

Perceived resilience of community supported agriculture in Germany

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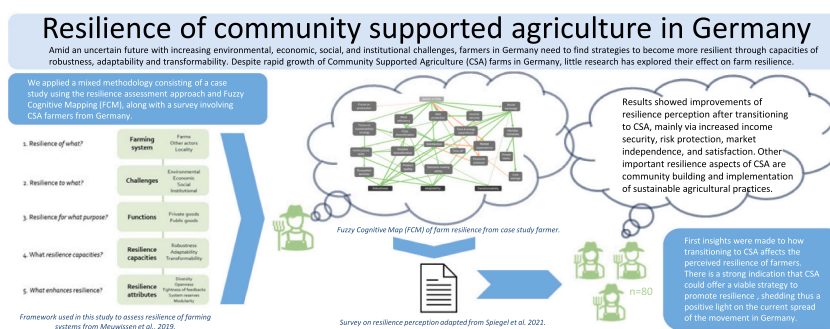
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HIGHLIGHTS

- Limited research has examined the impact of Community Supported Agriculture (CSA) on farm resilience.
- A resilience assessment framework was applied to analyze CSA farmers from Germany (n=80).
- CSA contributes to perceived resilience via income security, risk protection, market independence, and satisfaction.
- Farmers who switched to CSA reported greater perceived resilience gains than those who initially started with CSA.

GRAPHICAL ABSTRACT



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ABSTRACT

Context: Amid an uncertain future with increasing environmental, economic, social, and institutional challenges, farmers in Germany need to find strategies to become more resilient through capacities of robustness, adaptability, and transformability. Parallel to that, Community Supported Agriculture (CSA), an alternative food and value chain network in which producers and consumers share the risks involved in farming, is rapidly spreading in the country. CSA has the potential to address sustainability concerns while at the same time improving farm resilience.

Objective: The main objective of this study is to provide an understanding of how a CSA-structure on a farm may impact farm resilience. It also aims to investigate how CSA farmers in Germany perceive the resilience of their farms, its functions, and the challenges they may face in the future.

Methods: A mixed methodology was applied, consisting of a case study with one CSA farmer following the approach for a resilience assessment developed by Meuwissen et al. (2019), and a survey with CSA farmers from Germany. The case study involved an in-depth interview, a resilience perception assessment and a Fuzzy-Cognitive-Mapping workshop, whose results were used as a starting point for developing the survey.

Results and conclusion: The case study revealed mechanisms for improving farm resilience through CSA, particularly through increased income security, risk protection, market independence, and satisfaction. These same resilience improving mechanisms could also be identified among the surveyed CSA farmers. Overall, CSA farmers

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showed a high level of perceived resilience in comparison to non-CSA farmers from a similar survey in a different study.

Significance: The study is the first of its kind to analyze CSA farmers in Germany through the lens of farm resilience theory. The study provides first insights to how transitioning to CSA affects the perceived resilience of farmers as well as underlying motivations. The results provide a strong indication that CSA could offer a viable strategy to help combat the resilience crisis, shedding thus a positive light on the current spread of the movement in Germany.

1. Introduction

European farms are considered to be facing a “looming resilience crisis” (Feindt et al., 2022). A significant number of farmers are struggling to secure economic viability amid price fluctuations, unbalanced value chains and international competition, being often dependent on income alternatives (Meuwissen et al., 2020; Accatino et al., 2022). Meanwhile, climate change is seen as one of the biggest threats to farming, along with plant and animal diseases, biodiversity loss, soil degradation, water scarcity and soil erosion (Benton et al., 2003; Borrelli et al., 2020; Ortiz-Bobea et al., 2021; Webber et al., 2018; Jones et al., 2013). This becomes even more threatening when considering that many European farming systems are locked in on developmental trajectories oriented towards global commodity food systems and highly dependent on external inputs such as mineral fertilizers and pesticides (Accatino et al., 2022; Feindt et al., 2022). Farmers are also faced with social pressures such as rural outmigration, which has led to a lack of farm successors and of skilled and permanent laborers (Burton and Fischer, 2015; Spiegel et al., 2020). Other relevant challenges include changing consumer preferences and the frequent public debates about the negative impacts of agriculture on the environment, animal welfare and social issues (Tilman et al., 2011).

The situation in Germany regarding agricultural challenges is similar to the overall picture in Europe. A large number of farmers are clearly dissatisfied, which was expressed during public protests in the last years (Fritz, 2020; Gassmann, 2019; van der Ploeg, 2020; Welt, 2021). Main challenges include lack of financial viability (Deter, 2018; European Commission; European Investment Bank, 2020), low commodity prices coupled with strong price fluctuations (Brümmer, 2021; Deter, 2019; Eckinger, 2016; Zinke, 2021, 2022), lack of farm successors (German Federal Office of Statistics, 2021a, 2021b; Statista, 2022), and farmers’ reputation as environment polluters (Deter, 2020; Leopold, 2021; Der Spiegel, 2019).

To cope with the multitude of challenges, farmers need to be robust to adversities, able to adapt to changing conditions and/or even successfully transform their farms if needed. In other words, they need to be resilient. The need to develop resilience-enhancing strategies for European agri-food systems has been recognized (Feindt et al., 2022). For example, the EU Farm to Fork Strategy calls for strengthening the resilience of Europe’s food system and food systems in general by promoting sustainable food production and creating short supply chains (European Commission, 2020). Numerous strategies exist to enhance the resilience of agri-food systems, including diversification, digitalization, cooperation as well as new marketing approaches. Within these strategies, alternative food networks have emerged in the last decades as a viable alternative to the dominant food system structure. They are characterized by shorter distances between producers and consumers, non-conventional farming methods (such as organic, biodynamic or regenerative farming, or agroecology), commitment to sustainability and the existence of food purchasing venues (e.g., cooperatives, farmers’ markets) (Jarosz, 2008; Michel-Villarreal et al., 2019).

One type of alternative food network is Community Supported Agriculture (CSA), a system where food is not sold on the market but flows into its own transparent economic cycle, which is co-organized by producers and consumers. In practical terms, a CSA farm has a network of consumers, their members, who make a financial commitment

throughout a season or year to cover the farm’s operating costs (including a reasonable wage for the farmers) in the form of monthly or weekly payments. The members normally receive a weekly share of the food produced, which may be affected by seasonal and weather-related fluctuations – meaning that the risk of yield fluctuations or even of total yield loss is borne by the consumers and not by the producer. So, if the harvest for a certain product fails, farmers still get their payment. Therefore, members “share the risks and benefits associated with the uncertainty of farming” (Brehm and Eisenhauer, 2008, p.95). Often, the members are given the opportunity to influence the farmers’ decision on the product portfolio (Wellner and Theuvsen, 2017) and in some cases, members also assist with farm activities and decide together with the farmer on socio-ecological standards (Wellner and Theuvsen, 2017; Barbosa et al., 2022; Egli et al., 2023.). A key aspect of CSA is the direct social relationship between farmers and consumers based on mutual trust and cooperation, although recently CSA is sometimes more seen as an alternative marketing concept (Wellner and Theuvsen, 2017).

CSAs are often located near urban centers, within an average distance of 21 km, serving as local markets where there is considerable demand from residents for high-quality (often organic), regional food. That is also why a high percentage of CSAs are managed organically (Wellner and Theuvsen, 2017). Often, the focus of CSAs is on vegetable production, but there are also CSAs who produce herbs, dairy products, cereals, flour, seeds, bread, eggs, meat, fruit / nuts, honey and wine (Wellner and Theuvsen, 2017; Strüber et al., 2023.).

