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Article

Sustainable Food Supply Chains: Is Shortening the Answer? A Literature Review for a Research and Innovation Agenda

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Abstract: Short food supply chains (SFSCs) are increasingly garnering attention in food systems research, owing to their rising popularity among consumers, producers and policy-makers in the last few decades. Written with the aim to identify research gaps for the Horizon Europe research and innovation programme, this literature review provides a state of play of the definition and characterisation of SFSCs, and of their sustainability. Drawing on hypotheses about SFSC sustainability elaborated in an expert network in France, this review summarises a wide range of papers from various disciplines in the SFSC literature, written in English or French, while specifically highlighting the empirical results derived from European projects. Though the literature tends to generally agree on the social benefits of SFSCs, their economic and environmental impacts typically elicit more heterogeneous outcomes, while their health/nutrition and governance dimensions remain under-explored. Based on this review, recommendations for a future research and innovation programme are outlined, addressing the contribution of SFSCs to agrifood system transition and resilience in the current context of the Covid-19 crisis and of the Green New Deal objectives.

Keywords: short food supply chain; sustainability; local food systems; new indicators of wealth; literature review

1. Introduction

Amid a global food system widely acknowledged as unsustainable [1,2], short food supply chains (SFSCs) have garnered considerable research attention in recent decades, particularly in Europe, where they are increasingly renewed and reconfigured due to shifting consumer expectations and demand, producers' innovative organisational initiatives and food policy development [3]. SFSCs comprise a wide diversity of market-based initiatives, including on-farm direct sales, community-supported agriculture (CSA), farmers' markets, farmer shops, direct farmer-to-retailer, artisan, canteen or restaurant procurement schemes as well as digital platforms proposing well-identified farmers' products [3,4]. In order to make suggestions for the next Horizon Europe research and innovation investment programme (2021–2027), the Institute for European Environmental Policy (IEEP), a sustainability think tank, has sought to review current knowledge and research gaps concerning the sustainability of these chains. As designated experts by the IEEP, we propose in this paper a literature review of the empirical results concerning the sustainability of SFSCs, from which we highlight main axes for a future research and innovation programme. Our review complements another one published in *Sustainability* in 2019 [5] that focused on "alternative food networks" (AFN) based on 61 articles published until 2017, and considered the locations, methods and types of AFN and the sustainability dimensions studied but did not present empirical results. As AFN are one of the possible conceptions

of SFSC, in order to cover both a broader range of publications and sustainability dimensions, we first reviewed the diverse ways through which SFSCs have been addressed and characterised in the literature, within specific contexts.

In the Section 1, we present the theoretical approach and the methodology used to develop this literature review. In the Section 2, we highlight the diverse conceptions previously used to qualify SFSCs, and propose three research axes to further improve their characterization. In the Section 3, we capitalise on the results identified in the literature with respect to four dimensions of sustainability (economic, social, environment, health/nutrition) and in the Section 4, we examine the contribution of SFSCs to governance issues. In the conclusion, we highlight the main research, innovation and coordination action needs regarding SFSC sustainability issues, while considering the current Covid-19 global pandemic that is calling attention to these chains [6].

2. Theoretical Approach and Methodology

Standard economists typically assess an economic activity through indicators which aim to capture the economic wealth it produces. In line with political economics, some scholars argue that the notion of wealth should not be merely reduced to “classic” economic measures (gross domestic product, sales revenue, among others). Rather, they suggest that economic activities be evaluated and compared by using broader, multi-criteria socio-economic measures (e.g., quality of life, health) as well as environmental measures (e.g., ecological footprint) [7]. First developed at a macro-level, as alternative measures to the gross domestic product (GDP), these “new indicators of wealth” [8] are tools serving both scientific and political objectives, tied to the framework of sustainable development. They constitute one of the operational dimensions of political economics, to which the observation of activities in the service sector and the social and solidarity economy has largely contributed.

SFSCs are considered a relevant field, both for scholars and socio-economic actors, to highlight, beyond economic value, all other types of wealth relative to the different dimensions of sustainability [9]. In France, the official government definition of SFSCs, introduced in 2009 and associated with a national policy development plan, encouraged a series of surveys to be conducted on these chains, partly supported by the Ministry of Agriculture and Food, seeking to capture and assess their impacts, and value the diverse types of wealth they produce in order to support their up-scaling. These surveys have consolidated a network of experts from national or regional organisms in research, development or training, who co-produce data on SFSCs. Since 2015, forty of them have joined together to form the French National Network on Local Food (*RMT Alimentation Locale*) supported by the Ministry of Agriculture and Food. In 2016, experts in this network elaborated several hypotheses about SFSC sustainability (Table 1), first drawn from results produced in France with the ambition to confirm them and compare them with other countries [10]. They considered the five dimensions (economic, social, environmental, health/nutrition, governance) developed in the European FP7 GLAMUR project, a study which compared the performance of global and local food chains [11].

Table 1. Hypotheses guiding the literature review (based on [10]).

