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A systematic review of the ecological, social and economic sustainability effects of community-supported agriculture

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Introduction: Community-supported agriculture (CSA) offers a high potential to provide synergies between ecological, economic and social sustainability aspects. While CSA is still in a niche, it has experienced rapid growth and increasing interest during the last years. An overview of sustainability impacts of CSA based on quantitative empirical work is missing, which is needed for well-informed and targeted policies and funding, as well as to tackle research gaps.

Methods: Here we reviewed the literature to systematically assess empirical and quantitative findings regarding sustainability outcomes of CSA at different levels.

Results: We found that $<$ 30% of the 39 studies included assessed ecological sustainability aspects. If CSA farms were compared to reference systems, they mostly performed better with regard to resource use efficiency and greenhouse gas emissions. The majority of studies evaluated social aspects. While many studies showed that CSA yet fails to reach low-income households, and therefore members do not represent the average population, CSA membership improves health and sustainability behavior. Economic variables were assessed in more than half of the considered studies, but knowledge on the relative performance remains scarce. Nevertheless, first studies indicate high economic viability.

Discussion: Our review suggests a largely positive performance of CSA with regard to sustainability. Accordingly, if CSA would reach a bigger share in the food system, it could contribute to a transformation toward sustainable food systems. To address important knowledge gaps, we recommend the consideration of more and particularly ecological sustainability aspects, comparisons across different farming and marketing systems and the integration of knowledge from different sources such as theses and practical knowledge documented in various languages in different parts of the world.

KEYWORDS

alternative food systems, community-based farming, food system transformation, local food systems, resilience, solidarity

1. Introduction

In the light of climate change, biodiversity loss, increasing demand for agricultural products, social inequalities, and economic pressures, a transformation toward sustainable, resilient and inclusive food systems is urgently needed (Pigford et al., 2018). Alternative food systems, including farmers' markets and shops, community-supported agriculture, food cooperatives and organic agriculture, are increasingly recognized as promising approaches to address these challenges (Renting et al., 2003; Ilbery and Maye, 2005; Forssell and Lankoski, 2015).

In particular, community-supported agriculture (CSA) offers opportunities to provide synergies between ecological, economic and social aspects that could contribute to a transformation toward sustainable food systems (Nost, 2014; Bloemmen et al., 2015; Schmutz et al., 2018; Haack et al., 2020). Linking farmers and consumers (members) through long-term partnerships including upfront payments to cover production costs is a core principle of CSA (Lamb, 1994; Cone and Myhre, 2000; Volz et al., 2016). Thus, both risks and the harvest are shared. CSA differs from other cooperative approaches, for example community gardens, where gardening is mainly carried by unpaid and nonprofessional volunteers, or food cooperatives, where risks are not shared by producers and consumers and products are not necessarily obtained from primary producers (Haack et al., 2020). CSA farms are highly heterogenous for example regarding size, products, member involvement and legal forms (Volz et al., 2016). In its simplest form, CSA is a contractual agreement between a farm and a group of members (Cone and Myhre, 2000), but also models exist where both farmers and consumers are organized in one legal entity (Strüber et al., 2023). Likewise, underlying motives include securing livelihoods of farms, spiritual-communal practices (e.g., connection to nature, emphasis on community) or a political tool for sociopolitical change by opposing the capitalistic system through decommodification of food (Blättel-Mink et al., 2017; Paech et al., 2020). Environmentally friendly farming practices however, are a main principle of most CSA farms (Volz et al., 2016; Cristiano et al., 2020; Netzwerk Solidarische Landwirtschaft e.V., 2022b). Accordingly, reducing synthetic inputs, closing nutrient cycles, improving soil properties and biodiversity are inherent goals of many CSAs (Haack et al., 2020; Cristiano, 2021). Regarding social aspects, many CSA aim at fair wages, transparency, knowledge exchange and participation (Schmutz et al., 2018; Diekmann et al., 2020). Economic security is fostered through holding members and guaranteed sales (Matzembacher and Meira, 2019; Paech et al., 2020).

