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Business strategies towards climate-smart agriculture in Europe: A literature review

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Abstract

In response to increasing demands for sustainability, the entire agri-food sector is in transition towards climate-smart agriculture (CSA). The academic discourse on CSA has substantially expanded, including a large number of empirical studies, quite often case studies. There is a strong need to take stock of research, both from an academic and from a managerial point of view. This article integrates the dispersed insights in the literature and maps the implications for business strategies. Analysing 142 peer-reviewed articles published in Scopus and Web of Science databases (2000–2022), we find that business strategies for CSA rely on formal institutions as well as on informal relationships characterised by trust and social interactions. The importance of a multi-stakeholder network approach stems from the complexity of the CSA, the market failing to monetise environmental and social values and the substantial investments in new CSA technology that farmers cannot undertake independently. A successful interplay among stakeholders, however, requires alignment of value creation, distribution and capture at every individual actor and at the entire stakeholder group level.

KEYWORDS
business strategies, climate-smart agriculture, collaboration

1 | INTRODUCTION

The agri-food sector faces substantial challenges, such as increasing restrictions on pesticide and fertiliser usage and more stringent nitrogen policies stemming from the effects of climate change and the growing food demand (Kazancoglu et al., 2023; Yohannes, 2016). These challenges have profound implications for agricultural productivity and the livelihoods of rural and remote communities, while they further intensify the complex economic, environmental and social objectives within the agri-food systems (Camanzi et al., 2017; Giua et al., 2022; Jonathan Verschuuren, 2022). Addressing the increasing demand for food, among others, involves upscaling production. The upscaling, however, brings environmental externalities that threaten resilience (Khatri-Chhetri et al., 2019; Steenwerth et al., 2014; van Zonneveld et al., 2020; J. Verschuuren, 2018; Jonathan Verschuuren, 2022) and jeopardise the competitive environment, putting pressure, especially on small-scale farms, to be more innovative (Tell et al., 2016). In response to these challenges, climate-smart agriculture (CSA) emerges as a promising approach (Kröger & Schäfer, 2014; J. Verschuuren, 2018). CSA encompasses innovative practices and technologies designed to enhance agricultural productivity by incorporating the goals of production upscaling, intensification, adaptation, mitigation and resilience (Taylor, 2018).

The European Union (EU) has undertaken various initiatives, such as the Common Agricultural Policy (CAP) and the EU Green Deal, to promote CSA (Pe'er et al., 2020). Practices like organic farming, precision farming, agroecology, forestry and biodiversity have been promoted under these policies (Czyżewski et al., 2021). Despite widespread promotions and policy support to improve the sustainability of agriculture, substantial efforts are still needed to achieve climate-smart goals (Eurostat, 2022; Maloku, 2020; Taylor, 2018). Recognising the need for additional measures, the EU has allocated funding to the BEATLES European research project. This project explores various aspects of CSA, including business strategies, to support agri-food actors in overcoming 'lock-ins' and utilising 'levers' to accelerate large-scale transition to sustainable farming systems (BEATLES, 2023). This article presents one of the research outcomes derived from the BEATLES research project.

Recently, the academic discourse on CSA on CSA has substantially expanded, including a large number of empirical studies, quite often case studies (Centobelli et al., 2020). There is a strong need to take stock of research, both from an academic and from a managerial point of view. Most of the literature, especially in multidisciplinary and agriculture-specific journals, has focused on the need for responsible business innovations that support CSA (Klerkx et al., 2019; Klerkx & Rose, 2020). However, the expanding discourse lacks a comprehensive overview to guide food system actors in strategising their businesses for the adoption of CSA. This article aims to integrate the scattered literature in the frame of CSA and map business strategies that empower actors to make decisions contributing to system transitions for CSA.

Through a systematic literature review, we have collected and analysed 142 papers referring to CSA practices and technologies and the strategic choices made by diverse actors within case studies. This research addresses a crucial gap in the existing literature (the lack of a cohesive map of business strategies for action), contributing to the understanding of how interconnected business strategies can accelerate the transition to a more sustainable and resilient agri-food system in the face of a changing climate. The findings of this study make a valuable contribution to policy dialogues and managerial decision-making processes, particularly in guiding the selection of effective business strategies for CSA applications.

2 | SYSTEMATIC REVIEW OF INNOVATIVE BUSINESS STRATEGIES

In this article, we conducted a systematic review to guarantee transparency and replicability of the study (Page et al., 2021). Specifically, we have undertaken the following actions: selection of articles, first-round screening, bibliographic analysis, data extraction and analysis and comprehensive conceptual analysis.

2.1 | Selection of articles

This systematic review was conducted in November 2022 using Web of Science and Scopus databases. The search query and inclusion/exclusion criteria were established by the research team after several iterations and through dialogue with academic experts on CSA. A search query combining keywords and their synonyms was employed to identify relevant studies published up to November 2022.