Economy	Social	Environment	Health/Nutrition	Governance
-SFSCs increase farmers' income -SFSCs generate jobs -SFSCs increase farmers' workload -SFSCs contribute to the local economy	-SFSCs strengthen social relations -SFSCs favour collective action and social innovations -SFSCs remain, for the majority, inaccessible to low-budget consumers -SFSCs value women's work	-SFSCs reduce or increase GHG emissions, depending on logistics -SFSCs value agrobiodiversity -SFSCs favour environmentally-friendly practices (producers, consumers)	-SFSCs favour nutritious and healthy food	-SFSCs balance power relations in food chains in favour of farmers -SFSCs favour citizen participation in the functioning of food chains

In order to assist Horizon Europe in its research programming and contribute to efforts documenting the sustainability of SFSCs, we relied on these hypotheses as a roadmap to examine, in an in-depth manner, the results obtained in France, and cross-reference them with work carried out in developed countries, with a particular focus on the work published from past and on-going European (FP7, H2020) projects. We sought to confirm, balance and enrich these hypotheses by reviewing related papers and reports published in French or English in social and/or biotechnical sciences. The focus of the review is on market-based SFSCs involving at least two stakeholders (producers and consumers). Opinion papers on these chains published during the Covid-19 crisis have not been taken into account. Though our intention was not to exhaustively cover all published articles and reports on SFSCs, our aim was to improve and share the knowledge base regarding the main hypotheses on SFSC sustainability issued from the French National Network on Local Food, which are more general in scope (Table 1).

To conduct the bibliographic research, we used the keywords outlined in Table 2, and applied them to several academic journal databases (WOS, Scopus, Econlit, Food science, Elsevier, Sage, Wiley, Springer, Cairn, HAL, Open Edition, MDPI), as well as to Google Scholar. A total of 157 publications are included in this review, 14 of which address topics indirectly related to market-based SFSCs or to sustainability (i.e., publications discussing topics such as new indicators of wealth, organic movement, community gardens, participatory guarantee systems, among others). The remaining 143 publications are described in Table 3, and deal primarily with either SFSC conception and characterisation/methodology (61 publications) or SFSC sustainability, including governance issues within and around SFSCs (82 publications). We focused on recent papers, one-third of which were published during or after 2018. We searched articles from 2000 onwards, considering that the concept of SFSCs began to emerge around that time. The large majority of reviewed publications use a qualitative case study approach (78 publications), mainly based on interviews and/or participant observation. Cases vary both in their number (from 1 to more than a 100) and in the selected unit of analysis. Generally, cases were defined as one or more of the following: SFSC product (e.g., milk, apple food chain), SFSC actors (e.g., farmers, consumers, policy-makers), SFSC initiatives (e.g., farmers' market, CSA partnership), SFSC areas (e.g., regions, territory, city). Other publications comprise quantitative surveys (with large samples), theoretical articles, literature reviews, expert reports, entire books or book chapters and policy briefs. SFSCs have predominantly been studied from a social science perspective, while very few have been published in biotechnical sciences and in multidisciplinary studies combining both social and biotechnical sciences.

Table 2. Keywords used to conduct the literature review (applied in English and with equivalent terms in French).

Keywords Related to SFSCs	Keywords Related to Sustainability
Short food supply chains	Sustainability; performance; income; price; job; workload; work organisation; local economy; embeddedness; producer-consumer relation; food justice; social innovation; GHG; agrobiodiversity; environment; sustainable consumption; healthy/nutritious food; local food governance; food democracy
Direct sales	
Alternative food networks	
Local food	
Local food systems	
Food relocalisation	

Table 3. Overview of the publications included in the literature review on the conceptualization and sustainability impact assessment of SFSCs (143).

Publication Type	Dominant Discipline	Publication Year (Range: 2000–2018)	Geographical Reach
<ul style="list-style-type: none"> • Qualitative case study (78) • Survey/database analysis (18) • Theoretical article (16) • Review (12) • Expert report (10) • Book/book chapter (8) • Policy brief (1) 	<ul style="list-style-type: none"> • Social sciences (125) • Multidisciplinary (42) • Sociology (34) • Geography (23) • Economics (20) • Anthropology (6) • Biotechnical sciences (7) • Environmental sciences (4) • Plant science (1) • Microbiology (1) • Food science (1) • Multidisciplinary social-biotechnical sciences (11) 	<ul style="list-style-type: none"> • ≥ 2018 (51) • 2014–2017 (50) • 2010–2013 (24) • 2000–2010 (18) 	<ul style="list-style-type: none"> • Europe (104) • North America (16) • Oceania (3) • Intercontinental (20)

3. Defining and Characterizing SFSCs

In order to better capture SFSC impacts relative to different sustainability dimensions, we first discuss how SFSCs are generally conceptualized in the literature. We then discuss the typology of diverse SFSC initiatives (re)emerging in developed countries and conclude by pointing out three research pathways to be pursued in order to improve the characterisation of SFSCs.

3.1. Conceptualizing SFSCs

Introduced in the European rural development policy at the end of the twentieth century, short food supply chains (SFSCs) were first conceptually developed by Marsden et al. in 2000, who proposed three types of SFSCs: face-to-face SFSCs (direct sales, physical encounter between the producer and the consumer), proximate SFSCs (few intermediaries, local production and consumption) and spatially extended SFSCs (few intermediaries, information about the product's origin, export) [12]. Two fundamental elements are thus taken into account: the number of intermediaries between the producer and the consumer, and spatial limitations within a certain geographic area [13]. Moreover, following this conception, SFSCs imply a sales transaction.

In practice, European definitions tend to focus on face-to-face and proximate SFSCs. For instance, in France, in 2009, the Ministry of Agriculture officially defined SFSC or “circuit court” as a market sale of agricultural products involving, at most, one intermediary actor between the producer and the consumer, whatever the physical distance, but the state development programme has been focused on locally- to regionally-based short chains [9]. The European Commission's definition, adopted in 2011 and revised in 2013, combines both physical and social dimensions to delineate an SFSC as “a supply chain involving a limited number of economic operators, committed to co-operation, local economic development, and close geographical and social relations between producers, processors and consumers” [14].