In Germany, CSA farms were once a niche phenomenon but have seen a significant surge, growing from just under 50 to over 400 in the past decade (Bioland, 2020; Netzwerk Solidarische Landwirtschaft, 2023a). This trend indicates a growing relevance of this type of farm structure which is gaining importance in civil society, policy and academia, although the percentage of produced food in comparison to global food production is still low (Egli et al., 2023). Given the interest of young people in the movement, it offers some promises to address the current lack of farm successors and young people in the farming profession. Additionally, it promotes short supply chains and sustainable farming practices, such as the incorporation of biodiversity, water and soil protection measures, while also aiming to tackle the issue of financial insecurity (Netzwerk Solidarische Landwirtschaft, 2023b). It is therefore important to explore how CSA farmers perceive themselves in the context of resilience and whether and by which mechanisms the CSA structure may improve farm resilience. However, it seems little focus has been given so far to the contributions of CSA to farm resilience (Fomina et al., 2022). Some authors do comment on resilience in the context of CSA, albeit with informal definitions of the concept (Antoni-Komar et al., 2021; King, 2008; Kondoh, 2015; Landwehr et al., 2021; Piccoli et al., 2021; Rommel et al., 2022; Toth et al., 2016).

The present study aims to explore the potential of the CSA structure to improve resilience at the farm level. Specific research objectives are to (1) understand, through a case study, the mechanisms through which transitioning to CSA may affect resilience capacities and to (2) compare the level of perceived resilience of German CSA farmers relative to other non-CSA farmers across Europe. The framework for resilience assessment proposed by Meuwissen et al. (2019) served as analytical framework for the two-part-methodology consisting of (a) a case study with a CSA farmer, which was used to conceptualize (b) a survey aimed at German CSA farmers.

2. Material and methods

2.1. Resilience assessment

The theoretical framework adopted for this study is based on the approach proposed by Meuwissen et al. (2019), which was developed with the objective of providing a framework for assessing farming system resilience in the European context. In their study, resilience is defined as the “system’s ability to ensure the provision of the system functions in the face of increasingly complex and accumulating economic, social, environmental and institutional shocks and stresses, through capacities of robustness, adaptability and transformability.” (Meuwissen et al., 2019, p. 2). Accordingly, a system is mainly defined by the functions it provides, and the aim for a resilient farming system is the continuity of the provision of functions despite shocks and stresses. To achieve resilience, a system must encompass three capacities: robustness, the ability to withstand shocks and stresses; adaptability, the capacity to change components in response to such challenges; and transformability, the capacity for significant changes following severe shocks or ongoing stress, possibly even resulting in a change of the functions (Meuwissen et al., 2019).

The framework to assess resilience by Meuwissen et al. (2019) is built upon five steps and corresponding guiding questions as shown in Fig. 1.

A central aspect of the present study is its focus on assessing the resilience *perception* of farmers, instead of assessing resilience based on pre-defined socioeconomic and ecological indicators as e.g. done by Meuwissen et al. (2019). Perceived resilience relates to the farmer’s cognitive and affective valuation of their own capacity to anticipate, buffer, adapt and transform the farm in response to stresses (Jones and Tanner, 2017; Spiegel et al., 2021). The advantage of perceived resilience assessment over indicator-based assessment is that it does not have to be context specific, thereby allowing for comparisons between different farm types (Spiegel et al., 2021). However, both types of assessment should ideally complement each other (Jones and d’Errico, 2019). Taking this into consideration, and assuming that the farm’s resilience is strongly dependent on how it is managed by the farmer and on the farmer’s own perceived resilience (Darnhofer, 2014; Darnhofer et al., 2010), it is hard or even irrelevant in this case to distinguish between the farmer and the farm. Therefore, for this study we consider farm and farmer resilience as strongly interconnected. Contrary to the

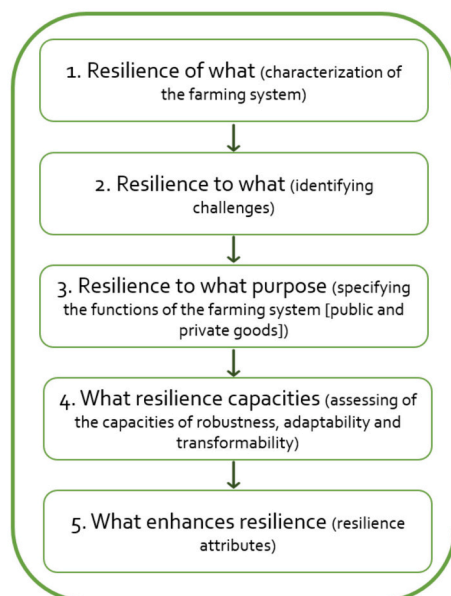


Fig. 1. Framework used in this study to assess resilience of farming systems from Meuwissen et al., 2019.

framework proposed by Meuwissen et al. (2019), our analysis centers on perceived resilience rather than indicator-based resilience. Additionally, we concentrate on the farm level, while their focus extends to the level of the farming system, encompassing a network of stakeholders interconnected to farms within a specific area.

2.2. General research design

This study links resilience as defined by Meuwissen et al. (2019) to CSA by exploring the mechanisms through which CSA-structure can influence farm resilience. The methodology is made up of two parts (Fig. 2). In part one, using a case study approach, we collected detailed information on a CSA case study farmer to gather detailed qualitative information about the effects of CSA on farm resilience, the aim of which was to contextualize a resilience perception survey for the German CSA context used in Part 2. The case study in part one was composed of three steps: (i) a semi-structured interview to obtain information about the farm management and history, (ii) a general resilience perception assessment with the farmer based on an adapted survey developed by Spiegel et al. (2021), and (iii) a Fuzzy-Cognitive-Mapping (FCM) activity to identify causal links related to CSA that affect resilience.

In part two, building on the results of the case study, a customized online survey, which was largely based on the survey of Spiegel et al. (2021), was adapted specifically to German CSA farmers. The objectives of the survey were to assess the perceived resilience of CSA farmers and compare their level of perceived resilience to that of other non-CSA farmers across Europe (Spiegel et al., 2021) and obtain a general picture of CSA farmers in Germany. Additionally, the survey was used to verify if CSA-related mechanisms found via the case study are also present among other CSA farmers in Germany. Spiegel et al. (2021) applied their survey to 972 farmers from diverse farming systems in Belgium, Bulgaria, Germany, Spain, France, Italy, the Netherlands, Poland, Sweden, and the UK, thereby offering a valuable dataset for a comparative analysis. The average farm size of their sample is 245 ha and only 5% of them are organic.

2.3. Part one: conceptualization of a CSA farm

The aim of part one was to gain detailed insights into CSA-farming in Germany which were later used in the design of the survey adapted from Spiegel et al. (2021) for CSA farmers in Germany. The first step of the case study consisted of a semi-structured interview with a CSA farmer to gather basic information about farm management and dynamics and learn about the transition to CSA. The interview addressed the first three steps of the resilience framework by Meuwissen et al., 2019, i.e., (1) defining the system, (2) its challenges and (3) how the farmer perceives the functions his farm provides (Fig. 1). At the end of the interview, a questionnaire to assess the farmer’s resilience perception was applied. The administered questionnaire was developed by Spiegel et al. (2021) and allows for cross-comparison between different types of farms. It is also based on the framework from Meuwissen et al. (2019)¹ and assesses farmers’ perceived resilience rather than objective indicators.

Additionally, a separate workshop with the farmer was conducted with the goal of creating an FCM to explore and elaborate on the casualities of the CSA structure on perceived farm resilience. An FCM is a graphical representation of organized knowledge that displays the relationships between elements within this knowledge domain. The visual result is a network, in which concepts (nodes) are connected through directed links. It is a semi-quantitative model since it assigns a degree of influence (positive or negative) that one variable can have on another. More specifically, system components must be variables that can either increase or decrease, and the relationships between components,

¹ For simplification, the questionnaire developed by Spiegel et al. (2021) will be further referred to as “the questionnaire”.

