The Organic Sector in Bavaria

Challenges, Opportunities and Prospects

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Abstract

In the context of anthropogenic climate change, the agricultural sector is identified as a significant contributor to greenhouse gas emissions. In light of this global challenge, organic farming is seen as a promising alternative to conventional farming, and is central to many political programmes, including the EU's Farm-to-Fork Strategy and the Bavarian BioRegio Bayern 2020 programme. However, the transition to a sustainable agricultural system characterised by organic farming, is a significant and complex undertaking. Not only is the mere conversion to organic farming required, but the underlying governance structures and consumer behaviour are also crucial for sustainable change in the agricultural system through organic practices.

This cumulative dissertation aims to assess the state of the organic sector in Bavaria, identifying both the barriers and opportunities for its development, and exploring its potential to serve as a model for a broader sustainability transition in agriculture. The objective of this thesis is to gain a better understanding of the processes and potentials associated with organic farming in the transition to a more sustainable agricultural system. This work provides contextual background on organic farming, covering its origins and development, the standards and values that underpin it, the regulatory framework, related certification and logos, the policy support available and the key actors involved. These elements frame the subsequent analysis of the sector.

The thesis adopts three research approaches. It employs an empirical mixed-method approach that combines interviews with organic farmers and actors from the organic sector in Bavaria, with the collection of quantitative data from certificates and document analysis. First, the thesis addresses the poor data availability that has prevented spatial analysis of different actors in the organic sector on a large scale. The results reveal spatial patterns of various actors within the Bavarian organic sector and offer insights into the structures, challenges, and possibilities associated with organic farming in Bavaria. These findings provide a foundation for future research into the impact of the spatial distribution of different actors and possible networks in the organic sector. This will facilitate the implementation of more targeted, large-scale measures at the institutional level, with the objective of overcoming challenges in the organic sector and strengthening and promoting organic farming.

Second, research focuses on officially designated organic model farmers. Their interactions and connections with colleagues, suppliers, customers, and others are presented, and the rationale behind these relationships is analysed. This analysis identifies key policies that can be employed to strengthen organic farming and alter the agricultural system. Furthermore, the interactions and connections elucidate fundamental mechanisms of farmers, which illustrate their capacity to act as change agents in the transition to a more sustainable agricultural system. The potential for organic model farmers to exert influence over a range of actors within and beyond the organic sector could prove pivotal in the transition process.

Thirdly, the functionality, advantages and disadvantages of the knowledge transfer network for organic farming based on organic model farmers, is examined. It illustrates the significance of knowledge provision for farmers with peers. Given the pivotal role of peer knowledge in the decision to convert to organic farming, the BioRegio Betriebsnetz, comprising 100 organic model farmers in Bavaria, represents a promising measure for accelerating the adoption of organic farming. This can advance a transition to a sustainable agricultural system. Although the participating model farmers report high levels of satisfaction and perceive the network's functionality and support to be satisfactory, the actual success of the network cannot be quantified due to a lack of available documentation. This knowledge transfer network can be used as a model for other regions within and outside Germany.

The findings from the scientific contributions, when considered alongside the contextual background knowledge on organic farming, reveal new facets in the barriers and opportunities of organic farming in Bavaria and in a broader context. Together, this contributes to the ongoing debate surrounding the sustainability transition of the agricultural system. The thesis further indicates the potential of research into the relational dynamics and networks within and beyond the organic sector. Such research can identify opportunities and barriers to transition making toward sustainability. The thesis points to modifications to regulatory and economic frameworks governing the organic sector that could facilitate the continued development of organic farming and effect a sustainability transition of the agricultural system.

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List of Abbreviations

ÄELF	Ämter für Ernährung, Landwirtschaft und Forsten
AbL	Arbeitsgemeinschaft bäuerliche Landwirtschaft e.V.
BBV	Bayerischer Bauernverband
BLE	Bundesanstalt für Landwirtschaft und Ernährung
BMEL	Bundesministerium für Ernährung und Landwirtschaft
BÖLW	Bund Ökologische Lebensmittelwirtschaft
BR2030	BioRegio 2030
BRB2020	BioRegio Bayern 2020
BRB	BioRegio-Betriebsnetz
BS2030	Bio-Strategie 2030
CAP	Common Agricultural Policy
EAFRD	European Agricultural Fund for Rural Development
EC	European Commission
FAO	Food and Agricultural Organization of the United Nations
IFOAM	International Federation of Organic Agriculture Movements
KErn	Kompetenzzentrum für Ernährung
KULAP	Bayerische Kulturlandschaftsprogramm
LfL	Bayerische Landesanstalt für Landwirtschaft
LVÖ	Landesvereinigung für den ökologischen Landbau e.V.
LWG	Bayerische Landesanstalt für Weinbau und Gartenbau
NOP	National Organic Program
StMELF	Staatsministerium für Ernährung, Landwirtschaft und Forsten
UN	United Nations
USDA	United States Department of Agriculture
WHO	World Health Organization
ZöL	Zukunftsstrategie ökologischer Landbau

1 Introduction

The role of agriculture has undergone significant changes over the last century, as globalisation and advances in technology have transformed the way food is produced and distributed. Historically, the primary role of agriculture has been to produce food. As Renting et al. (2009) write, “agricultural activity beyond its role of producing food and fibre may also have several other functions such as renewable natural resources management, landscape and biodiversity conservation and contribution to the socio-economic viability of rural areas” (p. 112). Further, agricultural productivity has increased dramatically due to the adoption of new technologies such as mechanisation, improved seeds, and fertilisers. This enabled farmers to produce more food with less land and labour, helping to feed a growing global population (FAO 2020). With the intensification of agriculture and the increasing use of inputs such as fertilisers and pesticides, concerns about the environmental impacts of agriculture have grown. In response, there has been a greater focus on sustainable agriculture practices such as organic farming, conservation tillage, cover cropping, and integrated pest management that aim to reduce the negative impacts of farming on the environment (Padmavathy and Poyyamoli 2011; Pretty et al. 2018). Agriculture has also played a significant role in driving economic development, particularly in developing countries where it is often one of the largest sector of the economy. Agriculture provides employment for millions of people, generates income, and supports rural livelihoods (Byerlee, de Janvry, and Sadoulet 2009). However, the globalisation of the food system has also brought challenges, such as price volatility and increased competition from imports (Bellemare 2015; Olper, Pacca, and Curzi 2014). Agriculture is a significant contributor to greenhouse gas emissions, but it also has the potential to mitigate climate change through practices such as conservation agriculture, agroforestry, and soil carbon sequestration (Loboguerrero et al. 2019; Wollenberg 2012). These practices not only reduce emissions but also have co-benefits such as improved soil health and increased resilience to climate change impacts. Consequently, a significant proportion of the United Nations' (UN) seventeen Global Development Goals are either directly or indirectly related to agriculture (UN 2024).

One of the best known, sustainable and most widespread alternatives to conventional farming is organic farming. It seeks to meet the challenges of today's agriculture without losing its integrity and values. The influences on organic agriculture are numerous and critical to its development. Whatever trajectory organic farming takes, it can have a significant impact on agriculture, upstream and downstream industries, and on human societies. Organic farming has developed more and more from a niche to mainstream, so that the question arises to what extent organic farming is still an alternative system or is it already part of the dominant regime. It is therefore essential to understand the dynamics and interactions of organic farming in order to demonstrate its potential for a sustainable transition in the agricultural system.

The objective of this study is to ascertain the potential of organic farming to facilitate the transition to a more sustainable agricultural system, taking into account the prevailing circumstances and the associated current and future challenges. In recent decades, based on ecological values and standards designed in harmony with them, a fragmented and idealistic movement with diverse goals has become a productive system that is evident across many areas of society. Organic farming now manifests in commodity chains, in various institutions, authorities, political actors and social ideas, as well as future debates. A comprehensive study of organic farming can facilitate the identification of both current challenges and prospects for the sector. To gain a comprehensive understanding of the current situation and the resulting influences and potentials, it is essential to examine the origin and subsequent development of the organic movement. The institutionalisation and manifestation that developed in the following decades through global standards, regulations, and the associated certification as well as policies for political support demonstrate the trajectory of organic farming to date. The resulting influencing factors and potential for organic farming to affect a transition in the agricultural system towards greater sustainability, as well as the heterogeneous landscape of actors, will play a decisive role in determining the future development path. Such comprehensive representations are essential and form the basis for the development of value-adding mechanisms, processes, and challenges, which were prepared in the form of three scientific contributions within the framework of this cumulative dissertation.

There is a need for support, further development and networking at many different levels in order to develop organic farming beyond its current status. To achieve this goal, it is necessary to identify the new potentialities that have emerged and to understand the possible contribution of organic farming to a sustainable agricultural system. This is less about the potential influence of organic farming (e.g., productivity, environmental impact, economic efficiency, sustainability), which is often already discussed in the scientific community (chapter 2), and more about the contribution of organic farming to sustainable transformation and, above all, the way to achieve this. The overarching questions are: Who is driving this transition? What potential do different actors have? What could help organic farming to contribute to the transition to a more sustainable agricultural system? What could the future of the organic sector look like? The questions are addressed in this dissertation by a comprehensive examination of the organic sector, elucidating the multifaceted factors that shape it. It presents novel insights into the potential for model farmers to facilitate transitions, analyses a promising knowledge transfer network, and illustrates the spatial anchoring of various actors and the associated inconsistent data availability. The findings presented herein provide insight into the challenges and prospects of organic farming. Additionally, they suggest avenues for future research.

To address these questions the research focuses on the state of Bavaria in Germany. Alongside Germany, which is the largest organic market in Europe, Bavaria has a highly developed organic sector with the largest organic area and number of farms in Germany. The unique aspects of Bavaria include not only the established structures in institutions, research, and the private sector, but also the holistic support for organic farming introduced since 2012 as part of the political programme BioRegio Bayern 2020 (BRB2020). The programme's objective has been, and continues to be, to enhance the stagnating conversion rates to organic farming through a multifaceted approach, including research, education, extension, funding and marketing (StMELF 2017). This suggests that the development of organic farming in Bavaria is well advanced compared to other regions in Germany and Europe. However, there is a significant gap between the stated goals and current developments, suggesting that there are challenges and barriers to the development of organic agriculture in Bavaria. The advantage of this research subject is that it demonstrates organic farming at a juncture of development where decisions are made that not only determine its progress in Bavaria but can also serve as a guide for other regions.

This dissertation aims to re-examine and re-evaluate organic farming. I first seek to understand the potential contribution of organic farming to sustainable agricultural systems and societal change in general. I therefore examine organic farming in Bavaria as it incorporates ecological values and responds to institutional influences and societal impacts. Chapters 6.3, 7 and 8 establish the transition context for organic farming in Bavaria. To gain a better understanding of organic farming, it is essential to provide contextual backgrounds that facilitate a deeper insight into the topic of organic farming. This will help to elucidate the nuances of organic farming in general and its specific situation in Bavaria. Furthermore, it helps to illustrate the evolution of organic farming as well as its current status and composition. While policy frameworks and financial support are important, they alone cannot guarantee the sustainable and holistic development of organic agriculture. Practical implementation must take into account the different farming conditions, specific challenges and needs of individual farmers. It is these aspects and how organic agriculture can effectively contribute to the transition to sustainability that are addressed here. The research gap is initially identified through an analysis of existing scientific discourse, and the research objectives are then formulated accordingly. Subsequently, an examination of the contextual background knowledge is presented, commencing with an overview of its origin and development. This is followed by an analysis of the standards and values of organic agriculture. The subsequent section focuses on the regulatory framework, certifications, and logos associated with organic agriculture. Finally, the political support for organic agriculture at the EU, German, and Bavarian levels is discussed. The actors in the Bavarian organic sector are then introduced, followed by the general development of organic agriculture in Bavaria in recent years.

The scientific papers that have been written as part of this dissertation are then presented. These focus on 1. the use of a previously unused data source to spatially anchor different actors in the organic sector in Bavaria; 2. examining the transformation potential of model farmers in organic agriculture; and 3. identifying the knowledge transfer within a politically initiated model farmer network.

Finally, I offer a conclusion to the dissertation.

2 Research Gap and Objectives

The scientific research in the field of agriculture, in general, and organic farming, in particular, is extensive and multidisciplinary. In order to contextualise this dissertation and identify research gaps, the scientific discourses on organic vs. conventional, the sustainability of organic farming, the Conventionalisation Debate and transitions in organic farming are presented to provide a conceptual framework for this work. This framework is crucial for evaluating and clarifying the recent dynamics within the Bavarian organic sector.

2.1 Scientific Debates related to Organic Farming

Despite extensive research, there are still gaps in the understanding of the current dynamics in organic farming and its transformative potential to a more sustainable agricultural system. Existing studies often focus on isolated aspects such as productivity or environmental impacts, without integrating these findings into a broader socio-ecological and political context. In particular, this entails the ongoing comparison of organic and conventional farming, the examination of the sustainability of organic farming and the debate surrounding the conventionalisation of organic farming. How organic agriculture can contribute to a transition to sustainability is also addressed in the following section. Although the topics are presented separately here, they are interrelated and can interact with each other, making it difficult to consider any aspect of organic agriculture in isolation.

2.1.1 Organic vs. Conventional

The subject of organic versus conventional farming encompasses a multitude of interrelated areas of research within the broader field of agriculture. The scientific contributions typically have the ulterior motive of demonstrating superior performance compared to other agricultural systems. Seufert and Ramankutty (2017) have made an important contribution to this debate by including various dimensions of the performance of organic farming. The authors' focus is on production, the environment, producers, and consumers. In general, the authors conclude that organic farming has both advantages and disadvantages, and that its performance is highly context-dependent. Organic farming offers a number of advantages, including higher biodiversity, improved soil and water quality per unit area, improved profitability, and higher nutritional value. Conversely, it also has potential costs, including lower yields and higher consumer prices (Seufert and Ramankutty 2017).

There is a considerable degree of variability in yields, which are frequently employed in discussions concerning the feeding of the global population. Meta-analyses have demonstrated that, on average, the yield per hectare in organic farming is 19-25 % lower than in conventional farming (De Ponti, Rijk, and Van Ittersum 2012; Seufert, Ramankutty, and Foley 2012). Recent studies have demonstrated that organic yields can achieve parity with conventional yields after a period of 10-13 years (Schrama et al. 2018). Additionally, the impact of warm temperate climates on the yield gap has been identified as a significant factor, with the yield gap increasing in such climates (De La Cruz et al. 2023). Another contribution suggests reframing the yield debate away from asking whether organic agriculture can feed the world's population to instead consider how organic agriculture can help feed the world's population (Wilbois and Schmidt 2019). While some comparative studies indicate a higher degree of stability (Lotter, Seidel, and Liebhardt 2003; Smith and Gross 2006), others suggest a lower degree of stability (Knapp and Van Der Heijden 2018; Smith, Menalled, and Robertson 2007).

In addition to yields, organic farming is frequently criticised for higher consumer prices compared to conventionally produced food. These are mainly due to the lower yields and sometimes higher production costs (Crowder and Reganold, 2015), the often unrealisable demand volumes (EC 2010a), and the partial need to develop alternative distribution channels (Brown and Sperow 2005). In this context, the price premium is an obstacle to organic farming, as it remains the largest perceived barrier to purchase (Aschemann-Witzel and Zielke 2017). The fundamental issue is that externalities are not incorporated into the conventional price. Inclusion of these costs would result in a significant reduction in the price differential between organic and conventional products (Carolan 2018). Conversely, the higher prices for organic products also make organic farming sometimes more profitable in comparison (Crowder and Reganold 2015; Nemes 2009). However, this does not always mean that a farmer can generate large profits (Valkila 2009).

In terms of environmental impact, organic farming is demonstrably more advantageous than conventional farming. Organic farming confers advantages in terms of soil quality and water quality. With regard to soil quality, the most significant advantage is the higher organic carbon content observed in organically farmed soils, which is typically higher than in conventionally farmed soils (García-Palacios et al. 2018; Gattinger et al. 2012; Mondelaers, Aertsens, and Van Huylenbroeck 2009). The low-tillage approach employed in organic farming has the additional benefit of enhancing soil structure, which in turn affects soil quality and reduces erosion (Seitz et al. 2019). Biodiversity is enhanced through organic farming (Bengtsson, Ahnström, and Weibull 2005), although there is a trade-off between biodiversity and yields (Gabriel et al. 2013; Gong et al. 2022). Conversely, plants (Tuck et al. 2014) and bees (Kennedy et al. 2013) are known to benefit from higher biodiversity. Nevertheless, intensive organic farming represents a further obstacle to biodiversity. Consequently, the objective of increasing biodiversity should be to diversify the areas under cultivation and reduce the field size at the landscape level (Tscharntke et al. 2021). The environmental impact of organic farming on water quality is the most uncertain of the various dimensions. The loss of nitrogen and phosphorus through agriculture plays a pivotal role in the level of water quality. Organic farming results in less nitrogen leaching (Mondelaers, Aertsens, and Van Huylenbroeck 2009; Sivaranjani and Rakshit 2019), although the variation is high.

Social factors are also influenced by organic farming, as demonstrated by Seufert and Ramankutty (2017). The authors employed the livelihoods approach in their analysis, by including relative profitability (determined by yields, production costs, and prices realised), relative resilience, the extent to which farmers are given autonomy, and the impact on other livelihood benefits (such as access to knowledge, access to credit, access to inputs, or access to markets). It has been demonstrated that organic farming is comparatively more profitable (Crowder and Reganold 2015), that farmers are more resilient (Milestad and Darnhofer 2003), that farmers are mostly influenced by the same economic factors as conventional farmers (Bacon 2005), and that organic farming promotes other livelihood benefits such as building social networks or better knowledge sharing (Bray, Sánchez, and Murphy 2002; Valkila 2009). Moreover, in comparison to conventional farming, organic farming requires a greater number of workers per hectare, with these individuals engaged in agricultural activities for a longer duration (Finley et al. 2018).

The list of different comparison factors illustrates that the relative merits of organic farming in comparison to conventional farming are contingent upon a multitude of contextual factors and the specific setup of the comparison. A limitation of such comparisons is that they fail to capture the multifaceted nature of the agricultural system, as they are mostly restricted to a single factor. As has been demonstrated, meta-analyses of different comparison parameters are often conducted when feasible. This results in significant discrepancies and performance ranges, which ultimately fail to adequately reflect the context-dependent nature of the subject matter. This is inherent to the nature of the debate, as the results always require generalisation in order to make an explicit statement. Moreover, the comparisons are either on a global scale or based on case studies of specific countries, regions, or types of farming. Furthermore, ideal types of farms or highly specialised farms are frequently employed. The assessment of productivity on a per-unit-area basis represents a purely economic perspective that fails to adequately capture the comprehensive contribution of an agricultural system.

In the context of Bavaria, there are only a few contributions that draw a comparison between organic farming and conventional farming (see the papers on soil erosion (Auerswald, Kainz, and Fiener 2003) or on optimal dairy farming technology (Breustedt, Latacz-Lohmann, and Tiedemann 2011)). The factors typically employed are insufficient for the purposes of an evaluation of organic farm performance in the context of Bavaria. This is because the assessment of performance is contingent upon a number of additional factors. Such factors might include the degree of diversification or specialisation of the farm, off-farm income, land value, degree of urbanisation, farm succession, innovative strength of farmers, anchoring in social networks and structures, and life cycle patterns. The ongoing debate on organic versus conventional farming has the potential to stimulate further research, including the examination of the sustainability of organic farming.

2.1.2 Sustainability of Organic Farming

In order to gain insight into the sustainability of organic farming, it is essential to provide a brief overview of sustainable agriculture. While there is no universally accepted definition of sustainable agriculture (Velten et al. 2015), the term is understood to encompass three fundamental characteristics: environmental health, economic viability, and social equity. Environmental health, as exemplified by the preservation of soil, water, and biodiversity, is a crucial aspect of sustainable agriculture. Economic viability, on the other hand, encompasses the ability to generate sufficient income and to diversify economic activities. Social equity, finally, refers to the fair treatment of workers and the assurance of food security for all. The definitions only acquired political relevance with the formulation of sustainable goals (e.g. Sustainable Development Goals). This would also necessitate a clear delineation between sustainable and non-sustainable agricultural practices (Janker, Mann, and Rist 2018). As will be demonstrated in Chapter 6, organic farming is arguably the most promising and widespread sustainable agricultural approach anchored in politics for addressing the current global challenges (e.g., climate change, biodiversity loss, and food security) within the agricultural system (Niggli 2015).

The discourse on the sustainability of organic farming should encompass the three dimensions of sustainability, economic, environmental and social. However, sustainability is usually discussed in terms of ecology, with organic farming proving that it can also be more financially sustainable. Although it has higher production costs, these are offset by the price premium and lower input costs (Niggli 2015). The social components, such as health benefits, have also proven to be more sustainable in organic farming, which can be explained by the absence of chemicals. In less economically developed countries in particular, such as in India, this improves working conditions. At the same time, local economies are supported, as direct sales channels are created (Dash, Priyadarshini, and Dulla 2024).

In a contribution from Eyhorn et al. (2019) the authors examine the sustainability performance of organic farming and they assess the measures required to enhance the sustainability of the agricultural system. In their comment they identify four key policy measures that can be implemented in a coordinated manner to advance a more sustainable food system. These include targeted support for transformative systems through a combination of push, pull, and enabling measures, with the objective of improving their performance. Another strategy is to stimulate the pull effect of increasing market demand for sustainable products. Incentivising incremental improvements in mainstream agriculture and food systems towards combined sustainability goals is another approach. Finally, raising regulatory requirements and industry standards to exclude particularly unsustainable practices is a further strategy (Eyhorn et al. 2019). The sustainability of organic farming must also be considered in the context of the landscape. Biodiversity responds differently to landscape context than yield and profitability benefits, suggesting that these sustainability metrics are decoupled. The most pronounced environmental sustainability benefits are observed in more intensive agricultural landscapes

(Smith et al. 2020). It is therefore imperative that the landscape context is given significant weight in the formulation of policy support measures.

For further development, Gamage et al. (2023) posit that two distinct development paths for a more sustainable agricultural system are emerging. First, incremental measures are required to enhance efficiency in conventional agriculture while concurrently reducing negative externalities. Second, an agroecological, pioneering restructuring of organic farming systems is necessary. This can be achieved through a combination of organic farming and improved sewage sludge, biochar with organic manure, biofertilisers, organic minerals, and digital technology, which collectively serve to reduce the constraints and challenges of organic farming. The innovative and sustainable approach of organic farming increases agricultural productivity and the quality of life of many farmers in an environmentally friendly manner. These measures can also contribute to achieving the 17 Sustainable Development Goals as agriculture has a direct or indirect influence on all of them (Gamage et al. 2023). The future research and innovation strategy for organic farming must prioritise productivity gains aimed at farms as a whole. Additionally, it is of paramount importance to ensure that organic farming maintains a positive environmental performance (Niggli 2015).

While the subject of this debate is frequently addressed in less developed countries and at the global level, it is also of significant relevance within the context of Bavaria. It highlights the decisions-making process of farmers deciding to pursue organic management of their farms, as well as the ways in which they seek and perceive advice throughout this process. In this context, further questions arise as to how farmers can adapt organic farming practices in a way that strikes a balance between profitability and environmental performance, while maintaining a sufficient level of productivity. Additionally, it is essential to consider how advice and knowledge transfer can be made appropriate for this endeavour. These undertakings are essential for a transition of the agricultural system towards greater sustainability through organic farming.

2.1.3 Conventionalisation Debate

The idea that organic farming can reduce its yield deficits with technologies, for example, leads to the next discussion regarding organic farming. This is the Conventionalisation Debate, which concerns the extent to which organic farming employs methods derived from the conventional agricultural system. Conventionalisation can manifest itself in various ways, including the use of conventional marketing methods (Guthman 2004), concentration, de-localisation, institutionalisation, and input substitution (Lockie et al. 2006), or the increasing size of organic farms (Best 2007). Darnhofer et al. (2010) provide a comprehensive overview of the background to the debate, emphasising the importance of measuring conventionalisation against the principles of organic farming rather than against the structural characteristics of a farm. Another comprehensive contribution to the Conventionalisation Debate has been made by Constance, Choi, and Lara (2015). They demonstrate how numerous influences can alter the organic farming system and render it more conventional. They address bifurcation, which represents the disparate types of farmers and approaches to farming, which should address the question of whether conventionalisation affects all farmers in a region in a uniform manner (Constance, Choi, and Lara 2015). It is essential to differentiate between conventionalisation and the professionalisation of organic farming. This also determines the extent to which organic farming should be inclusive. Should it be open only to those with altruistic and ideologically-minded motives, or should it also be accessible to farmers who are closer to economic profitability (Darnhofer 2006)?

At the same time, mechanisms and institutions for organic farming, such as support mechanisms or certification processes, have developed along the organic farming system. These generally reflect conventional structures. The certification process and the use of an organic label, which are often inextricably linked, also contribute to the Conventionalisation Debate. This is because a dichotomy emerges between organic farming that merely adheres to regulations and organic farming that is overly restricted and constrained by regulations (Teil 2014). In addition to the intrinsic mechanisms and processes inherent to the organic farming system, external factors also exert an influence on conventional processes. An example of this is the development of organic farming in Andalusia, where the institutional structures are conducive to conventional farming and are strongly influenced by public funding and international markets (Ramos García, Guzmán, and González De Molina 2018). The Conventionalisation Debate is a good example of the challenges facing organic agriculture. It is about preserving the organic identity while developing a growing professionalism. This is necessary in order to achieve economies of scale and thus offer organic products to a broad mass market. Furthermore, it is essential to comprehend the opportunities and challenges that arise from a more "conventional" organic agriculture in order to remain flexible for the future trajectory of the organic farming system.

