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Does short food supply chain participation improve farm economic performance? A meta-analysis

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20 **Abstract:**

21 Many researchers, policy makers and food activists view Short Food Supply Chains (SFSC) as attractive
22 levers for improving farm income and the sustainability of farming systems. However, the empirical
23 evidence documenting the association between SFSC participation and farm economic performance has
24 been mixed. In this study, through a meta-analysis using a logistic regression, we identify key factors to
25 explain differences between studies that find better economic performance in SFSC and those that do not.
26 Our meta-analysis consists of 48 studies published in English and French from 2000 to 2022 that examine
27 the economic performance of farms engaged in SFSC. Based on far more empirical evidence than previous
28 reviews, we find that the relationship between SFSC participation and farmer income remains ambiguous.
29 More specifically the findings indicate that the reported effect of SFSC on a farm economic performance
30 varies depending on location and the indicator used to capture the economic performance of farms. Studies
31 conducted in Europe are more likely to report higher farmer income as are studies that use profit satisfaction
32 metrics rather than measures of gross or net income. We also emphasize the need to interpret the reported
33 results cautiously because few are based on causal inference methods. Furthermore, the very few studies
34 that account for selection bias often do so with inadequate corrections.

35 **Keywords:** Meta-analysis, Farmers, Short Food Supply Chains, Income, Economic performance

36 **JEL CLASSIFICATION:** Q13, Q14

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47 **1 Introduction**

48 Local food supply systems (LFS) and short food supply chains (SFSC) have garnered increasing interest
49 from academia and policy-makers in recent decades. Their development has been encouraged in the
50 European Union (EU) by the European Agricultural Fund for Rural Development (EAFRD) devoting up to
51 10% of its expenditures to the promotion of food chain organization (Dwyer et al., 2016). Similarly, the
52 U.S. Department of Agriculture through the 2014 Farm Bill invested \$501.5 million over five years in
53 diverse programs promoting local food production (Martinez, 2016). A growing number of farmers have
54 chosen to market through SFSC and LFS even though this growth appears to be plateauing in the US (Low
55 et al., 2015). By 2015, 15% of EU farms sold more than half of their production directly to consumers
56 (European Parliament, 2016). In 2015, fewer than 9% of U.S. farms marketed food locally with 34% of
57 them using only direct marketing channels (Martinez & Park, 2021).

58 There is no “official” definition of LFS, which has a strong subjective aspect related to local context. It
59 refers most of the time to a distance of about 10 to 30 miles up to 100 miles between the point of production
60 and the point of sale (Feldmann & Hamm, 2015) but can also be understood in relation to a recognized
61 geographical area such as a county or a national park. By contrast, the EU rural development policy 2014-
62 2020 has adopted a common definition of SFSC, defined as a supply chain including a minimal number of
63 intermediaries (European Parliament, 2013). This is the case in France, where SFSC have been officially
64 defined by the French Ministry of Agriculture as a marketing mode involving no more than one
65 intermediary between the producer to the consumer and therefore including both direct sales as well as sales
66 through an intermediary such as a cooperative or supermarket (LOI N° 2010-788, 2010; LOI N° 2010-874,
67 2010)².

68 The dividing line and relationship between LFS and SFSC is blurred because SFSC embrace diverse forms
69 overlapping most of the time the local concept, regrouped in the “sales in proximity” category (Aubry &
70 Chiffolleau, 2009). Therefore, the European literature refers mainly to SFSC owing to the difficulties of
71 defining the “local” concept. However, the North American literature refers to LFS covering both direct-

² The term “circuit court” – short circuit – appears in the legal provisions, in Articles L. 1 and L. 111-2-2 of the Rural Code, in the 2010 law on the National Commitment for the Environment, and in the 2010 law on modernization of agriculture and fishing.

72 to-consumer (DTC) and intermediated sales (e.g., sales to institutions or regional distributors). In addition,
73 most studies included in this analysis do not look at SFSC or LFS in their entirety but rather at something
74 more restrictive such as direct marketing (DM) or at some component of DM such as community supported
75 agriculture (CSA) or farmer markets (FM).

76 Public opinion often considers agricultural incomes as structurally lagging behind incomes in other sectors
77 (Katchova, 2008; Rocchi, Marino, & Severini, 2021). The modernization of agriculture has put pressure on
78 farmers to invest continuously in new technologies and produce for mass food markets, thereby squeezing
79 economic margins (Ploeg et al., 2000). This increasing pressure on the value captured by farmers in
80 conventional supply chains has favored the emergence of local distribution channels (Marsden, Banks, &
81 Bristow, 2000; Renting, Marsden, & Banks, 2003). They represent an opportunity for farmers to capture
82 more of the overall margin by eliminating intermediaries and offer direct access to consumers who are more
83 willing to pay for locally produced foods. They can, therefore, contribute to improving the viability of farm
84 households and, indirectly, increasing the resilience of agricultural and food systems (Darnhofer, 2014;
85 Finger & El Benni, 2021). However, the positive impact of SFSC on farm viability has been questioned
86 because of numerous obstacles hindering their performance (Plakias, Demko, & Katchova, 2020;
87 Rucabado-Palomar & Cuéllar-Padilla, 2020). SFSC have limited sales volume, and sellers receive prices
88 that may not cover their higher production and marketing costs (e.g. significant labor, packaging and
89 transportation expenses) as well as transaction costs (e.g. information, negotiation and control costs)
90 (Cesaro et al., 2020; Kneafsey et al., 2013; Uematsu & Mishra, 2016).

91 To the best of our knowledge, one report and two articles have conducted systematic reviews of the effect
92 of SFSC participation on farm economic performance in addition to other aspects of their sustainability,
93 and they find conflicting evidence (Chiffolleau & Dourian, 2020; Enthoven & Van den Broeck, 2021;
94 Kneafsey et al., 2013). The results of the economic performance assessments of farms engaged in SFSC
95 are difficult to compare because they are based on different methodologies and data. In addition, SFSC is
96 an umbrella term covering a wide variety of marketing forms and levels of involvement such that the SFSC
97 marketing strategies adopted by farmers influence their economic performance (Enthoven & Van den
98 Broeck, 2021). Other variables such as farmer characteristics, time scale and geographic context might also
99 affect the economic performance achieved within SFSC (Enthoven & Van den Broeck, 2021).

100 We conduct this meta-analysis to identify the structural characteristics that might explain differences
101 between studies that find better economic performance in SFSC and those that do not. In addition, the
102 literature search conducted for this meta-analysis is the first exclusively concentrated on the effect of SFSC
103 participation on farm economic performance, allowing a more thorough analysis than previous reviews.