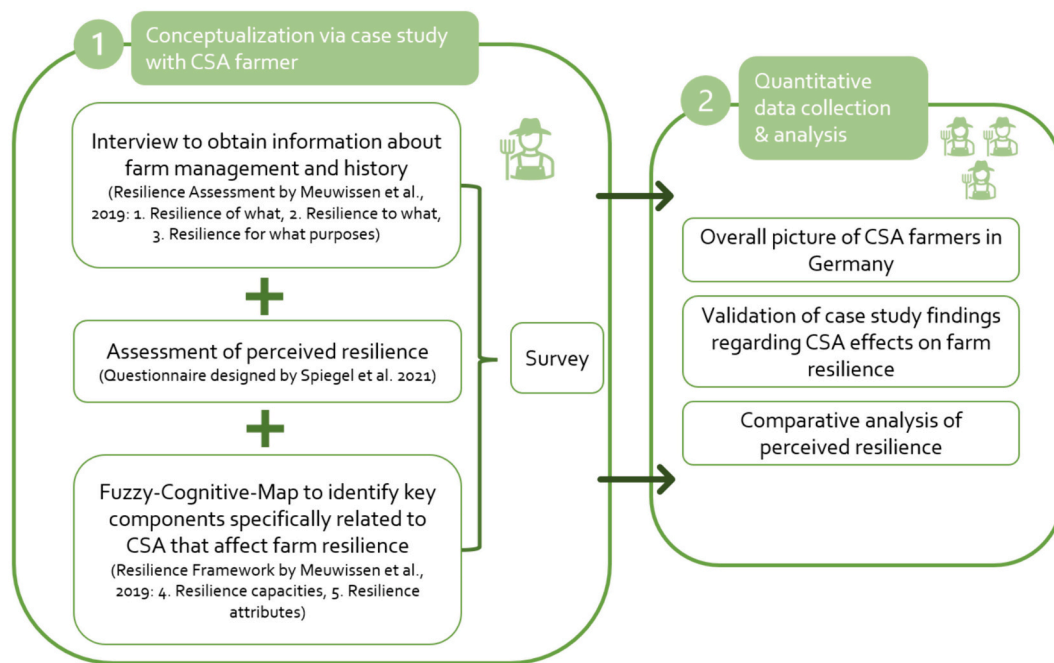


Fig. 2. Simplified diagram of the methodology.

represented as arrows, can have values ranging from -1 to $+1$ (Gray et al., 2013).

The FCM with the case study farmer addresses the fourth step of the resilience assessment framework (assessing resilience capacities). The starting point of the FCM was the farm's transition to CSA, asking the question: *How did transitioning to CSA affect the three resilience capacities (robustness, adaptability, and transformability) of your farm?* In other words, the goal of this activity was not to assess the level of these resilience capacities, but to understand which factors and mechanisms specifically related to CSA contribute to them through the perspective of the case study farmer. Therefore, all FCM components, except for the three resilience capacities, were created by the case-study farmer, as well as the connections between them. We utilized the Mental Modeler online tool, developed by Gray et al. (2013), to create the model.

The fifth step of the resilience framework (identifying the five resilience attributes) was not thoroughly addressed in the workshop due to time constraints.

2.4. : Part two: survey of CSA farms

Combining the information obtained via the interview, the questionnaire, and the FCM, a survey aimed at CSA farmers in Germany was designed. The goal was to perform a comparative analysis of perceived resilience with the data on other farmers obtained by Spiegel et al. (2021) and to assess whether the mechanisms contributing to resilience identified via the FCM are also perceived by other CSA farmers in Germany. In order not to discourage potential participation, the survey had to be kept short, with a completion time no longer than 15 min. Therefore, it ended up with a total of 23 questions of diverse formats, such as multiple choice, Likert scales, point allocation and open questions. The following outlines the various questions and indicates where the information from the CSA case study was integrated in the questionnaire:

- Questions 1 to 10 aimed at providing a picture of CSA farmers in Germany. They covered topics such as basic demographics, farm size and age, which products are sold, if the farmers' income depends exclusively on CSA and if they established their farm already as CSA or transitioned later.

- Questions 11 to 17 were based on the case study. Questions 11 and 12 assessed the farmers' satisfaction with their CSA system, considering the significant increase in satisfaction observed in the case-study farmer after switching to CSA. Question 13 was developed after analyzing the causal links in the FCM, exploring whether they resonate with other CSA farmers. It showed a list of statements the farmers had to agree with or not, which represented the main systemic changes brought about by CSA, as identified in the FCM. Questions 14 to 17 were related to the social component of CSA, as the case study farmer placed high importance on social exchange with his CSA members, which is also a factor often discussed in CSA literature.
- Questions 18 to 23 were taken from the questionnaire (Spiegel et al., 2021). In order to keep the survey as concise as possible, only the questions deemed as most essential to the CSA context were used, picking thus only one question for each topic and leaving out topics such as innovation, willingness to take risks, probabilities, and others which were also addressed by Spiegel et al. Therefore, the topics addressed in the survey were provision of farm functions (Question 18), future challenges in agriculture (Question 19), strategies to deal with these challenges (Question 20), and the perception of the three resilience capacities (Questions 21 to 23). All questions were presented following their original formulation by Spiegel et al. (2021), except for the last three questions, that were used to assess the perception of the resilience capacities. Those were changed so that they are based on three equally structured questions, each of them containing two statements to which the respondents had to provide their level of agreement on a scale from 1 to 7. This provided two scores relative to the two statements for each capacity. An average of these two scores was calculated which represent a composite index of a resilience capacity as suggested by Spiegel et al. (2021).

To gain access to a high number of CSA farmers, we established contact with Netzwerk Solidarische Landwirtschaft (NSL), a network organization comprising CSA farms. NSL serves as the primary organization in Germany representing CSA farmers. The network organizers showed interest in the study and sent an invitation together with their August newsletter to their members. However, as the initial response rate was very low, individual e-mails were sent to every CSA whose

contact information was readily available at the NSL website, totaling around 290 e-mail invitations. At the end of September, a total of 80 responses were achieved, representing around 20% of the current number of CSA farms in Germany that were registered in the NSL at the time. The survey questions can be found in Supplementary Material.

For analyzing the survey data, an explorative approach was taken. At first, data on farmers' demographics were assessed by taking averages and/or categorizing, then comparing with national statistics. Open questions such as the ones regarding farmers' position, member participation, challenges and strategies underwent qualitative content analysis, where they were manually and inductively grouped into categories. For analyzing the effects of CSA on the three resilience capacities robustness, adaptability and transformability, the respondents were split into two distinct groups: farmers who started out as CSA and farmers who transitioned to CSA at a later stage, given the understanding that farmers who had prior experience with other farm structures could provide comparative data on the changes that can unfold after transitioning to CSA. A Two-sample t-test was conducted in the STATA software package to compare those two groups. For each resilience capacity, the two statements were tested separately under two null hypotheses:

1. Difference of means assuming equal variances

The difference in means between the two groups for each selected variable was tested under the assumption that the variances were equal.

2. Welch's test for unequal variances

Alternatively, when not assuming equal variances between the groups, the Welch's formula in STATA was used to account for potential differences in variances. The average of all responses per response variable was calculated. The same was done with the average of all responses from the second response variable per category. The average of those two values per category served as a composite index for each resilience capacity. Additionally, we compared the composite indices for the resilience capacities from the case study farmer with the survey participants and the results assessed by Spiegel et al. (2021).

We applied the same t-test method outlined above to compare the responses of both groups to Question 13, which assessed the perceived systemic effects of transitioning to CSA.

3. Results

The following section is divided into two subsections, in accordance with the methodology. The first sub-section presents the results of the first phase of the study, i.e., a qualitative conceptualization through a case study of a CSA farmer, while the second sub-section describes the most relevant quantitative findings based on the survey data analysis.

3.1. Conceptualization of CSA – resilience causalities for the case study farm

The case study farmer runs a biodynamic horticultural farm since 2000, which is located about 50 km east from the center of Berlin, Germany. He started his CSA operation in 2017 and transitioned exclusively to CSA in 2018. Before 2017, his products were sold through box schemes and farmers markets. This specific case was selected because the farmer could share a comparative point of view of the changes in his farm dynamics brought by the transition to CSA, which was very significant for him. He shared a very positive view of the effects CSA had on his farm during the interview. Key changes leading to the positive effects of CSA are related to less financial pressure due to members' subscriptions, more efficiency of production in terms of work allocation and demand matching, and more time-off by not having to go to markets to sell his products. He was also able to reduce his

environmental impact by decreasing and diversifying his production, thus allowing the soil to recover. Other changes are listed in Table 1.