Search query: TS = (('business*' or 'industry' or 'agro-food industr*' or 'agri*food industr*' or 'private sector*' or 'firm*' or 'enterprise*' or 'corporat*' or 'intermediar*' or 'processor*' or 'retailer*' or 'smes' or 'organi?ation' or 'venture' or 'conglomerate' or 'cooperativ*' or 'food system*' or 'supply chain*' or 'manufactur**' or 'service provider*' or 'supermarket*') and ('strateg*' or 'decision mak* factor*' or 'driver' or 'lock-ins' or 'lever' or 'enabl*' or 'barrier' or 'element' or 'motivat*' or 'determinant' or 'behavi* factor*' or 'pressure*' or 'trigger*') and ('behav* chang*' or 'transition*' or 'adopt' or 'adapt*' or 'innovat*' or 'uptake' or 'shift' or 'transform*' or 'move' or 'scal*' or 'switch') and ('sustainable agricult*' or 'sustainable farm*' or 'organic farm*' or 'organic agricult*' or 'climate—smart agricult*' or 'climate—smart farm*' or 'precision farm*' or 'precision agricult*' or 'smart farm*' or 'smart agricult*' or 'smart farming technolog*' or 'digital agricult*')).

To manage the extensive results, we applied three initial selection criteria: (1) language: English, (2) publication stage: final paper and (3) discipline (see Appendix 1 for the selected disciplines). The initial search yielded 391 references in Web of Science and 999 references in Scopus. Integrating these references from both sources and removing duplicates (287 duplicates) resulted in a total of 1103 papers that underwent the first-round screening (Figure 1).

2.2 | First-round screening

To screen the articles aligning with our research objective and seeking empirical evidence, we used the following inclusion criteria: (1) a case study setting explicitly addressing business aspects, (2) a study focusing on CSA practices and technologies and (3) geographical relevance to Europe. The rationale for selecting case studies is rooted in the desire for in-depth empirical evidence and contextual understanding. This selection reduced the reference database to 239 records. Subsequently, two researchers have read the abstracts and assessed for inclusion eligibility. Articles were excluded if they (1) centred on sectors outside the scope of agriculture, such as tourism; (2) lacked empirical evidence; and (3) failed to discuss casual relations between business aspects and CSA practices and technologies. The two researchers' record selection differences have been thoroughly discussed and resolved by mutual agreements. The two authors of this article verified the accuracy of the extraction process independently, with an interrater agreement rate of 63%. The disagreements and discrepancies were resolved through thorough discussions. As a result, the database was reduced by 107 records (Figure 1).

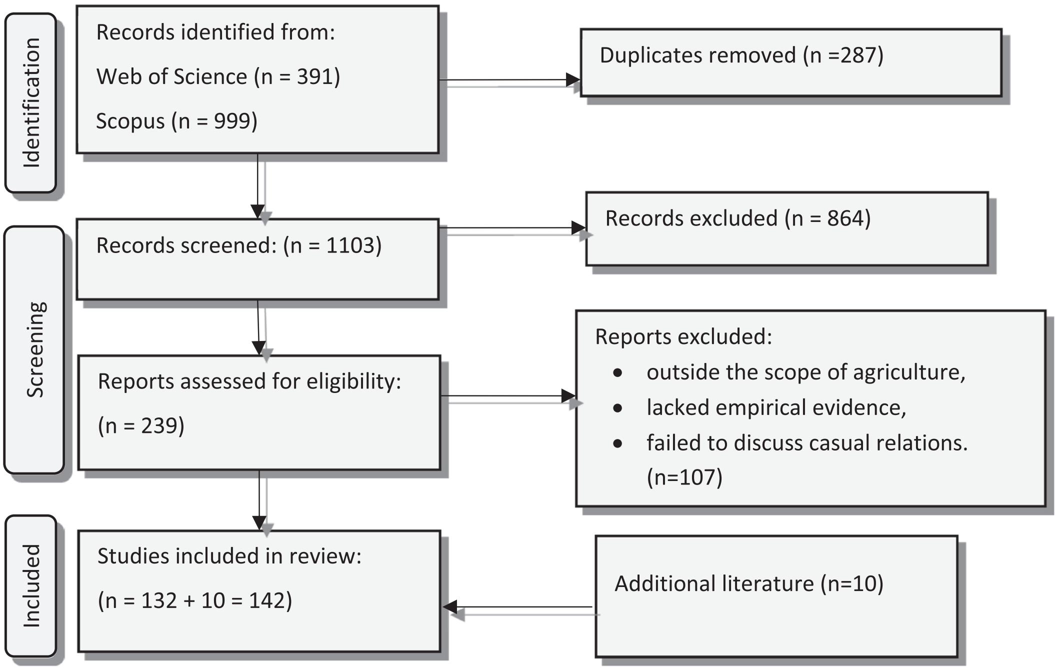

FIGURE 1 PRISMA flow diagram to illustrate the steps involved in the systematic review.

The remaining 132 articles met the inclusion criteria and underwent careful examination by two researchers, involving thorough reading of the full text. Additionally, we identified and included 10 more articles by examining the citations within the selected articles, bringing the total number of references to 142. We examined why these additional 10 articles were not found in the original search. Our examination reveals that the specific combination of the search queries failed to capture these articles despite their alignment with agricultural studies and provision of relevant insights from the perspective of business strategies. Apparently, these articles did not explicitly mention 'sustainability' or 'climate-smart' terms in the abstracts, titles or keywords.

Then, we used a bottom-up content analysis approach and extracted data sequentially (Purssell & McCrae, 2020). Accordingly, we conducted a comprehensive conceptual analysis of the selected articles. This process involved manual data coding after thoroughly examining each article, with the collected data recorded in a designated Excel spreadsheet. The synthesis focused on conceptual analysis of the full texts, with particular attention given to the selected articles' results, discussions and conclusion sections. We coded each paragraph by hand and interpreted the results carefully to identify general trends and patterns of business strategies.