Despite their political recognition in some contexts, there is currently no single official and universal conception of SFSCs, which makes comparison difficult. This is certainly associated with a shifting perception of “proximity”, or a context-based understanding of “local”. Some authors have underlined that SFSCs may enact different types of proximity—geographical, relational or organised, among others [15]; others have distinguished between “local food” and “locality food” [16], or “locally produced food for local consumers” and “locally produced food for distant consumers” [17], variations which stress the complexity of trying to delimit the meaning of “local”. Often, subjective, less quantifiable dimensions influence the construction of the “local” in SFSCs: these include, among others, the understanding of place as a socio-cultural construction [18–20], producers' [21] and intermediaries' [22] spatial perceptions and how these affect their mobility, consumers' spatial perceptions and their impact on food procurement strategies [23] and the role of knowledge-based relations between local actors [17]. In the European GLAMUR FP7 project, Brunori et al. [11] demonstrate that local and global chains,

in practice, are far from being mutually exclusive or opposed. Six criteria were proposed to describe the hybrid forms that may emerge along a spectrum between two radically opposed situations depicted as “truly local” and “truly global”: spatial configuration, product identity, physical distance, farm size, chain governance and technologies and resources which are used. This conceptualisation therefore suggests a shift away from dualistic language to describe SFSCs, a similar point previously made by Holloway et al. [24] concerning the alternative-conventional dichotomy often used to qualify food networks, and that has given rise to a vast literature on SFSCs using the notion of “alternative food networks” (AFN). In line with this perspective, recent research has also called for a mixed-methods approach for deconstructing and assessing various types of SFSCs, i.e., the consideration of both qualitative and quantitative dimensions [25,26].

3.2. Diverse Types and Trajectories of SFSCs

The last two decades have witnessed a proliferation of SFSCs, especially in Europe and North America [3,9,27,28]. Often operating in urban and peri-urban settings [29,30], SFSCs respond to an increasing desire of urban consumers to access secure, high-quality and sustainable food [31], and to producers’ need to capture a larger portion of the added value [3]. SFSCs also align with political efforts geared towards the localisation or relocalisation of food and agricultural systems [32].

SFSCs are generally divided into two overarching types: “traditional” and “neo-traditional” [33], and “modern” [34]. Further, in a recent report by the United Nations Industrial Development Organization (UNIDO) [4], six broad types of SFSCs are proposed: on-farm selling, farmers’ markets, farmers’ shops and box schemes, consumer-driven initiatives, public (collective) procurement, and hotels, restaurants and catering. These six categories do not capture the immense diversity of existing SFSCs, but help to highlight two types of SFSCs which are significantly more present in the current literature: farmers’ markets and consumer-driven initiatives (especially community-supported agriculture or CSA). On-farm selling would therefore be considered traditional SFSCs, box schemes and consumer-driven initiatives would be considered more modern forms of SFSCs. Farmers’ markets are considered “neo-traditional” in some countries, and “modern” in others.

Indeed, SFSCs have followed different trajectories in developed countries [35]. In Mediterranean European countries (e.g., France, Italy, Spain, Greece, Portugal), “neo-traditional” farmers’ markets were developed in the 1980s, alongside traditional open-air markets mixing at once producers selling directly their products and reselling other products, as well as retailers selling products in short and/or long chains [9]. On the other hand, in Anglo-Saxon countries (the UK, United States, Canada), farmers’ markets appeared earlier, in the 1970s, but are rather considered “modern” as there was no tradition of open-air markets in these countries [36,37]. Inspired by the *teikei* system invented in Japan in the 1960s, CSA emerged in the 1970s in Northern America and later in Mediterranean countries, and in both continents, embodied a form of resistance to the industrial food system, thus often referred to as “AFN” [3,9,35,38]. In Eastern European countries (e.g., Hungary, Poland, Czech Republic), farmers’ markets and CSA emerged alongside already-present non-market-based food self-provisioning (FSP) practices (herein including home gardens and community gardens) [39–42], which still play a fundamental socio-economic role at the individual and community levels. In Scandinavian countries, the literature has rather documented the emergence of a culinary “specialty food” movement relying on local supply networks, thus implicitly embedding SFSCs [43,44].

While the purpose of this paper is not to review in too much detail the different types of SFSCs (considering they are increasing in both number and type), it is relevant to underline the diversity of trajectories that the (re)emergence of SFSCs has followed and the different associated conceptions they produce. Acknowledging these nuances leads to a more precise, locally contextualized assessment of sustainability impacts.

3.3. Moving Past Definitions, Three Directions for Further Research on SFSC Characterisation

In seeking to map out the different definitions and characterizations of SFSCs, the literature review of recent research leads to the identification of three research directions that deserve to be explored in greater depth. First, current research is increasingly documenting and unpacking the innovative character of SFSCs, looking past the number of intermediaries or the physical distance in which they operate [45,46]. The EU has favoured the capitalisation of their good practices and innovations within different on-going or forthcoming projects in the H2020 programme [47,48] (see Appendix A). However, in light of their immense diversity, some constituents of SFSCs remain relatively unexplored, such as the important and potentially innovative role played by intermediary actors. The latter tend to be overlooked as just “connectors” rather than innovators, cooperators and contributors to SFSC development with valuable skills [46]. Apart from some preliminary studies mapping the links between farmers and intermediaries in “new food chains” [49], few studies, often in regional geography, management sciences or economic sociology, have addressed the role of food artisans [50], small independent businesses [22,51], chefs/restaurant owners [52] or wholesalers and retailers [53] in supporting and promoting SFSCs. By drawing attention to the nature of the intermediaries’ role (that is, deconstructing *who* intermediaries are and *how* they can add—or capture—product value in SFSCs), these studies underline the need to consider them. They can be a significant bridging point between consumers and producers, especially for farmers who have limited capacity/knowledge to market and sell their own products. Nonetheless, some authors have warned against the risk of “local washing”, i.e., the appropriation and cooptation of local food by the agri-food industry, namely large retailers, [54] a prospect reminiscent of the conventionalisation effects previously documented in the organic and fair trade sectors [55,56].