104 The paper is structured as follows. Section 2 provides a description of the methods employed in the meta-
105 analysis and the systematic review protocol used. Section 3 presents the results of the meta-analysis. In the
106 last two sections, we discuss our findings and present implications for future research and policy.

107 **2 Methods**

108 “Meta-analysis provides an objective approach to review empirical literature through applied statistical
109 methods that allow testing for the effect of different factors on the empirical results reported in the
110 literature” (Stanley & Jarrell, 2005). This meta-analysis seeks to identify the structural variables associated
111 with conflicting results regarding the economic performance of farms involved in SFSC. First, we conduct
112 a literature search to identify studies that examine the relationship between SFSC participation and farm
113 economic performance (see part 2.1). Second, we identify structural variables that might distinguish studies
114 finding positive economic effects for SFSC from those that do not (see part 2.2). Third, we use a logistic
115 regression analysis that controls for differences in study design characteristics to determine which factors
116 can explain variations in the economic performance of farmers using SFSC (see section 3).

117 **2.1 Literature search and selection criteria**

118 The literature review identifies all the articles investigating the effect of SFSC participation on farm
119 economic performance. It is performed by following the checklist of the Preferred Reporting Items for
120 Systematic Reviews and Meta-analyses (PRISMA) (Liberati et al., 2009) (Figure 1). The review protocol
121 containing information on the search terms, databases, eligibility criteria and selection process is presented
122 below.

123 **2.1.1 Information sources and literature search**

124 The literature review was conducted using Scopus and Web of Science databases that are among the most
125 valued databases for this field of interest. We applied a combination of three lists of comprehensive search
126 terms detailed in Table A1 in appendix, which explored the article title, abstract and keywords of every

published document identified. The list including “Farmer”, ”Grower”, ”Rancher” or “Producer” keywords was mainly used in order to avoid an excess of unsuitable articles. Additional filters were used in order to limit the search within the social science discipline. The last search was run on October 16th 2022.

2.1.2 Eligibility criteria

The Population, Intervention, Comparison, Outcomes, and Study (PICOS) design criteria was used to identify both qualitative and quantitative papers (Table A2 in appendix). All English or French articles published in peer-reviewed journals from January 2000 to October 2022 analyzing the effect of SFSC participation on farm economic performance are included. Studies not conducted in Europe, Northern America or Australia where the specific context could induce different outcomes were also excluded. Finally, literature reviews, theses and dissertations, letters, book chapters, reports, author comments, and other grey literature were not included. Contrary to research articles which are mainly written in English, grey literature is usually published in the language of the country where the studies take place. Consequently, grey literature we might consider would have not been representative of other non-English and French-speaking countries. In addition, studies from the grey literature have not necessarily been subject to a peer-reviewed process and it is thus more difficult to assess their quality.

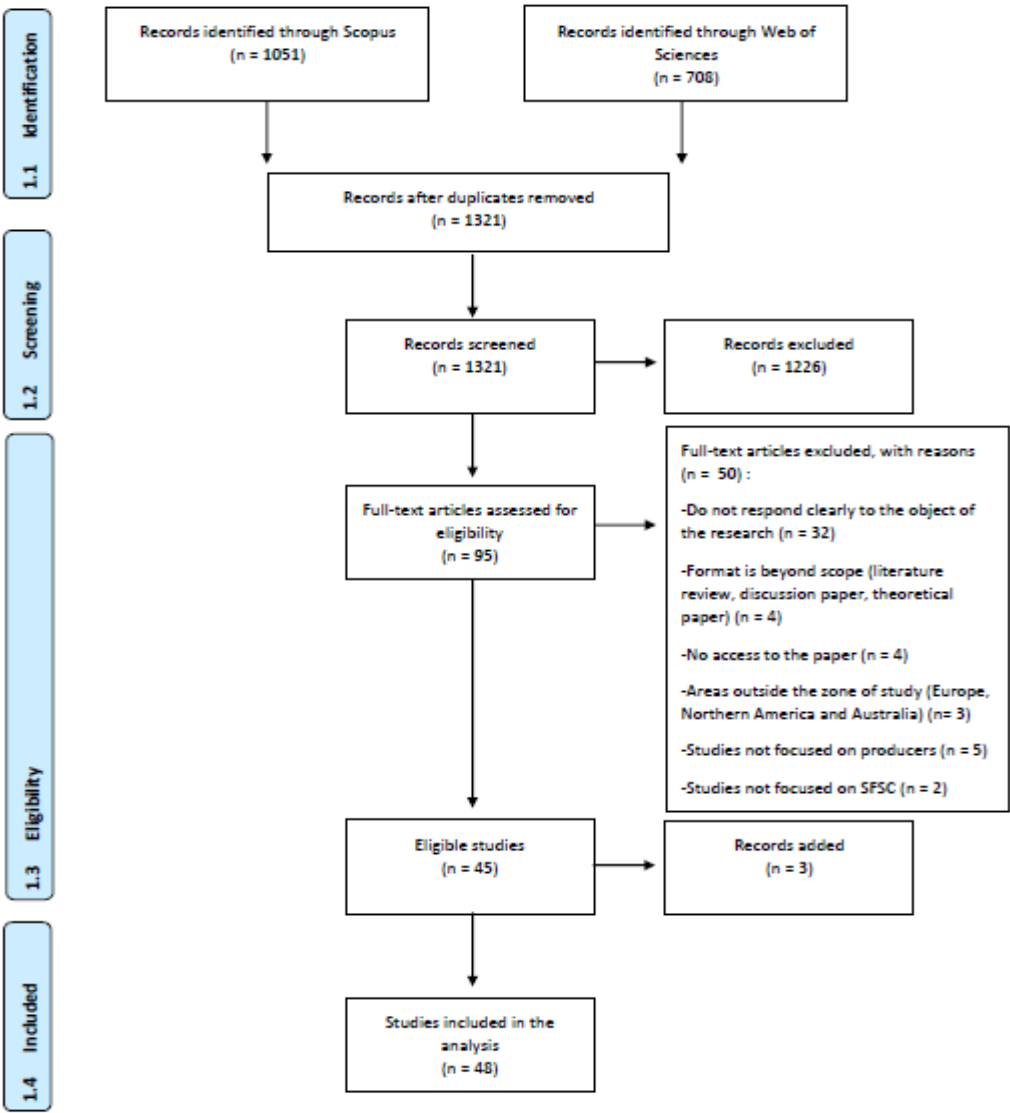
2.1.3 Study selection process

Figure 1 describes the process by which articles were selected for this analysis. After removing duplicates between the Scopus and Web of Science databases, 1321 candidate records were identified. Then two independent reviewers screened article titles and abstracts using an Excel spreadsheet, and disagreements between them were resolved through discussion. During this phase, 1226 records not meeting the eligibility criteria were excluded. The eligibility assessment continued with the lead author reviewing in detail the full-text of the 95 remaining articles. Among those, 50 records fell outside the scope of the review (not farmer specific or not conducted in Europe, Northern America or Australia) and were removed. Finally, we added three relevant studies to the 45 articles identified previously, leading to a total of 48 articles included in the literature review³ (Figure 1).

