thanks to solidarity mechanisms. This helps farmers to stabilise their income and better plan production, reduce wastage/loss of products, and increase investments efficiency and production organisation, thus increasing the overall resilience of the farm to external shocks and crises (Balcom et al. 2023; Lucas et al. 2024; Michel-Villarreal 2022).

One of the most interesting potentialities of collaborative SFSCs is the possibility to implement price governance and risk sharing (EC8) in order to achieve a fair and transparent vertical distribution of the value added generated in the value chain among the different actors involved (EC9). Indeed, some of the initiatives in the sample have mechanisms and agreements between the participating producers on the setting of prices at

the different stages of the value chain and on the quantity to be supplied by each participant. In some cases, these mechanisms are based on formal governance mechanisms (Kurtsal 2020), while in others, long-term face-to-face relationships allow for trust-based solutions. In GranPrato, for example, actors operate according to a supply chain agreement and some production specifications that they have jointly signed, which regulate production methods (cultivation, milling and bread-making), prices (of wheat, flour, bread and other products), membership and functioning of the SFSC initiative, traceability and control mechanisms, and promotional activities on the local market. Instead, Pipers Farm establishes long-term, informal, mutually beneficial relationships with local breeders, through which prices are agreed annually based on the cost of production plus a margin that reflects a fair deal for both breeders and the company, and insures breeders against price fluctuations.

The results of the interviews confirmed that participation in SFSCs usually allows for higher value added through the internalisation of additional functions such as processing, distribution, and marketing, but this implies additional costs to be covered, and often involves the operators' own unpaid labour (King et al. 2010). To partially overcome these problems, collective responses are often devised at the organisational level, with the development of collaborative initiatives based on the joint management of certain distribution and logistics steps and activities characterised by the presence of minimum scale constraints (Stoeva et al. 2024). For example, the availability of local facilities (e.g. abattoirs, mills, storage silos) and their collective management can allow producers to combine their efforts to supply the market with a wider range of products, while sharing the fixed costs of such facilities in a way that is more efficient and less burdensome for all. Moreover, the collective use and management of facilities are crucial to preserve the very existence of such small local infrastructures, which are threatened by rising energy costs and competition from the industrial sector, making it extremely difficult for them to stay in the market, since their small production scale does not allow them to benefit from economies of scale and efficiently manage the high fixed costs. For example, in the GranPrato supply chain, one of the farmers who owns some storage silos stores the wheat for all the members of the initiative for a fee and takes care of harvesting for the small producers who do not own a harvester. Similarly, the network miller processes the wheat from all the farmers and sells the flour to the network bakeries and shops. This allows these businesses to share the high fixed costs of machinery and facilities within the network, while benefiting from the economies of scale that result from the larger volumes produced and marketed.

The pooling of resource not only allows to achieve economic efficiency and cost reduction, but also determines the very possibility for some small producers to participate in the SFSC initiative. Indeed, there are often difficulties for small producers to access SFSCs, related to diseconomies of scale, especially when production processes require the use of machinery or facilities with high fixed costs (e.g. a mill, an abattoir, a warehouse or a harvester), and to the scarcity of workforce needed to manage labour-intensive processing and distribution activities. In ConServe, for example, producers have set up a joint processing facility to turn products surplus or second-quality produce that cannot be sold fresh because of its imperfect size or shape into more profitable alternatives (e.g. jams, preserves, soups) that are sold under the initiative's common brand. In

this case, on the one hand, the collective facility allows producers to share and reduce production costs, while on the other hand, the pooling of raw products allows them to increase the volume of processed production, benefiting from economies of scale and supplying a wider market.

Indeed, another related and common obstacle to producers' profitability in SFSCs that emerged from the interviews is the limited size of the market, which is often insufficient to sell the entire production of the farm and to achieve economic viability. The small volumes that can be marketed in SFSCs increase the average fixed costs per unit of product sold, thus limiting the profitability of using SFSCs, especially for farmers. For this reason, producers often set up multiple marketing channels (LeRoux et al. 2009), and for many of the interviewees SFSCs are only one of the multiple marketing channels used, all of which are useful for many reasons (limited capacity to absorb all production, different quality requirements, different target consumers, etc.). Even when the SFSC performs better than the long ones, a complete shift in the short term is often impossible and may not be desirable.