Second, scaling-up SFSCs while respecting their fundamental ideological motivations is another growing topic of interest [57–59] that merits further exploration, opening a debate between growing (in size) vs. multiplying small-scale initiatives, as discussed in the EIP-AGRI Focus Group on short chains in 2014–2015 [60]. The use of digital technology and social media platforms in SFSCs has recently been documented as a vector for scaling-up, notably in the ongoing H2020 SKIN and SMARTCHAIN projects. For instance, a recent study from the SKIN project evaluated the role of social media in SFSCs, particularly Facebook, but found producers use it more as a sales and marketing tool than as a platform for consumer interaction [61]. On the other hand, actors of online SFSC sales open-source platforms, like the international Open Food Network, emphasize the virtual dimension of SFSCs as enabling the democratisation and reappropriation of food, collective mobilisation and the building of resilient local food economies [62]. However, it remains to be debated whether virtual connection paradoxically risks the dissolution of producer–consumer linkages, despite its potential for improving access to local food products [63]. Moreover, as for other economic activities, one must also assess the use of IT in SFSCs using a political economy perspective, attentive to the risks of labour “uberisation” as well as of data appropriation by big players. Scaling-up SFSCs also requires a better consideration of competency-building. For instance, the development of SFSCs in Eastern Europe remains hindered by farmers’ lack of entrepreneurial/marketing skills, in addition to a competitive retail environment [39,60]. Similarly, a study recently conducted in Spain concluded that although small farmers tend to acknowledge the social and economic benefits of SFSCs, they do not perceive them as feasible from both a practical and capacity-based standpoint [64]. In addition to calling for an evolution in agricultural educational and training programmes, some pan-European studies, like SMARTCHAIN and SKIN, underline the need to create experience- and knowledge-sharing platforms in order to upscale SFSCs.

Third, since the (re)emergence of SFSCs at the turn of the twenty-first century, research has tried to propose a global overview of the importance of local food systems and has proposed, for instance, to evaluate an index of food localisation in different regions from indicators relative to production and marketing of local food products [65]. The IMPACT project carried out in the early 2000s estimated the incidence of SFSCs in 7 European countries but relied on surveys, expert consultation and grey

data to compensate for the lack of official statistics about these chains [66], a gap which has not yet been fulfilled [60]. Particularly, quantitative data documenting the supply and consumer purchases that SFSCs represent, as well as the number of actors and organisations they involve, is still lacking. Research could thus help qualify relevant indicators for a better consideration of SFSCs in national and European statistics.

Section 4 will review the main contributions on the sustainability of SFSCs along different dimensions (economic, social, environmental, nutrition/health).

4. Evaluating the Impacts of SFSCs

SFSCs are often perceived as more sustainable than industrial, long food chains. In what follows, we first separately consider four dimensions of sustainability (economy, social, environment, health/nutrition), then underline the need, beyond multi-criteria analysis, for systemic, interdisciplinary and longitudinal approaches. In the final section, we address the governance of SFSCs as both a pillar of sustainability and as a means to articulate different dimensions, especially within the context of cities and local territories.

4.1. The Economic Dimension

The emergence, or revival, of SFSCs, in various countries and for multiple actors, is often primarily motivated by an increase of farmers' income. This dimension may be difficult to assess, as many small-scale farmers do not practice cost accounting. In France, between 2009 and 2014, an in-depth survey was conducted associating researchers and professionals on more than 800 farms in diverse food sectors (dairy products, fruits and vegetables, among others) [67–69]. The survey considered a wide diversity of farms with regard to their size, their total number of years active, the farmer's professional/family background, their implication in SFSCs, their implication in collective organisations/professional networks and their geographic location. In order to ensure the representativity of farm diversity, cost accounting was implemented with the farmers who did not have it. The survey revealed that some farms operating in SFSCs gain a higher income per asset and per hour than farms operating exclusively in long chains—after at least five to seven years following their foundation—but that results are very heterogeneous among farms using SFSCs, and can even be negative. Research in Quebec found similar results [28,70]. The recent H2020 STRENGTH2FOOD project considered 186 farms in 7 countries and 6 food products, across 6 types of SFSCs and 4 types of long chains. Assuming small samples and low representativity, the results revealed more adequate prices and higher value-added in SFSCs compared with long chains, especially in farmers' markets and pick-your-own farms, while sales to retail shops represented the highest market share among SFSCs [71,72]. The survey conducted in France also demonstrated that collective farmers' initiatives for producing, selling (e.g., in collective farmers' shops) or transporting food, had a positive effect on their income [69]. It also demonstrated that combining sales in short chains with organic farming practices was associated with higher farmer income, and that economic performance depends not only on factors at farmer- and farm-level (especially skills and labour organisation), but also at chain and territorial levels (e.g., degree of local competition, profit margin allotted to the intermediary). Notably, increasing added value in SFSCs requires equipment and processing facilities that are in close proximity to farms (e.g., slaughter house, vegetable processing plant), and adapted to handle small quantities, which may also be seasonal and inconsistent [73].