During the past years, CSA has gained increasing attention and the number of CSA farms has grown in many world regions. In the United States over 12.000 CSA farms existed in 2017 (Woods et al., 2017; Samoggia et al., 2019). The first CSA in Europe was founded in 1978 in Switzerland, yet currently most European CSAs are located in France (>2,000) (Volz et al., 2016; Egartner et al., 2020). In Germany, only five CSA were founded between 1988 and 2010, but more than 400 farms are registered today (Diekmann, 2020; Netzwerk Solidarische Landwirtschaft e.V., 2022a). In China, the first CSA farm has been only founded in 2009, yet already 254 existed in 2016 (Tang et al., 2019). In Japan however, the interest in CSA has recently declined (Gugerell et al., 2021). Compared to the total number of farms [e.g., more than two millions in the US in 2017; (USDA National Agricultural Statistics Service, 2023)], CSA only provides a small proportion of total food production so far. Nevertheless, CSA is increasingly recognized in policy, civil society and academia, also during the COVID pandemic due to increased interest in regional food supply (Stephens et al., 2020; Enthoven and van den Broeck, 2021). In Germany, for example, it has been mentioned as a best-practice model with a catalytic impact in government documents and commissions (CDU et al., 2018; Zukunftskommission Landwirtschaft, 2021).

Despite the growing interest, to our knowledge, an overview of sustainability impacts of CSA is missing, which is essential, given the sustainability promises of CSA. In this study we provide a synthesis of ecological, social and economic sustainability outcomes based on quantitative empirical work in English and peer-reviewed literature. For this purpose, we (i) developed an analytical framework to assess sustainability outcomes of CSA at the farm level in a transdisciplinary process and (ii) reviewed the literature to systematically assess empirical and quantitative findings related to the different levels of the framework. On the one hand, this is an important baseline for well-informed and targeted policies and funding. On the other hand, this work will highlight relevant research gaps, given that research on CSA is still in an early stage (Cristiano, 2021).

2. Materials and methods

Within a transdisciplinary research project, we developed an analytical framework for a comprehensive assessment of sustainability impacts of community-supported agriculture at the farm level. This framework consists of dimensions, categories, sub-categories and key performance indicators. We then conducted a literature review to systematically assess empirical and quantitative findings related to the different levels of the framework.

2.1. Analytical framework

At the beginning of the transdisciplinary project "InnoLand-Sachsen", we developed an analytical framework to assess sustainability outcomes of community-supported agriculture at the farm level. In a first step, we developed a hierarchical indicator topology following Carmen et al. (2020). Therefore, we adapted a German tool to assess different sustainability benefits of farms for the society and the environment (Regionalwert Leistungen GmbH). At the highest level we also included three dimensions (ecology, social and economy), but used economy instead of regional economy to be more generic (Table 1). Regarding the ecological dimension, we distinguished the categories soil, biodiversity, inputs and outputs. We referred to in- and outputs instead of "water and climate" to further emphasize the management perspective, as well as desired (e.g., harvest) and undesired outputs (e.g., greenhouse gas emissions). We neglected "animal welfare" as animal husbandry is less relevant in many CSA farms including the ones involved in the project. Regarding the social dimension, we combined the original aspects "expertise" and "employment and work" to the category *team* to cover all aspects related to the employees of a farm. We divided societal effects into farm level aspects and surroundings, as well as members, which are specific for CSA. Here, we also integrated aspects from an existing indicator set to describe social and economic stability of CSA (Strüber et al., 2023). Regarding economy, we specified economic sovereignty in five categories (farm, costs, revenues, financial resources, operating area) to assess economic performance in more detail, also including CSA-specific aspects (Strüber et al., 2023). Finally, we removed the

TABLE 1 Analytical framework including the sustainability dimensions, categories and sub categories.

Dimension	Category	Sub category
Ecology: focus on biotic environment, but also including abiotic factors and farming activities with environmental impacts (Lebacq et al., 2013)	Soil	Fertility; erosion; density; climate
	Inputs	Water; vehicles/machinery; electricity; pesticides; fertilizer; seeds; seedlings; material/technology; energy
	Outputs	Climate; production; environmental impact; energy
	Biodiversity	Crop diversity; plant diversity; livestock diversity; animal diversity; land use
Social: farm community and society affected by farm activities (Lebacq et al., 2013; Terrier et al., 2013)	Team	Knowledge/learning; trust; diversity/inclusion; fluctuation; income satisfaction; full time/part time; buffer capacity
	Members	Knowledge/learning; trust; diversity/inclusion; fluctuation; satisfaction; engagement; identification; distance; supply; behavior; well-being/health
	Farm	Transparency; attractivity; goals/visions/strategies; bidding; community building
	Surroundings	Cooperation; competition; rejection/recognition; knowledge
Economy: economic viability of a farm (Latruffe et al., 2016), as well as general economic characteristics of the farm	Farm	Products; management; age; distribution; marketing channels
	Costs	Labor; running costs; investments
	Revenues	Membership fees; donations; subsidies; projects
	Financial resources	Liquidity; equity ratio; balance; diversification; contract duration
	Operating area	Yard; operating area; farm size
	Range	Shares; access; innovation; productivity