The Conventionalisation Debate reflects some of the foundational challenges inherent to organic farming, including bifurcation, institutionalisation, policy and market dynamics, economies of scale, and value-based agriculture. These findings are also highly pertinent to the Bavarian context, given that the majority of the contributions originate from Europe. However, it is these very factors that determine the trajectory of organic farming and the extent to which it can facilitate a transition to a more sustainable agricultural system. This reveals two pivotal lines of inquiry on the subject matter that form the basis of this dissertation. Firstly, what impact does the conventionalisation of organic farming have on its status as a sustainable agricultural practice? This is accompanied by a discussion of the extent to which organic farming must adhere to its principles and values in order to be regarded as such. Secondly, it is necessary to determine the extent to which organic farming must align with conventional practices in order to serve as a viable alternative in the transition to a sustainable agricultural system. In the future, the complex interaction of policy, technology, culture, market structures, and farmer agencies, with consideration of ecological values and principles, will be decisive for the socio-technical transition to greater sustainability.

2.1.4 Organic Farming and Transitions

The study of transitions in diverse systems has a long history and a variety of approaches (see Lachman 2013 for an overview) to explain it. The field of human geography also offers a promising intersection to a more comprehensive understanding of socio-technical transitions. This could be achieved by offering a more detailed socio-spatial context and by concentrating on the concept of relational place-making (Murphy 2015). It also deals specifically with multi-scalar, place-based and spatial factors and processes that influence transition dynamics (Binz et al. 2020). In recent decades, the focus has also shifted to the field of agriculture, with the primary aim of understanding and analysing the transition process to a more sustainable agriculture system and the mechanisms required for this. In this context organic farming is often cited as a form of sustainable agriculture (El Bilali 2020). From a purely technical point of view of production, organic farming would not be a prototype for sustainable agriculture, but it would be from the perspective of a co-evolution of technical and societal change. Obstacles to the current system, such as production methods, regulations, user practices, cultural values, behavioural patterns, infrastructure requirements, investment needs, technological blockages, power relations, etc., must be overcome to achieve a transition toward sustainable agriculture (Darnhofer 2014).

In order to adequately address the subject matter at hand, it is essential to distinguish between two distinct processes pertaining to organic farming. The first is the process of how organic farming continues to spread and thereby makes the agricultural system more sustainable, that is to say, the transition of the agricultural system. The second is the process that organic farming itself has undergone and continues to undergo in its development trajectory, that is to say, the extent to which organic farming is still an alternative food network. These two processes are correlated and influence each other to some extent, generating both trade-offs and synergies.

The scientific discourses that emerge from comparing organic with conventional farming, from assessing the contribution of organic farming to sustainability, and the debate on conventionalisation already contribute to scientific literature on the role of organic farming in making a sustainability transition. The comparison between organic and conventional farming is fundamental to promoting the transition of the agricultural system towards greater sustainability. If there were no or hardly any difference in the sustainability performance of the various sustainability dimensions, the discussion about the superiority of organic farming would be obsolete. The debate on the sustainability of organic farming is directly linked to this. The debate on conventionalisation also opens up the discussion of the extent to which organic farming still differs from the conventional system. This is essential for the conceptualisation of a transition in the agricultural system, as certain criteria, parameters and delimitations need to be identified in order to capture its entry into the mainstream. In addition, the Conventionalisation Debate questions precisely the extent to which organic farming is still "alternative".

This is precisely the question posed by Rosol (2019), who questions alterity in alternative food networks. She calls for “the need to base alternative food economies on a third pillar of alternative economic models and practices, which complements the pillars of alternative food and of alternative distribution networks” (Rosol 2019, 68). In the context of organic farming, Seufert, Ramankutty, and Mayerhofer (2017) ask "what is this thing called organic?" and show

how organic is codified in regulations. Depending on the goal of organic agriculture, it should introduce more product standards for chemical-free food for consumer or include more organic best practices for a holistic understanding of ecosystem and health (Seufert, Ramankutty, and Mayerhofer 2017). In the context of a transition in the agricultural system, different types of production will coexist (Dumont, Gasselin, and Baret 2020) and different transition pathways will be given priority (Lamine 2011). Rosol (2019) also identifies the processes, actors, and influences on the transition as crucial elements in her outlook on future research questions. She highlights the relationship between the alternative and conventional food sectors and the specific geographies within them, as well as the role of the public sector and regulations, such as certifications, as areas that remain understudied (Rosol 2019).

In the context of Bavaria, it is pivotal for researchers to be aware of and consider the various discourses on organic farming when evaluating the role of organic farming in the transition to sustainable agriculture. The multi-level perspective posits that socio-technical transitions are driven by innovations from niches (such as organic farming) that challenge the dominant regime (conventional farming). These challenges ultimately lead to system change (Geels 2002; Geels 2018; Grin, Rotmans, and Schot 2010) through different pathways and trajectories influenced by a multitude of factors like communication technologies (El Bilali and Allahyari 2018), knowledge systems (Ingram 2018), different logics in society (Runhaar et al. 2020) and our capitalistic system (Feola 2020). The socio-technical transition entails significant and multifaceted alterations, encompassing e.g. political, technological, market, and institutional domains. It occurs through a process of interaction between diverse actors, including policymakers, scientists, stakeholders, and companies (Grin, Rotmans, and Schot, 2010; Markard, Raven, and Truffer 2012). Organic farming represents an innovation, as it promotes e.g. biodiversity and the reduction of chemical inputs, and the question arises as to the degree of conventionalisation at which organic farming can lose its role as an alternative agricultural system (Darnhofer 2014, Rosol 2019). Conversely, the professionalisation and integration of environmental, social, and economic considerations within the framework of organic farming demonstrate its potential to serve as a pivotal element in the transition process. Rather than perceiving organic farming as a mere contrast to conventional practices, it is essential to view it as a dynamic force capable of influencing the trajectory of agricultural development within the context of sustainability transitions. In light of the ongoing scientific debates and the associated challenges and shortcomings, it is possible to derive research questions and objectives and to discuss them in more detail.

2.2 Research Objectives

This research aims to connect organic farming practices to broader theories of transitions and to examine how organic farming can lead to sustainable agricultural systems. It further aims to uncover how different actors, from policy makers to farmers, can influence and steer this transition.

The objective of this thesis is to examine organic farming and its associated challenges, opportunities, and prospects. The research area selected for this study is the federal state of Bavaria in Germany. A detailed background on the selected research area of Bavaria with regard to organic farming is provided in Chapters 6.3, 7, and 8. The organic farming sector in Bavaria is considered to be well advanced in its development, and as a result, it can serve as a comparative region for other regions facing similar challenges. In order to gain a comprehensive understanding of the various aspects and structures that make up organic farming, a detailed analysis is conducted.

The primary aim of this thesis is to present, analyse, and evaluate organic farming and its underlying system in Bavaria. The specific areas and topics of the organic farming system that have been highlighted and are key to this research are as follows:

> *The availability of data and the associated possibility of spatially anchoring different actors in the organic sector in Bavaria*
>
> *The potential for model farmers in organic agriculture to drive a transition.*
>
> *The evaluation of a policy initiated organic model farmer network and its benefits and potential for improvement.*

By recognising the three topics addressed in the scientific contributions and the topics and background information presented in the following sections of this work, it is possible to construct a broader picture of organic farming in Bavaria. The scientific contributions offer insights into mechanisms such as network formation and knowledge transfer, which are emerging as crucial processes for the transition of the agricultural system. These questions make it possible to gain new perspectives on organic farming and to frame problems and challenges differently. Furthermore, an open inquiry is required to elucidate the barriers to innovation and dissemination in organic farming in Bavaria, the potential for innovation, and the political measures that can facilitate this. At present, there is a paucity of knowledge regarding the Bavarian organic sector, including its composition, organisational structure, social networks and other pertinent characteristics.

The development of organic agriculture, from a pioneer-driven alternative farming method to a global agricultural system, needs to be understood in order to make suggestions and recommendations for the future. I follow Rosol (2019) and focus on the origins, standards, values, regulations, certification, logos, policy support, and actors that have played and will continue to play a pivotal role in the development of organic farming. By doing so, I aim to better understand the potential of organic farming in making a sustainable development transition in Bavaria. This work can therefore be seen as a contribution to a new understanding of organic farming and its environmental, economic and social performance within the framework of sustainable transition making.

3 Origins and Development of Organic Farming

The development of organic farming from a niche movement to a global agricultural system is an example of how systems can alter toward sustainability. It is crucial to understand the origins of organic farming in order to contextualise its subsequent development.

3.1 Origins of Organic Farming

Organic farming can be traced back to the late 19th and early 20th centuries when several pioneers of organic agriculture began advocating for a more natural and sustainable approach to farming. Various concepts and ideas that form the basis of organic agriculture have emerged primarily in the German- and English-speaking regions of the world. At that time, four developments took place which led to the development of organic agriculture independent of the German- and English-speaking worlds. These were "a crisis in agriculture and agricultural science, the emergence of biologically oriented agricultural science, the Life and Food Reform movement, and growing Western awareness of farming cultures of the Far East" (Vogt 2007, 9).

The debate in agriculture and agricultural science centred on the increased use of mineral fertilisers and how this, combined with increased mechanisation, was either the solution or the problem to the food crisis between the two world wars. In addition, the use of various substances also lowered the quality of food, and disease-promoting residues were discovered in vegetables and fruits. Biologically oriented agricultural science began to look at the composition of the soil and the effects of individual organisms. At the forefront was the concept of soil fertility through the addition of organic matter rather than mineral fertilisers and synthetic pesticides.

The return to a natural way of life, consisting of a vegetarian diet, physical exercise, natural medicine, and a return to rural life, were the principles of the 'Life Reform' and 'Food Reform' movements. Although the farming systems of the Far East had little influence on organic farming practices, the sustainable farming system that prevailed there served as an inspiration (Vogt 2007).

Diverse actors were responsible for the establishment and introduction of organic agriculture in German-speaking and in English-speaking countries. The development of organic agriculture occurred independently in the two regions, with the achievement of several goals, including the enhancement of soil fertility, the production of healthy food, the avoidance of chemical inputs, and the pursuit of farming practices that are in harmony with nature. Organic agriculture went through three stages of development, the stage of emergence (1924-1970), stage of expansion (1970-1990), and the stage of growth (1990-today) which are briefly summarised below (Behera et al. 2012; Ma and Sauerborn 2006).

In German-speaking countries, the beginning of organic farming is usually associated with Rudolf Steiner's lecture on "Social Scientific Basis of Agricultural Development" at Koberwitz in 1924. The theory posited that humans are integral parts of a cosmic balance that they must understand in order to maintain a harmonious relationship with their environment. This approach is better known today as biodynamic agriculture with the members being called anthroposophists, a term made popular by Ehrenfried Pfeiffer’s book Bio-Dynamic Farming and Gardening published in 1938 (Paull 2011). Following this, organic-biological agriculture was developed in the 1940s by Hans Müller and his wife Maria Müller and Hans Peter Rusch. They combined their own techniques with natural farming, British organic farming and biodynamic agriculture. This is the theoretical basis for the development of the organic-biological agriculture in the German speaking countries.

Sir Albert Howard is widely recognised as a pioneer and founder of the organic movement in English-speaking regions. Based on his work in India on plant breeding and protection, Howard published the book An Agricultural Testament (Howard 1940). This book summarised his experiences and emphasised the importance of the whole farm as the fundamental unit in agricultural research. In 1946, Lady Eve Balfour founded the Soil Association in the United Kingdom, an organic agricultural organisation based on the principles advocated by Howard. As part of the Haughley Experiment, she initiated the first long-term study of organic farming, comparing its effects with those of conventional farming systems at the whole-farm level (Vogt 2007). In the United States, Jerome Rodale has been a key figure in the popularity and spread of the organic farming movement. Fascinated by Howard's vision, he began experimenting with organic ideas himself. This led him to start publishing Organic Farming and Gardening magazine in 1942, with Howard as associate editor. Rodale focused on the conflict between organic and conventional agriculture as two visions of what the agricultural system will become (Heckman 2006). The origins of organic farming already reveal some characteristics that are decisive for its development and its potential to change the agricultural system. It is an alternative approach that is based on scientific findings, but its structures are not yet institutionalised, although international networks and connections already exist. The aspect of sustainability played a decisive role, as well as a growing social awareness of it. This was the basis for organic farming to become an established niche (Smith 2006).

3.2 Development of Organic Farming

The development of organic farming from a niche movement to a global agricultural system is consistent with the concept of transitions, where alternative methods emerge, challenge the dominant regime, and are partially integrated, becoming part of the mainstream. Therefore, organic farming fosters change in agriculture and food production (Geels 2018; Grin, Rotmans, and Schot 2010; Lachman 2013)

Organic agriculture has experienced significant growth and development worldwide since the 1960s, especially after the 1973 oil crisis and growing concern about agroecological issues. This period saw the emergence of new ideas and movements. The focus turned to what became known as ‘sustainable agriculture’, including organic, organic-biological, biodynamic, ecological, and natural agriculture but also organisations like Slow Food with a focus on local and high quality food (Chrzan 2004). During this period, the Soil Association in England introduced statutory specifications and quality controls, while the International Federation of Organic Agriculture Movements (IFOAM) was founded in 1972 (Greene 2001). Major organic agriculture associations and research institutions were also established during this time like the Federation Nationale d’Agriculteurs Biologiques in France or the Forschungsinstitut für Biologischen Landbau in Switzerland, now the largest organic research institute worldwide. Legislative action on organic farming began gradually in different countries, with the organic regulation being implemented in the United States and France in the 1970s and 1980s, respectively. The United States Department of Agriculture (USDA) issued a report and recommendations on organic farming, providing a definition and guidelines for the practice and calling for an action plan for its development (USDA, 1980). This publication was seminal in the evolution and legislation of organic agriculture in the United States (Ma and Sauerborn

2006). At the same time the IFOAM published their first standards for biological agriculture (IFOAM 1982).

The 1990s saw the establishment of trade organisations and regulations, and significant growth in organic farming globally. In 1999, the Food and Agriculture Organization of the United Nations (FAO) and the World Health Organization (WHO) established guidelines for the production, processing, labelling and marketing of organic foods to promote international harmonisation of standards (FAO and WHO, 1999). Organic farming emphasises holistic production management systems and the use of cultural, biological, and mechanical methods rather than synthetic materials. Organic agriculture is one approach among many methodologies that have specific and precise standards with different names, such as organic, biological, organic-biological, biodynamic, natural, and ecological agriculture (Ma and Sauerborn 2006). These methods have different approaches and origins, but each is based on standards and values of organic farming.

Organic farming continues to grow and alter, driven by increasing consumer demand for sustainable and healthy food and greater environmental awareness. Technological advances, standardised certification processes and increased political support have further manifested organic agriculture into the global food system. However, challenges remain, such as balancing growth while maintaining core values of organic farming, meeting demand for all products, or dealing with increasing conventionalisation. It remains to be seen what processes and levers organic farming will use to respond to these challenges and strengthen its resilience as an agricultural system.

4 Standards and Values of Organic farming

Organic standards and values are the foundation for today's organic agriculture. Each serves a unique purpose and plays a distinct role in shaping the principles and practices of organic agriculture. In this way, they contribute to the overall goal of ensuring that organic products are produced, processed, and marketed according to certain criteria. Standards define the criteria and best practices, while values represent the fundamental principles and ethical beliefs that guide the organic movement. These elements are interrelated and help shape the organic sector (Luttikholt 2007).

4.1 Organic Standards

Standards in organic farming are a set of guidelines and criteria that define the required practices and principles for the production, processing, handling, and labelling of organic products. Prior to the 1980s, there was no need for standards, as organic farmers were mainly selling directly to consumers. As the number of organic farmers grew and demand for organic products increased, the need for common standards and inspection systems became apparent. The main goals were to protect producers from unfair competition and consumers from fraud. In the past, organic standards covered production and processing methods, but as globalisation intensified, organic standards had to include environmental impacts and how products are packaged, transported, and marketed (Luttikholt 2007). The first version of Recommendations for international standards of biological agriculture (IFOAM 1980) was published by the IFOAM in 1980. Two years later this publication was refined to introduce the Standards of biological agriculture for international trade and national standards (IFOAM 1982) with validity restricted for two years. These standards are still being further developed by IFOAM and adapted to the needs and challenges of the current time. The standards are still valid today as "standards for standards" in order to take into account the feasibility of organic agriculture worldwide and to consider the site-specific characteristics of agriculture (Luttikholt 2007). They cover aspects such as soil management, pest control, animal husbandry, and the use of inputs, among others. In the mid-1980s, people slowly started buying organic products less for altruistic reasons and much more for self-interest regarding food safety and health (Dimitri and Oberholtzer 2005). At the same time, organic farming became the focus of policy makers, consumers, environmentalists, and farmers. The resulting interplay and power relations between consumers, governments, organic associations, and the growing awareness of environmental problems associated with agriculture led to the first regulations (Chapter 5) on organic farming in the USA and EU (Schmid 2007).

4.2 Values of Organic Farming

While organic standards provide criteria for organic agriculture, it is the organic values that reflect the principles of organic agriculture. The organic values or principles are the foundations and roots of organic agriculture. They express the global contribution of organic agriculture. Because of the different currents that have given rise to organic agriculture, and thus different values and principles, IFOAM launched a survey of global organic stakeholders in 2004 to define the principles of organic agriculture. As a result, the following principles were defined on which organic farming is based: the principle of health, the principle of ecology, the principle of fairness, and the principle of care (Luttikholt 2007). The IFOAM further describes the contribution of each principle as follows (IFOAM 2005, 4–6):

Principle of health: Organic Agriculture should sustain and enhance the health of soil, plant, animal, human and planet as one and indivisible.

Principle of ecology: Organic Agriculture should be based on living ecological systems and cycles, work with them, emulate them and help sustain them.

Principle of fairness: Organic Agriculture should build on relationships that ensure fairness with regard to the common environment and life opportunities.

Principle of care: Organic Agriculture should be managed in a precautionary and responsible manner to protect the health and well-being of current and future generations and the environment.

The big challenge here is to maintain the values of organic farming in the standards under globalisation, as it can contribute to the conventionalisation of organic farming. This can have negative consequences for the environment, animal husbandry, and rural development, and harm the image of organic. However, the standards have made global trade in organic products possible in the first place. Therefore Luttikholt (2007) summarises in her contribution to the

IFAOM values of organic agriculture that “the ideal solution would be a situation in which a balance can be realised between principles and standards” (p.356). At this point the IFOAM definition of organic agriculture should be mentioned. It is closely based on and intended to reflect the values of organic agriculture. As it is a definition for "all", issues such as markets, increasing demand and globalisation have not been included in order not to be biased towards the global North.

“Organic Agriculture is a production system that sustains the health of soils, ecosystems and people. It relies on ecological processes, biodiversity and cycles adapted to local conditions, rather than the use of inputs with adverse effects. Organic Agriculture combines tradition, innovation and science to benefit the shared environment and promote fair relationships and a good quality of life for all involved” (IFOAM 2008, 62).

This definition underscores the importance of ecological balance, social justice, and sustainable practices. Nevertheless, it still gives room for organic farming to evolve and provides an opportunity for new movements and innovations within organic farming. This in turn attempts to maintain the adaptive capacity of organic farming in order to enable governance interventions. These, along with institutionalisation, represent a crucial step in the pathway of a socio-technical transition in agriculture (Smith, Stirling, and Berkhout 2005).

5 Regulations, Certification and Logos of Organic Farming

Regulations form the legal framework ensuring compliance through inspection. Successful inspection by inspection bodies allows certification to use the organic logo and market products as organic. To use more than the basic EU organic logo, such as the logo of one of the German organic farming associations, a farmer must meet even stricter standards.

5.1 Regulations for Organic Farming

While the first standards for organic agriculture were being established, some countries had already published their first regulations for organic agriculture in the 1980s (e.g. Austria, France, Denmark), well before the first European regulations for organic production (Schmid 2007). At the time, the regulations were intended to remove barriers to free trade, allow governments to promote organic agriculture, and clearly distinguish organic agriculture from other types of agriculture (Lampkin et al. 1999; Michelsen 2002; Schmid 2007). National standards are anchored in law, providing legally enforceable definitions of organic production. In some cases, certification procedures and logos are also established. Regulations ensure compliance with established organic standards. They are often backed by penalties or legal consequences for non-compliance. Regulations typically include the certification process, inspection and accreditation of certification bodies, and provisions for the import and export of organic products. These regulations were critical for the legal and commercial definition of organic agriculture. This recognised and standardised organic farming practices and led to greater consumer confidence, which in turn stimulated market growth. The legal framework provided the basis for the development of the organic sector on a global scale, facilitating international trade and ensuring quality and uniformity.

The most influential international and transnational regulations for the global organic market are the EU Council (EEC) Reg. 2092/91, which came into force in 1993, and the USDA’s National Organic Program (NOP), which came into force in 2002 and for increased harmonisation of rules for organic production the Codex Alimentarius Guidelines from the FAO and WHO. Each of these strongly influences organic production and trade standards worldwide (Kilcher, Huber, and Schmid 2006). EC Reg. 2092/91 covered organic crop production and was developed in close cooperation with IFOAM. As the EC Regulation did not initially cover livestock, the EC Reg. 1804/1999 came into force in 2000, establishing common rules for organic livestock. The regulations also allow member states to have even higher national standards for livestock, but not to refuse imports on the basis of the regulation (Padel and Lampkin 2007). Regulations at the EU level are regularly revised and republished. The regulation EC Reg. 834/2007 replaced the regulation of 1991. In turn, this was supplemented by EC Reg. 889/2008, which established implementing rules for organic production, labelling and inspection. Additional regulations have been added, such as for aquaculture by EC Reg. 710/2009, which came into force in 2010 (Busacca and Lembo 2019). In 2022, the latest regulation to date came into force, EC Reg. 2018/848 on organic production and labelling of organic products, repealing Council Regulation EC Reg. 834/2007 (EC 2018).

In the United States, Congress passed the Organic Foods Production Act in the early 1990s. This was the basis for and authorised the creation of the NOP. In 1997, seven years after the act was passed, the National Organic Standards Board published the first draft of the standards. Emerging issues such as GMOs or the allowable use of irradiation were controversial at the time, and ultimately the NOP was modified through stakeholder involvement to meet the challenges of the time. The NOP was finally implemented in 2002 (Mosier and Thilmany 2016). Imports into the U.S. must be in full compliance with the NOP. The U.S. system allows certification bodies to act as agents for the U.S. certification program, which is published as part of the rule (Kilcher, Huber, and Schmid 2006).

Basic principles and standards for organic food production and labelling were also defined within the Codex Alimentarius Guidelines, published in 1991 by the FAO and WHO, for safer consumption and fairer trade (FAO and WHO 1999). The requirements in these Codex guidelines are consistent with the IFOAM Basic Standards and the EU Organic Food Regulation (EU Regulations 2092/91 and 1804/99). The guidelines are important to build consumer trust in the globalised organic market, but also to provide guidance to governments that are developing their own national organic food regulations. Especially for countries in the global south, it is important to meet EU or US standards in order to export organic products (Schmid 2007). The guidelines were to be reviewed every four years, but this has not been possible. For the list of input substances, there is a possibility of an accelerated procedure, which would allow a faster update of the changes. The technological progress of the organic food industry, the development of research in the field of organic agriculture/food and the growing awareness of the different consumer groups for such food lead to the need for constant updating of this list (Kilcher, Huber, and Schmid 2006).

By manifesting organic standards through regulation, the global trade of organic products was facilitated, and the agricultural system of organic farming became more mainstream. Regulations ensure that organic products meet uniform quality and safety criteria, build consumer confidence, and enable producers to access the organic market. This global framework supports the growth of the organic sector by facilitating compliance and trade. However, it is also responsible for the conventionalisation of organic farming, both in production and in the upstream and downstream supply chain. This has also institutionalised organic farming worldwide, thereby facilitating its growth beyond the early stages of development and establishing it as a promising alternative for a socio-technical transition of the agricultural system, yet regulations can also be seen as a barrier in the current system which need to be overcome (Darnhofer 2014).

5.2 Certification in Organic Farming

Certification is the process used to ensure that the farming practices comply with established regulations. It is the most commonly used regulatory instrument in agriculture (Brito, De Souza-Esquerdo, and Borsatto 2022). According to Article 34(1) of the EU Organic Regulation (EU) 2018/848, all operators who "produce, prepare, distribute or store organic or in-conversion products, which import such products from a third country or export such products to a third country, or which place such products on the market" (EC 2018, 39) must undergo an inspection procedure. The inspection bodies responsible for this vary from country to country and region to region. There are accredited private, governmental or a mixture of both inspection bodies (Janssen and Hamm 2011).