To assess the casualties related to CSA and perception of farm resilience, an FCM workshop was conducted. The results are presented as a network linking the transition to CSA with the three resilience capacities: robustness, adaptability, transformability. It consists of a total of 24 components and 55 connections, with an average of 2.3 connections per component (Fig. 3). A list of all components with their respective connections and correlations is available in the Supplementary Material. The model created via FCM was consistent with the content of the interview and provided more in-depth information. Three key details could be extracted from the FCM, which are related to finance, sustainability, and satisfaction. Transitioning to CSA had a direct effect on diverse aspects related to financial well-being, which are *risk protection*, *income security*, *market dependence*, and *financial pressure*. Transitioning to CSA also enabled the farmer to *focus on sustainability and ecology* by decreasing his need to *focus on production*. This in turn increased *crop diversification*, which led to *improved horticultural skills* and *product quality*, and more *routine diversification*. This shift in focus also increased his ability to deliver *ecosystem services*, which, in the view of the case study farmer, makes the farm more robust and adaptable. The importance of *social exchange* was also made clear, as it provides *income security* and improves personal *satisfaction*. Indeed, *Satisfaction* played a significant role in the FCM, as it had the most connections and, through directly improving *decision-making ability*, it positively impacts all three resilience capacities. Due to time constraints, it was not possible to obtain an explanation from the case study farmer on why exactly he linked one component to a specific resilience capacity and not to another.

The assessment of resilience capacities through composite indices (via the questionnaire from Spiegel et al., 2021) and FCM reveals insights into its different dimensions (Table 2). For example, robustness stands at a composite index of 3.3 and underscores the farm's ability to withstand shocks and disturbances. The FCM revealed that robustness is influenced by factors such as *crop diversification*, *income security*, and *risk protection*, as well as *ecosystem services*, *social exchange*, and *decision-making ability*. Adaptability stands at 4.7, highlighting the farm's ability to adjust to changing conditions. According to the FCM, *ecosystem services*, *horticultural skills*, and *social exchange*, as well as *decision-making ability*, *time off* and *work efficiency* are primary factors influencing a farm's ability to adapt. Scoring the highest among the three capacities with a composite index of 5.7, transformability is influenced by *decision-making ability*, *focus on sustainability/ecology*, and *social exchange*, reflecting the farm's ability to make fundamental changes over the long term.

Table 1

Comparison of the case study farmer's farm before and after transitioning to CSA, according to the information provided in the interview.

Before CSA (2000–2018)	After CSA (2018 - recent)
- Felt constantly under financial pressure	- Doesn't feel pressure anymore, more relaxed work atmosphere
- Marketing channels perceived as unreliable, often leading to food waste due to less demand than expected	- Demand is reliable and food waste minimized
- Workforce: 2 farm managers, 1.5 employees, 3 apprentices, 1 intern, 4 seasonal workers	- Reduced workforce: no more need for seasonal workers
- Three harvest days per week	- Only one harvest day per week
- Worked on Saturdays (farmers' market)	- No need to work on Saturdays
- Grew around 40 types of vegetables	- Grows around 60 types of vegetables
- Soil was already on its limit so scaling up production was not an option (trying to do that in the past had led to a vicious circle by increasing production costs)	- Feels satisfied, but still thinks farmers in general work too much for too little money

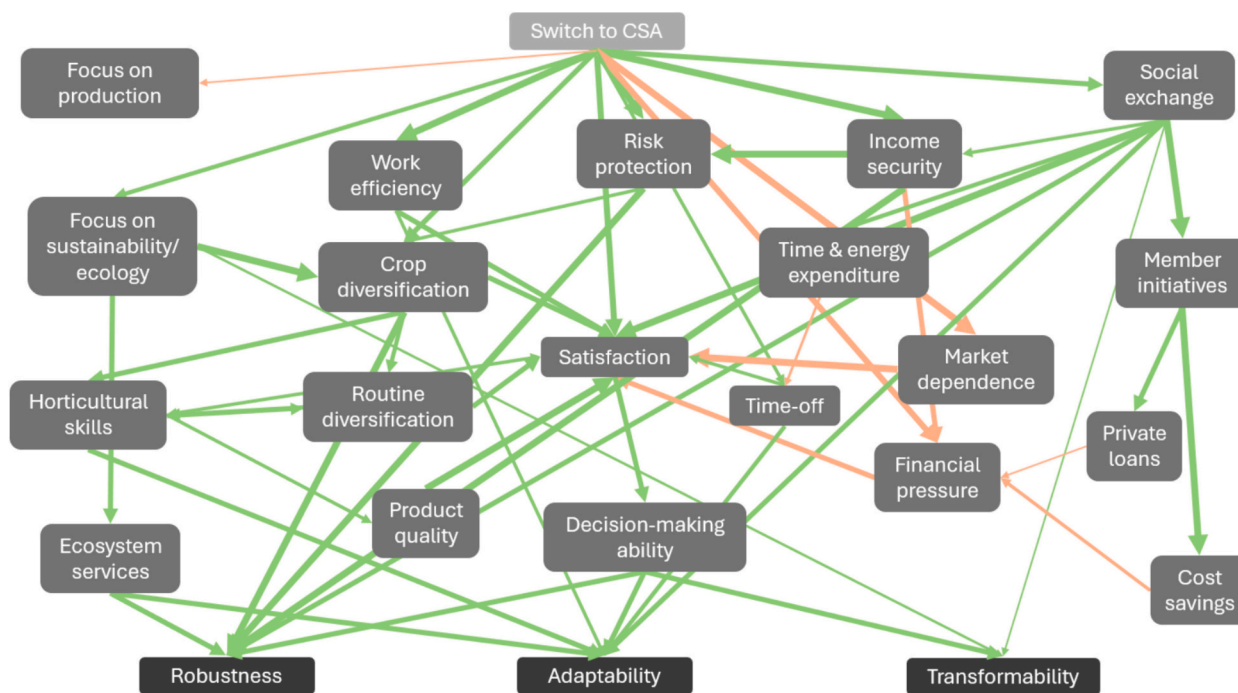


Fig. 3. Fuzzy-Cognitive-Map developed by the case study farmer during a workshop facilitated by the author. The strength of the connection is indicated by the thickness of the arrow. Green arrows represent positive connections (e.g., more risk protection leads to more satisfaction), while orange arrows represent negative connections (e.g., more financial pressure leads to less satisfaction). (For interpretation of the references to colour in this figure legend, the reader is referred to the web version of this article.)

Table 2

Resilience capacities and FCM components. The composite index for the resilience capacities is the average of a scoring (1–7) of statements done by the CSA-farmer. The components in the column of direct connections are the ones with direct influence on the resilience capacities in the FCM. The numbers next to the components refer to the strength of the connection (the closer to 1.0, the strongest).

Resilience capacity (composite index)	Direct connections
Robustness (3.3)	Crop diversification: 1.0
	Income security: 1.0
	Risk protection: 1.0
	Social exchange: 0.8
	Ecosystem services: 0.8
	Decision making ability: 0.7
Adaptability (4.7)	Ecosystem services: 0.8
	Horticultural skills: 0.8
	Social exchange: 0.8
	Decision making ability: 0.7
	Time off: 0.6
Transformability (5.7)	Work efficiency: 0.5
	Decision making ability: 0.7
	Focus on sustainability/ecology: 0.4
	Social exchange: 0.3

3.2. Resilience perceptions of CSA farmers in Germany

3.2.1. Characteristics of the CSA-survey respondents

The average age of the respondents was 41 years (St. dev.: 10,8), which is younger than the average age of farmers across Germany (German Federal Office of Statistics, 2021a). Regarding gender, 52% of them considered themselves male, 44% female and 4% nor male nor female. Around half of the surveyed CSA farms were smaller than 5 ha, being in contrast with the national statistic concerning all farms, from which only around 8% are that small (German Federal Office of Statistics, 2022). Most of them were in the south and northwest regions of Germany, which are also the regions with the highest numbers of

organic farms in Germany (DESTATIS 2021). Most of the farms (55%) were no older than ten years and around 50% of them had their CSA operation specialized in vegetables only. The majority (63,3%) started out already as CSA, and over 90% of the ones that transitioned later did so in the last decade. Regarding income, 52.5% had their operating farm income coming exclusively from CSA.