Increasing sales in SFSCs often requires collective organisations that are able to aggregate production from different producers, offering a more complete range of products able to attract consumer demand and access marketing channels otherwise inaccessible (e.g. public procurement). In our sample, Tamar Grow Local food hub, for example, collects and distributes food from producers to consumers in Tamar River catchment area in the UK, acting as an umbrella cooperative for a number of other local food initiatives, and interacting with other food hubs in the region part of the Good Food Loop food hubs network. This creates a shared distribution system that allows producers to widen their collective products' assortment and expand their customer base both quantitatively and geographically, while saving time and money and reducing environmental impact through a shared transportation system.

Enhancing social equity in SFSCs

On the social side, our study highlights how collaborative SFSCs are perceived to foster stronger cooperation among producers (SC14), the creation of trust (SC13), and the activation of collective action. The direct contact between producers and consumers allows the latter to access information and knowledge about products and production processes, acknowledging and giving appropriate value to the work of producers, while enhancing consumers' education on food-related issues (SC21). Consumers can also learn about uncommon products (such as niche products, local varieties, and traditional foods) that are not normally available in long marketing channels and acquire knowledge about food preparation. In the GranPrato initiative, producers highlighted during the interviews how often their new consumers, upon learning about the initiative, become aware of the very existence of farmland in the peri-urban areas of the city, increasing their awareness about the importance of preserving agriculture in these areas. In general, as highlighted in the literature, many interviewees from the sample initiatives highlighted the contribution of SFSCs to consumer food education and awareness (Warsaw et al. 2021), and the importance of knowledge exchange and sharing of good practices among producers.

With regard to consumers, the results also confirmed that SFSCs can sometimes be difficult for some consumers to access (SC22), as often highlighted in the literature (Conner et al. 2010; Guthman 2008; Hinrichs and Allen 2008; Warsaw et al. 2021). For some of the initiatives in the sample, the particular types of products sold, the specific production methods required, or the limited scale of production and the consequent difficulty in containing production costs, lead to higher (or even significantly higher) prices compared to LFSCs, reducing market opportunities and the possibility of scaling up for the initiatives, and limiting the access for low-income consumers. This may particularly affect the possibility especially for low-income consumers to participate in SFSCs, unless some solidarity mechanisms are put in place such as in some of the sample's initiatives. For example, in the case of Les Paniers Marseillais, solidarity food baskets are offered at reduced prices to low-income consumers in the poorest neighbourhoods of the city, to ensure that everyone has access to the fresh and local products provided by farmers who are members of the initiative. In this case, the farmers still receive the full price of the basket, while the price difference is covered by the association itself.

Preserving the environment through SFSCs

On the environmental side, the results showed how collaborative SFSCs are perceived to protect agrobiodiversity (EN28), as local/rare breeds and plant varieties can survive and be economically viable thanks to the facilitation of the flow of information on process and product characteristics, and to the opening up of market opportunities for small farmers who are unable to enter long food supply chains that demand standardised products and are not interested in local specificities (Ušča and Aļeksējeva 2023). In addition, greater diversification of production at the farm level, which is necessary to meet the more diverse demand of consumers in SFSCs, favours agrobiodiversity. Many of the initiatives in our sample are committed to agrobiodiversity preservation, such as Elkana with heritage wheat varieties, ConServe with local vegetable varieties or Pipers Farm with local cow breeds. For example, Elkana helps its farmers members to replant heritage wheat varieties, also by involving them in SFSCs where they can market these particular varieties, and educates consumers about the cultural importance and nutritional value of heritage crops.

SFSCs are also perceived to have a positive impact on reducing environmental pollution (E24, E25, E27), as producers tend to use low environmental impact farming techniques and consumers tend to pay more attention to how food is produced, favouring organic products, low chemical input, and bulk products. Finally, online marketing and logistics, as well as more precise planning of the production to be delivered, can contribute to reducing food losses and food waste in SFSCs (E26), also because such distribution channels often offer the possibility of selling products that other marketing channels would not accept or would accept only at very low prices, due to imperfections in their shape or size. For instance, in our sample, this is the case of ConServe, which allows producers to find a new market for second-quality and waste products by transforming them into processed products that can be sold at a profitable price, thus reducing food losses along the supply chain. Similarly, in Les Paniers Marseillais, the food basket distribution system ensures that almost no waste is left on the farm because everything,

including odd-shaped or ugly looking vegetables, is brought to the distribution points in bulk, which also reduces packaging waste.