original aspects "regional networks" and "regional economic flows," as they were partly covered in the social category *surroundings* and because regionalization was not a specific focus of our project. For each category we selected sub categories based on existing catalogs and literature (INL, XXXX; Regionalwert Leistungen GmbH; Sanders and Heß, 2019; Haack et al., 2020; Strüber et al., 2023). We further added the sub categories *buffer capacity* and *rejection/recognition,* as we experienced these aspects as important from our previous work with CSA farms (Voge et al.)[1]. For each sub category, we then proposed indicators to describe them. In a next step, we presented the initial framework to a group of seven CSA experts. The CSA experts consisted of five employees (four farmers and one coordinator) of three CSA farms in Saxony, Germany, a researcher from a project focusing on the transformative potential of CSA and an employee from a regional association strengthening direct marketing. During five workshops of around two hours each between October 2021 and March 2022, experts could first modify existing or propose additional indicators. Second the experts rated relevance and feasibility from 1 (not relevant/feasible) to 5 (highly relevant/feasible) (Carmen et al., 2020). Based on this assessment we selected a final set of indicators that were subsequently measured in the three CSA farms involved (where both evaluation criteria reached a score of 3 or higher on average). The analytical framework and its underlying indicators are merely descriptive. To evaluate actual sustainability outcomes, the observed indicator values need to be linked to specific sustainability objectives (Latruffe et al., 2016).

1 Voge, J., Newiger-Dous, T., Ehrlich, E., Ermann, U., Ernst, D., Haase, D., et al. (in review). Food for the plate and not for the waste - assessing yields, food loss and waste in community-supported agriculture in the region of Leipzig, Germany. *Int. J. Agric. Sustain.*

2.2. Literature review

We used the Preferred Reporting Items for Systematic Reviews and Meta-Analyses (PRISMA) to guide the selection of literature (Moher et al., 2009). We sourced literature from Web of Science using the following search term considering all fields: ("shared agriculture" OR "community supported agriculture" OR "community based agriculture") AND ("sustainable" OR "sustainability"). We restricted our search to the years 1945 to 2021 and updated the search August 15 2022.

We only included articles that (i) assessed sustainability-related outcomes of community-supported agriculture at the farm level, (ii) related to our analytical framework, (iii) agriculture, (iv) included empirical, (v) quantitative findings, and (vi) were written in English. For example, we excluded qualitative findings on the motivation or drivers of farmers and members to establish or join a CSA or investigations of non-members. Due to the limited number of articles within our scope, we did not apply any criteria regarding underlying statistics (e.g., regarding significance or sample size).

Regarding the included articles, we extracted all quantitative results that could be associated to the sub categories of our analytical framework, i.e., that used indicators describing these sub categories. We remained on the sub category level to achieve a higher consistency between our framework and the literature