³ One relevant study was not identified through the PRISMA selection process because it was slightly outside the period range of this meta-analysis (Govindasamy, Hossain, & Adelaja, 1999), another was published in a journal not included in Web of Science or Scopus (Richard, Chevallier, Dellier, & Lagarde, 2014) while the third one was not identified for unknown reasons (Park, 2015).

152 **2.1.4 Data Collection Process**

153 Content analysis was conducted by lead author while a second author checked the extracted content. Every
154 selected article was carefully read and the following information was tabulated by the lead author: authors,
155 year, setting, supply chain characteristics, methodology, sampling, outcome unit, outcome focus and the
156 effect found (Table B1 in appendix).



158 **Figure 1.** The PRISMA flow diagram

159 **2.2 Meta-analysis**

160 **2.2.1 Structural variables**

161 There is no guidance on which explanatory variables we should use; however, there are some study design
162 characteristics that the literature indicates may have an impact on the economic performance of farmers in
163 SFSC. In addition, some structural variables that have been frequently investigated in other meta-analyses
164 might also affect the economic performance of farmers in SFSC. In this study, we classify the structural

165 variables investigated into four categories: data sources (secondary or survey data), study characteristics
166 (study period, location, duration and number of SFSC forms examined), data analyses (endogeneity
167 correction and analysis method) and dependent variables (outcome unit). Table 1 presents these variables,
168 which are identified and coded.

169 First, we include variables that account for the nature of the data used in different studies. Because study
170 accuracy depends upon the quality of the data analyzed, data should be accurate and contain few and only
171 minor errors. Consequently, the data source is critical for the analysis. Data from secondary sources usually
172 have larger farm samples, increasing the generalizability of the study results. In addition, their larger sample
173 sizes provide results with lower standard errors, making it easier to distinguish the effects of SFSC from
174 random noise (Lee, Choe, & Park, 2015). However, they lack detail and flexibility due to the use of
175 predetermined categories (Lee et al., 2015). Kneafsey et al., (2013) argue that the positive results found by
176 localized case studies, which often use small sample questionnaires, contrast with findings from large
177 surveys, which more often report lower economic performance. The number of respondents from studies
178 identified varies greatly, ranging from 3 to 78,559 (Table B1 in appendix). Twelve percent of the studies
179 rely on samples that reflect the entire farm population (e.g. studies with samples based on census or
180 representative sample data). We control for two types of data sources used in studies identified: field
181 surveys and secondary databases.

182 Most of the studies use data for one year which may not be sufficient to provide a clear view of the economic
183 performance of farmers engaged in SFSC. Farmers entering in SFSC may need several years before
184 becoming viable, as SFSC participation may require investments and developing a customer base (Clark,
185 2020; Dono, Buttinelli, & Cortignani, 2022). Studies based on short-term data collection might, therefore,
186 produce results more favorable to SFSC because they do not account for this establishment period. In
187 addition, once a firm is established, time-varying factors (economic, climatic, etc.) can cause economic
188 performance to vary over time. Therefore, panel data can help us to understand whether the positive
189 performance is just a one-time occurrence or something the firm achieves consistently. To test the effect of
190 using multiple year datasets, we include a duration variable composed of two categories: one year and
191 multi-year.

192 The motivation for distinguishing between different study periods is that we want to examine whether the
193 returns to SFSC participation have been stable, increasing or declining over time. In addition, compared to
194 earlier studies, later studies generally display improvements in the models, methods and data employed.
195 For example, all of the limited number of research studies that evaluate the causal impact of SFSC on farm
196 economic performance with endogeneity correction were conducted since 2010. Similarly, in Europe,
197 questions on supply chain participation are more detailed in the recent farm accountancy data network
198 (FADN) surveys and agricultural census than the previous ones, allowing for studies with more
199 representative and larger samples.

200 We also test whether results differ by location. Farming systems vary across countries and continents, which
201 might affect the economic performance found in SFSC. In addition, farmers involved in SFSC might have
202 different motivations and face different challenges depending on their location. To test for the role of
203 location, we have classified the samples into two regions: Northern America and Europe.

204 Many studies fail to distinguish among SFSC types, even though there are a wide diversity of SFSC forms
205 (Aubry & Kebir, 2013). For example, studies estimating causal impact often use a binary variable to
206 designate farms using SFSC and provide limited or no descriptive statistics on the forms of SFSC used by
207 farms in their samples. Considering all SFSC to be the same might blur the effect of SFSC on economic
208 performance because it combines what could be opposing results of different SFSC types. In this meta-
209 analysis, it is difficult to consider the different SFSC forms given the limited information available.
210 However, we can distinguish between studies investigating the economic performance of a specific type of
211 SFSC and those involving multiple SFSC forms. We test whether the results from studies focused on a
212 single form of SFSC (FM and CSA in our case) differ from those that look at SFSC all inclusively.

213 Although a few studies evaluate the effect of SFSC on farm incomes based on causal inference methods,
214 only a subset of these studies make use of regression analysis methods accounting for selection bias. This
215 is partly due to the difficulties of measuring quantitatively the economic benefits of SFSC that could be
216 invisible and confidential (Kneafsey et al., 2013) while finding valid instrumental variables (IV) (which are
217 often used to address endogeneity issues) is one of the most challenging tasks in applied agricultural
218 economic analysis (Kubitza & Krishna, 2020). We test the effect of employing causal inference accounting
219 for selection bias by including a dummy variable equal to 1 if studies use such methods. Those studies

220 might provide different results because they control for unobserved factors affecting the adoption of SFSC
221 that are correlated with farm income. When selectivity corrections are neglected, results might be biased
222 indicating that earnings are over or underestimated.

223 Some studies examine the economic implications of SFSC involvement for farm viability while others
224 compare the economic performance of farmers in SFSC to those in LFSC (long food supply chains).
225 Consequently, they might provide different conclusions: farmers in SFSC might (not) be economically
226 viable but achieve lower (higher) economic performance than ones in conventional markets. To test whether
227 the nature of the analysis (relative/absolute) influences the results, we define a binary variable that
228 distinguishes studies looking at viability of farms in SFSC from those comparing economic performance
229 between SFSC and LFSC.