3 | ANALYSIS AND RESULTS

Initially, we focused on publication trends over time, examined geographical distribution, and assessed frequencies in types of CSA. Then, we extracted CSA strategies and types of innovation required for CSA applications.

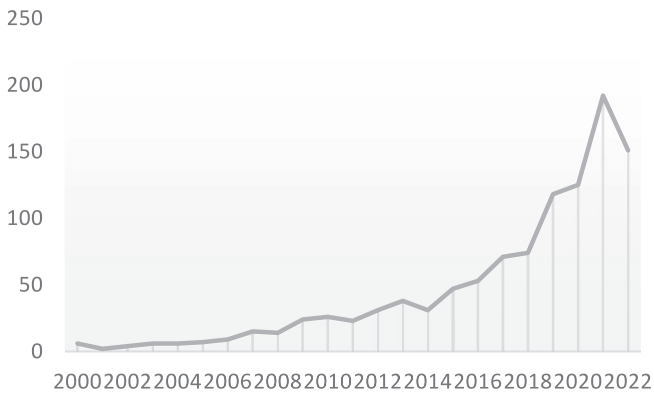

FIGURE 2 Number of publications per year ($N = 1103$).

As noted in Section 1, the body of literature on CSA has substantially expanded since 2000 (Figure 2). Noteworthy, but not visually presented in Figure 2, is the limited scholarly output between 1977 and 2000, amounting to only 30 published articles. However, a distinct upward trend is observed from 2000 onward, culminating in a peak of 191 articles in 2021. The vast majority, about 66% of the articles, have been published since 2017, with 98% emerging since 2010. Another substantial growth in the number of articles published is evident post-2020, emphasising the increased scholarly attention to the subject.

As Figure 2 shows, the fall in numbers in 2022 results from the search cut-off in November 2022, and accordingly, articles from November and December are not included. Anticipating ongoing growth, we foresee a continuous expansion of the literature body in this domain in the forthcoming years as well.

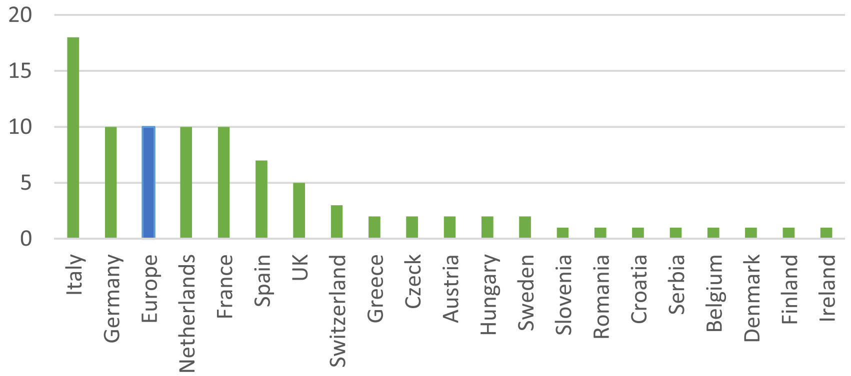

FIGURE 3 Geographical distribution. *Note*: ($N = 91$, other articles did not specify the study location).

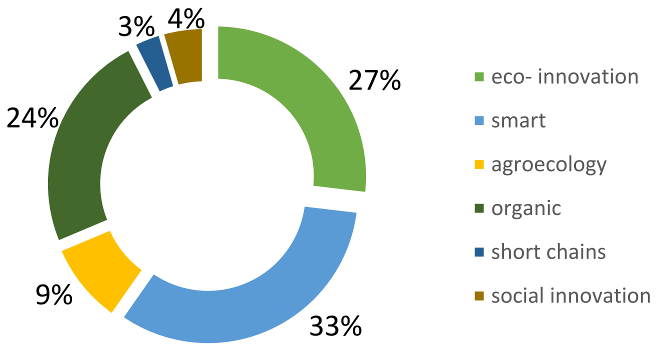

FIGURE 4 CSA types mentioned in the articles ($N = 142$).

This literature review encompasses studies from 20 European countries. Figure 3 shows the geographical distribution of the case studies reported in the selected articles.

As illustrated in Figure 3, the highest concentration of studies has been conducted in Italy (18), followed by Germany (10), The Netherlands (10), France (10), Spain (7) and European as a whole (10).

In terms of the categorisation of the CSA types, as shown in Figure 4, most of the studies (33%) focus on 'smart farming technologies[1]' followed by 'eco-innovations[2]' (27%) and 'organic agri-food[3]' (24%). The remaining 16% of articles discuss CSA practices related to 'agroecology[4]', 'social innovation[5]' and 'short chains[6]'. While we tried to provide precise definitions of the CSA types for categorising the articles, it is noteworthy to mention that many of the selected articles fall under multiple categories. For instance, distinctions between organic and smart farming, eco-innovation and agroecology are often blurred.

In terms of CSA strategies, articles focus on mitigation, adaptation and resilience. These strategies are not necessarily stand-alone and are often applied in an intertwined manner. According to Hartmann (2011), by combining multiple strategies simultaneously, agri-food actors are able to build even stronger resilient systems. Below, we provide a brief explanation of these CSA strategies.