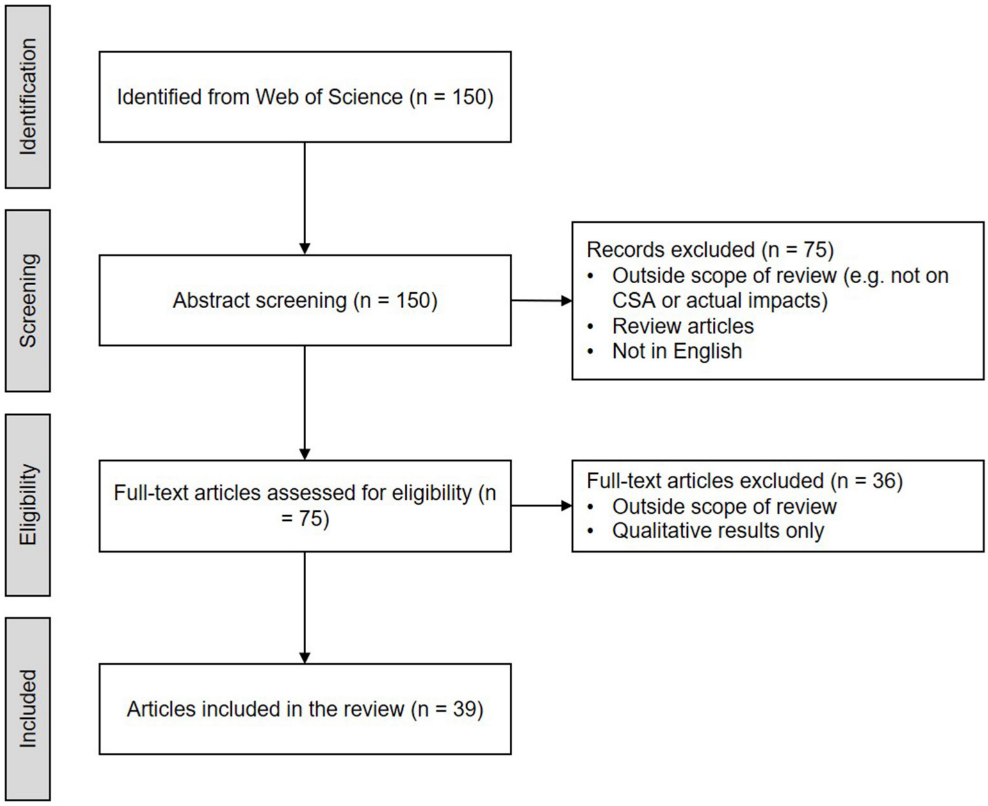

FIGURE 1
PRISMA flow diagram showing the steps involved in the systematic review (adapted from Moher et al., 2009; Begho et al., 2022).

included (e.g., when different indicators were used to describe the same sub category).

For each investigated variable, we extracted the country, number of CSA farms and members included, and the effect (positive, neutral, negative, unclear) if the outcome at the CSA was related to a reference system (conventional farm, average population, farm statistics etc.) or time period (e.g., time before joining a CSA) and could be clearly linked to a sustainability objective (Latruffe et al., 2016). The number of underlying CSA farms was not documented in four studies. Here we estimated the number of investigated CSA farms by dividing the members included by the average number of members included per CSA investigated in all other studies.

Regarding effects, a positive effect would indicate that the CSA farms achieved higher sustainability values for a given variable, for example if the investigated CSA farms produced less greenhouse gas emissions. Regarding diversity of CSA members, we rated an effect as positive, if they represented the average population, e.g., with regard to ethnicity, income or education. If values were similar to a reference system, the differences were insignificant if applicable or if CSA performed better than one reference system but worse than another, we classified the effect as "neutral." We classified an effect as "unclear," if it was ambiguous whether an observed difference between the CSA and a reference is desirable from a sustainability perspective, e.g., regarding farm size and age, or if the results were not compared to a reference. Based on this assessment we aggregated the number or proportion of variables showing positive, neutral, negative and unclear effects per dimension or sub-category. We used the statistical software package R 4.1.3 (R Core Team, 2022) run via RStudio (RStudio Team, 2022) for data analysis.

3. Results

3.1. Literature overview

Our literature search yielded 150 records, of which 75 were excluded after we screened the abstract and 36 after we assessed the full article, hence we included 39 articles in the review (Figure 1; Supplementary Tables 1, 2). The reviewed studies included more than 2,500 CSA farms (Table 2). The large majority of studies were implemented in the United States (26), where over 2,000 CSA farms were investigated. All other studies focused on European countries (nine), except for one study each in Brazil, China, and Japan. More than 85% of the studies were published after 2010, while the first study was published in 2000 (Supplementary Table 2). Major research areas included agriculture (14), environmental sciences and ecology (11), science and technology—other topics (11), and sociology (six; Supplementary Table 3).

3.2. Sustainability dimensions

In almost all CSA farms considered, social variables were investigated (Figure 2). Economic and ecological variables were

TABLE 2 Number of investigated CSA farms and underlying studies per country ($n = 39$).

Country	CSA farms	Studies
US	2,368	26
Spain	57	2
Multiple	41	2
Italy	20	2
United Kingdom	8	2
China	7	1
Romania	3	1
Turkey	3	1
Brazil	2	1
Sweden	1	1

One study investigated CSAs in two different countries (US, Hungary) and one in three different countries (Austria, Norway, Japan).