In addition to income, SFSCs reduce economic uncertainties in contrast to the market volatility typical of long chains [25], and ensure a regular cash flow that favours the greening of agricultural practices [74]. Nevertheless, the determination of a "fair" price in SFSCs remains a fundamental issue, both in direct sale schemes and in chains involving intermediaries [75]. Moreover, the potential economic impact of SFSCs collaborating with big retailers remains controversial [60], and requires more longitudinal data. Finally, as farmers often combine diverse short chains, as well as short and long chains, more research is needed, as a follow-up to STRENGTH2FOOD, in order to model/simulate the relevant combinations of chains according to farmers' capacities, objectives, products and territories [76].

For instance, procuring local food to catering companies, introduced in public policies in many European countries, is often unprofitable for small-scale farms [77,78], yet may be an interesting opportunity for mid-scale farms to combine with sales issued from long chains.

The economic dimension is also captured by the quantity of jobs created/maintained by SFSCs. In France, a national agricultural survey conducted in 2010 showed that farms in SFSCs represent more jobs per hectare than those in long chains (0,75 Full Time Equivalent/ha vs. 0,26) [79]. Similarly, in Quebec, farms operating in SFSCs created, on average, 4 full-time jobs per farm relative to the provincial average of 2.5 full-time jobs [70]. However, the quantity of direct or indirect jobs generated or maintained at the chain level but also in territories (for instance, those related to tourism) has not been assessed. Job quality should also be considered. For instance, the risk of “self-exploitation” has been highlighted in CSA models [80] due to a high workload and consumer pressure. Increased workload can also affect the continuity of the farm operation, i.e., the desire of the following generation to take over the family business [25,81]. Work organisation in SFSCs remains an important issue, also from an environmental perspective (see Section 4.3), while the use of digital technologies opens new, time-saving opportunities, yet requires skills [61].

On a broader scale, SFSCs are expected to contribute to the local economy. The New Economic Foundation (UK) proposed to evaluate the “local multiplier effect” of on-farm purchases, compared with purchases in supermarkets or grocery shops, and highlighted important differences [82]. Very few studies similar to this one have been done, and calculation methods are debatable [83]. However, this topic generates a new field of research concerning the mapping and calculation of detailed economic flows within and surrounding SFSCs related to the emergence of new organisational arrangements (e.g., food hubs) [84]. Still insufficiently documented are the emerging new economic models that incorporate SFSCs [85,86], including, among others, the social and solidarity economy, the circular economy, the platform/sharing economy challenging property rights, the auctioneer-driven economy encompassing, for instance, high-tech urban farming practices and the bioeconomy. These new models question relations with market intermediaries, and call for a further analysis of the types of contracts they may include, in order to compare them with those used in long chains. The H2020 programme includes a topic on innovative agri-food chains connecting producers and consumers intended to address the costs and margins of food chains and implying intermediaries are not systematically involved in fair trading practices (RUR-05-2020, see Appendix A).

4.2. *The Social Dimension*

The emergence or renewal of SFSCs is considerably tied to social motivations [35,87]. In contrast with the anonymous character of long supply chains, SFSCs “re-embed” the economy in personal relations of respect and trust between producers and consumers [88,89]. They also contribute to redevelop relations based on technical dialogue and cooperation between farmers [90], and include newcomers with no previous agricultural experience, who contribute, by sharing new ideas, to renewing the agricultural sector [81,91]. Moreover, SFSCs can improve gender equality [4] and value women’s work [71].

The social dimension is more largely captured by a wide range of multi-actor collective actions and territory-based social innovations [45] which promote place-based products [92], strengthen social cohesion/community-belonging [93,94], develop food democracy [95,96], renew institutional/state food aid programmes [97] and address food insecurity and food sovereignty, including racial and class inequalities [98,99]. Such actions thus stress the need for instilling food justice or solidarity among low-budget consumers who often remain excluded from these chains [18,100]. Nevertheless, solutions oriented towards communities with low socioeconomic status remain difficult to find or to stabilize in a democratic, emancipatory vs. charity perspective [9,101]. Further, access to SFSCs for low middle-class groups, neither rich nor poor, remains unconsidered.

In the context of increasing SFSC diversification and diffusion, examining the influence of these chains on the food habits of average consumers recently entering them is lacking. Most studies

document SFSCs involving consumers already practicing forms of sustainable consumption or just state a correlation between a higher density of SFSCs and a lower rate of obesity [102]. A few explored how SFSCs activate diverse social mechanisms among average consumers (influence, identification, learning, social control, self-promotion) [103,104], and how these factors can enable transitions towards more sustainable practices. The transition may also be facilitated by the contribution of SFSCs in shaping new foodscapes or food environments [105]. For instance, new on-going collaborations between geographers and epidemiologists evaluate how increased exposure to local food in shops or to neighbouring farms provokes changes in food behaviours, also taking into account consumer mobility (project Foodscape).

4.3. The Environmental Dimension

SFSCs are often criticised with regards to their environmental footprint: Schlich et al. [106] argued that lamb purchased from New-Zealand and transported by cargo to Europe generates a similar CO₂ emissions rate, in comparison to lamb purchased and produced in Europe, transported by trucks/cars and sold in short food chains. This study, based on life cycle analysis (LCA), was questioned and nuanced in the GLAMUR project [11] but confirmed in the STRENGTH2FOOD project [71], though in the latter only food transport is considered. However, transport accounts for just a small portion of greenhouse gas (GHG) emissions (CO₂, CH₄, N₂O) produced by food chains: the highest is due to agricultural production [107], therefore leading one to question the impact of SFSCs on farming systems. This does not prevent actors and researchers from seeking solutions to improve transport logistics in SFSCs, especially for the last kilometer in cities, while the first kilometer and rural settings are less considered [47,108]. On the other hand, new ways of evaluating an ecological footprint have been suggested. For instance, some scholars and professionals recommend changing the unit of measurement (GHG emissions per nutrient in the product or per euros procured by the product vs. per kilo) or developing territorial LCA [109,110].