Mitigation strategies aim to mitigate the negative impact of agri-food production on the environment (Steenwerth et al., 2014). Examples encompass agroforestry, conservation agriculture, enhanced crop and livestock management, use of renewable energy sources (Girotto et al., 2022), organic farming (Barkema et al., 2015; Brzezina et al., 2017; Bucci et al., 2018, 2019; Cristiano, 2021; Stephenson et al., 2022), regenerative agriculture, agroecology (Boulestreau et al., 2021) and the application of digital technologies, such as smart farming and precision farming (Arvanitis & Symeonaki, 2020; Baret, 2017; Barkema et al., 2015; Krutilin et al., 2022; Thompson et al., 2022; Thomson, 2022). These innovations aim to mitigate negative externalities.

Adaptation strategies aim to adapt the agri-food systems to the changing environment (Steenwerth et al., 2014). Agri-food production is directly affected by a changing climate, requiring adaptive measures more than other sectors (Kiprutto et al., 2015). The unpredictability and uncertainty introduced by climate change and global warming can be dealt with if producers, particularly those operating in open fields, adapt their business strategies, for example, through innovating in flexible production and farming systems (Barkema et al., 2015; Thompson et al., 2022; Vaglia et al., 2022). Adaptation strategies include precision agriculture, crop diversification, crop variety and improved water management (Battilani, 2015; Morel et al., 2020).

Resilience strategies aim to sustain climate-smart practices (Battilani, 2015; Caron et al., 2018; Hayward et al., 2013; Larsson et al., 2016; Weituschat et al., 2022). The multiple dimensions of resilience encompass actions such as building capacity, fostering knowledge and accelerating innovation (Anderson et al., 2019; Mendoza et al., 2019; Rommel et al., 2022). Resilience strategies, facilitated by collaborative platforms like cooperatives, ecosystems and social

[1]Smart farming technologies encompass internet of things, robotics and autonomous systems, artificial intelligence, big data analytics, blockchain, bio-innovation and precision agricultural technologies (Kazancoglu et al., 2023).

[2]Eco-innovations are defined as technological, social, organisational and institutional innovations that contributes to environmental sustainability (Blasi et al., 2015; Rennings, 2000).

[3]Organic agri-food practices encompass a holistic approach to farming that relies on ecological processes to protect biodiversity by avoiding synthetic inputs, in adherence to organic standards and principles (Kuepper, 2010).

[4]Agroecology encompasses a set of principles to organise the food systems based on maximising the positive interrelations between people, farming and nature and increasing the autonomy of farmers (Anderson et al., 2019).

[5]Social innovation in agrifood entails the novel approaches, practices and initiatives to address social challenges, enhance inclusivity and contribute the well-being of communities Zoll et al. (2021).

[6]Short chains represent production and consumption of environmentally benign and territorially embedded products that minimises the distance a product is travelling from its production to its consumption (Belda-Miquel et al., 2021).

networks, boost agri-food production towards sustainable and climate-smart agriculture (Battilani, 2015; Tey & Brindal, 2012).

In addition, the literature outlines several types of CSA innovations, which we grouped as follows:

1. Innovation in production strategies: This involves novel approaches to agricultural production, such as on-farm diversification (Esquivel et al., 2021). Novel production strategies integrate climate change challenges with agricultural productivity and efficiency (Long et al., 2016, 2017, 2019; Long & Blok, 2018; van Zonneveld et al., 2020). Unlike traditional production strategies that primarily emphasise efficiency, CSA innovation in production strategies considers multiple goals and perspectives, including social and environmental sustainability goals (Naspetti et al., 2017).
2. Innovation in products, services and techniques: This category encompasses the development of new products, services and techniques, with an increasing reliance on precision and smart agriculture (Arvanitis & Symeonaki, 2020; Long et al., 2019; van Zonneveld et al., 2020). Examples include incorporating smart devices and IoT systems, production automation and robotics (Barnes et al., 2019; Higgins et al., 2017; Javaid et al., 2022; Latino et al., 2021; Poppe et al., 2013; Vázquez-López et al., 2021). In addition, this category involves innovations in climate-resilient crop varieties that contribute to sustainability outcomes (Tester & Langridge, 2010).
3. Innovation in business strategies supporting local producers. This category encompasses innovative business strategies that represent alternative approaches to food production. Examples are 'ecosystem networks[7]', 'civic agriculture[8]', 'community-supported agriculture[9]' and 'participatory guarantee systems[10]'. These strategies are usually supported by local communities and designed for local markets, such as social innovations and short chains (Blättel-Mink et al., 2017; Cifuentes et al., 2018; De Bernardi et al., 2022; Kremen et al., 2012; Lamine & Cardona, 2013; Long et al., 2017; Medici et al., 2021; Navarrete et al., 2015; van Zonneveld et al., 2020; Zoll et al., 2021).

The choice of CSA strategies can impact the business strategies of agri-food actors (Avaria, 2020; Biro & Csete, 2021). When implementing mitigation strategies, such as transitioning from conventional to organic farming, the producers need to innovate in various business aspects, including marketing and distribution, to successfully bring innovative products (e.g., organic) to the market (Kuepper, 2010). This entails collaboration with retailers, addressing logistical considerations for alternative transportation methods and assessing consumer willingness to pay premiums for climate-smart products (Van Doorn & Verhoef, 2011). When implementing adaptation strategies, such as precision agriculture technologies, innovation in production strategies is needed, for example, changes in the farming system that can impact resource allocation, cost structures and revenue models (Barnes et al., 2019). Smart technologies can improve environmental performance by, for instance, reducing pesticide use and enhancing economic performance by improving productivity (Wolfert & Isakhanyan, 2022). However, agri-food actors need to build capacities to operate smart devices and data-driven solutions to achieve sustainable business innovation. This emphasises the dynamic interplay between CSA strategies and the evolving landscape of business innovation practices.