The three main agricultural challenges in the next 20 years, as well as their three main strategies to deal with these challenges (addressing step 2 of the resilience framework) were asked as open questions. Based on the responses, ten categories were identified for the challenges (Fig. 4) and twelve for the strategies (Fig. 5). Examining the top three challenges of the entire sample, climate change, as it relates to weather extremes and water availability, was overwhelmingly perceived as the greatest challenge to agriculture in the future, with 36% of surveyed farmers in agreement. Following this, 11% of farmers see economic viability, including securing decent income and managing rising input costs, as a major future challenge within their sector. In third position, mentioned by 9% of the surveyed farmers, were market access and conditions, encompassing factors such as changing consumer demand and increased competition. The top three strategies for addressing agricultural challenges (not necessarily corresponding to the top three challenges as mentioned above) include: climate adaptation strategies, such as crop diversification, utilizing more resilient crop varieties, and implementing agroforestry systems (supported by 18% of respondents); investing in community building (supported by 14% of respondents), and adopting soil regeneration techniques (supported by 11% or respondents).

The importance of different farm functions according to the surveyed farmers, is conducted in step 3 of the resilience framework. They had to allocate 100 points throughout a list of functions according to their relative importance (Fig. 6). Delivering high quality food products is apparently the most important function of the CSAs, with an average relative importance of 25.7. This farm function is followed by maintenance of natural resources in a good condition (17.9). The third most important function targets directly at the farmer, as it is to ensure a sufficient farm income (16.1).

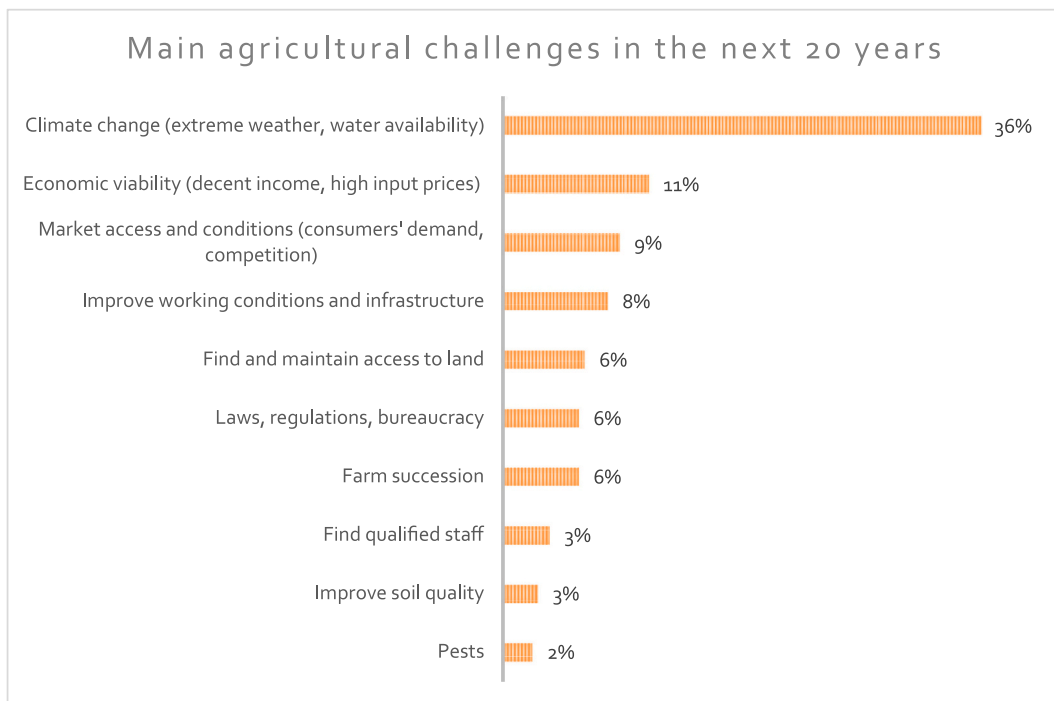


Fig. 4. Main agricultural challenges in the next 20 years as expressed by surveyed CSA farmers. The numbers indicate the percentage of the surveyed farmers that mentioned challenges related to one of these categories when asked for the three main agricultural challenges in the next 20 years.

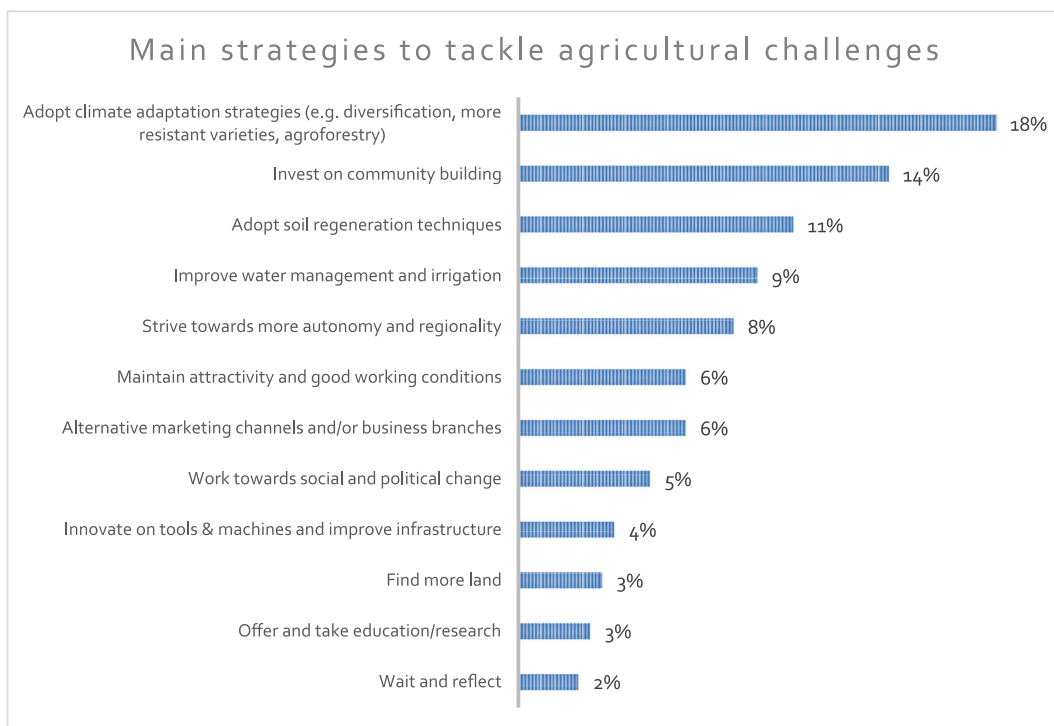


Fig. 5. Main strategies to tackle agricultural challenges in the next 20 years as expressed by surveyed CSA farmers. The numbers indicate the percentage of the surveyed farmers that mentioned strategies related to one of these categories when asked for the three main strategies to tackle agricultural challenges in the next 20 years.