The resulting control sectors of German private control bodies are: A: Agricultural production; AA: Agricultural production - seaweed and aquaculture; AI: Agricultural production - beekeeping; B: Production of processed food; C: Trade with third countries (import); D: Awarding to third parties; E: Manufacture of animal feed. Depending on the federal state in Germany, control sector H: trade, is also certified, although in some federal states it is reported separately and in some federal states it is integrated into control sector B. The reporting chain of the certificates in the case of Germany goes from the inspection bodies, which report on a quarterly basis to the respective state authority, in Bavaria the Landesanstalt für Landwirtschaft (LfL) (Bavarian State Institute for Agriculture). The state authorities in turn report the data to the Bundesanstalt für Landwirtschaft und Ernährung (BLE) (Federal Agency for Agriculture and Food). Then the BLE is responsible for reporting the data to the Bundesministerium für Ernährung und Landwirtschaft (BMLE) (Federal Ministry of Agriculture and Food), which again forwards the data to the European Commission (EC) (also see Gambelli et al. 2014).

Certification serves two main purposes. First, it ensures compliance and allows for the use of the organic label, which permits distribution and sale of organically produced products. Second, certification is the instrument to strengthen the consumer's trust that the production or processing has been carried out in accordance with the regulations foreseen for this purpose (Dabbert, Lippert, and Zorn 2014). The consumer trust in the integrity of the product is paramount (Janssen and Hamm 2011) resulting in consumers who have high levels of trust in certification and certified organic foods in the EU (B. Murphy et al. 2022). Therefore, the certification system also requires a response to violations and non-compliance. However, this is vaguely defined in the EU and is left to the individual member states, which can lead to different approaches. The risk of non-compliance also varies depending on the characteristics of the farm (Gambelli et al. 2014).

However, organic certification is not without controversy. For smaller farms in particular, certification can be seen as a disincentive to conversion. The costs associated with certification can have an impact on the economic performance of a farm, with larger farms more likely to be able to afford the costs of certification (Montefrio and Johnson 2019). Currently the EU is trying to counteract the conversion barrier of the high cost of certification by allowing group certification of several small farms (Solfanelli et al. 2021). This approach aims to make organic certification more accessible and thus promote the spread of organic farming.

Certification is necessary to participate in the organic market, but it is not required to follow organic principles on the farm. A distinction must therefore be made between the decision to farm organically and the decision to be certified (Veldstra, Alexander, and Marshall 2014). This aspect also plays a role in the debate on the conventionalisation of organic agriculture. In addition, certification only verifies compliance in the production process, not the quality of the product (Jahn, Schramm, and Spiller 2005). The price premium in organic farming is justified not only by the higher production costs, but also by the quality of the products, which is still a matter of debate. This debate will not be explored in depth here, but for a deeper insight, see the review by Lairon (2010) on the nutritional quality and safety of organic food (Lairon 2010).

A farm inspection for producers seeking organic certification is very comprehensive (Table 1). This shows the extensive process of the inspection conducted in order to get an organic certificate. In addition to examining agricultural practices, the inspection also encompasses an

Table 1: Procedure of a farm inspection for producers (LfL 2023)

1. inspection of the farm documents	1.1 Description of the farm
	1.2. Field index for all areas, documentation of fertiliser uptake and pesticide use
	1.3 HIT database or other documents on the livestock
	1.4. Receipts for purchased inputs (e.g. seed, receipts from seed database)
	1.5. Receipts for the purchase of merchandise (e.g. for the farm store)
	1.6. Receipts for the sale of goods (e.g. to wholesalers, butchers)
	1.7 Stable book or comparable records
2. Inspection of all farm buildings (e.g. stables, warehouse)	
3. Inspection of individual parcels of land and crops	
4. Plausibility check of the quantities sold	
5. Verification of the declaration	
6. If necessary, checking the separation between organic and conventional production	
7. Monitoring the requirements from the conversion plan and the conditions imposed during the last inspection	

evaluation of the administrative and structural elements of the farm. This comprehensive inspection serves the purpose of ensuring the thoroughness of the inspection bodies and to build consumer confidence.

The need for certification in organic farming to access markets highlights a key issue in the Conventionalisation Debate, the discrepancy between strict standards and the innovativeness, accessibility and sustainability of organic farming. While certification ensures compliance and consumer confidence, it also raises questions about the economic feasibility for small producers and the potential shift to more conventional standardised practices by farmers to meet certification requirements.

5.3 Organic Logos

Logos play a crucial role in labelling products within the organic sector. They link between production and consumption and serve to differentiate organic products from conventional products for the consumer (Golan et al. 2001).

Organic logos have a long history, initially being inconsistent and varying from country to country (Janssen and Hamm 2011). Over the years, a proliferation of logos developed, which ultimately led to consumer confusion (Kuchler et al. 2020). However, consumer confidence in the logos is crucial for an organic logo to be effective (Jahn, Schramm, and Spiller 2005). As a result, the EU introduced a mandatory logo in 2010, which came into force by July 2012. The main purpose was to simplify the identification of organic products for the consumers (EC 2010b). Any product sold as organic was required to display the new EU logo together with an indication of the origin of the raw materials. The previous voluntary EU logo from 2000 and the various national governmental logos were to be standardised and made obsolete (Zander, Padel, and Zanoli 2015).

In addition to certification according to the EU regulations, even stricter regulations are required by organic farming associations (e.g. Biokreis, Bioland, Demeter and Naturland). Depending on the inspection body, certification according to the standards of the farming associations and the EU standards can be carried out in the same inspection. This allows the company to use the logo of the respective association in addition to the EU organic label (Janssen and Hamm 2012a).

The topic of organic logos has generated a great deal of research because the decision to buy organic products is crucial for the entire organic supply chain. It is beneficial for both producers and retailers to understand the decision-making process, consumer preferences and their willingness to pay for organic produce (Gerrard et al. 2013; Janssen and Hamm 2011). Many contributions were published on this topic, including studies showing that private logos are more trusted than the EU logo in the UK (Gerrard et al. 2013), that knowledge of the EU logo is generally low in different European countries (Zander, Padel, and Zanoli 2015), and that organic meat is associated with higher animal welfare standards and related environmental issues in Italy (Zanoli et al. 2013). A study from Greece shows that the new EU logo for organic products does not influence consumers' willingness to buy or willingness to pay (Anastasiou et al. 2017). A more recent paper by Murphy et al. (2022) points out that trust in organic certification and products can vary widely across European countries, depending strongly on how products are certified and marketed. Yet the study also shows an overall high level of consumer trust in the certification process throughout the EU (B. Murphy et al. 2022). Other studies on consumer perceptions of organic products use eye-tracking methods to show a preference for local over non-local products and logos over text (Katz, Campbell, and Liu 2019), as logos are more trusted than text on products (Janssen and Hamm 2014). The basic recommendations for policy makers are to increase awareness of the logos through campaigns, thereby increasing trust in the certification process and thus increasing consumer awareness and trust in the organic logos, especially the EU logo (Janssen and Hamm 2012b; Janssen and Hamm 2012a).

Organic logos are an important part of consumer awareness and retailer differentiation of organic products. Organic products are not only explicitly labelled on products but also on displays or signs in supermarkets. This establishment in the conventional retail sector also shows how far mainstreaming of organic produce has progressed and is an indicator of change. The proliferation of organic logos - from producer associations, states and the EU - are further signs of the institutionalisation of organic agriculture.

6 Policy Support for Organic Farming

Political support is made possible by the regulations that create the legal framework. There are several programmes that support organic agriculture. The focus here is on the EU level, Germany and Bavaria in particular.

6.1 The Common Agricultural Policy and Support in the EU

While organic farming was initially associated with a few political parties, widespread political recognition of organic farming began in the mid-1980s with growing consumer interest in organically produced food and the potential contribution of organic farming to policy objectives such as environmental protection, surplus reduction and rural development (Padel and Lampkin 2007). In the early 1990s, after the introduction of regulations, the first programmes for the promotion of conversions followed. EU policymakers' interest in organic agriculture grew for two reasons: first, it provided social, environmental, and other benefits to society that were only partially compensated through normal pricing. Second, organic farming was still a young industry. Support was justified by the need to increase consumer choice and assist the industry until it could independently compete in the free market, all while contributing positively to rural development (Dabbert, Zanoli, and Lampkin 2001).

6.1.1 The Common Agricultural Policy

With the establishment of the EU organic regulation, organic farming could now be promoted within the European agricultural policy, more specifically the Common Agricultural Policy (CAP). After national support schemes for organic farming already existed, the EU-wide agri-environmental support programme (EC Reg. 2078/92) was introduced within the 1992 CAP reform and implemented in 1994. This reform reduced price support and introduced compensatory payments. From now on, each EU Member State had to offer a scheme for grants to support the conversion or continuation of organic production. Support for organic farming was one of a number of agri-environmental measures (Padel and Lampkin 2007). The programme was partially financed by the EU (50 % - 75 %), with the remainder to be provided by each Member State or region (Lampkin et al. 1999). Although the CAP is now supposed to support organic farming through agri-environmental measures, this is only a small part of the CAP. The largest expenditure within the CAP is allocated to the Common Market Organization measures. The reasons for overproduction and high costs at that time can be traced back to the CAP measures, which sought to maintain price stability for agricultural products through a combination of import levies, intervention purchases and export subsidies. The 1992 CAP reform changed this, replacing price stabilisation mechanisms with direct payments for certain commodities, with production quotas and set-aside to counteract overproduction. The payment was now made per hectare for crop or per head of livestock (Padel and Lampkin 2007). In many cases it has been assumed that there is no difference between organic and conventional producers in terms of eligibility and therefore the impact is likely to be negligible. Since payments were no longer based on yield but on area, some organic producers benefited. However, arable farmers were not able to produce the same proportion of subsidised crops due to fertility-building crops. This led to a reduction of total income from direct payments on organic farms by up to 38 % in comparison with the income of comparable conventional producers (Häring et al. 2005). Yet this negative effect was not widespread among organic farmers, and the 1992 CAP reform turned out to be of little benefit to organic farmers. It even contributed to a negative effect on farmers' willingness to convert, as the conversion phase and the associated restructuring of the farm created greater uncertainty for the sales market (Padel and Lampkin 2007).

The EU's agricultural policy is reformed every seven years. The 1992 CAP reform was replaced by "Agenda 2000", which covered the years 2000-2006. There were no major changes for organic farming in the new support period. However, due to lower yields and high market demand for organic crops, the compulsory set-aside requirement for fully organic farms was lifted in 2002 (Padel and Lampkin 2007). A key change during this period was the introduction of the second pillar (Pillar II). While the first pillar (Pillar I), i.e. direct payments, was 100 % financed by the EU, Pillar II, which was devoted to rural development and environmental conservation, was co-financed by the respective Member State or region. Through this second pillar, organic farming could now be promoted, as agri-environmental instruments were obligatory within the rural development programmes. Environmental cross-compliance was introduced as a condition for member states for granting aid. At the same time, the possibility of reducing these supports (modulation) to finance rural development measures was introduced. Modulation aims to achieve a greater balance between the various measures to promote sustainable agriculture and rural development by progressively reducing direct support (Harvey 2015).

The reforms were revisited in 2003 due to ongoing tensions between the World Trade Organization and the EU over overproduction, as well as the EU's eastward enlargement and the associated increase in spending (Daugbjerg and Swinbank 2004). This led to the introduction of a single payment per farm rather than direct payments based on area or headage. At the same time, the EU gave member states more power to decide which programmes to implement, leading to a dilution of the CAP. This was crucial for organic farmers, because depending on the country or region, they were either equal, better off or worse off (Padel and Lampkin 2007). Organic farming has benefited significantly from the reallocation of funds from Pillar I (price support and direct payments) to Pillar II (rural development). Among the projects identified as rural development programmes, many involved the conversion of farms to organic farming and the local promotion of organic food processing (Josling 2015). Within the "Health Check" of the CAP in 2008 European agriculture was moved to a more competitive footing and the production potential of European agriculture through the abolition of set-aside and milk quotas was unlocked. Further direct payments to farmers were reduced by up to 10 % (Daugbjerg and Swinbank 2011).

The next 7-year period of the CAP was 2007-2013, and after the introduction of Pillar II, it continued and gradually included more organic farming measures. Funding changed during this phase of the CAP. Until then, CAP funding was provided by the European Agricultural Guidance and Guarantee Fund. From 2007, Pillar I was handled by the European Agricultural Guarantee Fund and Pillar II by the European Agricultural Fund for Rural Development (EAFRD).

Specifically, the EAFRD can support organic farming with its objectives set out in EC Reg. 1698/2005. These objectives are designed to contribute to the development of rural areas along four principal axes. Axis 1 is designed to enhance the competitiveness of agriculture and forestry through the provision of support for restructuring, development, and innovation. Axis 2 is designed to enhance the natural environment and the rural landscape by providing support for land management practices. Axis 3 is intended to enhance the quality of life in rural areas and encourage diversification of economic activity (EC, 2005). These measures each contain a variety of explicitly described measures, with Axis 1 containing 16 measures, Axis 2 containing 13 measures and Axis 3 eight measures (for a detailed list see EC Reg. 1698/2005) (EC 2005, 14f.). Axes 1-3 are directly related to the three concepts of sustainability: economic, environmental and social. Axis 4 is the LEADER approach (Liaison Entre Actions de Dévelopement de l'Économie Rurale). It is a bottom-up approach in which participating citizens develop their rural, well-defined region through specially developed measures, linking agri-environmental programmes with other sectors, such as tourism. The priority of the restructured Pillar II was to ensure that the four axes did not become isolated and unconnected. The EC focused on exploiting the potential for cooperation between the axes, for example in the context of organic farming. Here, support for agri-environmental initiatives could be strengthened through strategies in marketing, training and support for diversification of rural areas. While it may be difficult to identify widespread use of cross-axis strategies in the rural development plans of different member states, many national and regional organic initiatives have relied on support that cuts across the axes (Lampkin 2010). The 2008 CAP Health Check further decoupled support from production. In addition, the Health Check led to a stronger focus on sustainable farming practices, increased flexibility of support through rural development programmes, and modulation through financial reallocation to these rural development programmes, all of which indirectly benefit organic farming (Daugbjerg and Swinbank 2011; Sanders, Stolze, and Padel 2011).

The CAP period 2014-2020 aimed to promote greater sustainability in European agriculture. The focus was no longer only on the goods produced by farmers, but also on the provision of environmental public goods that benefit society. The "greening" component introduced for this purpose was anchored in Pillar I for direct payments and set at 21.7 % of Pillar I, with a maximum of 30 % of direct payments (Stolze et al. 2016). Payments were provided for three greening measures. These include maintaining permanent grassland, crop diversification (a farmer must cultivate at least 2 crops when his arable land exceeds 10 hectares and at least 3 crops when his arable land exceeds 30 hectares. Also the main crop may cover at most 75 % of arable land, and the two main crops at most 95 % of the arable area). Further farms with an area larger than 15 hectares (excluding permanent grassland) must maintain an “ecological focus area” of at least 5 % of the arable area of the holding – i.e. field margins, hedges, trees, fallow land, landscape features, biotopes, buffer strips, afforested area. This figure will rise to 7 % after an EC report in 2017 and a legislative proposal (EC 2013a). Violations of greening will result in penalties, although “greening equivalency” has been introduced for farmers who already comply with greening measures to prevent them from being penalised. This is especially true for organic farmers whose practices have already been shown to have positive ecological benefits (EC 2023).

Payments through rural development programmes must take into account the basic requirements for greening in order to avoid "double funding" of such measures (EC 2013a). The greening measures however proved ineffective and at the same time reduced the share of funding from the CAP budget's Pillar II rural development programme. As these are earmarked for agri-environmental climate measures such as buffer strips or organic farming, the majority of Pillar I funding is still based on area and not ecosystem services (Pe'er et al. 2019). This assertion is also supported by the contribution by Linares Quero et al. (2022), where they show through a comparative study of 15 cases across Europe that the area-based support of Pillar I is an obstacle to an agri-ecological transformation of agriculture in the EU (Linares Quero et al. 2022).

In addition to the support provided by the greening component in Pillar I, the visibility and promotion of organic farming has also changed in some areas in Pillar II. In the Rural Development Regulation EC Reg. 1305/2013, support for payments for the conversion and maintenance of organic farming is mentioned in Article 29. In addition, support for organic farming is allowed in Article 16, Quality schemes for agricultural products and foodstuffs and Article 17, Investments in physical assets (EC 2013b). The actual implementation of Pillar II rural development programmes is left to each EU Member State and can be selected from a list of 20 measures (EC 2013a). This also applies to measure 11, for the promotion of organic farming, although the proportion of organic land in the member states does not correlate with the amount of rural development programmes for measure 11. This shows different importance attributed to organic farming by member states (Stolze et al. 2016). In principle, the 2014-2020 CAP was seen as a well-intentioned attempt to make agriculture more sustainable and environmentally friendly by increasing the provision of public goods, but it failed to achieve precisely these goals. There was no clear signal for these objectives, which did not result in a boost for organic farming. On the other hand, although organic farming was strengthened and explicitly mentioned in Pillar II, the result for the development of organic farming is ambivalent, as it depends strongly on the prioritisation of the member state (Pe'er et al. 2019; Stolze et al. 2016).

The current CAP for the years 2023-2027 entered into force on 1st of January 2023. It was designed under the motto "a greener and fairer CAP". The following ten key objectives have been set: to ensure a fair income for farmers; to increase competitiveness; to improve the position of farmers in the food chain; to combat climate change; to protect the environment; to conserve landscapes and biodiversity; to support generational renewal; to create vibrant rural areas; to protect food and health quality; and to promote knowledge and innovation (EC 2020a). The CAP has a special role to play in this period, serving as a key instrument for implementing the Farm to Fork Strategy (EC 2020b) and Biodiversity Strategy (EC 2020c). These in turn are key building blocks for agriculture and rural areas in the European Green Deal (EC 2019). While it remains uncertain whether the CAP will meet its ambitions, some contributions already suggest that the current CAP may fall short of the European Green Deal's objectives (e.g. 25 % of agricultural land to be farmed organically) (Barral and Detang-Dessendre 2023; Cuadros-Casanova et al. 2023).

The issues with the post-2020 CAP were addressed in a report for the European Parliament, which also provided suggestions (Guyomard et al. 2020). The report highlighted the need to strengthen many technical provisions of the CAP, to make the attainment of targets legally binding and to improve their implementation, reporting and monitoring. Also a consistent food policy is recommended to complement the CAP, also incorporating interventions on food diets (Guyomard et al. 2020). Yet nothing was changed or modified since the first draft regulations. The possibility for member states to choose their own implementation policy for the CAP, introduced since 2013, is now becoming a problem, but at the same time it is the reason why the CAP is accepted by member states in the first place. Each Member State is obligated to prepare a strategic plan for the CAP 2023-2027. This should lead each country to develop a comprehensive, cross-pillar approach to support agriculture and rural areas (Grajewski and Becker 2023). The CAP is still seen as a policy to support agricultural area and not the production and environmental services it provides. The final recommendation from the report, “making the CAP more coherent with the Green Deal is perhaps the best guarantee for its own sustainability” (Guyomard et al. 2020, 138), would also benefit the development of organic farming.

6.1.2 European Green Deal and Farm to Fork Strategy

As the CAP is seen as a key instrument for the implementation of the European Green Deal and of the Farm to Fork Strategy during the last and current funding periods, these two concepts and strategies will also be briefly explained and described here. This is because the development of organic farming in Europe is strongly influenced by the framework of the European Green Deal and the Farm to Fork Strategy. Their inclusion is therefore necessary, as it is unwise to look at the development of organic farming today and in the future in isolation.

The European Green Deal sets the overarching framework for Europe's sustainable development in the coming decades and aims to "transform the EU into a fair and prosperous society, with a modern, resource-efficient and competitive economy where there are no net emissions of greenhouse gases in 2050 and where economic growth is decoupled from resource use“ (EC 2019, 2). Regarding the environment, agriculture and food, it aims „to protect, conserve and enhance the EU’s natural capital, and protect the health and well-being of citizens from environment-related risks and impacts " (EC 2019, 2).

The European Green Deal includes eight major measures aimed at making various sectors such as energy, mobility, agriculture and construction more sustainable. Among these, organic farming can have the greatest impact on success of From ‘Farm to Fork’: designing a fair, healthy and environmentally-friendly food system, and is anchored in this measure. However, organic farming can also contribute to the objectives of other measures of the European Green Deal, e.g. reducing soil and water pollution, preserving ecosystems and biodiversity, increasing resilience to climate shocks or sustainable economic growth in rural areas, thus demonstrating the added value and synergies of organic farming. The fact that the EU has recognised the necessity and importance of the agriculture, food, soil and biodiversity sectors is reflected not only in the Farm to Fork Strategy, but also in the Soil Strategy (EC 2021a) and Biodiversity Strategy (EC 2020c) that have also been adopted. Both strategies will have a mention here, but will not be the subject of further discussion, as organic farming does not play a central role in them. All these strategies attempt to make agriculture more sustainable as part of the European Green Deal, although this is a very complex and challenging undertaking, as Boix-Fayos and De Vente (2023) found. According to the authors, the main challenges are maintaining crop yields, crop nitrogen requirements, land requirements, changing diets, reducing food waste and externalities. They also conclude that the transition to a more sustainable agriculture can only work through the holistic inclusion of technical, social, economic, cultural and environmental aspects due to the multitude and diversity of challenges (Boix-Fayos and De Vente 2023).

Through the Farm to Fork Strategy the EC calls attention to "the urgent need to reduce dependency on pesticides and antimicrobials, reduce excess fertilisation, increase organic farming, improve animal welfare, and reverse biodiversity loss" (EC 2020b, 3). The goal is to build a food chain that works for producers, consumers, the climate and the environment, while increasing the robustness and resilience of the food system. To achieve this, the EC identifies three main thematic blocks as follows. First ensuring that the food chain, covering food production, transport, distribution, marketing and consumption, has a neutral or positive environmental impact, preserving and restoring the land, freshwater and sea-based resources on which the food system depends; helping to mitigate climate change and adapting to its impacts; protecting land, soil, water, air, plant and animal health and welfare; and reversing the loss of biodiversity. Second ensuring food security, nutrition and public health – making sure that everyone has access to sufficient, nutritious, sustainable food that upholds high standards of safety and quality, plant health, and animal health and welfare, while meeting dietary needs and food preferences. Third preserving the affordability of food, while generating fairer economic returns in the supply chain, so that ultimately the most sustainable food also becomes the most affordable, fostering the competitiveness of the EU supply sector, promoting fair trade, creating new business opportunities, while ensuring integrity of the single market and occupational health and safety (EC 2020b).

Implementation was divided into six areas of the food system and explicit goals were anchored in them. These are ensuring sustainable food production; ensuring food security; stimulating sustainable food processing, wholesale, retail, hospitality and food services practices; promoting sustainable food consumption and facilitating the shift to healthy, sustainable diets; reducing food loss and waste; combating food fraud along the food supply chain. Organic farming is presented as a possible solution for the goal of ensuring sustainable food production. In the course of this, the need for further support for organic farming is mentioned, as according to the EU "it has a positive impact on biodiversity, it creates jobs and attracts young farmers. Consumers recognise its value" (EC 2020b, 8). This makes organic farming a crucial approach at the European strategic level, which should also manifest its new importance in future decisions. In order to meet this requirement and to support member states in stimulating supply and demand for organic products, as well as to increase consumer trust and demand, the EC introduced the Action Plan for the Development of Organic Production in 2021 (EC 2021b).

6.1.3 EU Action Plan for the Development of Organic Production

The Action Plan for the Development of Organic Production builds on the achievements of the action plan for the period 2014-2020. The target of 25 % organic production of the total agricultural area set in the Farm to Fork Strategy is very ambitious considering the development so far (Eurostat 2023). Therefore, the current action plan "aims to encourage a marked increase of the share of organic farming in the EU, through encouraging farmers to convert to organic farming, and to expand the accessibility of organic food to close the gap between a business-as-usual growth curve and the "extra effort" necessary to reach a 25 % target by 2030" (EC 2021b, 3). The action plan is divided into three axes, based on the structure of the food supply chain (producers, processors, retailers and consumers). This includes 17 subtopics with 23 planned actions (see appendix table A1 for detailed prescription). In the action plan, the EC also emphasises that organic farming is a key building block in the transition to more sustainable agriculture, providing a fair income while contributing to vibrant rural and coastal areas. For monitoring purposes, follow-up meetings with representatives of the European Parliament, member states, the Union's advisory bodies and stakeholders will take place every two years and a mid-term report will be prepared for 2024 (EC 2021b). The three axes reflect the awareness that it is necessary to develop the entire organic sector and not just production or consumption. The actions show more intensive efforts to support and develop the entire organic value chain. It also introduces points for more targeted action on research and innovation, consumer trust and knowledge transfer within Agricultural Knowledge and Innovation Systems. It remains to be seen whether the action plan can achieve the EU's ambitious goal with the target of 25 % organically farmed area. This is also the view of IFOAM, which sees the achievement of the target as a challenge but welcomes the new action plan because of the more specific measures, actions outside the EU level and the timetables for most of the actions. Especially actions 2, 3, 4, 9, 14, and 16 are considered to have the greatest potential contribution (IFOAM 2021).

6.2 Policy Frameworks and Support in Germany

Support for organic farming in Germany is presented here in two parts. First, the German strategic plan for the CAP 2023-2027 is briefly explained, following on from the previous chapter. Second, the German measures for the promotion, development and support of organic agriculture, which are independent of the EU, are presented.