230 To investigate whether the economic effects of SFSC involvement might be affected by the types of
231 economic measures used, we group the numerous economic indicators into three main categories: gross
232 income, net income and farmer self-assessment of their business situation. First, studies considering gross
233 income might provide more positive results than ones using net income because they do not consider
234 production costs that could be higher in SFSC due to their high labor requirements. Second, we must
235 recognize that the use of subjective performance measures may lead to findings that differ from those based
236 on objective performance measures. In many studies, subjective and objective measures of farm
237 performance have been often treated as equivalent although they are often not correlated (Jackson-Smith,
238 Trechter, & Splett, 2004; Mäkinen, Rantamäki-Lahtinen, Ylätaalo, & Vehkamäki, 2009). One explanation
239 is that farmers are not very familiar with economic indicators typically used in business analysis. They rate
240 their own financial success based on the liquidity available in their bank account for private consumption
241 and to pay the bills (Mäkinen et al., 2009). Subjective ratings therefore reflect a broader view of farm
242 performance than objective measures focused on more specific financial indicators capturing the production
243 side of agriculture at the enterprise level. Subjective measures most often focus on overall performance at
244 the household level reflecting the consumption possibilities of the farm family depending on both farm and
245 nonfarm incomes. SFSC farmers are more likely to rely on non-agricultural diversification activities (e.g.
246 equestrian activities) (Park, Paudel, & Sene, 2018; Rocchi, Randelli, Corsini, & Giampaolo, 2019) and off-
247 farm work (Bruce & Som Castellano, 2016) helping them to stabilize their total household income (Mishra,

248 El-Osta, Morehart, Johnson, & Hopkins, 2002). In addition, these studies are more likely to rely on different
 249 types of methods (e.g. logistic regressions) and data (field survey) than other ones.

250 2.2.2 Regression model

251 This meta-analysis examines the impact of the previously described structural variables on the reported
 252 economic performance of farms engaged in SFSC. A logit regression is used to model the likelihood of a
 253 study finding a positive effect of SFSC on farmer economic performance as a function of the structural
 254 variables (Maddala, 1986). The model assumes an underlying latent success variable y_i^* defined by the
 255 relationship:

$$256 \quad y_i^* = \beta' x_{ik} + \mu_i \quad (1)$$

257 Where we assume that μ_i are $IN(0, \sigma^2)$

258 However, in practice we observe y defined by

$$259 \quad y_i = 1, \quad \text{if } y_i^* > 0, \quad y = 0 \text{ otherwise} \quad (2)$$

260 According to the logit model, the probability of a study finding a positive effect of SFSC on farmer
 261 economic performance ($Y_i = 1$), given its characteristics (x_i) is $Prob[Y_i = 1 | x_i]$ and can be specified as
 262 :

$$263 \quad Prob[Y_i = 1 | x_i] = \frac{\exp(x_i' \beta + \varepsilon_i)}{\{1 + \exp(x_i' \beta + \varepsilon_i)\}} \quad (3)$$

264 The probability of finding a negative/neutral effect, $Prob[Y_i = 0 | x_i]$, is therefore

$$265 \quad Prob[Y_i = 0 | x_i] = 1 - Prob[Y_i = 1 | x_i] = 1 - \left[\frac{\exp(x_i' \beta + \varepsilon_i)}{1 + \exp(x_i' \beta + \varepsilon_i)} \right] = \frac{1}{1 + \exp(x_i' \beta + \varepsilon_i)} \quad (4)$$

266 The relative odds of finding a positive versus negative effect are given by

$$267 \quad \frac{Prob[Y_i = 1 | x_i]}{Prob[Y_i = 0 | x_i]} = \frac{[\exp(x_i' \beta + \varepsilon_i)][1 + \exp(x_i' \beta + \varepsilon_i)]}{[1 + \exp(x_i' \beta + \varepsilon_i)]} = \exp(x_i' \beta + \varepsilon_i) \quad (5)$$

268 By taking the logarithms of both sides,

$$269 \quad \ln \left[\frac{Prob[Y_i = 1 | x_i]}{Prob[Y_i = 0 | x_i]} \right] = x_i' \beta + \varepsilon_i \quad (6)$$

270 The maximum likelihood approach can be used to estimate the above equation.

271 The reduced form of the model is

272
$$EEFFECT = \alpha_0 + \beta_1 DSOURCE + \beta_2 DURATION + \beta_3 PERIOD + \beta_4 LOCATION + \beta_5 NSFSC + \beta_6 DANALYSIS + \beta_7 NANALYSIS + \beta_8 MEASURE \quad (7)$$

273 where our binary dependent variable (EEFFECT) equals one for studies reporting a positive effect of SFSC
274 on farm economic performance and 0 for studies reporting a neutral or negative effect. The selected
275 explanatory variables for this study include the data source (DSOURCE), the duration of data
276 (DURATION), the period when the studies were set up (PERIOD); the location where the studies are
277 conducted (LOCATION); the number of SFSC forms considered (NSFSC); whether the analysis employs
278 causal inference accounting for selection bias (DANALYSIS); whether comparisons with performance in
279 LFSC are made (NANALYSIS) and the types of economic measures used (MEASURE). A complete
280 description of the variables that have been employed is given in (Table 1).

281 **3 Results**

282 **3.1 Descriptive Statistics**

283 Table 1 presents the frequency distribution for each of the structural variables examined. Approximately
284 54% of the 48 studies included in this analysis report a positive impact of SFSC participation on farm
285 economic performance while 46% exhibit no effect or a negative impact. The number of publications
286 evaluating the economic performance of farmers in SFSC has dramatically increased since 2016, reflecting
287 increased research interest in this topic. More than 54% of the publications in this analysis were completed
288 between 2016 and 2022. Most of the studies were conducted in North America (70%), particularly in the
289 US⁴. The larger number of US articles may be explained by the availability of data, publication bias (number
290 of academics in the US, etc.) and because the review is looking only at English and French language
291 literature.

292 Among the 48 studies considered, 32 examine whether farmers using SFSC are more viable or have better
293 economic performance than they would in conventional supply chains while the remaining 16 studies

⁴ The single Australian study identified was included with the European studies.

294 consider whether farmers participating in SFSC are viable. The studies focus on one of three alternative
 295 performance measures; net income (60%), gross income (17%), or a self-assessment of the business
 296 situation (23%). Most studies rely on field surveys (60%) with data for a single year (85%). Only a few
 297 studies make use of regression analysis methods accounting for selection bias (13%). A limited number of
 298 studies focus on one SFSC form (25%), while most do not distinguish among multiple SFSC forms.