Concerning farming systems, as for consumer food behaviours, most studies have focused on SFSC actors already involved in sustainable/organic or agroecological farming practices and/or responsible/sustainable consumption practices. Given that conventional mid-sized farms are increasingly permeating these chains [60], more research is needed to document the impact of SFSCs on the agroecological transition of (conventional mid-size) farms. Still, few studies address this issue and highlight the positive impact of SFSCs on farming practices through consumer pressure, the renewal of technical dialogue between peers, or the economic risk alleviation in farmers' decisions to reduce their use of chemical treatments [74,111,112]. Nevertheless, a contrasted impact was also highlighted, according to the type of SFSC: while the effects of direct selling are statistically significant for mid-scale conventional fruits and vegetable producers, local procurement of supermarkets does not have any ecological impact, given that it remains regulated by the "zero default" norm, which obliges producers to use pesticides [74]. Moreover, even in direct selling, some technical advisers argue that the suppression of pesticide treatments can also simply be the effect of a low capacity to organize multiple tasks, and could potentially provoke ecological problems (ibid.). With regard to food and packaging waste, more research is needed to assess the potential of SFSCs to have a positive impact on these outcomes [34].

The FP7 GLAMUR project addressed other environmental indicators (resource use, pollution, biodiversity, food waste) to compare local vs. global food chains, but concluded that results are very context- and product-dependent. The study, however, revealed that local food chains seem to better preserve agrobiodiversity than long food chains [11]. The H2020 DIVERSIFOOD, LIVESEED and CERERE projects, focusing on farmer-led participatory breeding for organic farming, also highlighted the strong relation between "peasant"/local varieties and "alternative food systems" [113,114]. On the other hand, projects on (peri)urban agriculture stress the role of SFSCs in farmland preservation [115] and ecosystem services procurement [116], which can be considered indirect impacts of SFSCs and could be more directly and broadly addressed.

4.4. The Nutrition/Health Dimension

The health dimension has also been one of the key drivers of SFSCs' emergence or renewal, already a founding element of the Japanese *teikei* in the 1960s. Local food consumers are increasingly seeking fresh, nutritious and safe food [117]. These questions both the agricultural practices (see above) and the food processing techniques used in SFSCs. Concerning the latter, studies are only just emerging [73], especially for processing vegetables, which remains very little considered (ongoing H2020 FOX project, see Appendix A). For instance, geneticists highlight the nutritious potential of ancient varieties and landraces, typically more cultivated in SFSCs [118], for healthy and diversified diets [119] (see also the H2020 DIVERSIFOOD, LIVESEED and CERERE projects). Further, food technologists and socio-economists stressed the specific qualities of bread and pasta [120] made from the joint use of ancient varieties/landraces of wheat, organic farming and "mild technologies" (stone milling, slow fermentation, suppression of additives, etc.) [121]. Moreover, in the context of rising consumer gluten-sensitivity, geneticists, microbiologists and agronomists have also analysed the gluten quality of these products, in relation to consumers' evaluations [121,122]. However, more research is needed to assess how SFSCs de-commodify food, both culturally [123] and technologically, and generate new quality standards, beyond the scope of both industrial products and geographical indication labelling schemes, and procure diverse, safe food that is accessible to all. These on-going processes could also provoke new sanitary risks, as these chains may imply non-professionals (e.g., consumers contributing to food transportation logistics, consumer cooperatives), a topic that requires further investigation. Finally, the nutrition/health impact of SFSCs should also be studied in order to document potential changes in the food behaviour of average consumers towards healthier diets (as discussed in Section 4.2).

4.5. From Multidimensional to Systemic and Longitudinal Approaches

So far, the EU research and innovation programme has favoured the implementation of multidimensional approaches to assess the sustainability impacts of SFSCs. The already-mentioned FP7 GLAMUR and H2020 STRENGTH2FOOD projects made great contributions, taking into account both experts' and SFSC actors' sustainability indicators [11,124,125]. Results underline that a compartmentalized approach to SFSCs can lead to incomplete and insufficient observations (e.g., relying only on LCA to measure environmental impact) and confirm the need to consider both qualitative and quantitative data [11,25]. When multidimensional findings from French and Italian surveys [68,126] are also considered, as well as EIP-AGRI Focus Group expertise on innovative short chains [60], both researchers and participants tend to agree on the social benefits of SFSCs, and less on their economic and environmental outcomes [125]. The latter two dimensions typically elicit more variable results [3,11,13,60,68,127]. Research and innovation thus provide inputs in order to make tradeoffs and propose paths for progress. Two other EU projects, SKIN and SMARTCHAIN, offer supplementary insights regarding the interaction between sustainability dimensions, as well as on sustainability factors, for instance by highlighting the economic performance of cooperative SFSCs [72]. On the other hand, Maréchal et al. [128] adopted an "organic" approach to study the sustainability of SFSC initiatives in Belgium, highlighting the representations and perceptions that local actors have of their activity, and which are rarely divided into the three classic sustainability pillars. Nevertheless, an in-depth meta-analysis of case studies, expert reports and surveys at the European level would be useful for developing a more systemic assessment, beyond the case studies outlining good practices which have been mainly considered in the SKIN project [59,60]. Moreover, longitudinal studies, evaluating the change in conventional farmers' practices as well as those of consumers newly entering these chains, are needed to better capture the role of SFSCs in agricultural and food systems transition.