6.2.1 German National Strategic plan for CAP 2023-2027

In the current CAP period 2023-2027, the majority of CAP funds in Germany continue to flow into area-related direct payments. In order to meet the requirements for Pillar I direct payments, the so-called "conditionalities" have become stricter compared to the fulfilment of cross-compliance in previous years. While the share of the basic payment in Pillar I is 59 %, the direct payment types "eco-regulation" (23 %) and "grazing premium" (2 %) have been added to Pillar I. It shows the tendency towards an agricultural policy oriented towards the common good but is still far away from the calls of the Wissenschaftlicher Beirat für Agrarpolitik, Ernährung und gesundheitlichen Verbraucherschutz (Scientific advisory board for agricultural policy, nutrition and consumer health protection) to achieve a CAP for the common good in the post-2020 era (Wissenschaftlicher Beirat für Agrarpolitik, Ernährung und gesundheitlichen Verbraucherschutz 2018). An ex-ante evaluation was carried out to analyse the German National Strategic Plan and to assess the contribution of the plan to the ten objectives of the CAP. The administrative demarcation of subsidies for specific purposes has been criticised as underestimating the real impact of measures, which usually serve multiple purposes. It also points out that the CAP is an important component of support for agriculture and rural areas, but that there are other policy instruments available to provide support. Organic farming is mentioned in the context of achieving a number of objectives. It serves to improve the farmer's position in the supply chain by focusing on quality in primary production, which organic farming can serve.

Organic farming also serves the objective of environmental protection, which is supported under the second pillar. The same applies to the objective of improving social needs for food and health. The expansion of organic farming should play a decisive role here, while it receives substantial funding of almost 2.7 billion euros, but the target of 14.1 % of agricultural land (in the 2027 budget year) falls far short of declared EU and national policy goals (Becker et al.

2022). In its report Evaluation of support for organic farming in draft CAP Strategic Plans (2023-2027), IFOAM has shown how the new CAP 2023-2027 contributes to the development of organic farming across Europe and specifically in each Member State. IFOAM shows that the budget earmarked for the promotion of organic farming in Germany is too low to promote it adequately. At the same time, Germany is reducing the level of payments for organic farming compared to the previous period (2014-2022). This is due to the double funding problem caused by eco-schemes and rural development measures. Farmers who participate in the eco-scheme for the expansion of grassland will have 50 € deducted from their rural development payments (eco-premium payments). The German government's ambitious target of 30 % organic farmland by 2030 is considered unlikely to be achieved, as the organic share is currently 11 % and is only expected to increase to 14 % by the end of the funding period in 2027. The difference between 14 % and 30 % does not seem achievable in the remaining 3 years until 2030. The IFOAM points out that “the biggest effect to create more advantage for organic farmers would be if deductions of rural development measures are kept at an absolute minimum level” (IFOAM 2022, 23). From the perspective of organic farming, the current CAP period represents rather a step backwards in terms of development support, which will also have a decisive impact on the German target of 30 % organic farmland by 2030. Nevertheless, there are also other policies and programmes at national and regional level that are intended to contribute to the development of organic farming independently of the CAP.

6.2.2 Zukunftsstrategie ökologischer Landbau

Germany's efforts to achieve sustainable development can be found in its latest sustainability strategy from 2021 (Deutsche Bundesregierung 2020). Organic farming is listed there under the field of action "Sustainable agriculture and food systems", one of six measures in the sustainability strategy. In order to achieve the objective of a sustainable agriculture and food system, the Zukunftsstrategie ökologischer Landbau (ZöL) (Future Strategy for Organic Agriculture) was introduced in 2017 (BMEL 2019). Its objective is to support the development of organic agriculture with 24 measures divided into five fields of action (Table A2). In 2017 and in its second edition in 2019, the medium-term goal of the ZöL was 20 % organic farmland in Germany by 2030.

Although the efforts were generally considered to be promising, a final report was written on the subject of Assessment and impulses for the further development of the future strategy of organic farming (Sanders, Lampkin, and Liebl 2020). This report specifically addressed aspects that the authors felt needed further development. Extension services were found to be comparatively good, although some improvements were suggested, such as encouraging conversion advice from other farmers. With regard to education, the inclusion of organic topics in the vocational training of young farmers was recommended, which should be strengthened through cross-border cooperation. The production of domestic and low-cost protein feed should be supported, e.g. through political support or networking of actors from research, extension and the value chain. Policymakers can make a significant contribution to market growth, for example by providing regional market data or strengthening the organic value chain. Out-of-home consumption is seen as having great potential, and a recommendation is made to improve the regulatory framework and the networking of actors in the organic value chain. For research to improve the performance of the organic farming system, practical research networks should be created, linking organic farms with an affinity for research. This is the only way to develop solutions for the diversity of farming systems and regionalities and to strengthen the resilience of organic farming. The ZöL also has a crucial role to play in shaping a coherent and growth-oriented regulatory framework. Finally, in the context of the new CAP reform, sufficient funding for environmental services is needed. In this context, the ZöL offers itself as a discussion platform to concretise the ideas of the federal states and the federal government. The report concludes by stating that a 20 % area share remains an ambitious goal. Such an expansion is only conceivable if all the relevant players in economy and politics pull together and act coherently in their respective areas of competence.

6.2.3 Bio-Strategie 2030

With the change of government in Germany in 2021, the leadership of the Bundesministerium für Ernährung und Landwirtschaft (BMEL) (Federal Ministry of Food and Agriculture) also changed. The green federal minister of food and agriculture was tasked with developing the ZöL and at the same time achieving the goal of 30 % organic land in Germany by 2030, as set out in the coalition agreement. As a result, the Bio-Strategie 2030 (BS2030) (Organic Strategy 2030) (BMEL 2023) was drafted and presented to the public in November 2023. It builds on the ZöL and addresses current issues such as the coronavirus pandemic, the war in Ukraine, and the climate crisis. The BS2030 is not only the national strategy for achieving the 30 % target, but also supports many other national policy projects, such as the Action Program on Climate Change, the German Sustainability Strategy, the National Water Strategy, the National Strategy on Biological Diversity, the National Livestock Strategy, the Climate Protection Act, the Strategic Plan for Germany for the Implementation of the CAP and Rural Development as well as the goals agreed in the Key Issues Paper on the Food Strategy. The key action areas of the BS2030 were developed through participatory multi-stakeholder processes at various events. The central contents of the BS2030 are to better reward the public welfare services provided by the organic farming and food sector; to support the processing and trade of organic food and to increase its share in the out-of-home sector; to strengthen research, knowledge transfer, data availability and infrastructure for the organic food chain, in particular for breeding; and to reduce bureaucracy in order to facilitate the conversion to organic farming. Four fields of action along the value chain and two accompanying fields of action have been identified and developed. These fields of action are filled with a total of 30 measures (Table A3). It remains to be seen to what extent the BS2030 can contribute to achieving the German government's ambitious target of 30 % by 2030. While organic farming associations such as Bioland and Bund Ökologische Lebensmittelwirtschaft (BÖLW) (Federal Association of Organic Food Producers) welcome BS2030 and its measures (Bioland e.V. 2023; BÖLW 2023), Foodwatch is sceptical about the strategy and says "the 30 % target is a fairy tale of the Greens" (Foodwatch 2023). In fact, it is questionable whether the efforts to achieve this ambitious goal are sufficient and feasible, partly due to political disagreements within the governing parties and the reduced government budget of 60 million euros.

6.3 Policy Support in Bavaria

Political programmes and legal foundations for the development and promotion of organic farming range from the European level to the level of the member states and, in the case of Germany, also to the level of the federal states (Bundesländer). This research focuses on the state of Bavaria, which can be understood as a geographical and administrative region. A political programme, the BRB2020, was introduced in 2012 which was followed by the programme BioRegio 2030 (BR2030), both of which are now assessed in detail.

6.3.1 BioRegio Bayern 2020

In 2012, the Bavarian State Government, with the Minister of Agriculture, Helmut Brunner, introduced the BRB2020 (StMELF 2017). It pursues a holistic approach that focuses education, extension, funding, marketing, and research on the needs of organic agriculture. The aim was to double the production of Bavarian organic food by the year 2020. Development measures have been defined for each of these blocks.

Education on organic farming should be anchored in various institutions. Organic farming was more comprehensively anchored in the curricula of vocational schools and agricultural colleges. Since the winter semester 2015/2016, the University of Applied Sciences Weihenstephan-Triesdorf also offers a course in organic farming. In addition, training courses for teachers from vocational schools and technical colleges have been held as part of the "Organic Farming Education Campaign". In order to train people as farm managers, but also for organic associations or inspection bodies in organic farming, two state technical colleges, the Landshut-Schönbrunn and Weilheim Technical Colleges for Agriculture, offer the course "Organic Farming". The two academies for organic farming in Kringell and Bamberg offer modular further education courses with different emphasis on organic farming for farmers who have already completed their education or for lateral entrants.

Three structures are at the forefront of extension. Five offices for food, agriculture and forestry in Bavaria have specialised centres for organic farming. The advisors in Bamberg, Neumarkt, Deggendorf, Ebersberg and Kaufbeuren are contacts for conventional farmers who want to know more about converting to organic farming. The advice offered there is known as orientation advice. These structures have changed since July 2021 as part of the "Reorientation and Modernization of the Agricultural Administration" in Bavaria. There are now 32 Ämter für Ernährung, Landwirtschaft und Forsten (ÄELF) (offices for food, agriculture and forestry) throughout Bavaria that offer advice on organic farming, although it is questionable whether the quality of the advice can be maintained due to the significant expansion. Another structure is the Öko-Modellregionen (organic model regions), in which associations of municipalities contribute to strengthening organic farming with innovative projects and concepts. In the initially twelve, and as of March 2024, 35 Öko-Modellregionen, various regional initiatives are committed to establishing and expanding the marketing of regional organic food. The Öko-Modellregionen are intended to promote organic agriculture along the entire value chain and to raise the ecological awareness of the population and those in positions of responsibility. As a final building block, the BioRegio-Betriebsnetz (BRB) (BioRegio farm network) was established. It was analysed as part of this dissertation. It is a network of 100 long-standing and excellently managed organic model farms. They serve as competent contacts for farmers interested in converting to organic farming, but also for other groups from educational institutions and schools. The meetings take place on the model farmer's farms, allowing a combination of theoretical and practical demonstrations.

The area of funding is aimed at rewarding environmentally friendly farming and providing support for stable construction and marketing. The Bayerische Kulturlandschaftsprogramm (KULAP) (Bavarian Cultural Landscape Programme), which has been offering compensation payments for voluntary environmentally friendly farming measures since 1988, has been promoting organic farming since 2000. With the reorientation in 2012 with regard to climate, soil and water protection, biodiversity and the preservation of the cultural landscape, Bavaria recognised the achievements of organic farms within the KULAP even more than before. In 2012, the premiums amounted to €273/ha for arable land and grassland; €468/ha for horticultural land; and €975/ha for permanent agricultural crops. Based on the figures from the Staatsministerium für Ernährung, Landwirtschaft und Forsten (StMELF) (State Ministry of Food, Agriculture and Forestry) (StMELF 2023a), the premium amounts are now €314/ha for arable land; €284/ha for grassland; €485/ha for vegetable/horticultural land; and €1000/ha for permanent agricultural crops. New entrants to organic farming on the whole farm are granted the following allowance during the conversion phase in the first two commitment years: €423/ha for arable land and grassland; €630/ha for vegetables/horticultural land; and €1,300/ha for permanent agricultural crops.

The Bayerischen Sonderprogramm Landwirtschaft (Bavarian Special Programme for Agriculture) and the Agrarinvestitionsförderprogramm (Agricultural Investment Support Programme) are intended for structural support, such as building barns or converting from tethered to loose husbandry for dairy cows. This is intended to help organic farmers make future decisions towards organic farming. The processing and marketing of regional organic agricultural products is also supported. So far, for example, bottling or pasteurisation plants and storage facilities have been supported. The grants support regional processors with necessary investments for their future viability.

The BRB2020 programme foresees four blocks in the area of marketing development. Various events will be held with the aim of better informing consumers about organic farming. As part of the Bavarian Organic Experience Days, consumers have the opportunity to gain an insight into organic farming through farm festivals, guided tours, lectures, cooking events or hikes. In addition, trade fairs such as BIOFACH in Nuremberg give regional and national actors in the organic sector the opportunity to present themselves and connect.

Further the Bavarian organic label was introduced at the end of 2015 to meet consumer demand for higher quality and traceable origins of raw materials and their processing. It serves consumers when they shop and stands for organic quality that exceeds legal requirements, regional origin of raw materials and their processing, and a multi-stage, state-approved control system. All raw materials must come from Bavaria and all production and processing steps must take place in Bavaria.

However, the goal of doubling production could not be achieved by conversion to organic farming alone. For this reason, a broad alliance of organisations from agriculture, processing, trade, gastronomy, commerce, consumers, and society concluded the Ökopakt (Pact for Organic Agriculture) (StMELF 2023b). The participants are working to strengthen organic production in Bavaria and to expand organic farming. This is to be achieved through public relations work, educational and advisory measures, the use and sale of local organic products, marketing measures and consumer advice. Initially, 15 stakeholders signed the pact with StMELF, which has since grown to 36 members as of April 2023.

The fifth area of BRB2020's holistic approach is research. In Bamberg, three hectares of open land and 1000 sqm of modern greenhouses are used to conduct trials on current topics of horticultural practice in Bavaria. Cultivation trials on topics of interest to Bavarian horticulturists (field crops, variety trials) will be advanced. For example, the use of pelletised sheep's wool as a nitrogen fertiliser has been put into practice (StMELF 2023c).

In the area of organic nutrition, but also to stimulate demand, the aim is to supply organic products to out-of-home catering in kindergartens, schools and company canteens. Consumers are to be encouraged to buy and process Bavarian organic food. The aim is to communicate the "added value" of organic and regionally produced food. The Kompetenzzentrum für Ernährung

(KErn) (Competence Centre for Nutrition) was also opened in Kulmbach. Projects related to organic conscious nutrition, such as the analysis of the procurement situation for regional organic products in Bavaria, are to be supported there.

In the Annual report on organic farming, processing and marketing in Bavaria (Kaniber 2021) of the StMELF, represented by Minister of Agriculture Kaniber, from April 2021, the developments of the BRB2020 were referred to. The LfL was commissioned to evaluate the goal of doubling domestic production. In order to be able to compare all organic products produced in Bavaria at the level of the primary producer, the production, i.e. the production on land and in animal husbandry, must be extrapolated to a uniform monetary basis. The result was a change of 126 % in crop production and 91 % in livestock production, resulting in a final change of 94 %. Only farms that applied for the KULAP measure 'organic farming' were evaluated. According to the report, the error is likely to be small because the remaining farms are not taken into account. A much greater limitation of the evaluation is the lack of recording of harvest and production volumes of organic farms, with the exception of organic milk. Therefore, no reliable information could be provided, so the change is expressed in hectares or number of animals. In general, the report only provides an overview of topics such as market development, use of the Bavarian organic logo, extension services, Öko-Modellregionen, and out-of-home catering. It is difficult to assess the development of the BRB 2020 because no key figures were defined for the development of the sub-areas except for the main goal. In addition, there is an overview of the research projects and the approved funds from 2019/2020 for projects for the further development of organic agriculture (total €1,790,243) and projects related to organic agriculture (total €1,885,844).

6.3.2 BioRegio 2030

Since 2020, the BRB2020 has been continued by the BR2030 (StMELF 2023c). Its objective is to have 30 % of Bavaria's agricultural land cultivated organically by 2030. At the same time, the state programme aims to strengthen sales and demand in order to avoid market distortions.

The following eleven measures are planned to achieve the objective. Promotion of the Bavarian organic logo; improved exchange between all players in the organic market; support for Öko-Modellregionen; increased use of regional organic food in out-of-home catering; conversion of state-owned farms to organic farming; establishment of a practical research farm network for organic farming; teaching of the contents of organic farming in the training of green professions and in the food and nutrition trade; demand-driven expansion of organic farming education at agricultural schools; organic plant breeding at the LfL; establishment of the Bavarian Organic Board with the aim of further improving the networking of organic actors in Bavaria's agricultural and food industry and thus promoting market development in the direction of "Organic from Bavaria"; and expansion of the Bavarian Ökopakt.

In contrast to the BRB2020, the focus on "extension" is no longer listed in the BR2030. The structures for farm advisory services for farmers interested in conversion, which were still listed individually in the BRB2020, from the ÄELF, the BRB and the Öko-Modellregionen, are now no longer so clearly bundled for the focus on advisory services but can be found again in other subtopics. It seems that extension advice is no longer given the same attention. However the LfL has an information brochure (LfL 2020), which is also available online, on the decision to convert and the associated advice, which covers all the key points. The goal of BR2030 seems to be very ambitious, since the previous development in Bavaria from 2013-2020 showed an increase of the organic area of the total agricultural area from 6.9 % to 12.1 % (DeStatis 2022). The latest data from the StMELF from December 2022 shows a share of 13,4 % organic area in Bavaria (Kaniber 2023). This represents growth of 6.5 percentage points from 2013 to 2022, while growth of 16.6 percentage points from 2022 to 2030 would have to be achieved.

Following the Annual report on organic farming, processing and marketing in Bavaria from April 2021, as described in chapter 6.3.1, a further report was published in May 2023. In addition to the similar information on the development, special attention was paid to the development in the Öko-Modellregionen. In addition, for out-of-home catering the goal following goal has been set. “By 2025, at least 50 percent of the food used in all state canteens should come from regional or organic production" (Kaniber 2023, 37). The new wording is striking in that regional products can now also be used and not just organic products. In addition, there is again an overview of the research projects and the approved funds from 2021/2022 for projects for the further development of organic agriculture (total €2,402,008) and projects related to organic agriculture (total €1,058,100).

Policy support for organic farming has been introduced at the EU, German and Bavarian levels. At all levels, there is a shift in focus and perspective from pure agricultural production to the entire agri-food system. Incentives to reward environmental services are increasing. The overarching support programme, the CAP, also shows similar tendencies, although it remains focused on regulating agricultural area. In Germany and Bavaria, a holistic approach to support for organic farming is also being pursued. However, in view of the area targets set for organic farming, the political efforts do not seem to be sufficient. A sudden increase in organic area is not expected in the next few years. At the European level, the different conditions for the development of organic farming in the member states are taken into account, which, however, drives the idea of the CAP ad absurdum. The problem in agriculture is therefore so immensely complex because it is responsible for producing affordable food, but at the same time is expected to provide environmental services. Also it is becoming less and less attractive to run a farm (Dedieu et al. 2022). Nevertheless, more sustainable agriculture is a crucial building block in the development of a sustainable society. A clearer political positioning for organic agriculture at all levels is needed for further steps in setting the framework for a transition.

Policy support for organic farming is a crucial aspect of the transition of organic farming and its contribution to a more sustainable agricultural system. The CAP, the European Green Deal and national initiatives such as the German Strategy for the Future of Organic Farming and the Bavarian BioRegio programmes illustrate how targeted policy measures can foster the transition to more sustainable farming practices. While these policies provide financial and structural support, their contribution to promote changes in cultural, social and economic norms is less clear. Yet these are also needed to create a more resilient and sustainable agricultural system and to understand the farmer’s expectations. Nevertheless, the integration of environmental, economic and social objectives illustrates how policy frameworks can coordinate the transformative potential to support efforts for a system change in agriculture.

7 Actors in Organic Farming in Bavaria

For a better understanding of the circumstances in the context of the development of organic agriculture in Bavaria, the actors and their sphere of influence are identified and explained here. The aim is to show the interconnectedness, the specificity of the actors and the complex influences in organic agriculture in Bavaria. The role of actors and their assumed roles is of significant importance in the transition to a sustainable agricultural system (Wittmayer et al. 2017). In particular, networks of actors can establish and modify rules and practices in alternative niches over time (Bui et al. 2016). It can be argued that niches and regimes are networks of actors oriented towards and adhering to certain rules and practices (Holtz, Brugnach, and Pahl-Wostl 2008). It is therefore of great importance to identify the most significant actors within the Bavarian organic sector in order to ascertain the potential for organic farming to facilitate a transition to a more sustainable agricultural system in Bavaria.

7.1 State Authorities

The highest authority for agricultural matters in Bavaria is the StMELF. Together with its subordinate authorities and offices, the StMELF is responsible for ensuring high-quality and healthy nutrition, preserving forests and the cultural landscape, strengthening agriculture, rural areas and Bavaria's attractiveness as a tourist destination. In addition to the 32 ÄELF, the Ämter für ländliche Entwicklung (offices for rural development), the LfL, the Bayerische Landesanstalt für Weinbau und Gartenbau (LWG) (Bavarian State Institute for Viticulture and Horticulture), the Bayerische Landesanstalt für Wald und Forstwirtschaft (Bavarian State Institute for Forestry), the Bayerische Amt für Waldgentechnik (Bavarian Office for Forest Genetic Engineering), the Technologie- und Förderzentrum (Technology and Support Centre), the KErn, the Kompetenzzentrum für Hauswirtschaft (Competence Centre for Home Economics), the Bayerischen Staatsgüter (Bavarian State Farms), and the staatliche Führungsakademie für Ernährung, Landwirtschaft und Forsten (State Management Academy for Nutrition, Agriculture and Forestry) are responsible for implementing the responsibilities of the StMELF. Most of these authorities interact with organic farming, but especially the ÄELF, the LfL, the LWG, the KErn or the Bavarian State Farms.

The Competence Centre for Organic Farming is located within the LfL. Various research and development projects are coordinated in five working groups, which also serve as a hub for knowledge transfer between research and practice. The working groups are Systems Research in Organic Agriculture; Crop Production Systems in Organic Agriculture; Systems Issues in Animal Husbandry in Organic Agriculture; Legumes and Agroforestry Systems in Organic Agriculture; and BR2030 Network Projects. The Organic Academy for Viticulture and Horticulture is located within the LWG. It offers support in the decision to convert to organic farming, practical days and specialist conferences for producers, marketers and consumers, as well as qualification courses for the profession of organic farmer, gardener or winegrower. The KErn bundles knowledge about nutrition in Bavaria. It is responsible for out-of-home catering in Bavaria, one of the topics of BR2030. The KErn is also responsible for tasks related to the Bavarian organic label.

7.2 Organic Farming Associations and Umbrella Organisation

The four largest organic farming associations in Bavaria are Biokreis, Bioland, Demeter and Naturland. The history, development and ideologies of the organic farming associations are different, but they all have in common the additional and usually stricter requirements and guidelines based on the minimum criteria of the EU Organic Regulation. There are also additional costs associated with membership. Membership can bring benefits, for example in terms of marketing and pricing. It also enables a more intensive exchange with colleagues. Demeter expects its member farms to work according to biodynamic principles, which go back to Rudolf Steiner's Anthroposophical approaches of 1924. There are also differences in animal husbandry, e.g. tethering, castration of piglets, dehorning or the use of conventional protein feed (BLE 2022).

As an umbrella organisation, the Landesvereinigung für den ökologischen Landbau e.V. (LVÖ) coordinates the work of the associations and promotes organic farming at a political and social level. It carries out public relations work, provides advice and training and works closely with other organisations to improve the framework conditions for organic farming. This coordination helps to strengthen the joint presence of the individual associations and to communicate a uniform strategy for the promotion of organic farming in Bavaria (LVÖ 2023). This is achieved through activities in the following areas: Promotion of agricultural production according to the guidelines of organic farming and natural landscaping; stimulation of the end consumption of organic farming and organic food products; and influencing the organisation of state legislation and public administration in order to improve the financial and legal framework conditions for organic farming. Public relations, advisory services, organisational support, research and science, and training are to be used to achieve these goals. The political work of the LVÖ is integrated into a broad network of organisations and institutions from the fields of agriculture, politics, economy, science, environment and nutrition. At the same time, it works closely with the BÖLW.

7.3 Producer Associations in Organic Farming

Each of the four major organic farming associations has a producer association in Bavaria (Bioland Erzeugerring Bayern e.V.; Erzeugerring für naturgemäßen Landbau e.V.; DEMETER Erzeugerring für biologisch-dynamischen Landbau e.V.; and Biokreis Erzeugerring e.V.). The producer associations support farmers in converting to organic farming and provide their members with expert advice on cultivation in accordance with the EU Organic Regulation. Advisors from the associations are also active within the framework of the association's advisory service. The advice is complemented by the ÄELF. The four producer rings are members and organised in the Landeskuratorium für pflanzliche Erzeugung in Bayern e.V. (State Board for Plant Production in Bavaria e.V.).

7.4 Farmer Interest Groups

The largest association of farmers in Bavaria is the Bayerischer Bauernverband (BBV) (Bavarian farmers organisation), which represents the interests of Bavarian agriculture and forestry and acts as a service provider. It represents the interests of both organic and conventional farmers. The State Expert Committee for Organic Farming, one of the committees of the BBV, deals with current issues in organic farming as well as with cross-cutting issues that affect both conventional and organic farms in Bavaria. At the same time, the committee aims to strengthen organic farming in Bavaria, to bundle the concerns of all organic farms organised in the BBV and to incorporate them into the association's work. According to the BBV homepage (BBV 2021), it unites about 135,000 farming families. Over the years, the German Farmers' Association has built up a large network in politics, agro-chemistry, state authorities, and the agri-food industry, which helps it to exert a strong influence on political decisions (Nischwitz, Chojnowski, and Eller 2019).