299 **Table 1.** Frequency distribution of structural variables and dependent variable

Structural variables	Abbreviation	Coding	Dimension	Number of observations
Data source	DSOURCE	0	Field survey	29 (60%)
		1	Secondary data	19 (40%)
Duration	DURATION	0	One year	41 (85%)
		1	Multi-year	7 (15%)
Study period	PERIOD	0	[2000-2010]	9 (19%)
		1	[2011-2015]	13 (27%)
		2	[2016-2022]	26 (54%)
Location	LOCATION	0	Europe	14 (30%)
		1	US	34 (70%)
Number of SFSC forms	NSFSC	0	One form of SFSC	12 (25%)
		1	Multiple forms of SFSC	36 (75%)
Data analysis	DANALYSIS	0	No Endogeneity correction	42 (87%)
		1	Endogeneity correction	6 (13%)
Nature of the analysis	NANALYSIS	0	Farm viability	16 (33%)
		1	Comparison with conventional markets	32 (67%)
Types of economic measures	MEASURE	0	Gross income	8 (17%)
		1	Net income	29 (60%)
		2	Profit satisfaction	11 (23%)
Economic effect	EEFFECT	0	Negative or neutral	22 (46%)
		1	Positive	26 (54%)

300 **3.2 Empirical model**

301 Using logistic regression, we examine how different structural characteristics are associated with
 302 conflicting findings on the effect of SFSC engagement on farm economic performance.

303 Table 2 presents the results, which identify the structural variables that have a statistically significant
 304 association with findings of positive economic performance for SFSC participation. The empirical model
 305 also reports marginal effects, computed as the difference between the probabilities estimated at the sample

306 means when the outcome variable takes the values 1 and 0, respectively (Table 2, column 2). The confusion
307 matrix evaluates the predictive performance of the logistic regression model by comparing the classification
308 of the predicted responses with the effective values of the exogeneous variable in the sample. One of the
309 most common indicators derived from the confusion matrix is accuracy, which is the percentage of correct
310 predictions. Our model made 75% correct/appropriate predictions which is quite good considering the
311 sample size and the number of predictors (Table 3).

312 The structural variables for outcome measure type and location are statistically significant. The profit
313 satisfaction category exhibits a positive and statistically significant value, indicating that studies capturing
314 economic performance with a profit satisfaction measure are more likely to report a positive economic
315 effect of SFSC participation than studies using net or gross income measures. In terms of marginal effects,
316 studies using a profit satisfaction measure are 75.7 percentage points more likely to report that SFSC
317 adoption increases farm performance than studies using the gross income measures. The logistic regression
318 results also reveal that the economic performance of SFSC depends on location. Studies conducted in US
319 are significantly less likely to report positive economic benefits from participating in SFSC than those
320 conducted in Europe. Marginal effects indicate that studies conducted in North America are 48.4 percentage
321 points less likely to report a positive effect of SFSC adoption on farm performance than studies conducted
322 in Europe (or Oceania). Other structural variables in the analysis are not statistically significant.

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Table 2. Results of the logistic regression analysis of the economic performance benefits of Short Food Supply Chains

	(1) Coefficient estimate	(2) Marginal effect
DSOURCE		
Field surveys	-1.125 (1.127)	-.267 (.250)
DURATION		
Multi-year	-1.624 (1.308)	-.374 (.248)
PERIOD		
[2011-2015]	-1.698 (1.301)	-.399 (.269)
[2016-2022]	-.597 (1.161)	-.132 (.243)
LOCATION		
US	-2.352** (1.047)	-.484*** (.156)
NSFSC		
Multiple forms of SFSC	-1.386 (1.143)	-.311 (.219)
DANALYSIS		
Endogeneity correction	-.662 (1.736)	-.163 (.420)
NANALYSIS		
Comparison with conventional markets	.205 (.928)	.050 (.230)
Types of economic measures		
Net income	1.879 (1.755)	.372 (.247)
Profit satisfaction	3.982** (1.984)	.757*** (.219)
Constant	2.512 (2.379)	
Observations	48	
Pseudo R ²	.26	
ll	-24.482	
Chi ²	17.24	

Robust standard errors in parentheses

*** p<0.01, ** p<0.05, * p<0.1

Actual Values Predicted Values	Negative	Positive
Negative	14	4
Positive	8	22

339 **4 Discussion**

340 Based on far more empirical evidence than previous reviews, this meta-analysis does not establish an
341 unambiguous relationship between SFSC participation and farmer income. However, our meta-analysis
342 does show that the effect of SFSC on farm economic performance varies depending on location and the
343 economic performance indicator used.

344 Better economic performance of SFSC is more likely in studies conducted in Europe rather than the US.
345 This result does not indicate that all European farmers participating in SFSC are successful. Cesaro et al.
346 (2020) show that SFSC adoption does not significantly affect farm performance in the majority of European
347 member states. Notable exceptions exist, such as in Greece, Slovenia and Croatia where studies find a
348 positive impact of SFSC participation on farm performance (Cesaro et al., 2020). Differences in economic
349 performance between Europe and US might be explained by the specific differences in agricultural and
350 marketing systems between these areas (Kneafsey et al., 2013). For example, lower economic performance
351 found in US may be partly explained by the greater prevalence of CSA farmers than in Europe (7398 farms
352 in US against 2783 in Europe in 2015, despite there being more farms in Europe (Martinez & Park, 2021;
353 URGENCI, 2016)) who prioritize non-economic motivations more than participants in other forms of local
354 marketing channels (Schoolman, Morton, Arbuckle, & Han, 2021).

355 It is unclear whether the differences in economic performance between Europe and US might be attributed
356 to differences in the policy support for producers who sell through local markets. At the European level,
357 policy support relies mainly on financial incentives from the EAFRD which has been implemented between
358 2014 and 2020 to promote investments in facilities for selling and processing agricultural products (Dwyer
359 et al., 2016). Similarly, the Value-Added Producer Grant Program provides grant funding for agricultural
360 producers in the US to add value to their products through processing and marketing. It is funded by the

361 2014 Farm Bill devoting investments of \$501.5 million over 5 years in many programs promoting local
362 food production. However, some differences exist in terms of policies promoting local food production.
363 The USDA National Farm to School Program implemented in 2010 directly supports local food purchases
364 in school procurement while the green public procurement (GPP) scheme introduced by the European
365 Commission - to drive food procurement towards more sustainable supply and demand patterns - does not
366 acknowledge territorial criteria. In addition, the EU has recognized the importance of labelling schemes for
367 local products in order to support local farming, an approach that is less prominent in the US (Kneafsey et
368 al., 2013).