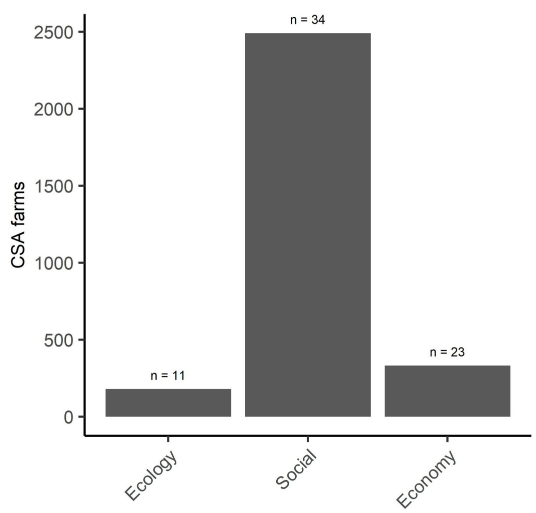

FIGURE 2
Number of CSA farms where ecological, social or economic variables were investigated. Number of underlying studies are indicated on the top of the bars.

investigated in around 13 and 7% of the farms, respectively. In 169 farms, structural variables were examined including management practices (with or without organic certification), organizational and legal form, which is about 7% of the farms considered.

3.3. Sustainability effects

Effects were unclear in 46% of the investigated variables, mainly because CSA farms were not compared to any reference, for example to a different farming system or the average population. Regarding ecological variables, CSA farms performed better than the reference systems in 44% of the cases (Figure 3). Negative effects were only identified in 6%. Regarding social variables, effects were more ambiguous. Positive effects were found in 25%

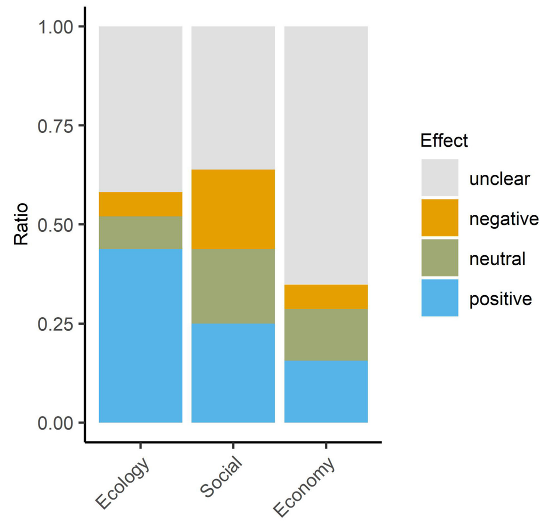

FIGURE 3
Ratio of investigated variables with positive, neutral, negative or unclear effect in each sustainability dimension comparing CSA and reference systems.

of the comparisons, neutral and negative effects in 19 and 20%, respectively (Figure 3). In economy, no comparisons were made for more than 60% of the variables investigated. Negative effects were found in 6%, compared to 17% with positive effects (Figure 3).

3.3.1. Ecological sustainability

Ecological variables covered inputs, outputs and biodiversity, while soil variables were never considered (Table 3; Supplementary Table 4). Regarding inputs, most studies found that CSA farms used less fertilizer, vehicles and machinery, pesticides and energy compared to reference systems. Organic substances were typically used in higher amounts. For example, one CSA farm in Spain used more organic pesticides compared to two conventional farms, yet their energy consumption was around 10 times lower compared to the energy consumption for pesticides used in the conventional farms (Pérez-Neira and Grollmus-Venegas, 2018). In a comprehensive life-cycle assessment, Pérez-Neira and Grollmus-Venegas (2018) showed that the investigated CSA performed much better for most ecological variables compared to two conventional farms. In particular, non-renewable energy demand was substantially lower both per ha cultivated and per kg of produce. Regarding climate emissions, only positive, neutral or unclear effects were found. For example, the global warming potential of seven CSA farms investigated in China was on average 61 and 39% lower compared to eight conventional and organic farms, respectively (Zhen et al., 2020). According to a study including four CSA farms in the UK, CSA could contribute to a 28% reduction of greenhouse gas emissions from dietary intake (Mills et al., 2021). Agricultural production was reported in three studies, yet not compared to any reference system (Table 3). This also applied for crop and livestock diversity. On average, 64 CSA farms investigated in the United States cultivated more than 44 crops (Galt et al., 2012; Paul, 2019).

TABLE 3 Number of variables with positive, neutral, negative or unclear effects in each sub category.