3.2.2. Influence of CSA on perceived resilience

The surveyed farmers showed a high level of satisfaction with their CSA operation, expressed as a number on a scale from 1 to 10. The average satisfaction level was 8.4 (St. dev.: 1.4). Besides, when asked if CSA was the right choice for their farm, 89.7% of respondents selected

the option “Definitely yes”, while 9% selected “Not sure, probably yes”, and the remaining 1.3% “Not sure, probably not”. They also had to rate the importance of social exchange with their members apart from purely financial aspects (i.e., paying for the shares) on a scale from 1 to 5: the average was 4.2 (St. dev.: 1.0). Furthermore, 90% of them expressed

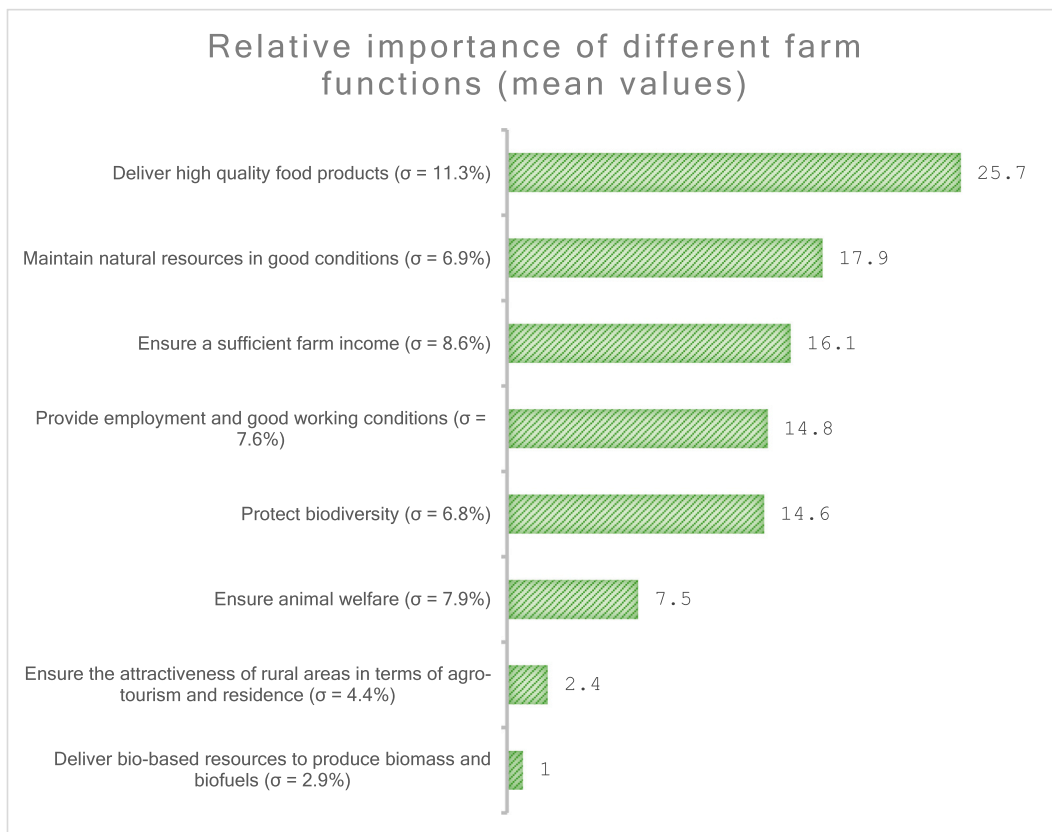


Fig. 6. Surveyed farmers’ results on the relative importance of different farm functions (survey is based on Spiegel et al. (2021)). The list of farm functions was presented to each respondent, who then had to distribute a total of 100 points between them according to their relative importance. The numbers indicate the average for each function based on the answers from all respondents.

receiving other forms of support from the members apart from purely financial aspects, mainly including assistance in the field, distribution logistics, and marketing/communication.

Concerning the effects on farm resilience of transitioning to CSA, the

farmers were shown a list of statements with which they had to agree with or not. The statements were all related to effects of CSA on a farm, which were identified via the case study. To gain a better understanding of the impact of transitioning to CSA on a farm, the respondents were

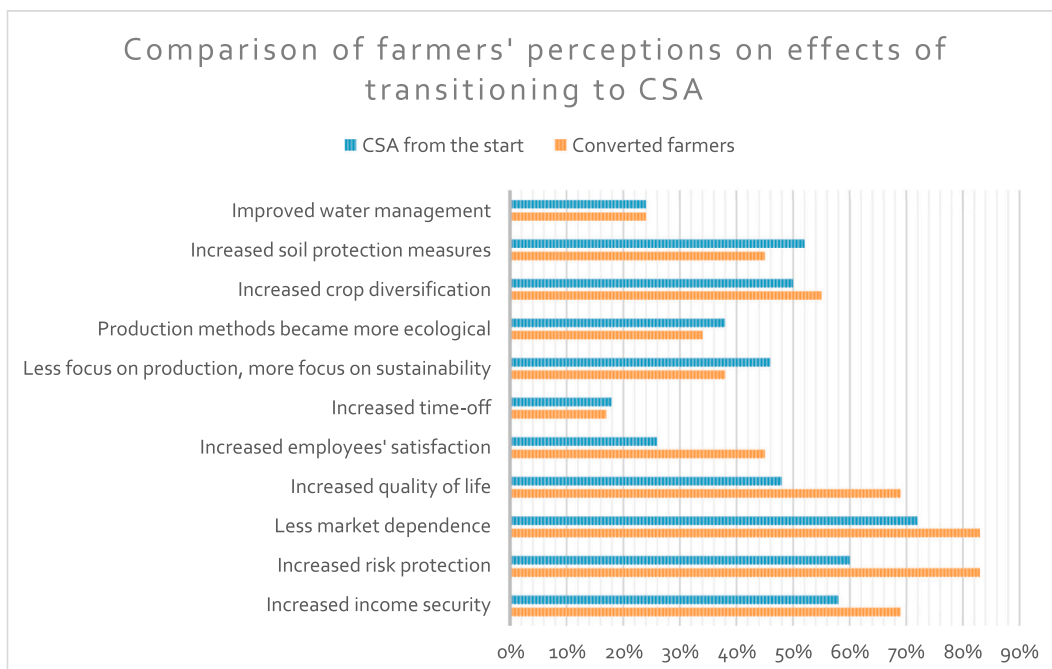


Fig. 7. The percentage of farmers from each group that agreed with the presented statements regarding the effects of transitioning to CSA.

divided into two groups: one comprised of farmers who initially established their farm as a CSA, and the other consisted of farmers who, like the case study farmer, transitioned to CSA later after having experience with other farm structures (refer to Fig. 7). By having this differentiation, certain mechanisms were more strongly perceived by farmers that converted to CSA than to the farmers that started out as a CSA, which indicates that these factors stand out more in CSA in relation to other farm structures. The biggest differences are seen in “increased employees’ satisfaction”, “increased risk protection”, “increased quality of life”, “increased income security” and “less market dependence”. Moreover, all CSA-converted farmers that reported having greater quality of life after transitioning to CSA (69%) also reported having at least one of the following: increased income security, increased risk protection and/or reduced market dependence. The majority (80%) reported having all three. Concerning effects that are more related to the environment (soil protection, ecological production methods, focus switch from production to sustainability), there was no significant difference between the groups in the proportion of farmers who identified with them.

Last, the three resilience capacities were assessed (step 4: “What resilience capacities?”). The indices for each capacity range from 1 to 7 and were calculated as suggested by Spiegel et al. (2021) (see section 2.4) and the results show relatively high scores for all three capacities (Table 3).

The surveyed CSA farmers had significantly higher indices for all capacities compared to the farmers from Spiegel et al. (2021), but lower adaptability and transformability indices compared to the case study farmer. It’s important to reiterate that the indices of the surveyed CSA farmers were based on only two statements, whereas the indices of the other two groups were based on three statements, which might have slightly affected the results.

The Two-sample *t*-test that was used on all 79 farmers to check whether there was a difference between the two distinct groups of farmers (those 50 farmers who started as a CSA and those 29 farmers who switched to a CSA) and their perception of resilience capacities showed no significant difference between the groups in all six statements (two for each resilience capacity) at a significance level of 0.05. Although farmers who transitioned to CSA reported a higher percentage of improvements in socio-economic aspects compared to those who initially started with CSA, no statistical significance was found between the two groups in their perceptions of systemic changes to their farms due to transitioning to CSA (Question 13). Data obtained from the survey can be found in the Supplementary Material.