369 We also demonstrate that better economic performance of SFSC is more likely to be found in studies using
370 profit satisfaction rather than gross or net income. This is consistent with Kneafsey et al. (2013), who
371 suggest that farmers' perceptions of their economic performance may differ from measured performance
372 through farm accountancy networks. This might be explained by the fact that subjective rating reflects a
373 broader view of farm performance than objective measures focused on more specific financial indicators.
374 Subjective rating can reflect performance at the household level including income sources beyond the
375 production and marketing of agricultural goods such as from non-farm activities and off-farm work. It could
376 suggest that farmers involved in SFSC might earn an adequate income by supplementing their income from
377 agricultural activities with non-agricultural income. Another possible explanation is that selling locally for
378 many producers is a great source of enjoyment and there are benefits for the community that might
379 compensate their relatively low monetary return (Sage, 2003; Silva, Dong, Mitchell, & Hendrickson, 2015).

380 Our meta-analysis reveals that results from studies focused on a single type of SFSC do not differ
381 significantly from studies considering multiple ones. This is consistent with the literature that does not
382 identify a specific SFSC form that works best for farmers. Some studies demonstrate that farmers using
383 DM have lower economic performance than those using intermediated marketing channels (Bauman,
384 Thilmany, & Jablonski, 2018, 2019). Azima and Mundler (2022) report the opposite effect while Park et
385 al. (2018) find no significant differences between them. When considering more precise SFSC strategies,
386 some studies report a negative impact for farmers participating in FM and CSA due to high competition,
387 market saturation, consumers' low willingness to pay and inefficiencies in production (Galt et al., 2016;
388 Silva et al., 2015; Uematsu & Mishra, 2016). In contrast, others find that CSA (Jablonski, Sullins, &

Thilmany, 2019; LeRoux, Schmit, Roth, & Streeter, 2010) and FM (Hunter, Norrman, & Berg, 2022; Schmit, Jablonski, & Laughton, 2019) achieve highest income or find no significant differences. Govindasamy et al. (1999) and Uematsu et al. (2016) report lowest financial performance for temporal marketing (e.g. roadside stores) and pick-your-own operations since they are available only for certain periods of the year and for certain seasonal products. Uematsu et al. (2016) and Silva et al. (2015) find higher economic performance for farmers selling to local retailers (e.g. regional distributors, local grocery stores, restaurants, and other local retailers).

The absence of significant effect for the few studies that account for selection bias might be explained by the fact that the correction they provide is often inadequate. Two studies account for selection bias only with the nonlinearity of the residuals from the first step model although using an instrument is highly recommended for a more robust identification (Park & Lohr, 2010; Park, Mishra, & Wozniak, 2014). In addition, some studies rely on instruments that might be considered as “bad instruments” which can lead to a bias in the resulting estimates that is much greater than the bias in OLS. Chen et al. (2019) use their endogenous explanatory variables aggregated at the county level (the number of farms adopting direct marketing) as an IV because having a large number of participants in DM provides farmers incentives to use this SFSC form. However, this IV clearly violates the exogeneity assumption as it might be confounded with other characteristics of the district encouraging farmers to participate in DM and simultaneously affect farm income. The vitality of the local retail environment is also used as IV and could also be suspected of violating the endogeneity condition (Park, 2015; Park et al., 2018).

5 Research and policy implications

Our findings have several implications for future studies addressing the economic consequences of SFSC participation. First, it is crucial to better understand the effect of SFSC participation on farm household income because it appears to differ from the effect determined through standard farm income measurements. It may also be necessary to investigate whether changes in farm business income are sufficient for reaching conclusions on the well-being of farm households (De Mey et al., 2016; Finger & El Benni, 2021).

415 Future assessments of farm economic performance in SFSC need to be expanded by taking into
416 consideration additional sustainability indicators. Conducting and coordinating parallel meta-analyses of
417 the social and environmental consequences of these supply chains could also be another avenue for
418 research.

419 Because of the lack of information in the studies identified, this meta-analysis focuses almost entirely on
420 the influence of structural variables related to study methodology without considering more fundamental
421 contextual variables. Previous research demonstrates that the effect of participation in SFSC on farm
422 performance varies as a function of the SFSC forms and the characteristics of the farmers, farms and the
423 area where the farms are located (Enthoven & Van den Broeck, 2021). There is especially a lack of
424 knowledge on the benefits of scaling up and using organic practices for farmers in SFSC (González-
425 Azcárate, Cruz-Maceín, & Bardají, 2022; Mount, 2012). Although we cannot answer the question whether
426 there is a SFSC scheme that works best, a very few studies have examined more closely the results for
427 specific SFSC forms such that more research is needed.

428 Despite these variables not achieving statistical significance in our analysis, we recommend that future
429 studies more cautiously employ regression analysis methods accounting for selection bias than previous
430 ones. Identifying the potential IV before conducting any survey or considering data from non-standard
431 surveys such as on location could improve the IV used. For example, the distance from the farm operators'
432 home to the nearest large town has been used as an IV because it can influence the likelihood to adopt SFSC
433 without affecting farm performance. In addition, we recommend the use of panel data which could increase
434 the credibility of methods accounting for selection bias by controlling for time-invariant unobservable
435 variables.

436 Based on our results, policymakers and outreach agencies should be aware that SFSC will not necessarily
437 improve the purely economic performance of farms. However, we suggest that they should continue to
438 recognize and build upon the multifunctional benefits (economic, social and environmental) of these supply
439 chains. If the full set of benefits is considered to be attractive enough, society should consider providing
440 additional resources and support to the producers who participate in these supply chains. Also, because the
441 effect of SFSC participation on farm economic performance is ambiguous, the efficiency of federal support
442 for SFSC must be given careful attention. Policy-makers need to define clear income targets for farmers

engaged in SFSC, especially during their start-up phase, and develop appropriate evaluation frameworks in order to assess whether policy measures have achieved their expected outcomes and how they can be improved. In addition, agricultural statistical surveys monitoring farm income and business activities need to collect additional information on farm households' disposable income. They should allow comparable analysis across countries and SFSC schemes by adding similar questions on supply chain participation in terms of marketing forms and level of involvement.

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698 **7 Appendix**

699 **7.1 Appendix A**

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Supply chain keywords	Population keywords	Topic keywords	Social science discipline filters
Local food	Farmer	Farmer	Web of Sciences
Local market	Producer	characteristics:	Business Finance
Local supply chain	Rancher	Feature	Business
Alternative food	Grower	Factor	Agriculture Multidisciplinary
Short food supply chain		Characteristic	Agricultural Economics & Policy
Direct marketing		Determinant	Management
Direct-to-consumer		Driver	Political Science
Direct agricultural market		Typology	Sociology
Direct sales		Type	Economics
Direct selling		Attribute	Urban Studies
Shortened supply chain			Social Sciences Interdisciplinary
Direct Farm Marketing		Farmer motivations:	Regional & Urban Planning
Community supported		Attitude	Geography
agriculture Farmers market		Motivation	Social Issues
Farm-to-school		Expectation	Multidisciplinary sciences
Farm-to-institution		Willingness	Scopus
Innovative marketing		Incentive	Business, Management and
Locally grown		Reason	Accounting
		Goal	Social Sciences
			Economics, Econometrics and
		Barriers:	Finance
		Barrier	Agricultural and Biological
		Challenge	Sciences
		Obstacle	
		Constraint	
		Difficulties	
		Struggle	
		Income Impact	
		Profit	
		Income	
		Expenditure	
		Earning	
		Revenue	
		Return	
		Financial	
		Performance	
		Viability	
		Wage	

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720 **Table A2.** The Population, Intervention, Comparison, Outcomes, and Study (PICOS) criteria.