Dimension	Category	Sub category	Positive	Neutral	Negative	Unclear	CSA farms	Studies
Ecology	Inputs	Water	1	1	0	1	8	2
Ecology	Inputs	Vehicles/machinery	5	1	2	11	112	8
Ecology	Inputs	Electricity	0	1	0	2	7	3
Ecology	Inputs	Pesticides	5	0	1	1	9	3
Ecology	Inputs	Fertilizer	14	0	3	2	57	4
Ecology	Inputs	Energy	7	0	0	2	57	4
Ecology	Outputs	Climate	4	1	0	9	17	4
Ecology	Outputs	Production	0	0	0	3	25	3
Ecology	Outputs	Environmental impact	1	0	0	0	7	1
Ecology	Biodiversity	Crop diversity	0	0	0	2	64	2
Ecology	Biodiversity	Livestock diversity	0	0	0	1	48	1
Social	Team	Knowledge/learning	1	0	1	2	68	5
Social	Team	Diversity/inclusion	0	0	1	8	83	2
Social	Team	Income	4	2	0	2	2110	5
Social	Team	Satisfaction	4	0	0	1	23	3
Social	Team	Full time/part time	0	0	0	4	59	4
Social	Members	Knowledge/learning	4	2	0	0	8	3
Social	Members	Diversity/inclusion	0	16	48	38	166	21
Social	Members	Fluctuation	0	0	0	10	187	8
Social	Members	Satisfaction	0	0	0	2	13	2
Social	Members	Engagement	3	1	0	6	30	7
Social	Members	Identification	1	1	0	1	16	3
Social	Members	Distance	0	0	0	1	5	1
Social	Members	Supply	1	0	0	3	13	4
Social	Members	Behavior	39	21	0	8	33	11
Social	Members	Well-being/health	7	6	1	0	6	2
Social	Farm	Transparency	0	0	0	1	19	1
Social	Farm	Goals/visions/strategies	0	0	0	1	19	1
Social	Farm	Community building	1	0	1	1	10	3
Social	Surroundings	Cooperation	0	0	0	1	56	1
Social	Surroundings	Knowledge	0	0	0	4	56	1
Economy	Farm	Products	0	0	0	2	43	2
Economy	Farm	Management	3	0	0	1	20	2
Economy	Farm	Age	0	0	0	9	174	9
Economy	Farm	Distribution	0	0	0	3	48	3
Economy	Farm	Marketing channels	2	1	0	1	46	3
Economy	Costs	Running costs	1	9	3	19	33	5
Economy	Costs	Investments	0	2	0	0	7	1
Economy	Revenues	Membership fees	1	0	1	9	152	10
Economy	Revenues	Donations	0	0	0	1	19	1
Economy	Financial resources	Liquidity	0	1	0	1	37	2

(Continued)

TABLE 3 (Continued)

Dimension	Category	Sub category	Positive	Neutral	Negative	Unclear	CSA farms	Studies
Economy	Financial resources	Balance	8	2	1	1	97	7
Economy	Operating area	Operating area	0	0	0	11	166	10
Economy	Range	Shares	0	0	0	14	191	12
Economy	Range	Access	1	0	0	0	16	1
Economy	Range	Productivity	2	0	2	2	26	4

Only variables with at least 5 underlying CSA farms are shown.

3.3.2. Social sustainability

Most social variables covered team (i.e., employees) and member aspects (Table 3; Supplementary Table 4). Variables related to the entire farm or the surroundings were only addressed in a few studies. Regarding CSA farmers, positive effects were found for satisfaction and income. For example, Hunter et al. (2022) found that happiness and positive future beliefs were higher in CSA farms compared to other alternative food networks. Farmers in Romania stated that they are more satisfied and respected since being a CSA farmer (Moellers and Bîrhală, 2014). In the US, the gender pay gap in CSA farms was around one third lower compared to the average (Fremstad and Paul, 2020), less partners needed to work off-farm compared to organic farming (Galt et al., 2012) and earnings were more than 350% higher than on average, yet still not enough to secure living (Paul, 2019). In a CSA in Spain, income was up to around 50 and 75% higher than income from investigated conventional farms (Pérez-Neira and Grollmus-Venegas, 2018).