4 | NAVIGATING THE TRANSITION TOWARDS CSA

The content analysis of the selected articles reveals the significance of the multi-disciplinarity nature of CSA practices and technologies. Below, we elaborate on how this is dealt with through a multi-stakeholder approach and collaborative business strategies for the successful application of CSA.

4.1 | Multi-stakeholder engagement

As already mentioned in Section 1, CSA encompasses a complex network of multiple actors with varying roles, interests, powers and priorities (Belda-Miquel et al., 2021; Doernberg et al., 2016; Plumecocq et al., 2018). A successful CSA application, therefore, requires an integrated multi-stakeholder approach. In this line of reasoning, engaging various actors is a prerequisite rather than a preference to navigate the transition accordingly (Smith, 2008).

The results of the bottom-up coding exercise conducted within this research reveal a wide range of stakeholders engaged in CSA. The stakeholders engaged in CSA strategies are from the entire value chain, starting from seed companies to farmers, cooperatives, unions, resource providers, food processing and retail companies, as well as local and global consumers, policymakers and civil society organisations (Smith, 2008). While we did not prioritise the roles of these stakeholders, we observed that the predominant focus of the papers we have analysed (>60%) centres on primary food producers (i.e., farmers), assigning other stakeholders a role of supporting them in the transition. This observation is expected, given that CSA innovations primarily occur at farm gate, with implications and interests extending to a broader spectrum of stakeholders.

Figure 5 illustrates the diversity of stakeholders engaged in innovations and application of CSA practices and technologies. These stakeholders significantly impact how the agri-food sector can

[7]Agrifood ecosystem networks aim to localise and democratise food systems, promoting local and organic agriculture and reducing the distance between producers and consumers (Belda-Miquel et al., 2021, p. 141).

[8]Civic agriculture is broadly used to describe alternative strategies to support small-/mid-scale agricultural operations based on local resources and addressed to a local population (Medici et al., 2021, p. 1).

[9]Community-supported agriculture is an integral step towards a food system that operates outside the market (Zoll et al., 2021, p. 640). For example, a group of people finance farm costs and in return receive a harvest share (Blättel-Mink et al., 2017, p. 417).

[10]Participatory guarantee systems are quality assurance initiatives that are locally relevant, emphasise the participation of stakeholders, including producers and consumers, and operate outside the frame of third-party certification (Cifuentes et al., 2018, p. 3).

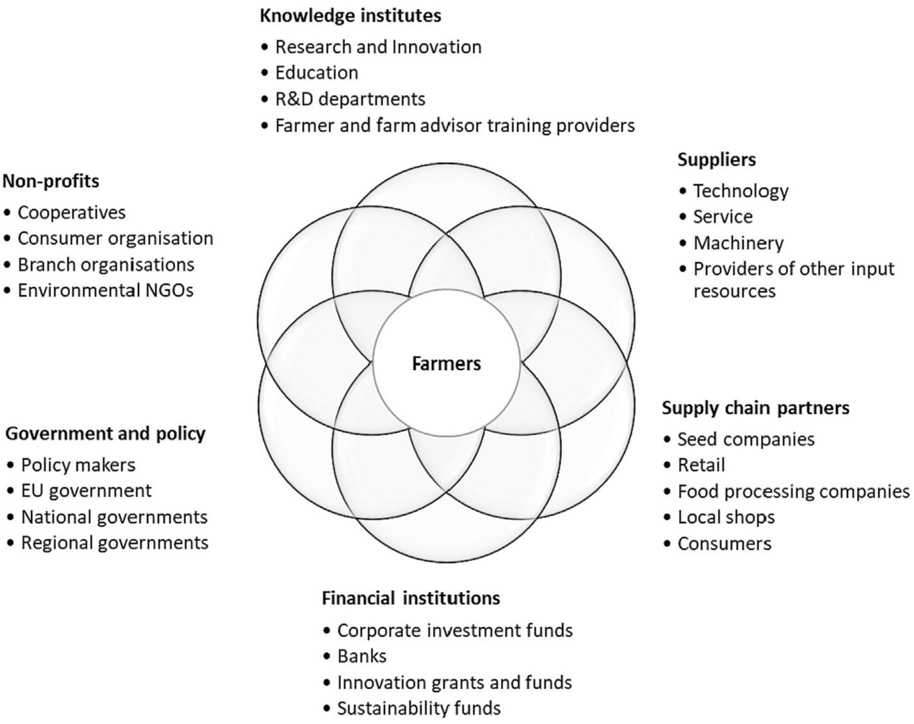

FIGURE 5 Stakeholder mapping of CSA practices and technologies.

become climate-smart and resilient (Ryan et al., 2023; Schulp et al., 2022).