Parameter	Inclusion criteria	Exclusion criteria
Population	Farmers	Articles outside the study zone (Europe, Northern America and Australia)
Intervention	Participation in local food system/short food supply chain	
Comparison	Not applicable	Not applicable
Outcomes	Characteristics, motivations, barriers and economic outcomes of farmers involved in SFSC	Articles not responding clearly to the object of research and to its purpose Articles not targeting SFSC
Study design	Both quantitative and qualitative studies	Literature reviews, theses and dissertations, letters, book chapters, reports, author’s comments and other grey literature

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722 **Table A3.** Supply chain abbreviations

Supply chain name	Abbreviation
Alternative food system	AFN
Community supported agriculture	CSA
Direct marketing	DM
Farmers market	FM
Farm-to-institution	FTI
Farm-to-Restaurant	FTR
Long food supply chain	LFSC
Local food system	LFS
Short food supply chain	SFSC
Solidarity purchase group	SPG
Value-based supply chain	VBSC

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31 **7.2 Appendix B**32 **Table B1.** Research articles examining the effect of SFSC participation on farm economic performance

	Author	Year	Setting	Supply chain	Farmer sample	Data analysis	Outcome unit	Nature of the analysis	Economic effect of SFSC
1	Govindasamy et al.	(1999)	US	DM	Farmer survey (n= 455 with 79% of farms engaged in retailing). Not representative of general farm population (NR)	Logit model	Profit satisfaction	LFSC comparison	Positive
2	Verhaegen and Van Huylenbroeck.	(2001)	Belgium	Innovative marketing channels	Interviews with actors involved in 6 innovative marketing channels (direct selling (2), co-operatives (2) and labelled traditional marketing channels (2)). NR	Cost–benefit analysis	Net income	LFSC comparison	Positive
3	Govindasamy et al.	(2003)	US	FM	Farmer survey (n= 36) of farms retailing at FM. NR	Logit model	Profit satisfaction	LFSC comparison	Positive
4	Hunt	(2007)	US	FM	Farmer (n=65) and other vendors (n=16) survey of farms marketing through FM. NR	Cluster analysis and probit model	Net income	LFSC comparison	Positive
5	Hardesty and Leff.	(2010)	US	FM, CSA and wholesale	Farmer interviews (n = 3 with 1 farms engaged in FM, 1 in CSA and 1 in wholesale). NR	Cost and return analysis	Net income	LFSC comparison	Negative/Neutral
6	LeRoux et al.	(2010)	US	FM, CSA, Farm stand and U-pick	Farmer interviews (n= 4, with farms marketing through FM (1), CSA (1), Farm stand (1) and U-pick (1). Farmer survey (n= 14) of farms selling local food. NR	Cost and return analysis	Net income	LFSC comparison	Negative/Neutral
7	Park and Lohr.	(2010)	US	Local selling	Farmer survey (n=817) of farms selling local food. NR	Ordered probit model, Heckman's method	Gross income	LFSC comparison	Negative/Neutral
8	Lohr and Park.	(2010)	US	Local selling	Farmer survey (n= 787) of farms engaged in local selling. NR	Stochastic production frontier models	Gross income	LFSC comparison	Negative/Neutral
9	Detre et al.	(2011)	US	DM	ARMS (2002, n =11,303 farms with 3% of the farmers in the sample using DM). R	Probit model	Gross income	LFSC comparison	Positive
10	Schmit and Gómez.	(2011)	US	FM	Vendor survey in 27 FM (n=103) and market manager survey (n= 21). NR	Multinomial logit specification and ordinary least squares (OLS)	Profit satisfaction	Viability	Positive

11	Broderick et al.	(2011)	Australia	Farm-to-restaurant, supermarket and food service distributors, FM, home delivery	Farmer interviews (n=6) of farms engaged in SFSC. NR	Interviews	Net income	Viability	Positive
12	Galt et al.	(2012)	US	CSA	Farmer interviews (n=54) of farms engaged in CSA. NR	Descriptive statistics	Profit satisfaction	Viability	Negative/Neutral
13	Galt.	(2013)	US	CSA	Farmer interviews (n= 54) of farms engaged in CSA. NR	OLS model and interviews	Profit satisfaction	Viability	Negative/Neutral
14	Richard et al.	(2014)	France	SFSC	Farmer survey (n = 507) of farms engaged in SFSC. NR	Descriptive statistics and interviews	Net income	LFSC comparison	Positive
15	Kim et al.	(2014)	US	FM	Price data were collected, yields were provided by the USDA, cost of production are from various studies, Marketing costs are reported by Utah's growers using a survey	Simulation model	Net income	LFSC comparison	Positive
16	Park et al.	(2014)	US	DM	ARMS (2008, n = 340 with 10% of the farms in the sample use direct selling). NR	Multinomial logit (MNL) model with selectivity approach	Gross income	LFSC comparison	Negative/Neutral
17	Tudisca et al.	(2014)	Italy	SFSC (Direct sales, FM, e-commerce, farm shop, SPG and vending machines)	Farmer interviews (n=20) of farms marketing through AFN. NR	Descriptive statistics	Profit satisfaction	Viability	Positive
18	Silva et al.	(2015)	US	CSA, FTI, FTR, wholesale and FM	Farmer survey (n=135 with 60% of the respondents participate in wholesale markets, and less than half market to restaurants or institutions, with 47% using FM and more than 40% using CSA. NR	Multivariate probit model and ordered probit model	Profit satisfaction	LFSC comparison	Negative/Neutral
19	Hu and Shieh.	(2015)	US	Direct sales (« delivery » to consumers, self-establishment of organic store, sales in private farms, market or on streets,	Farmer interviews (n= 274) of farms participating in direct and indirect sales. NR	Analysis of variance	Net income	LFSC comparison	Negative/Neutral