An alternative to the very influential BBV is the Arbeitsgemeinschaft bäuerliche Landwirtschaft e.V. (AbL). Like the BBV, the AbL represents the interests of conventional and organic farmers and advocates for sustainable, socially and environmentally compatible agriculture and the corresponding political framework conditions. The central concern of the AbL is to raise awareness of social issues in agriculture. The aim is to prevent one-sided economic or environmental views from ignoring the people involved and thus the social effects of policies. The AbL positions itself in opposition to the BBV, as the latter represents the interests of large farms and the agricultural industry too one-sidedly (AbL 2024).

7.5 Training and Research Facilities

For the development of organic farming in Bavaria there is a need for training opportunities for newcomers, farmers or those who want to become organic farmers. The two state academies for organic farming in Kringell and Bamberg are aimed at interested organic farmers as well as conventional farmers who are interested in special aspects of organic farming. Farms in the orientation phase receive practical decision support and those changing careers can qualify for the farmer's qualification. The two training centres in Kringell and Bamberg offer modular training courses with different emphases on theoretical and practical aspects of organic farming. While the focus in Kringell is on animal production, the seminars offered in Bamberg focus on organic fruit, vegetable and viticulture. Basic training as a farmer is provided by the agricultural college. At the state agricultural colleges in Landshut-Schönbrunn and Weilheim, you can specialise in organic farming and graduate in three semesters as a state-certified organic farmer or master farmer.

The University of Applied Sciences Weihenstephan-Triesdorf (HSWT) and the Technical University of Munich (TUM), Campus Weihenstephan, offer bachelor programmes with a specialisation in organic farming. In addition, both institutions conduct research on organic farming and sustainable agricultural systems in various departments. The research activities of the two universities are complemented by the LfL with the Competence Centre for Organic Farming. The LfL is also located in Freising in close proximity to universities, which facilitates cross-institutional cooperation and research projects.

The current ensemble of official institutions supporting organic agriculture indicates a high level of legitimacy and institutionalisation of organic farming in Bavaria. Note that many other actors are involved in organic agriculture in Bavaria, including farmers, processors, certification companies, wholesalers, retailers and consumers. Together, these diverse actors involved in organic farming in Bavaria, from state authorities to farmers' associations and educational institutions, form an interrelated construct that supports the development of organic farming and a possible transition to more sustainable agricultural practices. This already indicates that organic agriculture is mainstreamed in Bavaria and that transition making is advanced. The actions and cooperation of these different actors is crucial in moving organic farming forward and enabling change. Their collective efforts help promote the values of organic agriculture, ecological balance, economic viability, and social justice. By understanding the roles and interactions of these actors, we can better assess the complexity and potential of organic agriculture as a transformative force for the agricultural system in Bavaria and beyond.

8 Development of Organic Farming in Bavaria

Since organic agriculture is a matter of institutional significance, efforts have been made to measure its development (Seufert and Ramankutty 2017). However, data on organic farming and its development is often incomplete or requires further explanation for better understanding. Despite incomplete data sets, trends in development can still be recognised. The following section discusses the development of organic farming in Bavaria. It uses various parameters such as the number of farms, agricultural area dedicated to organic farming, farm size, arable crops, and animal husbandry. To understand the proportional development, the data on the development of organic farms and organic cultivated area is compared to all farms or the total agricultural area. Limitations of the data are mentioned when discussing the respective diagrams.

8.1 Statistical Data on Development

Figure 1 and Figure 2 are compiled from data available from LfL that indicate growth in the area of organically farmed land and the number of organic farms from 2003 to 2021 and from 2012 to 2022. The variation in values is due to differences in the databases used. Figure 1 is based on farms reported by organic inspection bodies according to inspection areas. Figure 2 shows data from farms registered in the KULAP for organic farming (KULAP B10 or A11). After 2012, the two diagrams display similar trends. There is a slight increase in both the area and number of farms from 2012-2014, which becomes more pronounced from 2015 onwards. The charts also indicate a reversal in the ratio of area to farms. The data indicates that the average area farmed per farm is steadily increasing even as the number of farms increases. This trend is also demonstrated in Figure 5. The years 2012-2021 can be selected for a comparable time horizon. Here, the percentage growth for the number of farms and the area is 73.1 % and 98.2 % for Figure 1 and 76.9 % and 94.2 % for Figure 2. Although the exact percentage changes differ, both confirm an increase in the area and number of farms. Nevertheless, the data in both diagrams cannot be claimed to be complete. Figure 1 lacks some data as not all inspection bodies submitted their data. Additionally, the data reports certified farms according to the control sector, but a farm can be inspected in multiple control sectors, allowing it to carry out further processing in addition to agricultural production. According to the organic inspection bodies, the farms are then no longer purely agricultural. Figure 2 shows that

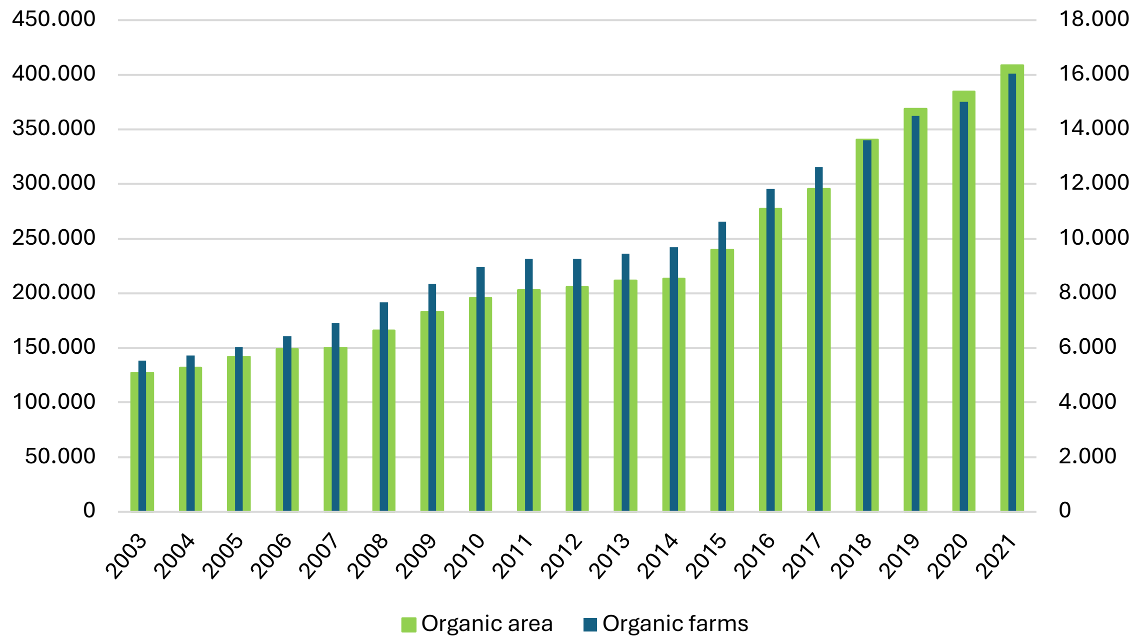

Figure 1: The development of the organically cultivated area (ha) and the organic farms in Bavaria reported by the inspection bodies. According to the LfL, some figures are incomplete as some inspection bodies have not provided any data (LfL 2024).

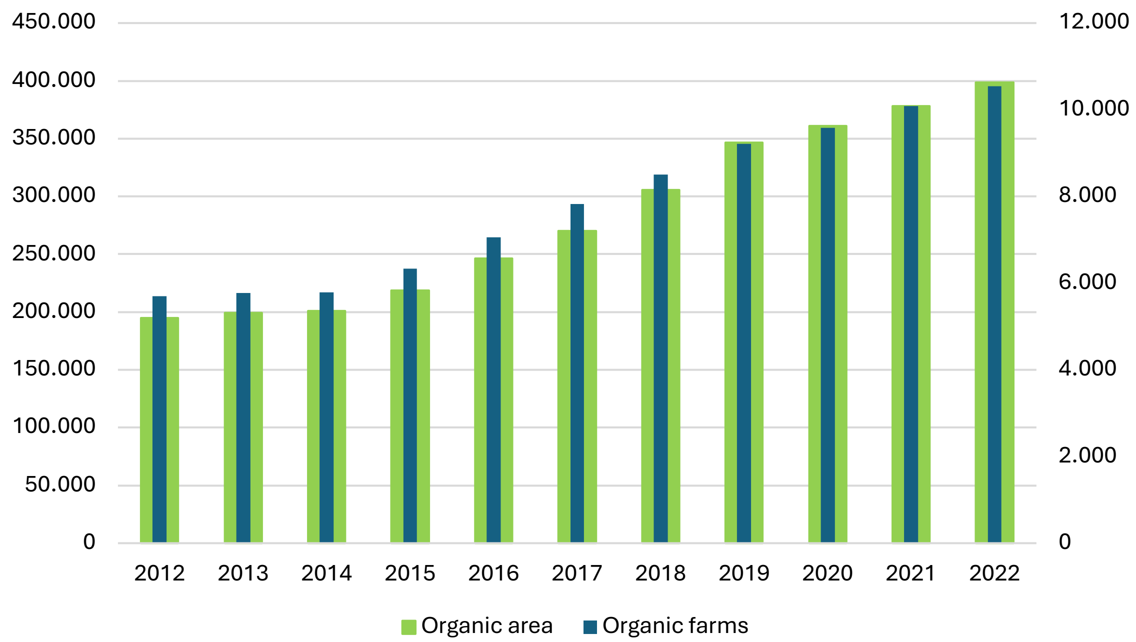

Figure 2: The development of the organically cultivated area (ha) and the organic farms in Bavaria which have applied for KULAP B10 or A11 and are therefore eligible for support for organic farming (LfL 2024b).

not every organic farm has applied for KULAP B10 or A11. This means that some farms may practice organic farming but have not applied for KULAP and therefore would not be included in this data.

To improve classification of the previous values, they must be related to the overall agricultural data. These data come from agricultural censuses conducted every 3-4 years throughout Germany, unlike the data from Figure 1 and Figure 2. Still Figure 3 confirms the trend in the number of organic farms in Bavaria over the years. The total number of farms has shown a negative trend, while the number of organic farms is increasing. This has resulted in the percentage of organic farms in relation to all farms increasing. In 2010, only 5.8 % of farms were organic, but by 2020, this figure had already risen to 11.6 %. This represents a growth of 71.8 % in the number of organic farms between 2010 and 2020, while the number of all farms decreased by 14 %.

Similarly, the organic area has steadily increased over the same period, while the total agricultural area has slightly decreased (Figure 4). As in Figure 3, this trend favours the share of organic. In 2010, the share of organic area is only 6.1 % and develops to 12.1 % by 2020. The organic area is 93.9 % more in 2020 than in 2010, while the total

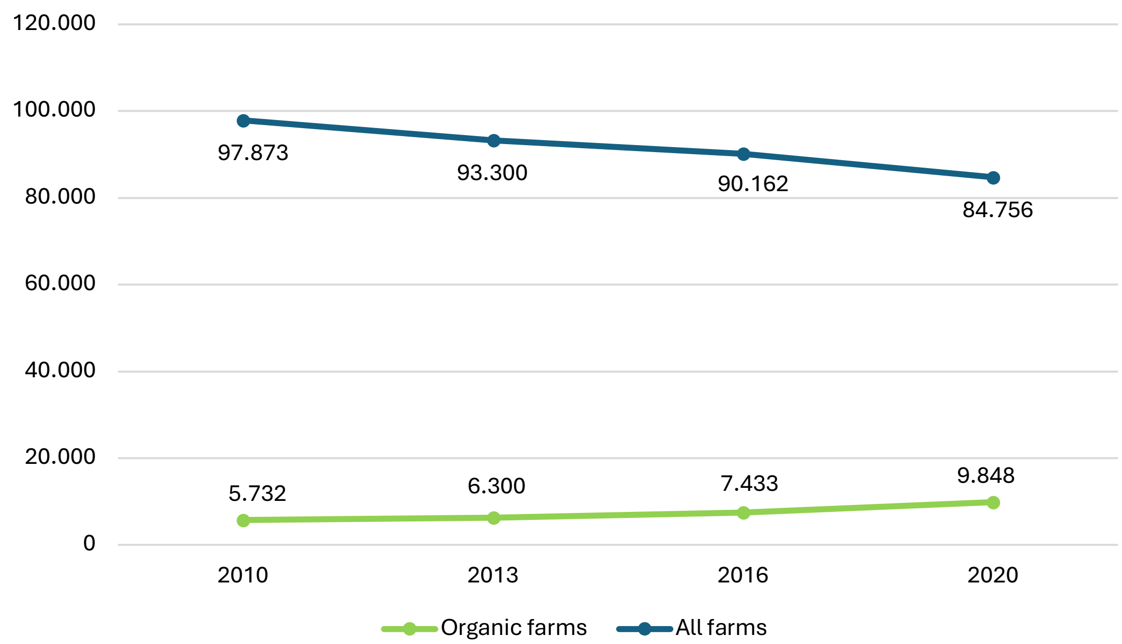

Figure 3: Number of farms and organic farms in Bavaria over the years according to the agricultural census (DeStatis 2024).

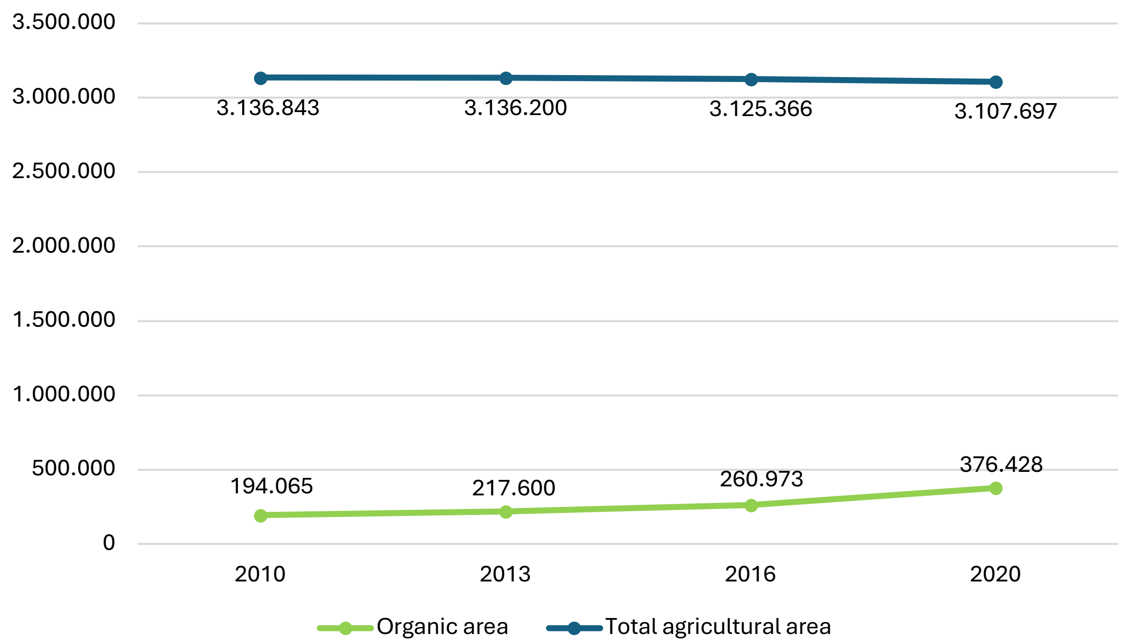

Figure 4: Agricultural area and agricultural area with organic farming (ha) in Bavaria over the years according to the agricultural census (DeStatis 2024).

agricultural area decreased by 0.93 % in the same period. The data in Figure 3 and Figure 4 are taken from the agricultural census, which is conducted for the whole of Germany. As this can only be carried out every 3-4 years, possible changes in a shorter period cannot be captured and limit this data set.

Figure 5 confirms the findings from the previous four figures that organic farms are increasing in size. In general, there is an increase in the number of farms in each size category between 2010 and 2020. In particular, the 20 to <50 ha category lost 4 percentage points and under 5 ha lost 0.72 percentage points of the total number of farms over the same period. Conversely, the categories 50 to <100 ha (1.89 percentage points) and 100 to <200 ha (1.63 percentage points) showed the largest proportional increase. The rather small category 5 to <10 ha also increased from 14.17 % to 14.82 % of the total number of farms. If the time horizon is changed from 2016 to 2020, a different picture emerges. During this period, the percentage share of the small area categories decreased (under 5 ha from 2.57 % to 2.02 %; 5 to <10 ha from 15.11 % to 14.82 %; 10 to <20 ha from 28.93 % to 28.54 %; 20 to <50 ha from 32.80 % to 31.12 %). On the other hand, the trend of the share of larger farms shows a consistently positive picture (50 to <100 ha from 15.3 % to 16.97 %; 100 to <200 ha from 4.56 % to 5.35 %; 200 to <500 ha from 0.7 % to

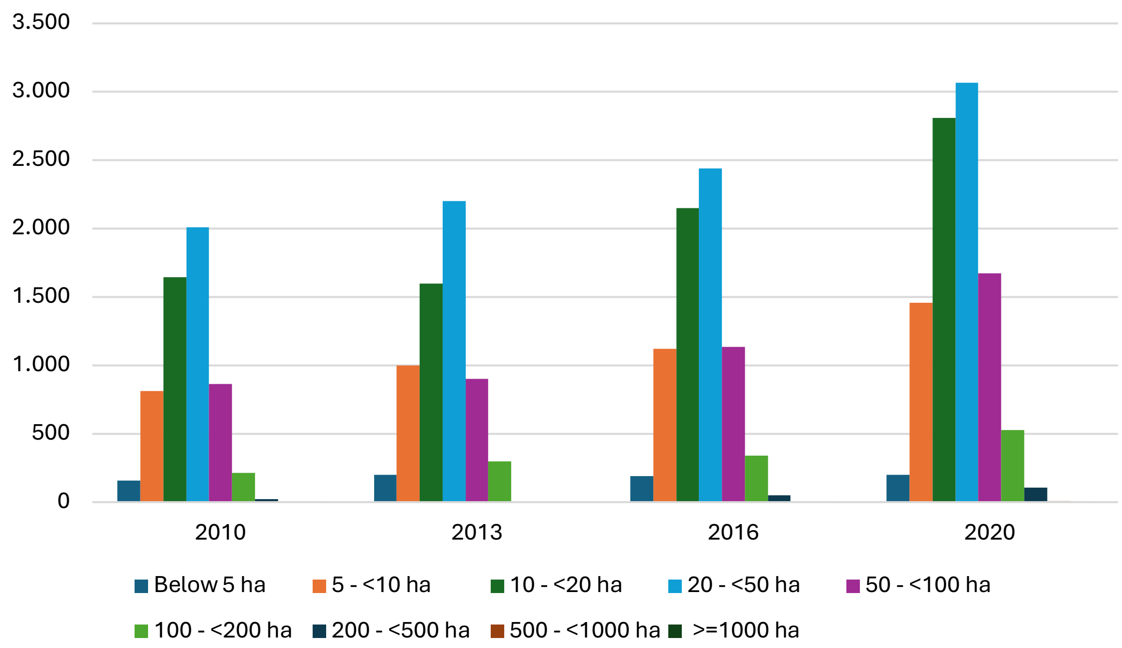

Figure 5: Number of organic farms by size category in 2010, 2013, 2016 and 2020 in Bavaria (DeStatis 2024).

1.1 %; 500 to <1000 ha from 0.03 % to 0.07 %). In general, the size of organic farms in Bavaria is rather small. Together, the two categories 10 to <20 ha and 20 to <50 ha already account for 59.7 % of all farms in Bavaria in 2020 (5876 of 9848). If the adjacent categories are also included, i.e. all farms between 5 to <100 ha, 91.54 % of all farms are already covered (9006 of 9848). The number of farms larger than 200 ha is very low at 116. From this data, it can generally be concluded that the size of organic farms in Bavaria is rather small, but are slowly increasing in size.

In addition to the data on the number of farms, size and area, the different types of organic farms are now discussed in more detail. For this purpose, a distinction is made between the number of livestock farms and the number of animals as well as other farm types such as arable farming, horticulture or fodder farms.

Table 2 shows the changes in livestock farms and animals on organic farms, with a focus on cattle, pigs, sheep, and chickens, as these were the only animals recorded in all four agricultural censuses. It is worth noting that only since the 2020 census have the animals been subdivided more specifically, such as dairy cows, piglets, or laying hens. Unfortunately, these animal categories could not be selected to show comparable data.

Table 2: The development of organic farms with livestock, the number of animals kept organically and the average number of animals per farm over the years in Bavaria (DeStatis 2024).

	Year	Cattle	Pigs	Sheep	Chickens
Farms	2010	3.501	632	633	1.669
	2013	3.700	700	700	2.000
	2016	4.074	507	695	1.728
	2020	5.096	509	901	2.485
Animals in organic husbandry	2010	162.098	32.381	37.578	237.333
	2013	183.600	28.800	38.000	437.900
	2016	216.261	30.674	43.795	827.877
	2020	276.183	35.427	54.145	1.436.094
Animals per farm	2010	46,30	51,24	59,36	142,20
	2013	49,62	41,14	54,29	218,95
	2016	53,08	60,50	63,01	479,10
	2020	54,20	69,60	60,09	577,91

From 2010 to 2020, the number of farms with pigs decreased noticeably. During this period, the number of farms with cattle, sheep, or chickens increased by 42 % to 48 %. Notably, the number of organically kept pigs also increased. This is demonstrated by the ratio of animals per farm for pigs, which increased from 51 to 69 pigs per farm. While the number of sheep increased by 44.09 % and cattle by 70.38 %, the growth in chickens was exceptionally high at 505.01 %. As a result, the number of chickens per farm also increased from an average of 142 chickens to 577. The growth rate for cattle per farm has decreased by 17 percentage points, while the number of sheep per farm has remained relatively stable over the years, ranging from 59 in 2010 to 60 sheep per farm in 2020. The data indicates that cattle farms outnumber all other livestock farms combined. In contrast, the number of organic pig farms is decreasing. The figures from 2013 are all rounded, which is a notable observation. However, it is unclear why this is the case.

All farm types, except horticulture, have shown growth from 2010 to 2020 in organic farming (Table 3). Livestock farms are not included in this table as they have already been presented prior to that. The highest number of farms in 2020 are fodder farms, which are also involved in arable farming, but for fodder production rather than as a cash crop like the arable farms in the

Table 3: Number of farms, area and area per farm (ha) by organic farm type and orientation. For combined crop or combined livestock, farms are grouped together that cannot be assigned to one of the other farm types due to the specified thresholds (DeStatis 2024).

		Arable farming	Horticulture	Permanent crops	Fodder
Farms	2010	1.267	80	113	3.459
	2013	1.600	100	200	3.700
	2016	1.939	84	149	4.374
	2020	3.120	73	216	5.357
Organic area	2010	42.052	889	1.080	116.877
	2013	50.300	-	-	126.400
	2016	63.662	1.127	1.500	156.239
	2020	120.594	684	2.280	202.705
Area per farm	2010	33,19	11,11	9,56	33,79
	2013	31,44	-	-	34,16
	2016	32,83	13,42	10,07	35,72
	2020	38,65	9,37	10,56	37,84
		Finishing	Combined crop	Combined livestock	Crop and livestock
Farms	2010	72	74	95	572
	2013	100	-	-	600
	2016	104	94	105	584
	2020	157	93	156	676
Organic area	2010	1.924	3.254	3.548	24.441
	2013	2.100	-	-	26.800
	2016	3.009	2.913	4.184	28.341
	2020	5.640	4.731	5.363	34.430
Area per farm	2010	26,72	43,97	37,35	42,73
	2013	21,00	-	-	44,67
	2016	28,93	30,99	39,85	48,53
	2020	35,92	50,87	34,38	50,93

table. The organically farmed area for arable farming and fodder type farms is by far the highest, while the area used for horticulture is negligible at 684 ha. An increasing number of farms can be classified as crop and livestock farms, meaning they cultivate land for crops and have animal husbandry. The number of crop and livestock farms has increased by 118 % over the period 2010 to 2020, indicating a growing trend towards a mixed farm type. Although small in total

number, the combined crop farms have the largest area on average, alongside the crop and livestock farms, at just over 50 ha. On average, the combined livestock, finishing, fodder, and arable farms are 34-38 hectares in size. However, horticulture and permanent crop farms are significantly smaller, at around 10 hectares.

The figures for organic farming in Bavaria show a steady growth over the last decade. They show that the demand for organic products from Bavaria is growing steadily, with different products enjoying different levels of demand, which is partly due to the changing lifestyle of society. Growing numbers also lead to new development steps that bring new challenges. In general, these figures are evidence of products that have reached the masses of society and are in high demand. Such volumes require professional structures for storage, logistics and distribution, which indicates further progress into the mainstream. The interplay between supply and demand and the associated economies of scale will be decisive for further development.

8.2 Organic Farming in Bavaria

As previously outlined in the preceding contextual chapters, organic farming is not merely a distinct form of agricultural production. The reputation and status of organic farming on a global scale, as well as within the European and German contexts, have been shaped by a multitude of actors. Consequently, the evolution of organic farming has been influenced not only by a series of historical events, actors, and actions, but its future trajectory will also be determined by them. Every organic farm in Europe has been shaped by historical events and decisively influenced by overarching measures at the European level since the early 1990s.

A similar situation can be observed in Bavaria. However, the Bavarian organic sector has its own development trajectory, which can be attributed to a number of actors, groups of actors, and decisions. Historically, southern Germany was an area where some pioneers and early organic protagonists settled (Vogt 2007). However, the landscape of southern Germany cannot be generalised, which is also evident in Bavaria. The southern region of Bavaria is characterised by the Alps and the foothills of the Alps. In contrast, the northern region is much flatter, with the Danube plain being a particularly noteworthy area. The eastern region of Bavaria is notable for its woodlands, particularly in the Bavarian Forest. The northern region of Franconia also exhibits an undulating landscape but with low rainfall and here viticulture is prominent.