Stakeholders that have an impact and are impacted by the CSA practices and technologies have diverse backgrounds in terms of size and market power as well. This diversity raises fairness concerns regarding who carries the costs and who benefits from CSA implementation (Smith, 2008; West, 2020). Some scholars suggest co-design and co-creation of fair solutions with all engaged stakeholders independent of their size, competitive position and market power to guarantee fairness (Kröger & Schäfer, 2014). When co-designed and co-created, agri-food enterprises are inclined to innovate and apply CSA practices and technologies, even if they are small and operate in rural and remote areas (Khatri-Chhetri et al., 2019; Osman et al., 2016). Such multi-stakeholder creation can also take the form of knowledge sharing and resource optimisation (Schulp et al., 2022). CSA is a knowledge-intensive practice that often requires learning to work across different disciplines, which is a labour- and capital-intensive activity (Ryan et al., 2023). However, when stakeholders are included in decision-making processes for design, implementation and monitoring, they are more likely to invest and mobilise their resources. Thus, CSA can benefit from multi-stakeholder collaboration that can ensure the strategies of individual actors are harmonised, and all relevant stakeholders are on the same page (de Olde et al., 2017; Planko & Cramer, 2021).

In sum, within each of stakeholder interactions, a dynamic interplay unfolds, where individual actors create, share and capture values (Millet & Casabianca, 2019). A successful interplay among stakeholders, however, requires alignment of value creation, distribution and capture at every individual actor and at the entire stakeholder group level.

4.2 | Business strategies for enabling CSA

Business strategies for CSA are considered coordinated actions that agri-food actors undertake to establish and maintain sustainable competitive advantage while minimising environmental externalities (Teece, 2010). The current discourse of literature emphasises several business strategies targeting sustainable business models for individual actors and the entire multi-stakeholder network simultaneously, and aiming at incorporating environmental, social and economic values (Morel et al., 2020; Oskam et al., 2021; Rommel et al., 2022). In this section, we discuss six main strategies found in the literature.

The first strategy is called collective business strategy, also known as co-governance along supply chains or socio-ecological networks (C. Eastwood et al., 2019; Swaffield et al., 2019). Such strategies are the basis for solidarity and mutual understanding that contributes to the stakeholders' collective thinking and perception of fairness. Collective business strategies take form through dialogues and peer learning that play a crucial role in fostering shared understanding and facilitating the shift in farming practices towards sustainability (Anderson et al., 2019; C. Eastwood et al., 2019). In the context of CSA, collective business strategies can support farmers in integrating fairness considerations into their individual business models (de Olde et al., 2017; Planko & Cramer, 2021; Zoll et al., 2021). Similarly, Eastwood et al. (2021) recommend creating multi-stakeholder networks (see Figure 5) to support and promote a quick and efficient implementation of CSA (C. R. Eastwood et al., 2012; C. Eastwood et al., 2019; C. R. Eastwood et al., 2021). In the context of digitalisation and smart farming, Lamine and Cardona (2013) conclude that network strategies expand the concept from the individual farm level to the agri-food system level, helping farmers to face the CSA-related innovation challenges jointly (Lamine & Cardona, 2013).

The second strategy incorporates environmental and social goals into the current business models. This strategy relates to CSA innovation in production strategies (Section 3). Farmers focusing on intensive large-scale production and short-term economic gains might show less interest in incorporating environmental and social impacts, such as human health goals, into their business models (Blasi et al., 2015; Boulestreau et al., 2021; Rennings, 2000). However, Dias et al. (2021) have found that farmers can enhance their financial performance through environmental orientation and sustainability commitments. Hereby, the engagement of various experts, such as marketing experts, engineers, agronomists and advisory services, might raise awareness of the competitive advantage tied to CSA (Dias et al., 2021). Such innovative business strategies catalyse societal progress, pursuing social and environmental value beyond mere economic considerations of individual actors (Lüdeke-Freund et al., 2016; Oskam et al., 2021).

Moreover, the strategy of incorporating environmental and social goals into the business models highlights the responsibilities for negative externalities that can be shared by the engaged stakeholders (Breuer & Lüdeke-Freund, 2017; Poetz et al., 2012). When responsibilities for negative environmental externalities are shared, actors perceive the efforts and risks invested in CSA innovation applications as fairly distributed (Planko & Cramer, 2021).

The third strategy is known as resource pooling by stakeholders to support CSA. CSA practices and technologies rely on relatively large investments, while the return on the capital investment often fails to create an attractive business case, especially for the farmers. Medici et al. (2021) suggest a community-supported format, wherein a member subscription fee is used to invest in CSA applications that can ease the burden for the farmers, overcoming first-mover barriers (Medici et al., 2021). In this construction, the more members contribute, the less financial burden per member will be, making subscription a pivotal mechanism for mitigating failure risks for the farmers (Blasi et al., 2015; Zhllima et al., 2021).

The fourth strategy is called innovation networks. This strategy is related to innovation in products, services and technologies (Section 3). As highlighted by Favilli et al. (2015) innovation networks serve to boost CSA through creating a trustworthy environment conducive to shared commitment (Favilli et al., 2015; Khan et al., 2021; Tensi et al., 2022). In innovation networks, key principles are knowledge sharing, collaborative pursuit of common goals and alignment of organisational structures (Boulestreau et al., 2021; Favilli et al., 2015; Schmidt et al., 2012; Wezel et al., 2020). This strategy includes actors willing to collaborate for CSA application and not a broad range of stakeholders per se. Innovation networks with enduring interpersonal connections, as preferred by farmers, foster economic growth and create a new balance between the agricultural industry and the environment, benefiting producers/processors, consumers and nature simultaneously (Mantino & Forcina, 2018). Bentivoglio et al. (2022) for instance, emphasises the role of innovation networks in supporting the adoption of smart farming technologies by farmers through enhanced skills, such as self-awareness, communication and attitude (Bentivoglio et al., 2022). Moreover, value chain actors, such as producer organisations, cooperatives, branch organisations and advisory service providers, are essential to create a common understanding of the innovation, enhancing collective learning process and mobilising support for it (Giua et al., 2022; Klerkx et al., 2010).