SFSCs in urban and peri-urban areas can contribute to survival of agriculture and protect agricultural land from urbanisation. This is the case of GranPrato and Les Paniers Marseillais, which, respectively, in Prato (Italy) and Marseilles (France) contribute to the preservation of cultivated peri-urban lands, threatened by urbanisation and industrialisation processes.

Conclusions

Methodological and empirical contributions and limitations

The methodology implemented in this study presents some innovative elements, such as the impact weighting procedure with pairwise comparison of decision-making criteria, and the comparison between SFSCs and LFSCs, which can contribute to the literature on impact assessment methodologies in this field. In fact, this methodology allows to capture not only the respondents' perceptions of the impact of SFSCs and LFSCs on the economic, social and environmental items analysed, but also the relative importance they attribute to each of the items, thanks to their matching and weighting with the decision-making criteria evaluated by the same respondents in the pairwise comparison procedure. In this way, it is possible to examine at the same time the perceptions and evaluations of producers at different stages of the value chain on various aspects of sustainability, on the impact of SFSCs versus LFSCs, and on the importance of the different areas of criteria when making production and marketing decisions.

Obviously, the qualitative interviews and the self-assessment procedure employed are primarily capable of capturing the opinions and perceptions of the operators interviewed. However, in order to mitigate potential bias and to avoid misinterpretation effects, the self-assessment procedure was carried out with the intermediation of an interviewer who supported the respondents in understanding the questionnaire and its items. In addition, results related to SFSCs were compared with those related to LFSCs, which gave us another way to check for random answers or misunderstanding of questions. Furthermore, the aim of our work was not to draw any conclusions about which type of distribution channel or initiative performs better in terms of sustainability, but rather to understand which aspects of sustainability are more valued by producers participating in SFSCs, which they believe are promoted or hindered by SFSCs and/or LFSCs and what collective strategies they implement to improve their overall performance within SFSCs.

The self-assessment procedure is also able to impart a transformative nature to the evaluation (Cooper 2014; Lopez-Merino and Lamine 2024; Otieno et al. 2023), enabling SFSCs operators to self-assess their performance in different marketing channels and identify corrective actions if needed, gain awareness on the potential impacts of their choices, activate a collective reflection, lead a more conscious individual and collective decision-making.

At the empirical Level, the implementation of the methodology with the 13 case studies of the article provided some interesting insights, in line with previous literature. Indeed, the results allowed us to answer the two research questions of the paper,

highlighting producers' perceptions of the impact of SFSCs (I) and the role of collaboration and relationships in maximising the benefits and reducing the costs of SFSCs (II).

The results showed not only producers' positive perception of the economic impacts of collaborative SFSCs, but also their strong perception of the importance of social and environmental aspects, and the perceived negative impacts that LFSCs seem to have on these dimensions.

In the economic sphere, SFSCs can allow producers to obtain higher prices, increase their access to markets and bargaining power, achieve greater resilience, and reduce marketing risks. In terms of social benefits, SFSCs can favour farmer–consumer interaction, cooperation among producers, the development of trust, social capital, and a sense of community, and increase consumer awareness of food habits and healthy diets. On the environmental side, SFSCs can enable more sustainable production and transportation methods, lead to reductions in pollutant emissions and packaging, reduce food losses and food waste, and contribute to the preservation of agrobiodiversity.

It is worth emphasising that for many of the producers and other supply chain actors in our sample, the underlying motivation for joining SFSCs is really about transforming socio-economic relations to support agriculture and supply chains that protect and regenerate nature and provide fair livelihoods and "good" food. In these cases, participants often stressed that the success of their initiatives could not be reduced to economic indicators, nor easily compared with long, "conventional", industrialised and large-scale supply chains, as this would risk portraying their initiatives as "poorly" performing in economic terms, failing to capture the synergy between their economic activities and neglecting their socio-environmental benefits.

The results also showed how actors within collaborative initiatives implement collective strategies and mechanisms to share the specific functions, risks, and costs associated with selling through SFSCs, in order to be able to jointly achieve economies of scale, maximise benefits and reduce costs of SFSCs. This can be done through informal collaborative relationships or formal agreements and may involve cooperation in performing some specific tasks or functions related to production or distribution (e.g. processing, transportation, etc.), the sharing of machinery, equipment and facilities (e.g. harvesters, warehouses, etc.), agreements on production modalities and prices, but also the peer-to-peer exchange of knowledge, practices, and ideas.