Investigated CSA members were generally not representing the average population. They were typically white, well-educated and with higher income than the average population (Table 3). Moreover, women were typically overrepresented. In contrast, effects on members' behavior and well-being and health were largely positive or neutral (Table 3). For example, various studies found that CSA members more often prepared food at home, ate less processed food and more vegetables and fruits (MacMillan Uribe et al., 2012; Wilkins et al., 2015; Allen et al., 2017; Rossi et al., 2017; Vassalos et al., 2017). CSA membership was further related to sustainability behaviors such as recycling (MacMillan Uribe et al., 2012; Vassalos et al., 2017). However, no significant positive effect was found regarding the reduction of food waste (Russell and Zepeda, 2008). Among others, health benefits included lower expenditures at the pharmacy and higher self-evaluated health since joining CSA (Allen et al., 2017; Rossi et al., 2017). Mostly positive effects were achieved regarding knowledge transfer and learning, for example, related to cooking expertise and nutritional awareness (Rossi et al., 2017). Regarding engagement, CSA membership was associated with higher volunteerism (Obach and Tobin, 2014; Carolan, 2017) and higher participation in political events (Carolan, 2017).

3.3.3. Economic sustainability

Economic variables encompassed all categories (farm, costs, revenues, financial resources, operating areas, range), yet actual effects were largely unclear (Table 3; Supplementary Table 4). Only regarding the financial balance, several studies found a positive effect. Zhen et al. (2020) showed that average profit per hectare was nearly three times higher in CSA compared to conventional farms. The gross benefit in a CSA in Spain was nearly 17 times higher than the costs (Pérez-Neira and Grollmus-Venegas, 2018). One study in Sweden indicated that farm management is more efficient compared to other types of alternative food networks (Hunter et al., 2022). In contrast, running costs were found to be higher regarding delivery and labor (Zhen et al., 2020), as well as marketing (Hardesty and Leff, 2010). Regarding economic productivity, the number of positive and negative effects was equal. Studies in Romania (Moellers and Bîrhală, 2014) and Spain (Pérez-Neira and Grollmus-Venegas, 2018) found that more labor is needed compared to other farms. However, profit and sales per labor hour were substantially higher compared to other direct marketing approaches in 21 CSA farms in the United States (Jablonski et al., 2019).

4. Discussion

We found that <30% of the quantitative studies included investigated ecological aspects and in around 40% of these studies relative effects compared to other farming systems were either unclear or not investigated, thus a reliable evaluation of the ecologic sustainability of CSA is not yet possible (Christensen et al., 2018; Wellner, 2018). Nevertheless, existing studies show a clear positive trend. In particular, regarding resource use efficiency and greenhouse gas emissions, investigated CSAs mostly performed better than conventional systems. Research on crop yields, crop and livestock diversity, and soil health remains incomplete or is not yet performed. Environmental effects have been investigated widely and more often than social and economic aspects for agri-food systems generally, but also with regard to organic agriculture and local food systems (Mundler and Laughrea, 2016; El Bilali et al., 2021). To which extent these findings are transferrable to the CSA context needs to be evaluated. With regard to slowly changing processes in complex ecosystems such as soil, changes in soil functions as response to altered management practices might be only detectable after decades (Nortcliff, 2002; Bai et al., 2018; Bünemann et al., 2018). In this case, the use of proxies and systemic modeling approaches combined with field data might be essential to evaluate altered management practices long-term sustainability (Bünemann et al., 2018; Rabot et al., 2018; Vogel et al., 2018).

Nearly 90% of the quantitative studies included addressed social sustainability aspects. Given that CSA is a social innovation centered around a community of producers and consumers, their relationship, solidarity, cooperation, trust, engagement and participation, this is hardly surprising (Jarosz, 2000). Moreover, in contrast to many ecological variables that require continuous and long-term effort for data collection, a wide range of social aspects can be captured with one-time (online) surveys or interviews. However, the majority of studies within the social dimension assessed socio-economic variables of CSA members including gender, age, income, ethnicity and education. Accordingly, CSA members do not represent the average population, for example with regard to low income households (Galt et al., 2017). Besides various internal mechanisms to offset costs, e.g., membership fees related to income or anonymous bidding rounds, externally subsidized memberships could improve access to CSA and related health benefits (Izumi et al., 2018). Apart from the limited diversity of CSA members, most studies found positive social effects, particularly with regard to health and sustainability behavior, for example, including dietary changes, which can substantially reduce environmental impacts of food systems (Willett et al., 2019).