The fifth business strategy suggested by the scholars involves the use of platforms and associations. Platforms and associations that facilitate interactions with various stakeholders can reduce the social barriers to individual innovation decisions (Belda-Miquel et al., 2021; Boulestreau et al., 2021; König, 2004; Laajimi & Albisu, 2000; Osman et al., 2016; Santiago-Brown et al., 2015). Platforms and associations typically exhibit a more formal structure alongside professional services to connect the members and help them innovate in CSA. Consequently, members affiliated with platforms and associations are more inclined to apply CSA practices and technologies (Laajimi & Albisu, 2000). In platforms, efforts to facilitate the application of CSA practices and smart precision technologies are commonly complemented by the collaborative initiatives of knowledge institutes (e.g., research and education), as well as the contributions of experimental farms and training centres (Guareschi et al., 2020; Polge & Pagès, 2022; Slimi et al., 2021).

The sixth business strategy scholars suggest includes community-building social networks, common markets and partnerships. These strategies take on more informal characteristics. Community-building social networks are often related to joint farmer events, organised farmer interactions or shared food-related interests (Zoll et al., 2021). Navarrete et al. (2015) propose creating a common market to encourage farmers to diversify food production (Navarrete et al., 2015), and Osman et al. (2016) conclude that establishing new partnerships can overcome the current economic and legal barriers to CSA practices. In addition, Laajimi and Albisu (2000) conclude that member farmers engaged in partnerships are more likely to invest in CSA technologies even if their turnover is low (König, 2004; Laajimi & Albisu, 2000; Osman et al., 2016).

In summary, we have mapped six key business strategies for CSA. Some of these strategies, such as platforms and associations, rely on formal institutions like cooperatives. In contrast, other strategies, such as social networks, common markets and innovation networks, rely on informal relationships characterised by trust and social interactions. All these strategies suggest intensive knowledge exchange and shared responsibility among engaged stakeholders. While each strategy provides distinct pathways for advancing CSA applications, they all require multi-stakeholder collaboration, where sustainability considerations are integrated into existing business models. The rationale for emphasising the multi-stakeholder network-level approach lies in the complexity of the CSA practices and technologies, market failures to monetise environmental and social values and the substantial investments that farmers are unable to undertake independently.

5 | DISCUSSION

Similar to socio-technical transition to sustainability, the transition to CSA requires a multi-level approach (Markard et al., 2020), and the integration of multiple disciplines to engage stakeholders for mutual understanding and benefit (Swaffield et al., 2019). Within an integrated multi-stakeholder approach, actors are interlinked to develop transitional strategies, yet decisions are made by the individual actors (Hoek et al., 2021). Nevertheless, scholars agree that the transition towards CSA cannot be accomplished by a few actors alone (Fischer et al., 2012; Hartmann, 2011). This transition demands cutting-edge technologies, forward-thinking business strategies and political and socio-economic transformations (Markard et al., 2020). In addition, this transition needs the alignment of interconnected, yet sometimes conflicting goals, such as disagreements in land use purposes and tensions between intensification and nature conservation, among stakeholders (Skrimizea et al., 2020; Zurek et al., 2022). Such multi-level and multi-stakeholder transition prompts individual actors to reconsider strategic approaches for creating, sharing and capturing value in economic, social and environmental terms (Slimi et al., 2021; J. Verschuuren, 2018).

The classical business literature often suggests business strategies that put a strong emphasis on the translation of value propositions into the cost and revenues of individual entities (Gassmann et al., 2014; Osterwalder & Pigneur, 2010; Tell et al., 2016). However, these models fall short of capturing multi-stakeholder interactions (Teece, 2010). While there is a focus on key partners, influential and supportive stakeholders are often overlooked. Another limitation of existing business models is the economic challenge to monetise sustainability value (Ponsioen et al., 2020). Consequently, this failure places the responsibility of enhancing sustainability in agriculture directly on farmers. Despite farmers' endeavours to enhance sustainable food production, they often lack the appropriate resources to adopt and scale up CSA independently (Dolfsma et al., 2021; Ryan et al., 2023). For instance, the investments and risk of financial failure are high during the early stage of innovation adoption. Most of the farmers, especially small-scale farmers, cannot carry these high risks and initial investments (Long et al., 2016). Therefore, especially during the early stage of innovation adoption, protection and collaboration among diverse stakeholders, in the form of financial and capacity-building support, must be organised, and responsibilities to carry risks must be shared (Long et al., 2017).

The business strategies proposed in Section 4.2 require a shared commitment from the engaged stakeholders and the broader community, underpinned by robust network governance structures (Provan & Kenis, 2008). However, it remains uncertain whether farmers should independently initiate and organise these networks or if government support (e.g., subsidies and funds) is essential to boost collaboration. As existing funding schemes decline over time, while private funding has not yet matured sufficiently to drive widespread adoption and introduce CSA into the market at a reasonable cost (Wolfert et al., 2021). This creates a gap between the maturity of the innovation and its readiness for absorption by the market.