Certainly, the results of this study must be interpreted with reference to the limited sample and the specific case studies analysed, which are very diverse in terms of SFSC typologies, actors involved, socio-economic, political, and institutional context of origin—factors that could not be fully taken into account due to the lack of information and the objectives of the background funding project—and the authors do not claim to generalise these findings to the whole diverse and complex universe of short food supply chains. Nevertheless, this work provides some interesting results on the costs and benefits of producers' participation in collaborative SFSCs, as well as their impact on economic, social, and environmental dimensions, which confirm what is already found in the literature.

With this article, we aimed to make a methodological and empirical contribution to the understanding of the costs and benefits of producers' participation in SFSC initiatives, feeding the debate on the sustainability impacts of SFSCs and their contribution as

an alternative and innovative tool to support the development of more sustainable and resilient local agrifood systems.

Future research focusing on the functioning and governance mechanisms of different SFSC models could improve our understanding of how different organisational structures affect sustainability and shed light on the suitability of these models to actors' business structures, typologies, values, and expectations. Another interesting stream of research might be related to the external factors influencing the impact of SFSCs (e.g. socio-economic context, policy environment, and institutional framework); understanding their role in influencing actors' behaviour within SFSCs, and thereby the impact of these marketing channels on the different sustainability domains, could be crucial for designing innovative solutions within collaborative SFSC initiatives that align with actors' expectations as well as with the embedding context.

Practice and policy implications

This work also provides some possible guiding principles and lines of action for strengthening SFSCs—grounded in the good practices that emerged from the case studies analysed—that can be pursued by producers' collective organisations and supported by non-governmental organisations, as well as some policy recommendations that can inform local policy-makers wishing to support SFSCs as a tool for transitioning towards more sustainable agrifood systems.

The results of this work showed that participation in SFSCs is often not as straightforward for producers as it may seem, since the re-internalisation of supply chain functions (e.g. packaging, transportation, marketing retail, etc.) leads to an increase in production and distribution costs.

In this respect, producers participating in SFSCs can adopt some strategies, the core of which lies in collective action, as we have seen in the discussion section and in the good practices implemented in the initiatives of our sample. Indeed, collaboration and coordination among producers can enable cost sharing and reduction, increased production, and knowledge exchange, which ultimately allows small producers to access the market and achieve economic viability thanks to greater economies of scale and economic efficiency (Bouaïcha 2023; Kurtsal et al. 2020; Stoeva et al. 2024). In particular, the results of the in-depth interviews with producers highlighted some key factors that enhance the development and performance of SFSCs, such as: (I) the acquisition of new knowledge and skills by producers to manage supply chain functions (e.g. marketing, retailing, logistics, etc.) that in LFSCs are externalised to other operators; (II) investments in collective facilities that enable networks of food producers to aggregate their fragmented product supply and share logistics and distribution costs (e.g. in GranPrato, Adamah Biohof, and Tamar Grow Local); (III) the improvement of product traceability and quality communication through forms of collective branding (e.g. collective trademarks and labels) that make products recognisable to final and intermediate consumers (e.g. GranPrato, ConServe); (IV) the targeting of new emerging segments of the SFSCs market, such as those reached by online platforms (e.g. Pipers' Farm, Tamar Grow Local), public procurement, rural tourism and agritourism, which can offer interesting opportunities but also require facing new challenges, introducing innovations and thus acquiring skills and knowledge.

To act effectively in this sense, it is essential for producers to gain a proper awareness of the costs and benefits of their activities, being able to assess them in order to compare different marketing channels (short and long), choose the combination of marketing outlets that better suits the characteristics of their products and their business (as well as their objectives and expectations), adjust their production and distribution activities to improve their performance, and undertake collective actions when needed.

Public institutions and non-governmental organisations can play an important role in supporting these collective actions and processes through encouragement, financial support, and training. Indeed, education and training of food producers in communication, marketing, and the management of logistics and distribution should be supported, as well as peer-to-peer knowledge and practices exchange. Collaboration between food producers, through forms of collective organisation that help them manage production, logistics, and distribution costs should be encouraged and incentivised, as well as investment in collective facilities that enable networks of food producers to share these costs and aggregate their products supplies. Finally, producers' efforts to self-assess the costs and benefits of their activities should be supported, including through research, to improve their economic viability in collaborative SFSC initiatives.

Abbreviations

SFSCs Short Food Supply Chains
LFSCs Long Food Supply Chains

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Author contributions

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Availability of data and materials

Data and material are available upon request to the corresponding author.

Declarations

Competing interests

The authors declare that they have no competing interests.

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