5. Governing SFSCs towards Integrated Sustainability

As highlighted in the key conclusions of the FP7 GLAMUR project, food chain governance is an important determinant of impact assessment [11]. Although this could have been included in the previous section as a dimension of sustainability, it merits a specific section as governance dynamics could favour (or limit) the articulation of the different pillars of sustainability at both the chain and territorial levels. In line with the SKIN project [59], one can consider both internal and external governance, the latter referring to the political context surrounding SFSCs.

5.1. SFSCs at the Heart of New Local Food Policies

SFSCs have been the subject of a growing literature in several disciplines (geography, rural sociology, food planning and political sciences, among others) interested in the emergence of urban food policies as expressions of new place-based, horizontal and inclusive governance schemes, for instance through food policy councils [129]. Studies examining these councils have mostly focused on large-scale cities, from the pioneer case of Toronto [130,131], now included among others in the international Milan Urban Food Policy Pact (2015), through which cities worldwide commit to act locally to develop more sustainable food systems [132]. In centralised states like France, local food policies act as an expression of decentralised power dynamics and of the growing role of local authorities [133]. Within these policies, studies are especially examining the rise of farm-to-school programmes to support local farmers and provide children with fresh, local foods and agricultural education [134]. More recent research also highlights how food policies specifically shape land preservation or farm land access in peri-urban areas [135,136]. Nevertheless, some scholars have raised questions about the empowerment processes produced by these policies and governance structures [137]. While cities remain central to food governance dynamics, few studies consider this issue in small-scale cities and rural territories [135,138]. However, the role of these spaces is expanding, for instance in the case of “territorial food projects” (*Projets alimentaires territoriaux*) included in the 2014 French Agricultural Law [133] or in the development of bio (organic/eco)-regions [139]. Moreover, more longitudinal research is needed in order to highlight the conditions of local partnerships, and of the organisation of local socio-ecosystems around SFSCs. This organisation opens a new line of innovation and research about local reindustrialisation (i.e., installation of local processing units to transform local raw material) beyond local distribution, and calls for adaptation/innovation in food systems and the training of concerned actors (farmers, bakers, etc.) [121].

5.2. SFSCs and Power Issues

As briefly evoked in Section 4.2., these chains also favour the experimentation of new inclusive economic models and tools in line with the social values expected from them, including, among others, fair trade, equity, participation, transparency and food and employment relocalisation [86]. Recent papers explored the development of “prosumption” in SFSCs, i.e., the implication of consumers in productive tasks [140]. Another new research direction has focused on the extension of participatory guarantee systems, usually studied in the realm of organic farming [141], to SFSCs and local food systems [112,142]. This orientation reaffirms the role of civil society in developing new forms of agrifood governance [143], a phenomenon first observed in CSA initiatives and equivalent systems. Lastly, some studies assess “mid-tier chains”, which are developing at regional levels and involve more intermediaries, but whose actors collaborate, and assume or promise a combination of economic objectives as well as social and environmental values. These “values-based chains”, which may be juxtaposed with territorial branding [144,145], may be considered one of the possible ways of articulating different sustainability dimensions in a hybridised manner, as well as of the scaling-up of SFSCs. However, more research is needed, as they can also preserve or create new power imbalances and unfair trading practices, especially when the use of IT is concerned and/or large food retailers are involved.

5.3. SFSCs in Food Systems Resilience

One of the most recent, and salient topics of research on SFSCs concerns their contribution to food system resilience, especially regarding the capacity of food systems to guarantee food procurement in case of sanitary, climatic, social or economic shock. For instance, Smith et al. [146] highlighted the complementarity between short and long chains in procuring food during major flooding in Australia. In the earlier FP7 FOODLINKS project, the resilience of SFSCs was highlighted as a key factor to be used in policy changes—SFSCs can complement long chains, thus diversifying the sources of food supply [13]. More research is, however, needed to qualify and quantify the concrete economic, social and spatialized flows in each type of chain, including their importance and vulnerabilities, in order to guide decision-makers [147]. Another new direction of research, initiated in the FP7 FOODMETRES project, consists of assessing the foodshed of cities and testing diverse scenarios to increase self-sufficiency in relation to possible evolutions in diets, population, etc. [148]. SFSCs and food relocalisation, implying local reindustrialisation, have been suggested as key components of self-sufficiency from a food planning perspective. However, their current/potential role has to be more deeply examined in relation to possible shocks, as demonstrated during the Covid-19 crisis in which they played a key role in reassuring consumers [149].

6. Conclusions

The literature review demonstrated the high potential of SFSCs to improve sustainability, as they have been renewed or created in relation to large expectations regarding “new indicators of wealth”. Three main conclusions are outlined. First, though the publications reviewed in this paper tend to generally agree on the social benefits of SFSCs, their economic and environmental impacts typically elicit more heterogeneous outcomes, while their health/nutrition and governance dimensions remain underexplored. A significant part of the literature, however, has been focused on face-to-face SFSCs (especially CSA and farmers’ markets) while these chains are up-scaling and involve a diversity of intermediaries, including large retailers and digital developers [46]. Second, while place-based specificities were pertinent for outlining the different conceptualisations and trajectories of SFSCs, these distinctions did not appear significant for discussing the sustainability impacts of SFSCs. Our review, however, includes many studies conducted in France, so the effect of the country context may have been underestimated. Third, regarding SFSC or AFN sustainability assessment, recent research in Eastern Europe, for instance, calls to balance the market-based vision of sustainability dominating the literature, and to consider a “quiet” or “household” sustainability anchored in daily practices of self-food provisioning, e.g., non-market SFSCs, and structured around other social and environmental outcomes not directly linked with market transactions (e.g., care, generosity) [150–153].