4. Discussion

Community Supported Agriculture (CSA) offers a promising approach to enhancing perceived farm resilience, as demonstrated by a case study and a survey among CSA farmers. They attribute CSA to improving social and economic aspects, such as increased employee satisfaction, risk protection, quality of life, and income security. Additionally, farmers involved in CSA perceive themselves as less dependent on conventional market forces, thereby boosting their resilience to

Table 3

Comparison of the composite indices for each resilience capacity between the surveyed CSA farmers, the farmers assessed by Spiegel et al. (2021), and the case study farmer. The indices of the surveyed CSA farmers were based on only two statements, whereas the indices of the other two groups were based on three statements, which might slightly affect the results.

Resilience Capacities	Surveyed CSA farmers (SD)	Spiegel et al. (2021)	Case study farmer
Robustness	4.7 (+/- 1.2)	3.9	3.3
Adaptability	4.8 (+/- 1.2)	3.9	4.7
Transformability	4.6 (+/- 1.7)	3.8	5.7

economic shocks and stress. Surveyed CSA farmers did not perceive a general impact of CSA on environmental factors, such as water management and soil conservation methods, but perceived positive relationships between crop diversification and risk protection. Unexpectedly, improved satisfaction of farmers and farm workers was found to be the main effect of CSA farming, and this was perceived as being a highly influential factor on improved resilience, affecting decision-making ability and coping with change. Therefore, CSA farmers scored themselves higher in all three resilience capacities than average farmers as surveyed by Spiegel et al. (2021). Finally, with over half of the surveyed CSA farmers operating farms smaller than 5 hectares and primarily growing vegetables, concerns arise about the scalability of CSA to larger agricultural farms in Germany. This indicates that CSA under current conditions serves as a niche solution rather than a widespread approach for enhancing food system resilience.

4.1. Discussion of case study results

A primary objective of this study was to investigate how the CSA structure can contribute to farm resilience. By creating an FCM within a case study approach (Fig. 3), several factors and causalities stand out, which reinforces the relevance of the study findings. First, the central importance of *social exchange* is apparent, as this component has a direct, positive influence on all three resilience capacities, as well as to the component *satisfaction*, and to significant economic factors such as *income security*, *private loans*, and *cost savings* (the last two indirectly). This is no surprise, given that the social dimension is a strong pillar of the CSA concept, being alluded to even in the movement’s name (*Community Supported Agriculture*). It is also argued by other authors that the success of a CSA farm relies on its capability to involve members by ensuring the performance of communication and community engaging practices (Diekmann and Theuvsen, 2019; Samoggia et al., 2019).

Another important component is *risk protection*, which is also one of the main aspects of the CSA structure through the financial sharing of risk. When examining dairy systems in northwest Germany, Popp and Nowack (2020) found that financial risk management tools were considered by system actors to be the most important tools to ensure the system’s resilience and wellbeing. Besides having the members share the risks financially, CSA farmers may also rely on *crop diversification for risk protection* (Landwehr et al., 2021; Paul, 2019), as was also expressed in the FCM. Crop diversification was found by other authors to be a key strategy to tackle climate variability and provide more income stability (Bowles et al., 2020; Kurdyś-Kujawska et al., 2021). It can also be argued that the financial sharing of risks enables CSA farmers the freedom to diversify their crops.

Regarding *market dependence*, Zoll et al. (2021) found that farmers involved in alternative food networks generally consider themselves less dependent on the usual market forces and their businesses are economically viable, even though no major profits are gained, which resonated with findings from Doernberg et al. (2016) and Hardesty and Leff (2010). However, although improving reliability of income, the CSA model often fails to provide adequate income to farmers (Paul, 2019). On a similar note, some authors discuss self-exploitation and uncovered operating costs among CSA farmers (Brown and Miller, 2008; Doernberg et al., 2016; Jarosz, 2008).

The case study farmer perceives ecological factors as playing a significant role in increasing resilience as well. The variables *ecosystem services*, *crop diversification*, *horticultural skills* and *focus on sustainability/ecology* lead to increased perceived resilience capacities. In relation to *horticultural skills*, findings from Bouttes et al. (2019) align with what our case study farmer expressed. By interviewing 20 dairy farmers in France who were transitioning to organic farming, they found that farmers perceived organic farming as technically more demanding and saw that as a welcoming professional challenge, an opportunity to learn and break out of their routine, which also aligns to the FCM variable *routine diversification*. Other important reasons for the farmers to transition to

organic agriculture were to improve their quality of life (analogous to *satisfaction*), have more free time (analogous to *time-off*), be more peaceful and in harmony with themselves. The same study showed that farmers saw themselves in a vicious circle before transitioning, feeling the pressure of having to “get big or get out” while acknowledging that they were already exhausting the soil, a similar situation to the one the case study farmer found himself in prior to transitioning to CSA (as explained in the interview).

The component *satisfaction* proved to be highly central, which came as a surprise to the case study farmer during the workshop. It is influenced by 10 other variables and leads to increased *decision-making ability*, which increases all three resilience capacities. The ability to cope with change is linked to mental health and the emotional buffer of individuals, which enables them to absorb the impact of change (Marshall et al., 2014). A significant part of a farm’s resilience is dependent on decisions made by the farmer running it. Even though not every shock requires an immediate decision from the farmer, how the consequences from a shock may unfold on the farm most likely relies on past decisions. This also reinforces the relevance of perception-based resilience assessments, given the decisive role that satisfaction, or a positive state of mind, may have in a farmer’s resilience capacities.

Since it was not possible to obtain an explanation for the causal links in the FCM from the case study farmer himself, the logic behind them is open to interpretation, especially in regard to the resilience capacities. Interestingly, risk protection is directly connected to robustness (with a connection strength of 1.0), but not directly to adaptability and transformability. Also, income security is directly related to robustness and to none of the other capacities. This indicates that robustness is seen as a capacity that aims at maintaining the economic basic functions of a farming system. In contrast to that, adaptability is directly connected to work efficiency and time-off, indicating that it is seen as related to changing workflows and opening the system for new options. Transformability has fewer variables that are directly connected to it, and both decision-making ability and social exchange are also directly related to robustness and adaptability. One outstanding variable for transformability is “focus on sustainability/ecology”, which is directly connected to it, and only indirectly to robustness and adaptability (Fig. 3). Apparently, a focus on sustainability/ecology can help facilitate a transformation of the existing system. Maintaining a functional ecosystem can be seen as a prerequisite for any type of farm structure to thrive, so if the farmer has its focus on it, the farm structure can go through a transformation while still providing its ecological functions (which were deemed as very important by the case study farmer).

4.2. Discussion of survey results

In regard to CSA contributions on perceived farm resilience, what stands out is that farmers who transitioned to CSA at a later stage attribute a higher percentage of improvement in socio-economic aspects to CSA compared to those who implemented CSA from the start. This improvement of socio-economic factors can be considered a strong selling point for the CSA movement. It also speaks more to farmers that are not necessarily ideologically motivated as many CSA farmers are (Diekmann, 2020; Wellner and Theuvsen, 2018). Some scholars draw a parallel between the current CSA movement and early phases of the organic agriculture movement, which initially was also predominantly carried out by intrinsically motivated enthusiasts (Diekmann, 2020; Smith, 2007; Wellner and Theuvsen, 2018).

In relation to environmental factors, the positive impact of CSA does not seem to be that strong. Less than half of all surveyed farmers agreed that transitioning to CSA led to improved water management or more focus on sustainability and ecological cultivation methods. The only effect that seems to be more significant according to the survey is increased crop diversification, which is seen as an important measure for improving environmental performance of agriculture (Reckling et al., 2023). Around 55% of converted farmers stated having diversified after

starting CSA. Of these, 88% also stated having increased risk protection, which may indicate a positive relationship between crop diversification and risk protection, as suggested by other scholars (Landwehr et al., 2021; Paul, 2019; Kurdyś-Kujawska et al., 2021). This relationship could also be observed in the case study.

Regarding farm functions, what is most noticeable is that the surveyed CSA farmers tend to put more value in protecting natural resources and biodiversity than the mixed-system farmers assessed by Spiegel et al. (2021). However, in contrast to the case study farmer, the surveyed CSA farmers still place more importance on the variables “ensure a sufficient farm income” and “provide employment and good working conditions for employees” (summed) than on the variables “maintain natural resources in good condition” and “protect biodiversity” (summed).