This concise overview already highlights the considerable diversity of the landscape in Bavaria. While other attributes, such as soil quality or climatic features, and distinctive crops, including asparagus, wine, and hops, warrant further examination, they are beyond the scope of this summary. Given the prominence of agriculture in Bavaria, it is unsurprising that this sector plays a significant role in the state's politics. The Bavarian government, under the leadership of the Christlich-Soziale Union (CSU) (Christian Social Union), has long exploited this fact and enjoys close ties with farmers and their largest representative, the German Bauernverband (Nischwitz, Chojnowski, and Eller 2019). This power imbalance continues to influence the structure and direction of agriculture in Bavaria to this day. However, Bavaria also has interest groups that are explicitly committed to the development of organic farming, such as the LVÖ, in which the four farming associations have joined forces. This structure testifies to the special position of organic farming in Bavaria. Furthermore, the special status of organic farming is reflected in research, with the State Academies for Organic Farming and the Universities (Chapter 7.5). Furthermore, the state programme BRB2020 and its subsequent iteration, BR2030, illustrate the political significance of organic farming. At the time, it was the first federal state in Germany to establish an organic farming promotion programme. It is noteworthy that, despite the conservative leadership of the StMELF at the time by Helmut Brunner (CSU), such a forward-thinking decision was made for the advancement of organic farming. Organic farms generally require fewer external resources such as fertilisers, herbicides, or pesticides. Consequently, they are less attractive to large agricultural companies such as BayWa, Germany's largest agricultural trader, as there is less potential for profit. In the interviews conducted with organic farmers for this dissertation (Chapter 0), it was mentioned on several occasions that they were initially rather negative about Minister of State Brunner. However, in retrospect, they acknowledge that he was the best thing that could have happened to Bavarian organic farmers and the development of organic farming in Bavaria. His successor, Minister of State Kaniber, was often accused in the interviews of merely managing Brunner's achievements and glossing over the current situation of organic farming. It is therefore necessary to subject the political view of organic farming to further scrutiny.

The data published by the state government and its evaluation are consistently positive, and organic farming is presented as a success story. However, this presentation is viewed critically, as has emerged from discussions, telephone calls, and interviews conducted as part of this dissertation. As is often the case in politics, figures are presented in a way that has the greatest possible impact. Upon examination of the data in isolation and in proportion, it becomes evident, that the anticipated goals stated in the B2030 programme (30 % organic area by 2030) will be hard to achieve (Chapter 8.1). The reasons for this are manifold and the factors behind the decision to convert to organic farming are diverse. As the targets are measured solely in terms of area, conversion to organic farming is crucial to achieving the targets. However, it is not sufficient to focus solely on conversion: the entire organic sector must be considered. Upstream and downstream structures, processes, and actors are equally important in ensuring that conventional farmers convert and that converted farmers do not revert to conventional practices again. In order to achieve a sustainable change in the agricultural system, it is necessary to consider the entire sector, as well as the external and internal influencing factors. Organic farming can be considered the cornerstone of sustainable agriculture. Organic farming has become so firmly anchored in our society that it can serve as the most promising prototype for sustainable agriculture. This is evidenced by its history and the development steps it has already undergone, including the definition of standards and regulations, its anchoring in political agendas, support systems, certification processes, public recognition, and its contribution to sustainable agriculture.

However, it is precisely in these areas that thorough monitoring and strategies for the future are needed. In addition to the dwindling number of farms, the general trend in agriculture also shows the closure of processors, especially slaughterhouses. This affects both conventional and organic processors. This bottleneck, which is becoming ever more acute, was frequently mentioned during the discussions within this dissertation, because longer transportation routes combined with additional stress on animal welfare will bring the sustainability of organic farming into question. Furthermore, the agricultural sector is burdened by the actions of politicians, which have the potential to negatively impact the entire industry. The most recent farmer protests, which were triggered by the abolition of subsidies for agricultural diesel, serve as an expression of farmers' discontent. In general, however, the incentives for greater animal welfare, sustainable agriculture, and a higher regional quota are insufficient. It is uncommon for farmers to relinquish financial compensation for altruistic views, as every farm must be operated in an economically sound manner. A calculation of environmental impacts based on scientific findings and the associated sanctions or remuneration would presumably serve as a push factor to break up the prevailing conventional structures. Criticisms of organic farming, such as lower yields or higher costs in production and trade, are fundamentally not far-reaching enough. Yields can be increased through more research and better techniques. In this context, upstream and downstream issues such as yield destruction in the field, food waste, year-round availability of products, and feeding the world's population must also be addressed so that yield is no longer the decisive argument when simply comparing conventional and organic farming. The same applies to the higher costs of organic production and products. Organic products are more expensive due to a more labour-intensive cultivation method, which varies depending on the crop. Furthermore, lower yields necessitate higher prices per unit or kilogram for economically sound farming. The pricing of upstream and downstream environmental damage caused by intensive conventional cultivation would significantly reduce the large price difference between conventional and organic produce (Carolan 2018). It is conceivable that factors such as quality, animal welfare, sustainability, and regionality may exert an even more pronounced influence on purchasing decisions. However, this also shows that society needs to rethink its diets and purchasing behaviour. It is therefore evident that a more expensive, sustainable and environmentally friendly product, such as meat, would be purchased and consumed less frequently. The argument of social inequality that is often raised in this context, namely that only wealthier people would then be able to afford such products, would have to be counteracted by better education in schools and campaigns, not only with regard to food but also with regard to farming methods. Nevertheless, these processes are challenging to implement, time-consuming, and the outcomes are difficult to quantify.

The assessment of organic farming in the context of Bavaria is complex. Some aspects can be regarded as positive (e.g. development of figures, institutional structures), while others indicate potential for improvement (e.g. monitoring and data availability, achievement of stated objectives). Given that the organic sector is not a fixed entity, spatial and topic-specific solutions are necessary to facilitate positive development for the future of organic farming.

Clearly, programmes such as BRB2020 were conceived as a preferred strategy for the promotion of growth and further development of the organic sector. Nevertheless, the holistic approach attributed to them merits scrutiny. While the measures are undoubtedly far-reaching, the term "holistic" seems somewhat overambitious in this context. Challenges and barriers that arise in the process must be identified and overcome in a manner that is harmonious with the farmers, as they are the foundation of agriculture and organic farming. A clear political commitment to organic farming, moving away from a narrow political perspective towards a broader, more inclusive approach that considers the common good, would be beneficial for the entire agricultural sector in Bavaria, as it would facilitate the transition to more sustainable agriculture. It is necessary to disrupt these structures and patterns from above and below in order to distribute responsibilities and to ensure accountability. The target of 30 % organic area by 2030 in Bavaria is unlikely to be achieved. Instead, the focus should be on strengthening organic farming by setting the political framework conditions in such a way that the incentive to convert increases and by addressing the needs of farmers in general. In a relatively brief period, the effects of climate change, such as dry soils or heavy rainfall, and political conflicts, such as those in Ukraine, have tested the resilience of the agricultural system. Organic farming can contribute to the improvement of soil quality with enhanced water retention capacity and reduced environmental pollution. However, in order to achieve more resilient commodity chains of agricultural products, the concept of regionality must also be considered. The combination of organic and regionality would enhance the resilience of the agricultural system and reduce its dependence on external factors from global supply chains or markets (Hunt et al. 2015; Moreno-Pérez and Blázquez-Soriano 2023). Nevertheless, the implementation of this approach requires political commitment and social awareness-raising, which is frequently thwarted by interest groups and social reluctance.

9 Organic Farming today

To gain insight into the current state of organic farming, it is essential to examine the evolution of organic farming, and the challenges and prospects discussed in the debates around organic farming (Chapter 2) and the chapters on the background and insights on organic farming (Chapter 3-7).

In a comprehensive article on the subject, Reganold and Wachter (2016) set out to evaluate organic farming in the twenty-first century. They do so in the context of four key sustainability metrics: productivity, environmental impact, economic viability, and social well-being. With regard to productivity, they demonstrate that it is approaching conventional agriculture in terms of harvesting, with explicit attention to the crop grown and the spatial conditions. These are crucial to the variance. The environmental impact is generally lower, but this is offset by relatively poor land use efficiency. Even so, this too has improved significantly in recent decades, partly due to more professional mechanisation. The profitability of organic farming is also very dependent on the farm. However, it is becoming increasingly clear that with environmental awareness and the possible inclusion of externalities in the costs, organic farming would become financially more attractive than conventional farming (Carolan 2018). The social impact of organic farming and the wellbeing it generates has been relatively understudied, but some studies indicate that it can have a positive impact on the economic development of communities (MacRae, Frick, and Martin 2007) and can lead to increased employment of farm workers and cooperation among farmers (Mendoza 2004). Thus, the article by Reganold and Wachter (2016) reveals the diversity and interconnectedness of the organic food system, which renders it a dynamic and fascinating subject (Reganold and Wachter 2016). Areas of organic farming that have also found their way into science and warrant brief mention here include consumer behaviour, purchasing decisions, regulations, and policies. These topics are also directly and indirectly related to and influence other areas.

An understanding of the historical roots of organic farming provides insight into its evolution. In terms of absolute numbers, organic farming remains a relatively minor global phenomenon. However, in Europe, it has already become a widespread form of agricultural production. The potential benefits of organic farming are diverse and extend to both plant cultivation and animal husbandry. Under prevailing local natural and social conditions, an organic farm can operate in a manner that is both economically healthy and beneficial to the community. In addition, organic farmers have the option of aligning themselves with the standards and values of organic farming through compliance, which provides them with a sense of stability and security in a world characterised by increasing tensions and uncertainties. The institutions and mechanisms that regulate these development paths, such as precisely defined regulations and the associated certifications, serve to reinforce the legitimacy of organic farming in politics and society. The contemporary understanding of organic farming has undergone a significant transformation. In contrast to the pioneers, who perceived it as an integrated agricultural system with the primary objective of enhancing soil health, which subsequently results in improved well-being for animals, humans, and society, it is currently predominantly conceptualised as "chemical-free." This understanding is reflected in practices and regulations worldwide. In all organic regulations, the term "organic" is primarily defined in terms of the distinction between "natural" and "artificial" substances that may be used (Seufert, Ramankutty, and Mayerhofer 2017).

Organic farming must further demonstrate its value and efficacy against the conventional farming system. The soft factors, such as social structure and secure farm succession, are often difficult to quantify. The advantage of lower externalities is challenging to perceive when purchasing an organic product. Conversely, the parameters that are more easily measured put organic farming to the test against other farming methods. In the current context of climate change, sustainability represents the most compelling argument in favour of organic farming. However, this advantage must be continually demonstrated. Nevertheless, organic farming must continue to evolve, potentially incorporating established approaches from conventional agriculture while somehow maintaining its identity and values. Achieving this delicate balance represents a significant challenge. It is important to note that 100 % organic farming is a utopian ideal that may have negative consequences as well. The goal is not to impose this ideal on conventional farmers, but rather to provide them with an alternative perspective on organic farming. This will enable them to convert to organic farming and contribute to a more sustainable agricultural system. Today, organic agriculture shows considerable progress and potential in terms of productivity, environmental impact, economic efficiency, and social value added. In these terms, it is clear that organic agriculture serves as a sustainable alternative to conventional agriculture.

10 Data and Methodology

A mixed-methods approach, encompassing a literature analysis, stakeholder interviews, an online questionnaire, and manual data extraction, was used in this research (Balnaves and Caputi 2001; Creswell and Creswell 2023; Mayring 2014; Silverman 2024). A more detailed account of the data collection and analysis can be found in the scientific articles (Chapter 0).

An extensive literature analysis was conducted to identify the topic, embed the work within the existing literature, and identify potential scientific contributions. The qualitative data collection was conducted through semi-structured interviews with five individuals from various offices engaged in organic farming in Bavaria and eight organic model farmers affiliated with the Bio-Regio Betriebsnetz. An online questionnaire was developed for the quantitative data collection. The survey was distributed to all 100 model farms within the Bio-Regio Betriebsnetz. The response rate was 22 %. A further quantitative data set was generated through manual extraction. A total of 12,904 organic certificates were recorded for the Federal State of Bavaria. For this purpose, all zip codes in Bavaria were entered into the BVK - Bundesverband der Öko-Kontrollstellen e.V. (Federal Association of Organic Control Bodies) directory on the Internet. The assigned organic certificates were then documented according to the relevant control sector.

The most appropriate data analysis and processing methods were selected for each data collection method. The transcripts were subjected to qualitative analysis using the MAXQDA software, with different passages from the transcripts assigned to different pre-defined codes (Mayring, 2014). The quantitative data from the online survey was summarised using the Microsoft Excel software. The data from the online questionnaire was subjected to basic statistical analysis, including the number of responses, and presented graphically. Given the relatively low response rate, it would be inappropriate to draw definitive conclusions from the results. Instead, these results should be regarded as an indication of emerging trends that warrant further observation. The quantitative data set comprising the certificates was also processed in Excel. Initially, the data was standardised, as the nomenclature of the control sectors varied. The data was then prepared in such a way that the number of certificates could be assigned to each postcode and each control sector. The data set was subsequently employed to generate digital thematic maps, which were used to present the data visually. The geospatial analysis software ArcMap, by Esri, was employed to generate the maps.

11 Scientific Publications

The following three scientific contributions were prepared as part of this dissertation.

Table 4: Overview of scientific publications (* corresponding author)

Author(s) and Publication	Year	Journal
Authors: Kilian Hinzpeter*, Jutta Kister Mapping the organic sector – spatiality of value-chain actors based on certificates in Bavaria (under review since September 2024)	-	Journal of Rural Studies
Authors: Kilian Hinzpeter*, Gordon M. Winder Niche–Regime Interactions of Organic Model Farmers in Bavaria, Germany: Linking Activities of Individual Farmers (published) Sustainability 2024, 16(8), 3206. Doi: 10.3390/su16083206	2024	MDPI Sustainability
Author: Kilian Hinzpeter* Dissemination of Organic Farming Knowledge through Model Farmers: Exploring the BioRegio Betriebsnetz in Bavaria, Germany (published) Doi: 10.1080/1389224X.2024.2371291	2024	The Journal of Agricultural Education and Extension

11.1 Mapping the organic sector – spatiality of value-chain actors based on certificates in Bavaria

Hinzpeter, Kilian & Kister, Jutta (2024): Mapping the organic sector – spatiality of value-chain actors based on certificated in Bavaria. In: Journal of Rural Studies

This paper was submitted on 19 September 2024. It is now under review

Conceptualisation, K.H.; methodology, K.H.; investigation, K.H.; resources, K.H.; visualisation, K.H.; writing-original draft, K.H. and J.K; writing-reviewing and editing, K.H. and J.K.; supervision, K.H. and J.K.

The submitted manuscript can be found in the appendix.

The aim of this paper is to provide a spatial representation of the organic sector rather than of organic farms. Usually, only the number of farms or the size of the area is used to assess the development of organic agriculture, which does not do justice to the complexity of the organic sector. Instead, in this paper value chain actors in Bavaria are spatially located. The data used were collected from publicly available organic certificates. The certified companies, which can be precisely located by their addresses, could be presented in different actor-based large-scale maps. The visualisation with a GIS programme made it possible to identify different structures for different actor groups. This allows a multi-actor analysis of companies issued an organic certificate to participate in the organic sector. Such an assessment is needed for a comprehensive understanding of the spatiality of actors in the organic value chain.

The spatial analysis of multiple actors in the value chain provides a new perspective on the spatial distribution and regional disparities of the organic sector. Until now, there has been a lack of spatial analysis beyond the producer group. This is also due to the lack of data for large-scale analyses of different actors. However, it is precisely such large-scale multi-actor approaches that are needed to gain a better understanding of the structures in the organic sector and thus to take targeted, regio-specific measures.

This paper is a first attempt at a comprehensive spatial assessment of the status quo of the organic sector in Bavaria. It broadens the debate on the poor data availability for analysis in organic agriculture by drawing attention to the need for large-scale spatial multi-actor mapping. This would enable region-specific measures to support organic farming in weak regions and thus contribute to rural development. The development of the organic sector is complex and heterogeneous, which makes spatially specific measures unavoidable. Building on this paper, qualitative analyses would be needed to identify the different spatial characteristics and thus provide a deeper understanding of the different development paths of individual regions and the supply chains. This would allow for a better understanding of the potentials and barriers to the development of organic agriculture and its potential contribution to the transformation of the agricultural system.

11.2 Niche–Regime Interactions of Organic Model Farmers in Bavaria, Germany: Linking Activities of Individual Farmers

Hinzpeter, Kilian & Winder, Gordon M. (2024): Niche–Regime Interactions of Organic Model Farmers in Bavaria, Germany: Linking Activities of Individual Farmers. In: Sustainability, 16 (8): 3206.

This paper was first submitted on 19 February 2024, revised on 27 March 2024, accepted on 9 April 2024 and published on 11 April 2024

Conceptualisation, K.H.; methodology, K.H.; investigation, K.H.; resources, K.H.; visualisation, K.H.; writing-original draft, K.H.; writing-reviewing and editing, G.W.; supervision, G.W.

Note:
The paper can be found in the appendix. The following reprint corresponds to the original version of the article, which is made available for download by MDPI. The format of the original document has been adapted to optimise readability. It is reproduced in accordance with the publisher's guidelines.

This paper uses an innovative method to show the interaction of organic model farms with the organic sector and the dominant conventional regime. The farm webs created by the analysis of in-depth interviews show the relationships and dependencies of eight different model farms in Bavaria. As state-appointed model farms, these play a special role in the Bavarian context and can therefore be regarded as change agents. As change agents, each farmer has the task of using and changing the dominant system while strengthening the organic farming system. It is precisely their interaction from the "niche" with the "regime" that needs to be assessed, categorised, and analysed. This structured assessment can reveal the influence and transformation potential of farmers, also for the larger agricultural context. It is precisely this potential of individual farmers that has so far been neglected as an influencing factor and, indeed, farmers have been a mostly overlooked group.

Despite their designation as model farms, the organic model farmers do not shy away from contact with conventional actors. There are specific reasons why farmers enter into certain connections and relationships, demonstrating a high degree of flexibility and pragmatism with an intrinsic motivation to advance organic farming. The research demonstrates that each farmer built his own collaborative network, and that each farmer's agency is individual. In addition to the findings from the farm webs and the multiplicity of connections and the individuality of each farm, the paper sought to understand the decision-making and rationale behind these linkages. A next step would be to better classify the transformation potential of the organic model farmers and to assess their impact on others. Such an approach helps to identify the roles of farmers in transitions, as well as the challenges they face and the barriers they have not been able to overcome. Until now, the idea that individual farmers can be change agents and influence change has been neglected. For policy makers, this offers new opportunities to stimulate sustainability transitions in the agricultural system through behavioural understanding and careful selection of model farmers.

11.3 Dissemination of Organic Farming Knowledge through Model Farmers: Exploring the BioRegio Betriebsnetz in Bavaria, Germany

Hinzpeter, Kilian (2024): Dissemination of Organic Farming Knowledge through Model Farmers: Exploring the BioRegio Betriebsnetz in Bavaria, Germany. In the Journal of Agricultural Education and Extension

This paper was first submitted on 17 March 2023 and rejected on 4 May 2023. It was resubmitted on 27 September 2023, revised on 8 January 2024, resubmitted on 30 January 2024, revised on 14 March 2024, resubmitted on 2 April 2024, revised on 3 May 2024, resubmitted on 13 May 2024, accepted on 30 May 2024 and published on 3 July 2024.

Conceptualisation, K.H.; methodology, K.H.; investigation, K.H.; resources, K.H.; visualisation, K.H.; writing-original draft, K.H.; writing-reviewing and editing, K.H.; supervision, K.H.

Note:
The paper can be found in the appendix. It corresponds to the original version of the article, which is made available for download by Taylor & Francis. The format of the original document has been adapted to optimise readability. It is reproduced in accordance with the publisher's guidelines.

This paper deals with the BioRegio Betriebsnetz (BRB). The focus is on a network that uses organic model farmers as actors in the dissemination of knowledge for organic farming. Another special feature is that this network was established by a political initiative, the BioRegio 2020 programme. A mixed method approach consisting of an online questionnaire and in-depth interviews was used to understand the functions and framework conditions of the network. Furthermore, the feasibility of the BRB was assessed, with a special focus on the model farmers and their opinions and behaviour towards the BRB. A particular contribution of the research is the assessment of a combination of grassroots knowledge transfer by farmers to other farmers interested in converting to organic farming, and a network established and managed by policy makers. The practical challenge is to capture the implementation and success of BRB from the farmer's perspective, thus providing a different perspective in the evaluation.

The role of organic model farmers in knowledge transfer has been much neglected in the literature, but it has been shown that the dissemination of agricultural knowledge plays a crucial role for sustainable forms of agriculture (Šūmane et al. 2018). It is precisely here that farmers play an important role as grassroots actors in the agricultural system, as they constitute the largest part of the agricultural system in terms of numbers. Such low-threshold offers are important for the adoption of organic farming in order to minimise barriers to contact.

This article stresses the need to consider the potential of such networks for knowledge transfer in organic farming. Networks with similar characteristics can lead to increasing heterogeneity for knowledge transfer if the approach is successful. The path should lead away from purely statistical analyses towards more social aspects, as these are the basis for a successful bottom-up network and grassroots knowledge transfer. The influence and potential for change of organic model farmers in a construct such as the BRB is of enormous interest for future research as it enriches the agricultural advisory services. And they, in turn, make a critical contribution to the spread of organic farming and the transition to a more sustainable agricultural system. Moreover, this approach demonstrates that change is not solely driven by top-down policies or large economic actors, but also by the collective actions of individual farmers. This broadens the understanding of the necessity of grassroots knowledge transfer for a transition to a more sustainable agricultural system. Additionally, it illustrates that a transition may possess a stronger socially centred character in agriculture than previously assumed.

12 Conclusion

Agriculture has historically fulfilled a number of important social functions, including the provision of food, maintenance of the landscape, and employment. Nevertheless, while in the recent past, during the middle and latter decades of the 20th century, the primary objective of food production was to feed the world's population, the priorities of the services that agriculture should provide have shifted. In addition to the production of healthy and safe food to feed the world's population, agriculture exerts an influence on most of the 17 Sustainable Development Goals (UN 2024). In addition to the direct influence on goals such as zero hunger and good health and well-being, agriculture also exerts indirect influence on other goals, including clean water and sanitation, affordable and clean energy, responsible consumption and production, climate action, life below water and life on land.

Organic farming, as a sustainable form of agriculture, can contribute to the achievement of both direct and indirect goals. The extent of this contribution is contingent upon a multitude of factors, with the primary factor being the extent to which organic farming is adopted and practiced. This is once again influenced by a number of factors, including societal demand for organic produce, the professional and sustainable functioning of the organic commodity chain, political support, or the need to repeatedly demonstrate the sustainable contribution of organic agriculture as a form of agriculture.

In light of the aforementioned considerations, this dissertation analyses and reassesses organic farming in the context of the state of Bavaria, Germany. This is achieved on the one hand through the scientific contributions made for this dissertation and on the other hand through the contextual backgrounds and areas of tension discussed in this thesis. The overarching objective of this dissertation is to identify and assess the challenges, opportunities, and prospects associated with organic farming and to understand its broader implications for sustainable agriculture.

The research has yielded insights into the spatial dynamics, transformation potential, and policy benefits of organic agriculture in Bavaria through specific, in-depth studies the spatial presentation of organic actors, of organic model farmers, and a knowledge transfer network for organic farming.

A key finding that was already apparent during the topic identification phase is the sometimes incomplete and sometimes difficult-to-access availability of data in the field of organic farming. This is also true of Germany and Bavaria. This limitation renders it challenging to identify the spatial distribution of actors within the organic sector. The results indicate that, based on self-collected organic certificates, there is a heterogeneous distribution of different actors in the organic sector in Bavaria. This disparate distribution of actors in the organic sector across Bavaria suggests that the sector exhibits varying structures and patterns in different regions. This finding also indicates that it is similarly challenging to implement measures to enhance the growth of organic farming on a large scale, as the prevailing structure cannot be recorded in a spatial context. Indeed, a more comprehensive spatial analysis than that of producers alone is necessary to fully comprehend the intricacies of the organic farming system. In light of the ambitious organic farming targets set by the EU and Bavaria, it is imperative to enhance the availability and scope of data in order to provide more targeted support for underperforming regions with tailored measures and to promote organic farming as a whole.

Further key findings indicate the significant role of organic model farmers in the agricultural transformation process. They possess a high degree of transformation potential, which can be observed through a high level of relationships and connections with other actors in the entire organic value chain. Through their position as model farmers, they can serve as a hub between conventional and organic farmers, organic farming associations, and upstream and downstream companies, among others. Their willingness to serve as a conduit for knowledge transfer and communication renders them a pivotal element in the advancement and promotion of organic farming, thereby contributing to the transformation towards sustainable agriculture. The actual impact of the individual model farmers within their relationships and connections deserves further research.