Drawing on hypotheses issued from the French expert network *RMT Alimentation Locale*, this review calls attention to several research gaps. From the perspective of the EU Horizon Europe programme, for a contribution to the EU Green New Deal and given the current Covid-19 context, some of these gaps appear particularly important to fulfill. We suggest that they be addressed along two priority research and innovation issues.

First, the role of SFSCs in food systems transition should be addressed, in relation to their up-scaling. Indeed, even if SFSCs may still represent a small part of food sales and consumer purchases in developed countries—this remains an hypothesis as we do not yet have quantitative data—their coexistence with long chains in farms and territories [154], their introduction into field crop sectors [121] as well as their increasing use by regular consumers in addition to purchases in supermarkets, as observed for instance in France [155], encourage a new path of research on the transformative capacity of SFSCs, on conventional farming techniques and regular food behaviours and on the mainstream agro-industrial system. On one hand, longitudinal interdisciplinary assessments of farmers’ and consumers’ practices, according to the type(s) of SFSC(s) they use, would be of great value to identify concrete levers and barriers to develop sustainable production and consumption, as initiated in recent research in France [74,104]. On the other hand, the intersection of work on

transition theory and on social innovation could be strengthened to assess if SFSCs marginally improve the agro-industrial regime, based on intensive production and long chains, and/or elaborate a new values-based and more sustainable regime, coexisting with the agroindustrial one [121].

Second, the contribution of SFSCs to food systems resilience becomes particularly relevant in the context of the Covid-19 crisis: even if global chains have been resisting this unforeseen shock, their vulnerabilities have been highlighted (e.g., high dependence on logistics and on hired labour force, among others). In parallel, food relocalisation and SFSCs, herein including the development of food self-provisioning, have been largely mediatised as an important strategic resource to reassure citizens, to improve food security and to recover food sovereignty [149], a notion initially developed in Southern countries [156]. This issue not only questions the capacity of SFSCs to ensure food supply, as previously mentioned, it also calls for a further assessment of multiple socio-economic, material and spatialized flows around food, in line with work on territorial metabolism [157]. It prompts the need to evaluate the diverse assets, vulnerabilities and risks associated with these flows and to simulate diverse shocks and scenarios by developing new collaborations with the scientific community working on resilience and risk management. These simulations would provide new arguments to balance short and long, local and global and market and non-market food chains, and structure their complementarity from the perspective of expected or potential shocks (natural disaster, rise in the price of oil, strikes by logistic operators, among others). They could also consider shortening international trade flows, in terms of intermediaries, in order to transform uncontrolled dependencies into voluntary, cooperative and equitable interdependencies, thus adopting some characteristics of short chains in global trade.

Finally, this review calls attention to three main needs that could be addressed through coordination actions, which the Horizon Europe programme can support (within Coordination Support Action projects) but which also depend on political decisions and the availability of public bodies, European or national, to better include SFSCs in their action programme: (i) following the model of the EIP-AGRI Focus Group on short food chains [60], renewing a network of experts at the European level to make a qualitative and quantitative in-depth meta-analysis of case studies, expert reports and surveys addressing sustainability dimensions, in order to propose a systemic and contextualised impact assessment of SFSCs, taking into account market and non-market based SFSCs; (ii) through a larger mobilisation of public training organisms, implementing appropriate and innovative training tools, devices and methods to build the skills needed for SFSC development and multi-performance; and (iii) with the help of research organisms, better including SFSCs in European, national and regional public statistics with relevant indicators.

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Appendix A

Table A1. Recent and ongoing European projects on or related to short food supply chains.

Date	Project Title	Main Objective	Website
2011–2013		Develop and experiment with new ways of linking research to policy-making in the field of sustainable food consumption and production	www.foodlinkscommunity.net/foodlinks-home.html
2013–2016		Assess the impact of global and local food chains (20 cases in 10 countries)	www.glamur.eu
2016–2019		Reduce knowledge gaps by reconnecting producers and consumers	www.shortfoodchain.eu
2019–2023		Develop innovative processing technologies for fruits and vegetables	www.fox-foodprocessinginabox.eu
2016–2021		Qualitatively assess the organisational development of 12 SFSCs and their impact assessment (social, economic, environmental)	www.strength2food.eu
2018–2021		Foster and accelerate a shift towards collaborative SFSCs (analysis of various types)	www.smartchain-h2020.eu
2020–2024	RUR-05–2020: Connecting consumers and producers in innovative agri-food supply chains (CSA)	-AgroBRIDGES: Building bridges between consumers and producers by supporting short food supply chains through a systemic, holistic, multi-actor approach- based toolbox -COACH: Collaborative agri-food chains: Driving innovation in territorial food systems and improving outcomes for producers and consumers -COCOREADO: Connecting consumers and producers to rebalance farmers' positions through ambassador training	
2020–2024	CE-FNR-07–2020: FOOD 2030-Empowering cities as agents of food system transformation (CSA)	-CITIES2030 Co-creating resilient and sustainable food systems towards the FOOD2030 PROJECT -FOOD TRAILS Building pathways towards FOOD 2030-led urban food policies	

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