More than half of the studies included covered economic aspects. However, knowledge on actual economic performance compared to other systems is still very limited. Nevertheless, first studies indicate high economic viability of CSA farms. If this pattern is generalizable, CSA could provide a suitable alternative to farm growth or termination in the light of economic competition in the agricultural sector (Paech et al., 2019). In this context, diffusion of CSA is another emerging topic in the CSA literature screened here. Amongst others, diffusion relies on institutional support, access to affordable land and sufficient demand (Doernberg et al., 2016; Pisarn et al., 2020; Zoll et al., 2021). For example, Diekmann and Theuvsen (2019a) found that 27% of non-participants would be interested in CSA membership in Germany, i.e., much more than the proportion of the German population currently organized in a CSA, which is <1% (own estimation based on Netzwerk Solidarische Landwirtschaft e.V., 2022a). However, members need to be hold, e.g., by increasing crop diversity and cooperation among different CSA farms (Galt et al., 2019). In this context, understanding and fostering the values and preferences of CSA members is crucial to establish long term relationships (Chen, 2013a,b; Diekmann and Theuvsen, 2019b). Reducing fluctuation is particularly relevant in the context of current inflation rates, which will also provide insights on the economic resilience of CSA.

Besides the observed bias in current CSA literature toward social variables, we also observed a clear geographical imbalance. While most studies analyzed in this paper focused on the US, the country with the largest number of CSA farms, no study investigated French CSA farms, where the vast majority of European CSA farms are located (Samoggia et al., 2019; Egartner et al., 2020), yet this might also be related to our search strategy (see below). Moreover, besides Brazil, China and Turkey no countries from the Global South or emerging economies were considered. In the light of contrasting socio-economic conditions, knowledge from different types of countries is crucial. To obtain an overview of the current status of CSA, the international CSA network Urgenci (urgenci.net) is launching a global census in 2023, which will provide an important baseline for future research. Many of the studies considered only cover a limited number of CSA farms, focus on few sustainability aspects and often remain descriptive.

While our study offers an important overview of sustainability-related effects of CSA, it faces two major limitations. First, we only included English articles indexed in Web of Science, which leads to a bias toward articles published in US journals and particularly neglects research from the Global South (Gibbs, 1995; Lund, 2022). Given that CSA research is often geographically limited and closely related to practice, many studies are likely to be published in other languages. This could also explain, why despite the large number of CSAs, no study from France was included. In Germany (and probably also elsewhere), the number of theses on CSA is rapidly increasing. While most of them are in German and not published in scientific journals, many of them offer valuable insights that should be considered, if certain quality criteria are fulfilled. While CSA is the most common term in international literature, including country-specific terms, for example AMAP (Association pour le Maintien d'une Agriculture Paysanne) in France and teikei in Japan could increase the literature base and the geographic scope. Second, we only included quantitative findings related to our framework and without applying any criteria regarding the statistics of the selected paper. In particular regarding social aspects, qualitative studies offer additional valuable insights, for example related to underlying values, identity and social practices (Diekmann and Theuvsen, 2019b; Neulinger et al., 2020; Zoll et al., 2021). Consequently, our literature review is only a first step and more literature need to be included to draw broader conclusions on existing findings of the sustainability of CSA.

Based on our review we suggest that more studies investigating actual sustainability effects of CSA farms following standardized protocols are needed, in particular including comparisons across different farming systems and with regard to their ecological effects. As empirical work in this context might require high efforts, proxies and findings related to organic farming could be considered. More research is essential for CSA stabilization, development and scaling, as well as the development of policies to support CSA. This also includes approaches to reduce the fluctuation of CSA members, to increase their diversity and to understand and utilize future consumer potentials. Moreover, existing knowledge should be better integrated and publicly accessible. The German CSA network for example, collects bibliographic information on existing theses. Ideally, the central findings of such research would be integrated into one structured and international database to simplify access and knowledge transfer. Finally, more funding is needed to support these efforts. In the light of the high sustainability promises of CSA shown so far and the urgent need to transform food systems toward sustainability, such funding would be well placed to support this goal. Therefore, obstacles for CSA to gain access to existing programs and funds (e.g. common agricultural policy in the EU) could be reduced and new programs could be established.

Data availability statement

The original contributions presented in the study are included in the article/Supplementary material, further inquiries can be directed to the corresponding author.

Author contributions

JR identified the relevant studies for the review. LE performed the analyses and wrote the paper in collaboration with JR and JP. All authors designed the study and revised multiple versions of the manuscript.

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Conflict of interest

The authors declare that the research was conducted in the absence of any commercial or financial relationships that could be construed as a potential conflict of interest.

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Supplementary material

The Supplementary Material for this article can be found online at: https://www.frontiersin.org/articles/10.3389/fsufs.2023.1136866/full#supplementary-material

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