However, the significance of knowledge transfer, particularly in the context of alternative and sustainable forms of agriculture, is underscored. The model farmer network, BRB, which was initiated in Bavaria with the specific objective of supporting organic farming, represents an effective model for the successful promotion of organic farming with limited financial resources. As responsibility is transferred to model farmers who possess both intrinsic motivations to promote organic farming and a social and professional network of individuals, motivation and satisfaction within the network remain high. It is evident that there is a necessity for enhancement in terms of publicity of the network, as without the farmer-to-farmer talks, the fundamental function of the network is compromised. In order to apply such a network elsewhere, a precise analysis of the prevailing situation in the respective area is required in order to make the right choice of farms, ensure institutional support, provide financial support, and to do so based on the existing potential for organic farming in the region. Collectively, these insights contribute to a more comprehensive understanding of organic farming and its potential to support sustainable agricultural practices.

The findings of the three scientific papers can be augmented by supplementing them with the contextual background knowledge and information on organic farming presented in this work. This reveals that, while the research underscores the significance of organic farming in achieving environmental sustainability goals, it also signals the contribution organic farming can make to rural socio-economic development. In addition to these active influences, the entire construct of organic farming in Bavaria has undergone significant changes over time and will continue to evolve. In recent years, organic farming has become increasingly mainstream. Paradoxically, the proliferation of organic farming standards has contributed to this shift, as it has discouraged farmers from experimenting with and adopting new approaches to organic farming. Concurrently, the standards, as the name implies, transform organic farming into a standardised form of agriculture. The necessity for standards is concomitant with the regulations that are a prerequisite for certification. Further certification plays a pivotal role, as it allows the use of logos and the marketing of organic products but is also the prerequisite for a farm to benefit from European and national subsidies. The political manifestation of organic farming, as evidenced by the implementation of programmes and measures at the EU, German, and Bavarian levels, also indicates a shift towards greater mainstream acceptance.

However, organic farming still faces the challenge of asserting itself in various debates against other systems, particularly the conventional agricultural system. The emerging challenges are economic, social, ecological, and political. The economic challenges pertain to economies of scale and higher efficiency. Social challenges include acceptance and purchasing behaviour. Ecological challenges relate to higher biodiversity and lower groundwater pollution. Political challenges concern stronger support for organic farming and higher costs for externalities through agriculture. It is imperative that organic farming overcome these challenges while remaining true to the values that define it. In light of this, it becomes evident that a new way of thinking about the potential for transformation among farmers is required. To further disseminate organic farming and enhance its resilience to future challenges, a combination of bottom-up and top-down measures and transformation impulses is necessary. Moreover, organic farming must continue to evolve along paths that do not necessarily mirror the phases of conventional farming but are tailored to the social and ecological challenges of the present era. This leads to the question of whether organic farming, in its current structure and with its current tasks, can modify the mainstream in such a way that it retains its idealistic pillars or becomes a more sustainable "conventional" agricultural system.

The challenge is to consider the diverse range of agricultural conditions that characterise each farm, which are unique in their own right. It is therefore essential to have access to large-scale data and to be able to carry out spatial analysis in order to gain an understanding of the prevailing situation. It is only through this knowledge that well-founded future planning and support can be implemented. Also the individual adaptation at the country level, as provided for in the new CAP, is inadequate, as the different measures are prioritised in such a way that organic farming does not reach its potential, but can be transformed into a more sustainable "conventional" system (IFOAM 2022). Given the continued importance of agriculture and its functions for human society, it is imperative that appropriate attention is paid to this sector, despite its relatively marginal economic significance.

Despite the prevalence of organic farming in Bavaria and its demonstrated positive trajectory, the sector is nonetheless situated within a context of tension. The objective is to reinforce and expand the organic sector while continuously demonstrating its viability as an alternative to the conventional system. Organic farming in Bavaria is undoubtedly in a stronger position to develop due to the established stakeholder structures and institutionalisation. However, this is counterbalanced by a powerful conventional farming lobby. Political decisions frequently prioritise short-term economic interests over long-term ecological considerations. These political barriers impede the advancement of organic farming. Arguments against organic farming, such as low yields, could potentially be mitigated by research, reducing waste in the field due to fewer standardised regulations, and changing consumer behaviour with less animal products and more seasonality. However, this endeavour would also negatively affect some upstream and downstream actors. This phase of transition should therefore be supported more politically, so that organic farming does not have to act as a driving force that has to fight for every promotion, measure, and consideration. The effort and resources thus freed up could be significantly invested in research and institutional structures relating to organic farming. It is therefore important to provide support to actors and networks that are capable of driving change. The availability of knowledge is a critical factor in this process. In addition to the technical knowledge required to engage in organic farming, it is also important to have information about political, bureaucratic, social, and economic issues. Questions like, what implications does the revised CAP have for me, how should applications be completed correctly, which products are worth growing, what products are in high demand, or to whom can I sell my goods can serve as a determining factor in whether or not farmers decide to convert to organic farming and how they subsequently manage their farm. This work provides illustrative examples of the processes in question, as well as an analysis of the challenges they present and areas for potential improvement. While these examples are highly specific in terms of theme and spatial context, they nonetheless contribute to a more nuanced understanding of the potential transition process of the agricultural system.

The transition of the agricultural system is a topic that continues to yield insights. In light of the increasing necessity for sustainable agricultural practices, it is imperative that future research prioritises an understanding of the relational dynamics and networks within and beyond the organic sector. This would facilitate a more comprehensive understanding of the impact of connections and networks of farmers within the agricultural system. In light of these considerations, it is imperative to modify the regulatory and economic frameworks governing the organic sector in order to facilitate the continued evolution of organic farming and effect a sustainability transition of the agricultural system, taking into account the impending climatic challenges.

In conclusion, this dissertation contributes to the field of organic farming research. The dissertation has provided practical insights for policymakers, farmers, and stakeholders, emphasising the necessity of collaborative efforts to overcome challenges and achieve the broader goals of sustainability and environmental conservation. As we continue to make a transition towards a more sustainable agricultural system, it is important to persist in supporting and developing organic farming practices.

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Appendix

Table A 1: The Action Plan for the Development of Organic Production, its axis, topics, actions and detailed implementation (summarised from EC 2021c).

Axis	Topic	Action	Implementation
Axis 1: Organic food and products for all: stimulate demand and ensure consumer trust	Promoting organic farming and the EU logo	Action 1: As regards information and communication, the Commission will:	starting in 2021, give a greater focus to organics among the themes covered by the annual call for proposals on information measures on the CAP
			starting in 2022, collect continuously data about the environmental, economic and social benefits of organic farming and inform citizens, including farmers, about these benefits by enhancing the use of social media
			starting in 2022, measure consumers' awareness of the EU organic logo to monitor progress since the 2020 Eurobarometer. Continue conducting Eurobarometer surveys as a valuable tool to measure the effectiveness of the Commission's actions to promote the organic logo
			identify main events to inform about organics, in particular in member states where demand is below the average EU level, in cooperation with the European Parliament and other bodies such as the European Economic and Social Committee, the Committee of the Regions, and Commission Representations in member states

		Action 2: As regards promotion, the Commission will continue to secure an ambitious budget in the EU promotion policy for boosting the consumption of organic products that are aligned with the ambition, policy and actions of the Farm to Fork strategy and Europe's beating cancer plan. The Commission will, starting in 2021:	allocate an enhanced budget in the framework of the annual work programmes of the agricultural promotion policy, with a view to raising consumer awareness of, and stimulating the demand for, organic products
			step up the promotion of EU organic products in targeted third country growth markets

			through, for instance, the participation in fairs in cooperation with member states
			raise awareness of export opportunities for EU organic producers, to take advantage of our network of Free Trade Agreements and equivalency agreements
			stimulate the sector's visibility through awards recognising excellence in the organic food chain in the EU
	Promoting organic canteens and increasing the use of green public procurement	Action 3: To stimulate a greater uptake of organics in public canteens, the Commission will, together with stakeholders and member states:	boost the awareness of the criteria for GPP issued in 2019, of the work on Public Procurement of Food for Health, and of the Joint Action Best-ReMaP
			integrate organic products into the minimum mandatory criteria for sustainable food public procurement to be developed as part of the legislative framework for sustainable food systems by 2023
			analyse the current situation as regards the application of EU GPP. The Commission will use the national action plans on organic farming to monitor the application of GPP and call on member states for an increase in the use of GPP by public authorities. It will

			also invite member states to fix ambitious national targets for organics in GPP
			prepare, in close cooperation with the European Economic and Social Committee, the Committee of the Regions and the Covenant of Mayors, specific events for public administrations in charge of public catering, to raise awareness of EU GPP by linking these initiatives to the European Climate Pact, starting in 2022
	Reinforcing organic school schemes	Action 4: As part of the review of the EU school scheme framework planned for 2023 under the Farm to Fork strategy, and in accordance with Europe's beating cancer plan, the Commission will:	engage with member states to identify ways to increase further the distribution of organic products in the school schemes. The Commission will call on member states to continue increasing this share, and those further behind will need to make extra efforts
			carry out a study on the real price of food, including the role of taxation, with a view to developing recommendations

	Preventing food fraud and strengthening consumer trust	Action 5: The Commission will, starting in 2021, strengthen the fight against fraudulent practices and in particular:	ensure a robust supervision of control systems in member states and third countries; increase cooperation with Member State administrations and third countries recognised as equivalent, relying – inter alia - on their means and results of previous audits
			assist member states in developing and implementing an organic fraud prevention policy, through targeted workshops to share lessons learnt and best practices
			cooperate with the EU Food Fraud Network and Europol in analysing the sector to prevent fraud and coordinate investigations; increase cooperation with competent authorities and law enforcement bodies in third countries to exchange information on the organic trade and fraud
			support member states with guidance on reinforced imports control at the border
			promote stronger measures to tackle fraudulent practices through the sanctions catalogues
			put in place measures to inform consumers and/or to recall from the market products where fraud is identified
			develop early warning systems, using artificial intelligence for data mining in EU (e.g. the Information Management System for Official Controls - IMSOC) and Member State databases

	Improving traceability	Action 6: The Commission will, as of 2021:	develop a database of certificates of all EU operators, and later also relevant third country operators, building on the analysis already started under the 2014 action plan, and as a follow-up to European Court of Auditors recommendations
			promote the enrolment of competent authorities and control bodies and the signing of certificates of inspection in TRACES digitally. This paperless process will reduce the administrative burden and the risk of forgery of documents
			coordinate regular traceability exercises on organic products in cooperation with member states, their control bodies and third countries, especially in cases of food fraud suspicion
		Action 7: The Commission will, as of 2021:	in synergy with the work on digital product passports, assess to what extent the traceability of organic products could benefit from blockchain or other digital technologies and envisage, in a second step, a pilot project with stakeholders. These steps will be supplemented by actions under Horizon Europe on the use of blockchain technologies in the agri-food sector as well as other targeted research & innovation actions aimed at developing innovative solutions to trace organic food
	The contribution of the	Action 8: With the objective of reinforcing	aim at obtaining clear commitments from relevant stakeholders to support and increase the distribution and sale of organic products, in the context of the Farm to Fork strategy's

	private sector	the role of retailers, wholesalers, catering services, restaurants and other businesses, the Commission will, starting in 2021:	code of conduct for responsible business and marketing practices, and disseminate best practices in relevant platforms like the Circular Economy Stakeholder Platform
			establish partnerships with businesses willing to promote the use of organic products as part of their corporate sustainability policy. These measures will be further discussed in the platform for Business and Biodiversity
Axis 2: On the way to 2030: stimulating conversion and reinforcing the entire value chain	Encouragin g conversion, investment and exchange of best practices	Action 9: In the framework of the new CAP and CFP, the Commission will:	starting in 2023, assess the specific circumstances and needs of member states regarding the growth of the organic sector, and ensure member states make the best use of the possibilities offered by the new CAP to support their national organic sector. This support will include technical assistance, the exchange of best practices and innovations in organics, and the full use of relevant CAP instruments such as eco-schemes and rural development environmental management commitments, which include organic farming. Farm advisory services on specific topics will be strengthened, notably as part of Agricultural Knowledge and Innovation

			System (AKIS), to promote relevant knowledge exchange
			starting in 2022, promote the exchange of best practices (education and training curricula, courses, materials, etc.) at EU and national level allowing education providers (e.g. technical schools, universities) to develop courses on organic farming as part of the general curriculum and present innovative solutions targeting the organic sector (production, processing, retailing and consumption). EU demonstration farm networks will be set up on specific topics to promote a participatory approach (dissemination). Best practices and synergies with the EIP-AGRI projects will be promoted via the future CAP network
			encourage member states to include the increase of organic aquaculture in their reviewed Multi-annual National Strategic plans for aquaculture, and to make the best use of possibilities offered by the EMFAF 2021-2027 for achieving this purpose. The Commission will also facilitate the exchange of best practices and innovation on organic aquaculture in the context of the Open Method of Coordination.
	Developing sector analysis to increase market	Action 10: To provide a comprehensive overview on the sector, the	publish regular reports on organic production in the EU based on Eurostat data, containing, in particular, information on surfaces, holdings involved in organic production, and the main production sector

	transparenc y	Commission will, starting in 2021:	
			publish a yearly report on imports of organic products from third countries
		Action 11: The Commission will, starting in 2022:	intensify the collection of market data in collaboration with member states and extend the EU Market Observatories' analysis to organic products
	Supporting the organisation of the food chain	Action 12: The Commission will, starting in 2021:	carry out an analysis of the degree of organisation in organic sector supply chains and identify ways to improve it in consultation with producer organisation representatives and other concerned stakeholders
			investigate the legal possibility of forming or joining specific organic producer organisations and, where possible, encourage member states to allocate funds for this purpose. Producer organisations have greater market power and can generally help strengthen the position of organic farmers in the agri-food supply chain, particularly when faced with unfair trading practices. If there is sufficient evidence that unfair trading practices penalising organic producers occur, the Commission shall address them by using all the tools at its disposal
		Action 13: The Commission	raise awareness and provide better information about 'group certification', allowing small holding farmers to share the

		will, starting 2022:	cost and administrative burden of certification, in line with Regulation 2018/848 on organic production
	Reinforcing local and small-volume processing and fostering short trade circuit	Action 14: The Commission will, starting in 2023:	engage with member states and stakeholders to foster local and small-scale processing, in line with the objective of Regulation 2018/848 on organic production to move towards 'shorter organic supply chains, providing environmental and social benefits', and as part of its efforts to support trade for organic products within the EU single market. This action will be reinforced by targeted research & innovation under Horizon Europe, including support for the use of digital technologies
			encourage member states to support the development and the implementation of 'Bio districts'
		Action 15: As organic farming can enhance social inclusion in rural areas while promoting decent working and living conditions, the Commission	assist member states in designing measures for organic farming in rural areas that promote gender equality and youth farmers/employment, which could include the sharing of best practices

		will, starting 2022:	
	Improving animal nutrition in accordance with organic rules	Action 16: The Commission intends to:	support research and innovation under Horizon Europe on alternative sources of organic vitamins and other substances that might turn out to be necessary, and on alternative sources of protein keeping in mind their technical and economic feasibility
			explore means to support the application for feed additives produced without GMM, feed based on insects as well as marine feed stocks
			adopt an algae initiative in 2022 to support EU algae production and support the EU algae industry to ensure the supply of algae as alternative feed material for organic animal farming
	Reinforcing organic aquaculture	Action 17: Starting in 2022, the Commission intends to:	support research and innovation on alternative sources of nutrients, breeding and animal welfare in aquaculture; the promotion of investments in adapted polyculture and multi-trophic aquaculture systems; and the promotion of hatcheries and nurseries activities for organic juveniles
			identify and address as appropriate any specific obstacles to the growth of EU organic aquaculture
Axis 3: Organics leading by example: improving the contribution of organic	Reducing climate and environmental footprint	Action 18: The Commission will, starting in 2022:	take steps, to set up, in cooperation with stakeholders, a pilot network of climate positive organic holdings, to share best practices. A proposed mission in the area of Soil Health and Food could contribute to the pilot network in particular through the deployment of living labs and lighthouses

farming to sustainability			and other activities supporting carbon farming
	Enhancing genetic biodiversity and increasing yields	Action 19: In order to enhance biodiversity and increase yields, the Commission intends to:	starting in 2022, earmark funding under Horizon Europe to support the preservation and use of genetic resources, pre-breeding and breeding activities, and the availability of organic seeds, and to contribute to the development of organic heterogeneous plant reproductive material and plant varieties suitable for organic production
			set up EU demonstration farms networks to promote a participatory approach (dissemination). Best practices and synergies with the EIP-AGRI projects will be promoted via the future CAP network
			strengthen farm advisory services, notably as part of Agricultural Knowledge and Innovation System (AKIS), to promote knowledge exchange of material suitable for the organic farming
			support research and innovation on improving organic yields
	Alternatives to contentious inputs and other plant protection products	Action 20: The Commission:	starting in 2023, intends to earmark funding under Horizon Europe for research and innovation projects on alternative approaches to contentious inputs, paying particular attention to copper and other substances as assessed by the European Food Safety Authority
			starting in 2022, will, building on the forthcoming regulation on biopesticides, and via the strengthened farm advisory services,

			notably AKIS, foster where appropriate the use of alternative plant protection products, such as those containing biological active substances
	Enhancing animal welfare	Action 21: In the context of the Animal Welfare Platform, the Commission will:	continue working with member states and civil society to find concrete and operational ways to further improve animal welfare in organic production
	Making more efficient use of resources	Action 22: The Commission intends to:	adopt a Framework on bio-based, compostable and biodegradable plastic, which will include principles and criteria under which the use of sustainable bio-based materials that are easily bio-degradable in natural conditions is beneficial to the environment. The Framework will cover all plastics, including for uses in all types of agriculture, and will therefore also be highly relevant for organic farming leading the way in terms of sustainability
		Action 23: The Commission will:	promote the more efficient and sustainable use of water, the increased use of renewable energy and clean transport, and the reduction of nutrient release, in all types of farming, with organic farming leading the way, and with the involvement of the member states through their CAP Strategic Plans, as well as with the new Strategic Guidelines for aquaculture and EMFAF

Table A 2: The five fields of action with a total of 24 measures of the ZöL (BMEL 2019).

Field of action	Number	Measures
Make the legal framework sustainable and coherent	1	Further develop European production regulations for organic farming to address specific problems
	2	Support breeding and production of seed and vegetative propagating material for organic farming through legal changes
	3	Examine the potential of valuable protein sources
	4	Expand research into alternative protein feedstuffs
	5	Support technical processes for the production and processing of protein-containing feedstuffs
	6	Establish a demonstration network for fine-seeded legumes and expand the existing networks
	7	Improve framework conditions for plant protection in organic farming
	8	Reduce or avoid obstacles in immission control legislation
	9	Facilitate the implementation of hygiene requirements for craft businesses
Facilitate access to organic farming	10	Examine changes to the training regulations and the framework curriculum
	11	Initiate networking and exchange between educational stakeholders
	12	Evaluate and further develop teaching materials and teaching units
	13	Expand support for conversion advice for agricultural businesses
	14	Expand support for the training and further education of advisors
	15	Drive forward the development and provision of advisory tools

Fully exploit and further expand the demand potential	16	Promote cooperation management of organic value chains
	17	Expand support for organic value chains in the BMEL framework plan
	18	Increase the organic share in the procurement of products in the BMEL's business area
	19	Implement information measures to increase the proportion of organic products in public procurement
	20	Promote advice on the use of organic products in out-of-home catering
Improve the performance of organic farming systems;	21	Define and implement the federal government's organic research priorities Reward environmental services appropriately
Adequately reward environmental services	22	Ensure sufficient funding for the promotion of organic areas
	23	Introduce conversion premium for partially converting farms
	24	Develop an overall concept for the efficient remuneration of environmental services

Table A 3: The six field of action with a total of 30 measures of the Bio-Strategie 2030 (BMEL 2023) (Gemeinschaftsaufgaben Verbesserung der regionalen Wirtschaftsstruktur) (GRW) (Joint tasks for the improvement of regional economic structures), Verbesserung der Agrarstruktur und Küstenschutz (GAK) (Improvement of agricultural structures and coastal protection).

Field of action	Number	Measures
Input markets (aim: The input markets are geared towards the growth target of organic farming)	1	Promoting plant breeding and animal husbandry for organic farming

	2	Develop input markets for organic farming and the organic value chain further develop the organic value chain
	3	Development of digital instruments for better data and operational management
Production (aim: The performance potential of organic farming is fully exploited)	4	Exploiting the yield potential of organic crop production
	5	Strengthening legumes as the basis of organic farming systems
	6	Communicating the potential of organic grassland management
	7	Strengthen organic animal husbandry and feeding
	8	Further develop, strengthen animal welfare in organic farming and make it transparent
	9	Further develop region- and location-specific conversion concepts
	10	Promote biological and genetic diversity in the agricultural landscape and of crops and livestock
Processing and Trade (aim: Organic food processing and trade are strengthened)	11	Promoting value chains through management and networking
	12	Further developing fair partnerships
	13	Harness support programmes for small and medium-sized enterprises in the organic value chain
	14	Support establishment and expansion of regional and organic processing and marketing capacities
Nutrition and society (aim: The demand for	15	Further expand communication on "organic"

organic food is strengthened)		
	16	Increase share of organic food in federal administration canteens and in other public communal catering facilities
	17	Making it easier for out-of-home catering companies to use organic food
	18	Strengthen advice for out-of-home catering companies interested in converting
	19	Strengthen education on the production and processing of organic food along the value chain
Research, Knowledge Transfer, Data Availability, Infrastructure (aim: Research, knowledge transfer, data availability and infrastructure for the organic agriculture and food industry will be expanded in the interest of transforming the agriculture and food system)	20	Align research strategies and programmes for organic agriculture and food industry
	21	Strengthen BMEL departmental research and equip it for policy advice in the field of organic food and farming
	22	Strengthening the structure of the regional research landscape, extend young scientists and knowledge of the organic food and farming sector and strengthen innovations

	23	Trigger transformations with practical research on organic production and sustainable nutrition
	24	Anchoring knowledge transfer and research communication structurally and improve methodically
	25	Promote teaching of organic agriculture and food production at universities
	26	Improve data availability on organic farming and the organic food industry
Coherent legal and funding framework (aim: consistently focus the legal and funding framework on strengthening the organic farming and food industry)	27	GRW and GAK to continue to focus on the goals of sustainability, environmental and climate protection and the GAK to the organic farming and food sector.
	28	Align CAP more closely to the goals of sustainability, environmental and climate protection and organic farming
	29	Further develop Regulation (EU) 2018/848 and establish a coherent national legal framework to strengthen the organic food and farming sector
	30	Harness organic farming methods as an option for action for the Global South to achieve the human right to adequate food

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Mapping the organic sector – spatiality of value-chain actors based on certificates in Bavaria

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Abstract:	Organic farming is attributed to environmental, economic, and social benefits - both in sustainable development of rural areas and the protection of nature for the well-being of human lifes - making its expansion a key focus of policy objectives across various scales. Its development is typically assessed in terms of number of farms or production volume. We argue, that the importance of comprehensive spatial assessments of various actors in the adjacent value chain is being overlooked. This study addresses this gap by using data from EU-organic certificates to map the spatial distribution of the organic sector in Bavaria, Germany. By analyzing the distribution at the district level, we uncover different patterns and reveal the uneven presence of actor groups across the region. Our findings illustrate the complexity of the sector, highlighting the need for multi-actor analysis to capture the interwoven dynamics and factors influencing the successful development of the organic sector and the benefits attributed to it. The resulting maps point to different networks of actors, indicating a heterogeneous local development potential. These insights enable to identify the existing development potential and shortcomings in organic farming, so that more targeted measures in rural and environmental policies can be implemented. Thus, further research of interaction and the potential for influence through multi-scalar politics and regional planning appears of great value.
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Mapping the organic sector – spatiality of value-chain actors based on certificates in Bavaria

Keywords
Organic farming, organic sector, organic certification, sustainability policies, spatial distribution

Abstract

Organic farming is attributed to environmental, economic, and social benefits, which is why its expansion is anchored in policy objectives on various scales. Its development is typically assessed in terms of number of farms or production volume. We argue, that the importance of comprehensive spatial assessments of various actors in the adjacent value chain is being overlooked. This study addresses this gap by using data from EU-organic certificates to map the spatial distribution of the organic sector in Bavaria, Germany. By analyzing the distribution at the district level, we uncover different patterns and reveal the uneven presence of actor groups across the region. Our findings illustrate the complexity of the sector, highlighting the need for multi-actor analysis to capture the interwoven dynamics and factors influencing the successful development of the organic sector and the benefits attributed to it. The resulting maps point to different networks of actors, indicating a heterogeneous local development potential. These insights enable to identify the existing development potential and shortcomings in organic farming, so that more targeted measures in rural and environmental policies can be implemented. Thus, further research of interaction and the potential for influence through multi-scalar politics and regional planning appears of great value.

1 Introduction

More sustainable forms of agriculture strive to address multiple needs in order to meet future challenges related to environmental, social and economic issues. Organic farming (synonymous in this work with organic agriculture), as an alternative to conventional agriculture, aims to meet high ecological standards, while at the same time satisfies social demands and allowing for economic viability (Bellon and Penvern, 2014). Furthermore, organic farming is considered to have a positive effect on rural development through e.g. job creation, biodiversity and landscape preservation, as well as diversification of income (Darnhofer, 2005; Lobley et al., 2009; Pugliese, 2001).