				production and marketing groups or cooperating with other farmers) Indirect sales (sales to middleman, production and marketing group, delivery companies, supermarket, organic specialty stores, restaurants and others)					
20	Park.	(2015)	US	DM	ARMS (2008-2010, n = 5183 with 646 farms using DM and 4537 not DM). R	Recentered Influence Functions apply on the Unconditional quantile regression model	Gross income	LFSC comparison	Negative/Neutral
21	Tudisca et al.	(2015)	Italy	DM	Farmer survey (n=30) of farms adopting a SFSC strategy. NR	Descriptive statistics	Net income	LFSC comparison	Positive
22	Galt et al.	(2016)	US	CSA	Farmer survey (n= 111) of farms engaged in CSA. NR	Descriptive statistics and correlation analysis	Net income	LFSC comparison	Negative/Neutral
23	Uematsu and Mishra.	(2016)	US	DM	ARMS (2008, n = 4,629 farms). DM strategy includes Roadside stores (n =161), direct sales to local grocery stores, restaurants, or other retailers (n =153), FM (n = 118), Regional distributors (57) and CSA (12). R	Quantile regression	Gross income	LFSC comparison	Negative/Neutral
24	Mundler and Laughrea.	(2016)	Canada	SFSC	Farmer survey (n=32) of farms engaged in SFSC. NR	Descriptive statistics compared to national averages	Net income	LFSC comparison	Negative/Neutral
25	Morel et al.	(2017)	France	DM	Farmer interviews (n= 20) of farms engaged in DM. NR	Stochastic Modeling	Viability	LFSC comparison	Positive
26	Bauman et al.	(2018)	US	DM	ARMS (2013, n= 17 474 farms with 1,013 selling local food). R	Descriptive statistics	Net income	LFSC comparison	Positive

27	Park et al.	(2018)	US	DM	ARMS (2008-2010, n = 5,959 farmers with 234 farms using only direct to consumers, 157 using only direct to retailers and 180 using both direct to retailers and consumers). R	Multinomial treatment effect model	Gross income	LFSC comparison	Negative/Neutral
28	Khanal et al.	(2018)	US	DM	ARMS survey (2012, n = 18,728 farmers) with 5.4% using direct selling. R	Unconditional quantile regression	Net income	LFSC comparison	Negative/Neutral
29	Morckel.	(2018)	US	FM	Farmer survey (n= 45) of farms engaged in FM. NR	Descriptive statistics	Profit satisfaction	Viability	Positive
30	Schmit et al.	(2019)	US	DM	Farmer sample (n= 67 with 47 farms using DM). NR	Means difference tests	Net income	LFSC comparison	Positive
31	Bauman et al.	(2019)	US	Direct-to-consumer and local sales from on-farm store, u-pick, roadside stands, CSAs and FM; local retail outlet such as a restaurant or grocery store; Regional distributor such as food hub; Local institutions such as school or hospital	ARMS (2013-2014, n= 44 536 with 2624 farms selling local food). R	Stochastic profit frontier model	Net income	LFSC comparison	Negative/Neutral
32	Brekken et al.	(2019)	US	Values-Based Supply Chain (VBSC) and DM	Farmer survey (n= 182) of farms engaged in VBSC. NR	TOA-MD Simulation	Net income	LFSC comparison	Positive
33	Chen et al.	(2019)	US	DM	ARMS (2012, n= 14960 with 7.17% of farms adopting DM). R	Bivariate binary choice model	Gross income	LFSC comparison	Negative
34	Malak-Rawlikowska et al.	(2019)	Europe	SFSC (pick your own, sales to individual consumers, Internet deliveries, delivery to consumer, FM, Sales to small	Farmer survey (n=186 with 65% of farms engaged in SFSC) NR	Descriptive statistics	Net income	LFSC comparison	Positive

				retail outlets (one intermediary))					
35	Sroka et al.	(2019)	Germany	DM	Farmer survey (n=199 with 56 using DM). NR	Classification and regression trees	Profit satisfaction	LFSC comparison	Positive
36	Paul.	(2019)	US	CSA	Farmer interviews (n=16) of farms engaged in CSA. NR	Interviews	Net income	LFSC comparison	Positive
37	Clark.	(2020)	US	On-farm selling	Case study on one farm. NR	Cost and return analysis	Viability	Net income	Negative
38	Jablonski et al.	(2020)	US	SFSC (FM, roadside stands, and u-pick), Intermediated channels (direct to restaurants, institutions, or to regional aggregators)	USDA ARMS (2013–16 , n = 78,559 farms) of farms selling local or non-local food. R Samples include 73,191 (positive labor expenditure) and 26,694 (positive wage) producers without local sales and 3,899 (positive labor expenditure) and 1,569 (positive wage) producers with local food sales	Descriptive statistics	Net income	LFSC comparison	Positive
39	Mundler and Jean-Gagnon.	(2020)	Canada	SFSC	Farmer survey (n=32) of farms involved in SFSC. NR	Descriptive statistics compared to national averages	Net income	LFSC comparison	Negative/Neutral
40	Alonso Ugalia et al.	(2020)	France	SFSC	Farmer interviews (n=48) of farms engaged in SFSC. NR	Interviews	Net income	Viability	Positive
41	Hochuli et al.	(2021)	Switzerland	DM	Agroscope annually surveys (n = 3500 dairy farms with 1019 using DM). R	Descriptive statistics and non-parametric test	Net income	LFSC comparison	Negative/Neutral
42	Medici et al.	(2021)	Italy	CSA	Interviews (n = 19 CSA). NR	Descriptive statistics	Profit satisfaction	Viability	Positive
43	Floris	(2021)	Slovakia	SFSC	Farmer survey (n= 43 with 17 in SFSC)	Descriptive statistics	Net income	LFSC comparison	Positive
44	Jablonski et al.	(2022)	US	LFS	USDA ARMS (2013–2016, n = 3,908 beginner farmers using LFS).NR	Descriptive statistics	Net income	viability	Positive
45	Azima et al.	(2022)	Canada	DM	Farmer survey (n=613 farms using DM). NR	OLS controlling for endogeneity	Profit satisfaction	Viability	Positive
46	Hunter et al.	(2022)	Swedish	SFSC	Farmer survey (n=286 farms involved in SFSC) NR	Bi-variate correlations	Net income	viability	Negative/Neutral
47	Dono et al.	(2022)	Italy	DM	Farm accountancy data network (FADN, 2014-2016, n = 4612 with 17.6% of farms using DM) NR	Descriptive statistics, parametric and non-parametric test	Net income	LFSC comparison	Negative/Neutral

48	Floriš et al.	(2022)	Slovakia	DM	Farmer survey (n = 43 farms with 17 involved in SFSC) NR	Descriptive statistics	Profit satisfaction	LFSC comparison	Positive
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