The effectiveness of collective business strategies depends on having an orchestrator when community meets challenges to self-organise (Belda-Miquel et al., 2021). While appointing a network orchestrator may entail costs, it is essential for establishing network legitimacy with a wide range of stakeholders (Batterink et al., 2010). Network orchestrator plays a crucial role in attracting potential new collaborators, encouraging interactions and fostering knowledge exchange (Paquin & Howard-Grenville, 2013).

Collaborative business strategies, however, can raise risk of competition. For example, in the rapidly expanding organic market, it becomes more challenging to engage in collaboration due to competition issues (König, 2004). The suggested co-design and co-creation methods engaging all stakeholders independent of their size, competitive position and market power create mutual understanding and raise inclination to innovate in CSA practices and technologies jointly.

Last but not least, the significance of understanding culture cannot be overestimated (Manta et al., 2023). Farmers often consult and count on the information they receive from peers because they perceive it as trustworthy (Laajimi & Albisu, 2000; Navarrete et al., 2015). Opinions of, for instance, family members and advisors are regarded as more relevant than those of any other official instances (Naspetti et al., 2017; Walder et al., 2019). Therefore, understanding informal networks and the role of cultural interactions among farmers (Sharma et al., 2021), as well as among all engaged stakeholders, can help create reciprocity and articulation of principles among actors (Manta et al., 2023; Rover et al., 2020).

This paper makes contribution to the transition to CSA in Europe by offering insights into business strategic choices. The emphasis is placed on advocating for a multi-stakeholder network-level approach and the urgency for new governance structures that can effectively support individual actors, primarily farmers, in applying CSA practices and technologies. Moreover, this paper contributes to policy dialogues and calls for a collaborative effort to support farmers adopting CSA until the innovation matures for market uptake. Additionally, this paper enhances our understanding of how collectively governed business strategies rely on formal institutions and informal relations.

The results of this research are focused on the European regions while CSA has received more attention in developing regions, especially in the FAO's policy (Lipper & Zilberman, 2018). The geographical area can be seen as a limitation in the interpretation of the results beyond the European region. Another important aspect that the literature failed to address, and so does our paper, is the tension that can manifest among stakeholders. The literature also lacks clarity regarding the effective emergence and governance of multi-stakeholder collaboration networks for CSA applications. Therefore, we recommend further research to focus on tensions and potential conflicts, as well as on the governance structures of multi-stakeholder collaborations.

6 | CONCLUSION

The main purpose of this review was to integrate the scattered literature in the frame of CSA and map business strategies that empower actors to make decisions contributing to system transitions for CSA.

We recognise that CSA is a knowledge, labour and capital-intensive practice that extends values beyond monetary aspects to encompass non-monetary dimensions. A key prerequisite for the successful transition for CSA involves strong collaboration among relevant stakeholders. In this article, we mapped six business strategies that can help farmers access financial resources, expand their market and enhance farming (digital) skills and knowledge that will eventually scale up CSA. These strategies rely on both formal institutions and informal networks to unburden farmers in investing in CSA while they are also caught in a system from which they lack the power and capital to escape. However, the success of these business strategies is dependent on the involvement of stakeholders in decision-making processes for design, implementation and monitoring through co-creation processes. Finally, the creation of effective multi-stakeholder business strategies and establishment of appropriate governance structures need an integrative system approach in policy dialogues as well to cover the gap between the CSA innovation maturity and market uptake.

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APPENDIX A

Selection criteria of disciplines in Web of Science = ('environmental sciences' or 'agriculture multidisciplinary' or 'green sustainable science technology' or 'environmental studies' or 'agronomy' or 'food science technology' or 'geography' or 'computer science information systems' or 'engineering environmental' or 'plant sciences' or 'economics' or 'engineering electrical electronic' or 'agricultural economics policy' or 'ecology' or 'regional urban planning' or 'sociology' or 'management' or 'multidisciplinary sciences' or 'veterinary sciences' or 'computer science artificial intelligence' or 'computer science theory methods' or 'engineering chemical' or 'geosciences multidisciplinary' or 'operations research management science' or 'computer science hardware architecture' or 'soil science' or 'automation control systems' or 'energy fuels' or 'education educational research' or 'anthropology' or 'urban studies' or 'business' or 'history philosophy of science' or 'public environmental occupational health' or 'nutrition dietetics' or 'agriculture dairy animal science' or 'computer science interdisciplinary applications' or 'development studies' or 'agricultural engineering' or 'biodiversity conservation' or 'biology' or 'horticulture' or 'political science' or 'public administration' or 'social sciences interdisciplinary' or 'water resources' or 'business finance' or 'communication' or 'engineering multidisciplinary' or 'ethics' or 'social issues' or 'psychology multidisciplinary' or 'psychology experimental' or 'logic' or 'information science library science' or 'forestry' or 'fisheries' or 'education scientific disciplines' or 'engineering civil')).

Selection criteria of disciplines in Scopus = (subjarea, 'agri', 'envi', 'soci', 'engi', 'comp', 'ener', 'busi', 'econ', 'eart', 'deci', 'mult', 'vete', 'psyc').