When comparing the indices for the resilience capacities, the *t*-test showed no significant difference between the two distinct groups, farmers who switched to CSA and those who started as a CSA. However, the surveyed CSA farmers had significantly higher indices for all three capacities than the farmers from Spiegel et al. (2021). It is noticeable that for both the CSA farmers and the farmers from Spiegel et al. (2021), the three resilience capacities are well balanced. As Meuwissen et al. (2019) defines resilience as an ability that can be reached through the three capacities robustness, adaptability and transformability, it seems to be advantageous for farms to be equally strong in each capacity, even if some capacities remain latent at times. Finally, the fact that around half of all surveyed farms are smaller than 5 ha comes as no surprise, since the concept of CSA is often associated with small farms and horticultural farms that are typically smaller than arable cropping ones (Diekmann, 2020; Moellers and Birhala, 2014; Struś et al., 2020; Vasalos et al., 2017). Additionally, the smaller size categories show a higher share of farmers that depend exclusively on CSA for farm income. This observation raises the question of CSA applicability for bigger farms, which is relevant since most farms in Germany have between 10 and 100 ha (German Federal Office of Statistics, 2022). Moreover, the strong focus of CSA on horticulture can also be a limiting factor for its spread. However, as also shown by this survey, CSA doesn’t need to be the only marketing channel of a farm, but one among others. What also adds to this discussion is the fact that the rapid growth of the movement is very recent, but it still constitutes a niche market. The fact that the case study farmer has a steady waiting list for new members is a good indication that the demand may be currently higher than the supply, and it would have been useful to ask the surveyed farmers regarding waiting lists as well, although addressing the question of CSA scalability was not the focus of this study.

4.3. Limitations of the study

Although the survey indicates that CSA farmers perceive themselves as more resilient than the group of farmers surveyed by Spiegel et al. (2021), drawing definitive conclusions about the contribution of CSAs to overall agricultural resilience requires caution. More information on the share of CSA agriculture in Germany as well as studies linking the quantitative impacts of CSA on the resilience of agricultural systems is needed. Such studies could substantiate farm functions with various indicators, such as gross margin per hectare and total food production, among others, while also examining their correlation with resilience capacities. However, given that CSA represents a niche segment within Germany, its impact on overall agricultural resilience remains uncertain. Furthermore, CSA is mostly focused on vegetable and fruit production, which means it is most likely not a viable alternative model for grain production systems, which represent the most dominant form of production in Germany.

In contrast to our study, Spiegel et al. (2021) applied their survey to 972 farmers from diverse farming systems in Europe with an average size of 245 ha and only 5% organic farmers. Approximately half of the farms within our survey were smaller than 5 ha and the majority of them

were organic. These differences should be kept in mind when comparing these two distinct datasets.

As resilience is a complex and subjective topic, it is hard to entirely express it in numbers. Although interesting and helpful, the composite indices for the resilience capacities presented in this study are simplified and should not be interpreted as a final and fixed assessment. As [Darnhofer \(2014\)](#) argued, measuring resilience can be like aiming at a moving target, since properties that make a farm resilient at a given point in time might be irrelevant at a later point when the context has changed.

It is important to mention that the study design carries possible biases. Since the survey was based on only one case study of a farmer who had a fairly positive view on CSA, negative influences of CSA were barely identified, as well as other possible resilience-affecting mechanisms. Involving more than one case study farmer for the FCM-exercise would help address these biases. However, due to the time-consuming nature of conducting an FCM with stakeholders, it was only feasible to involve one farmer for our study. There is also a potential bias due to self-selection of the survey participants. For example, farmers who may have already been familiar with the topic of resilience or those who perceive themselves as such, possibly due to managing successful CSA farms, took part in the survey. Additionally, since the survey was conducted in September (e.g., end of the peak harvesting season for most horticulture farms), farmers who had enough time to participate in the survey were probably those running a successful CSA and therefore may have had a more positive view of themselves as resilient.

Regarding the FCM workshop, it can be considered successful for its research purpose, contributing with valuable input for the development of the survey for the CSA context. It provided an overview of relevant system components that were influenced by the transformation to CSA and how they affect the resilience capacities. The downside experienced in this workshop is that it is hard to define when or if the FCM is complete. Further research could focus on an explanation from the case-study farmer for the causal links, especially the ones directly linked to the resilience capacities. Also, the data obtained via the survey offers a wide range of possible analyses that were not performed in this study, such as, for example, how each capacity may correlate to each other or to the importance given to specific farm functions. This could be conducted in follow-up research.

5. Conclusions

This study is the first of its kind to analyze CSA farmers in Germany through the lens of farm resilience theory, thereby successfully providing first insights on the mechanisms through which CSA may impact farm resilience. It can be concluded that these are mainly socio-economic factors, such as increased income security, risk protection and market independence, which is reinforced by the fact that farmers who later converted to CSA demonstrate higher identification with these positive effects than farmers who started out as CSA. Moreover, social exchange between producers and consumers, and all that unfolds from it, has also been shown to play a role for CSA farmers, as expected and as often discussed in the literature. Compared to the sample of farmers surveyed by [Spiegel et al. \(2021\)](#), the CSA farmers surveyed in this study perceive themselves as being robust, adaptable, and transformable towards adversities, shedding thus a positive light on the spread of the CSA movement in Germany.

A large number of farmers are clearly dissatisfied, which was expressed during public protests in the last years ([Fritz, 2020](#); [Gassmann, 2019](#); [van der Ploeg, 2020](#); [Welt, 2021](#)). Main challenges include the lack of financial viability ([Deter, 2018](#); [European Commission; European Investment Bank, 2020](#)), low commodity prices coupled with strong price fluctuations ([Brümmer, 2021](#); [Deter, 2019](#); [Eckinger, 2016](#); [Zinke, 2021, 2022](#)), lack of farm successors ([German Federal Office of Statistics, 2021a, 2021b](#); [Statista, 2022](#)), and farmers' reputation as environment polluters ([Deter, 2020](#); [Leopold, 2021](#); [Spiegel, 2019](#)).

The current situation of agricultural management brings along different challenges, and CSA can serve as a viable strategy to address them. CSA is not suitable for every farm or every consumer, but one should not aim for "one-size-fits-all" solutions, since every region and farm is unique, and attempts to homogenize the way agriculture is done can be seen as one of the reasons for the crisis agriculture is facing. Besides, the idea behind CSA of securing income and protecting from risk through social engagement can serve as inspiration for developing models that are more suitable for other types of production systems, such as larger-scale arable farms.

The methodology applied can be considered successful for the purpose of this study. The mix of methods was able to firstly provide a qualitative in-depth analysis as an exploratory starting point for obtaining quantitative data, from which firmer conclusions were drawn, while using data formats that enabled comparison to other literature results.

Finally, it can be concluded that, based on farmer perception, CSA contributes mostly positively to resilience at the farm level, especially for small farms. Although not the focus of this study, the resilience improvement brought by CSA likely goes beyond the farm gate due to its unique marketing strategy and interaction with consumers. Therefore, the present research calls for further exploration of CSA in the resilience literature, as well as further dissemination of the concept among consumers and policymakers.

CRedit authorship contribution statement

Anna Rosman: Writing – review & editing, Writing – original draft, Visualization, Validation, Methodology, Investigation, Formal analysis, Data curation, Conceptualization. **Joseph MacPherson:** Writing – review & editing, Writing – original draft, Validation, Supervision, Methodology, Conceptualization. **Marie Arndt:** Writing – review & editing, Writing – original draft, Validation. **Katharina Helming:** Writing – review & editing, Supervision, Conceptualization.

Declaration of competing interest

The authors declare the following financial interests/personal relationships which may be considered as potential competing interests.

Joseph MacPherson reports financial support was provided by German Federal Ministry of Education and Research (BMBF). If there are other authors, they declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

Data availability

Data will be made available on request.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.agsys.2024.104068>.

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