Therefore, several EU and national strategies include organic farming as an important building block for the development of a sustainable agri-food system (StMELF, 2017; Meredith et al., 2018). The EU Farm to Fork Strategy, as an example, identifies organic farming as a means of providing ecosystem services to society (EC, 2020). With the EU target of 25% organic farming by 2030, the new Common Agricultural Policy (CAP) is expected to support organic farmers with various measures such as tailored funding instruments, accompanied with investments and advisory services, and the 'Action Plan for the Development of EU Organic Production' was communicated by the European Commission as a directive (EC, 2021a).

In addition, there are also political measures on national level to promote organic farming. In Germany, the 'Bundesprogramm Ökologischer Landbau' (BÖL) (Federal Organic Farming Program) aims at improving the framework conditions for organic farming. Also, the strategy process for the future development of organic farming was developed by the Bundesministerium für Ernährung und Landwirtschaft (federal ministry for food and agriculture) within the framework of the 'Zukunftstrategie Ökologischer Landbau' (Future Strategy for Organic Agriculture) (BMEL, 2019) and was recently replaced by the new 'Bio-Strategie 2030' (Organic Strategy 2030) (BMEL, 2023). At the administrative level of the German states (Bundesländer), there are further targeted measures, such as the 'BioRegio Bayern 2020' program in Bavaria (StMELF, 2017) and the successive 'BioRegio 2030' (StMELF, 2023).

Many of the objectives contained in such policies are directly related to a multitude of functions attributed to agriculture (Renting et al., 2009). Wilson (2009) claims that more attention should be paid to the influence of spatiality in agricultural multifunctionality. The organic food system has changed from a loosely coordinated local network of producers and consumers to a globalized system of formally regulated trade. The system facilitates the interconnection of geographically disparate production and consumption sites (Raynolds, 2004), establishing a network of supply chains. These include traditional wholesalers and supermarket chains, as well as alternative distribution channels, predominantly local in nature (Milford et al., 2021). However, looking at production and consumption alone would not do justice to the complexity of the organic food system as there are more actors and associated linkages along the organic value chain.

Yet the development and spatial distribution of organic farming is almost exclusively assessed on the basis of the producer (organic agricultural area, the number of organic farms) or the consumer (turnover of organic products) (Antczak, 2021; Blaće et al., 2020; Darnhofer et al., 2019; Kujala et al., 2022; Lindström et al., 2020; Schmidtner et al., 2012; Stolze and Lampkin, 2009). In order to do justice to the multiplicity of actors and processes in the organic production system, the term 'organic sector' is used in scientific contributions (Darnhofer et al., 2019), but also in the EU planning document 'Action Plan for the Development of Organic Production', without further specifying its participants there (EC, 2021a).

Therefore, for profound assessment of the development of organic farming, or rather the organic sector, it is crucial to take into account more than the evaluation of the organically cultivated area or the number of organic farms, but rather to explore the interactions and relationships among various actors involved in the production and distribution of organic food produce (Dannenberg and Kulke, 2014), including their spatial allocation (Wilson, 2009), as it is well known that food chains are very heterogeneous in nature, depending on the agricultural product (Maye and Ilbery, 2006).

The aspect of spatial proximity is crucial for fulfilling the multifunctional role of organic farming and should therefore be central to the assessments, in science as in policy. However, due to heterogeneous data sources and availability, it is difficult to spatially locate different actors in the organic sector. This limits the analysis of large-scale assessments of spatial distribution of different actors in the organic sector. Studies reveal that several factors account for the uneven distribution of organic agriculture, including physical, structural, socio-cultural, and economic factors (Ilbery et al., 2016; Kujala et al., 2022). Heterogeneous causal processes influence the development of area, number of farms or turnover, such as the conversion to organic farming (ART and ECOZEPT, 2013; Darnhofer et al., 2005; Lamine and Bellon, 2009; Xu et al., 2018) and the decision to buy organic products (Aertsens et al., 2009; Bazoche et al., 2014; Hasselbach and Roosen, 2015). Most prominent, it is known that farmers' decisions to produce goods are directly correlated with the availability of secure promise of purchase by other actors along the value chain, preferably in close proximity (Klein and Tamásy, 2016).

Based on these facts, the spatial distribution of different actors in the organic sector along the commodity chain is necessary to assess.

The objective of this work is to show the spatial distribution of a wider set of actors as part of the organic sector in Bavaria. Hence, we investigate how to represent the real spatial development processes in the organic sector in data. This is approached by collecting the required data from publicly available EU-organic certificates.

For the first time, the spatial distribution of these actors is displayed large-scale, in our case at the scale of districts level (Landkreise). The work thus fills the gap of the insufficient spatial representation of different actors in the organic sector. Depicting this data allows for further analysis and new perspectives within the framework of economic geography approaches (e.g., relational economic geography, short-food-supply-chains, cluster development), as well as a better understanding of the integral development of the organic sector. In the context of the policy aims assigned to organic farming to relevant policy components such as rural development, biodiversity and climate protection, this endeavor seems to be of vital importance for further evaluation and research.

First, the paper outlines the policy goals, the measures derived therefrom and the benefits assorted to organic farming at the EU, German and Bavarian levels. This is followed by an insight into organic certification and its function as a regulatory instrument. Then, the paper gives an overview on the current spatial representation of the development of organic farming and the organic sector in data and delineates the gap in relation to current research attempts. The methodology and data collection are then presented. Subsequently, the maps generated by the data are shown and described in detail in terms of their patterns and distributions. The following discussion aims to answer the questions of the usefulness and limitations of certificates as a data source and the possibilities of targeted measures to support rural development and the development of organic farming. This is followed by a conclusion and an outlook on what new possibilities are revealed by this work.

2 Policy goals for organic farming and organic certification

Organic farming is considered crucial to achieving several policy goals on various scales. Therefore, an extensive network of policy strategies has been introduced for this purpose, all of attributing several benefits to organic farming. The extent to which the politically desirable benefits of organic farming are achieved is measured and continuously monitored using specific indicators.

The Farm to Fork Strategy is the agricultural strategy for achieving the EU's targets for a fair, healthy and environmentally friendly food system, which again explicitly highlights the urgent need to increase organic farming (see Table 1) (EC, 2020). It is part of the overarching policy initiative, the European Green Deal, with the objective to make Europe the first climate neutral continent by 2050 (EC 2019). As basic goals of the Farm to Fork Strategy, the EU defines that "the EU's goals are to reduce the environmental and climate footprint of the EU food system and strengthen its resilience, ensure food security in the face of climate change and biodiversity loss and lead a global transition towards competitive sustainability from farm to fork and tapping into new opportunities" (EC, 2020, p. 7). The benefits and services of organic farming are compatible with many of these objectives.

Table 1: Policies, scale, indicator to measure and benefits attributed to the development of organic farming by policy (EC, 2020; BMEL, 2023, 2019; StMELF, 2023, 2017) (Utilised agricultural area (UAA)

Policy/ strategy (Date)	Scale	Goal and indicator to measure achievements	Benefits attributed to organic farming by policy
Farm to Fork strategy (since May 2020)	EU	25 % of UAA by 2030	Reduction of fertilizers, antimicrobials & pesticides, Positive impact on biodiversity, job creation & young farmers, Set mandatory food procurement by schools, hospitals and public institutions
Zukunftsstrategie ökologischer Landbau (since Feb 2017)	Germany	20 % of UAA by 2030	Conserving resources, environmentally friendly, development prospects, reduction of nitrogen, ammonia emissions and water nitrate pollution, biodiversity

Bio-Strategie 2030 (since Nov 2023)	Germany	30 % of UAA by 2030	Reduction in the use of nitrogen, avoidance of easily soluble mineral nitrogen fertilizers, higher carbon sequestration in the soil, contribution to the protection of biodiversity and the climate, conservation of resources and environmental compatibility, high innovative strength
BioRegio Bayern 2020 (since Apr 2012)	Bavaria	double the production of organic food in Bavaria by 2020	Farmers, the environment and consumers benefit from organic and regional products, contributing to the diversity and strengthening of small-scale agricultural structures and creating jobs and added value in rural areas.
BioRegio 2030 (since Jul 2019)	Bavaria	30 % of UAA by 2030	Same as BioRegio Bayern 2020

The Farm to Fork Strategy was challenged by Schebesta and Candel (2020) who doubted how it will become a game changer based on the following four determinants: "the unresolved ambiguity of food sustainability, the discrepancy between policy objectives and the specific legal actions proposed, the vulnerable institutional embedding within the European Commission, and limited coordination with the EU's Member States" (Schebesta and Candel, 2020, p. 586). Others assessed how targeted reduction in the use of land, fertilizers, antimicrobials, and pesticides have an impact on the yields of EU agriculture and directly impact European and worldwide food prices (Beckmann et al., 2020) or how the implications of the Farm to Fork Strategy would lead to an economic imbalance and an overall net welfare loss (Wesseler, 2022).

The policy that provides the framework for all measures and allows for financial support of farmers is the CAP. Besides the direct payments within Pillar I of the CAP (European Agricultural Guarantee Fund (EAGF)) financial support is provided under the new CAP Rural Development Program, which allows support for organic farmers within Pillar II through the European Agricultural Fund for Rural Development (EAFRD) (EC, 2022). In this way, organic farming makes valuable contribution to CAP objectives such as “ensuring a fair income for farmers, rebalancing farmers’ position in the value chain, ensuring sustainable development and efficient management of the natural resources, protecting biodiversity ecosystem services and habitat and landscapes and improving the response of EU agriculture and EU aquaculture to societal demands on food and health, as well as animal welfare” (EC, 2021a, p. 12). Thus, organic farming demonstrates its multiple functionalities, also with regard to the development of rural areas, in which organic farming plays a key role. A major change in the new CAP is the possibility of additional support in Pillar I through so-called “eco-schemes”, such as e.g. organic farming, integrated pest management practices, carbon farming, agro-ecology, agro-forestry, where various environmental services are to be paid for, with each EU member state being able to select the appropriate eco-schemes for its country from a catalogue (EC, 2021b).

The explicit goals and recommended actions to achieve the objectives have been circulated by the European Commission in the ‘Action Plan for the Development of Organic Production’ (EC, 2021a). It is based on three main axes: 1. Stimulate demand and ensure consumer trust; 2. Stimulating conversion and reinforcing the entire value chain; 3. Improving the contribution of organic farming to sustainability. Within these axes, 23 actions, e.g. promoting organic canteens and increasing the use of green public procurement, encouraging conversion, investment and exchange of best practices, supporting the organization of the food chain, are proposed to achieve the objectives.

There is no stringency in EU strategies and policies as to whether the term organic farming refers to the farming method, the area, or the entire organic sector. In the report of the European Commission entitled “Analysis of the EU organic sector” from 2010 (EC, 2010a), the term organic sector is used in connection with organically farmed area, with organic livestock, with the number of producers, with markets, and total food expenses in the EU. In addition, the term organic sector is used by the European Commission when talking about rural development programs, and in this context, agri-environmental measures are related to the organic sector (EC, 2010a). Further within the ‘Action Plan for the Development of Organic Production’, the notion organic sector is frequently used without defining it (EC, 2021a).

In contrast to the European Commission’s report, Konstantinidis (2018) summarizes that the organic sector is today multi-faceted, multi-layered and reciprocal, and has clearly deviated from its early social and environmental ideals by “relying on mechanization, migrant wage labor, and fossil fuels, engaging in monocultures, and marketing its products in long-distance international markets” (Konstantinidis, 2018, p. 9). This is an indication of how complex and interwoven the organic production system is, and how there are trends towards more conventional production and decisions. This topic is addressed in greater depth in the conventionalization debate (see Darnhofer et al., 2010; Ramos García et al., 2018).

At the German level the ‘Bundesprogramm Ökologischer Landbau’ (BÖL) (Federal Organic Farming Program) (BLE, 2023) is the funding instrument for the implementation of the ‘Zukunftsstrategie ökologischer Landbau’ (Future Strategy for Organic Agriculture) (BMEL), 2019) and now the Bio-Strategie 2030 (BMEL, 2023). The BÖL considers four measures to be the most important: 1. Identification of the need for research, initiation and support of research projects on the topics of production, processing and marketing; 2. Preparation of the acquired knowledge in a target group-oriented way; 3. Support and strengthening of the supply and demand of organically and sustainably produced products with a variety of further education and training programs; 4. Information offers and competitions, supporting information services and trade fair appearances of the industry on organic agriculture (BLE, 2023).

For the state of Bavaria, these nationwide initiatives and measures have been supplemented since 2012 by the state program ‘BioRegio Bayern 2020’, followed by the state program ‘BioRegio 2030’. This is a holistic approach to the promotion of organic farming in Bavaria. The focus is on education, extension, promotion, marketing, and research specifically tailored to the needs of organic farming. The objective was to double the domestic production of organic food from Bavaria by 2020 (StMELF, 2017). In terms of production value in €, the target was just missed with an increase of 94 %, with crop production increasing by 126 % and livestock production by 91% (see more detail in Kaniber 2021). Despite the continuation of the state program, no detailed program has yet been published for ‘BioRegio 2030’. Although organic farming is already highly developed, Bavaria shows a heterogeneous distribution in 2020 (Figure 1) with the highest number of organic farms per state in Germany (10,989 (31.05 %)) and the largest organic area (386,496 ha (22.71 %)) while having most producers/processors (4,363 (25,15 %)) (BLE, 2020).

The general development of organic farming in Bavaria from 2012-2020 saw an increase in area of 86.6%, an increase in the number of farms by 67.8 %, while the general agricultural area in Bavaria decreased by 1.5% during this period. As a result, the share of organic farming

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increased from 6.4% in 2012 to 12.1% in 2020 (LfL, 2023; DeStatis, 2022a). This shows very clearly that the share of farms as an indicator can be misleading if the total absolute area decreases at the same time. The area-related targets that are actually intended to be achieved can thus no longer be achieved effectively.

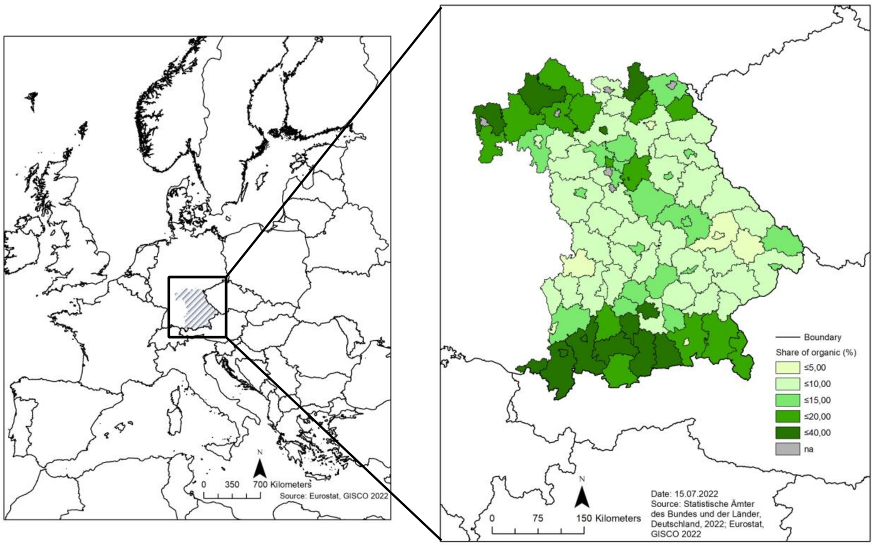

Figure 1: Location of Bavaria within Europe and Germany (left) and the share of organic area in 2020 in Bavaria (right) (DeStatis (Statistisches Bundesamt) 2022a)

Policy efforts to support rural development, including the benefits of organic farming, are frequently based on scientific evidence. The contribution and the similarities between organic farming and sustainable rural development (Pugliese, 2001), the different advantages of organic farming and its added value for rural development using the example of a case study from Austria (Darnhofer, 2005) and the possibilities of conversion to organic farming for regional development in Sicily (Italy) using the example of lemon farmers (Testa et al., 2015) are some examples. Given that organic farming is supported by EU funds through rural development programs, and that the impact of neighborhood effects (Ilbery and Maye, 2010) on organic farming diffusion can be linked to the benefits of proximity to processors and markets (Läpple and Kelley, 2015), it is essential to determine the precise spatial distribution of the organic sector, not only of producers but also of other actors, in order to evaluate the progress of EU`s policy objectives.

3 Organic certification as regulatory instrument

Organic farming was first legally anchored in the EU in 1991 with the EU Commission's definition of organic crop production (EC Reg. 2092/91), which came into force in 1993. The aim was to reduce confusion and fraud within the EU, thereby protecting both consumers and producers, and to support the development of the organic market in the EU (Vogt, 2007). On the basis of this legal foundation, over the years, many additions have been made to explicitly subsidize farms wishing to convert to organic farming, as well as to facilitate the import and export of organic products within the EU.

The legal framework for organic farming established in the EU allows governments to subsidize organic farming. Standards and certification as a regulatory instrument ensure compliance and protect producers from unfair competition and consumers from fraud, thereby building confidence in organic produce (Stolze and Lampkin, 2009). To verify compliance, private and governmental inspection bodies and organizations have been contracted to inspect the respective farms for the six control sectors A: Agricultural production; AA: Agricultural production – seaweed and aquaculture; AI: Agricultural production – beekeeping; B: Production of processed food; C: Trade with third countries (import); D: Awarding to third parties; E: Manufacture of animal feed. Depending on the federal state in Germany, control sector H: trade, is also certified, although in some federal states it is reported separately and in some federal states it is integrated into control sector B. This certification process is the most widely used regulatory instrument to ensure compliance in agriculture (Brito et al., 2022). The basic EU-organic certification allows for marketing organic products and using the EU organic logo. In some countries, such as Germany, a national organic logo has been most widely used for a long time. Additionally, there are four major organic farmers' associations in Germany (Biokreis, Bioland, Demeter, Naturland) that also provide a logo to assure consumers of the stricter specifications of the organic farmer association (Janssen and Hamm, 2011). This resulted in the additional use of organic certification logos to the introduced EU logo since the latter is mandatory (Janssen and Hamm, 2014).

Certification in organic farming is a controversial issue. It serves as a means to protect and build confidence in organic production, even if it is only about production techniques and not product quality. Yet certification is not necessary for farmers to follow organic guidelines, but it is necessary to market organic produce. Furthermore, the certification process and the associated institutionalization may have an adverse impact on the sustainability performance of organic farming (Alexandre De Lima et al., 2021). The additional costs associated with certification by third-party certifiers can also be a disincentive to conversion, and larger farms in particular are more likely to be able to afford the costs (Montefrio and Johnson, 2019), although the possibility of group certification since the new EU regulations should counteract this (Solfanelli et al., 2021). There is also a tendency for a shift from public to private certification depicting a change in the mechanisms in the agri-food sector (Hatanaka et al., 2005).

The European Commission's regulation on organic production and labelling of organic products (EC Reg. 2017/625) provides a definition of organic control authority. It states that it "means a public administrative organization for organic production and labelling of organic products of a Member State to which the competent authorities have conferred, in whole or in part, their competences in relation to the application of Council Regulation (EC) No 834/2007, including, where appropriate, the corresponding authority of a third country or operating in a third country" (EC, 2010b, p. 20). The European Commission also defines delegated body as "a separate legal person to which the competent authorities have delegated certain official control tasks or certain tasks related to other official activities" (EC, 2010b, p. 20).

In Germany, this means that there are 19 different organic inspection bodies that certify according to the regulations. They operate according to region and control sector and also carry out, to varying degrees, the additional inspection of the four organic farmers' associations. At the moment, it is the responsibility of each individual German state (Länder) to receive the reports from the respective control bodies in accordance with Article 34 of Regulation (EU) 2018/848. The inspection bodies report on a quarterly basis to the respective state authority, e.g. 'Landesanstalt für Landwirtschaft' for Bavaria, which in turn reports the data to the Federal Agency for Agriculture and Food (BLE). In turn, the BLE is responsible for reporting the data to the Federal Ministry of Agriculture and Food (BMLE), which again forwards the data to the European Commission (also see Gambelli et al., 2014).

Due to the large number of inspection bodies and the long reporting chain, which differs from country to country and, in the case of Germany, also from state to state, there is no homogeneity in the data reporting of organic certificates and the availability of these certificates. In addition, the data available in the certificates can only be extracted and used with considerable effort. This data bottleneck prevents a comprehensive analysis of the organic sector based on certificates. Nevertheless, this paper attempts to demonstrate the possible added value of analyses based on data from certificates, and thus to spatially locate several actors in the organic sector in Bavaria.

The organic certificate itself, as used in this work, is a data-rich protocol that includes not only the name and location of the company or farm, but also which products have been inspected and at what stage of the conversion process (organic, in conversion (two-three years), conventional). Organic certification therefore plays a crucial role in the organic sector for the reasons just mentioned. It is not required to practice organically, but to participate in the organic sales market. Farms that are not certified, but that are managed according to organic criteria, are of little interest to politicians, markets, or farmers' associations. These farms usually choose to market themselves in an alternative way (e.g., direct farm sales) (Rosol, 2018), thereby building trust with consumers. Hence, it is important to distinguish between the decision to farm organically and the decision to be certified (Veldstra et al., 2014). Certification is the regulatory backbone of the organic sector. It is the foundation of public trust, but allows industrial-like division of labor, marketing of long-distance, unbound to the direct contact to the producer. In addition, depending on the country, the certification system is a lucrative business and a service that is increasingly in demand.

4 The Spatial Representation of Organic Farming

We use the specification of the organic sector introduced by Darnhofer et al. (2019). They “use the term ’organic sector’ to refer to all actors linked to organic agriculture and food, including: organic farmers, farmers’ associations, umbrella organisations, advocacy groups, processors, traders, certifiers, consumers, researchers, and policymakers” (Darnhofer et al., 2019, p. 201). Further they “propose to focus on relations between five sets of actors: the organic farmers associations, the State, established or mainstream farmers associations, advocacy groups engaged in politicizing the agrifood system, and various actors along the food value chain" (Darnhofer et al., 2019, p. 203).

In the context of the evaluation of organic farming in Bavaria (ART and ECOZEPT, 2013), attention was also paid to the decision to convert, as this is considered to be a key factor influencing the development of organic farming. The factors can be divided into three categories: 1. Internal factors, e.g. expertise, competence and experience of the farm manager, requirements for buildings and land, availability of sufficient (qualified) labor, arrangements for farm succession as well as motivation and willingness of the farm manager to take risks; 2. Farm setting, e.g. acceptance and support on the farm, existence of local/regional (organic specific) collection structures, storage and processing or marketing structures, availability and proximity of expert advice; 3. Economic/political framework conditions, e.g. favorable political framework and market conditions, level of financing and financing conditions. The type of farm (e.g. fodder production, cash crops, livestock, special crops) also plays a crucial role (ART and ECOZEPT, 2013; Baumgart et al., 2011). This range of factors influencing the conversion decision shows the multitude of opportunities and challenges in the development of organic farming. In addition to hard factors, soft factors such as acceptance and support in the operational environment indicate that emotions and sensitivities also play an important role (ART and ECOZEPT, 2013). The influencing factor of downstream structures and actors in the value chain, such as buyers, storage, and processors, is one of the main focuses of this work.

Existing research on the spatial distribution of organic farming have attempted to explain the distribution in terms of various factors of influence. Although the change in the share of area or number of organic farms over time gives a general picture of the growth or decline of organic farming, there is a lack of spatial differentiation. Usually, the development of whole countries is presented in this way, although this is not very informative about the actual spatial development of organic farming in the respective country. Several existing studies show the spatial distribution of organic farming for different countries (Ilbery and Maye, 2010; Ilbery et al., 2016; Läpple and Cullinan, 2012; Schmidtner et al., 2012; Kujala et al., 2022; Blaće et al., 2020; Antczak, 2021). For example, Läpple & Cullinan (2012) described the development and distribution of organic farming in Ireland, focusing on various factors (e.g., policy impacts, farming systems, soil quality, market access) that explain the development. The influence of the neighborhood effect on the distribution of organic farming as a comparison in England and Wales (Ilbery and Maye, 2010) and in Germany (Schmidtner et al., 2012) are further contributions that address the spatial distribution of organic farming. To explain the distribution of organic farming, Ilbary at al. (2016) contributed and identified physical, structural, and sociocultural factors as key factors leading to different regional concentrations of organic farming. Based on their approach, Kujala at al. (2022) have shown the spatial distribution of organic farming in Finland and have further contributed to the understanding of the different factors influencing the concentration of organic farming by adding an economic factor as decisive for the spread of organic farming.

All of the above studies are based on recent third-party data. Agricultural surveys/censuses are not conducted annually. The level of detail also varies from country to country and year to year. The most common data sources in the articles are government agencies, so accuracy and completeness are not questioned, although there may be limitations. To show multifactorial spatial distributions more extensively through different maps, Läpple & Cullinan (2012) use not only producers, but also meat processors, milk processing facilities and main marts in one of their maps, but the source of the data for markets and processors is not apparent. Only Malek et al. (2019) pursued a similar approach to this paper. They display the global distribution of organic crop farmers using certificates from publicly available datasets. While there were issues with availability depending on the country, only the most readily available data sets were used. For Germany no response was received. For the purposes of this work, the certificates were obtained from a different Web site, but only individual certificates and not a complete data set.

A discrepancy arises when the development of organic farming is so multifactorial, but the presentation of its spatial distribution is reduced to the number of organic farms or the proportionate area. As a result, the development of organic farming is attributed to the number of farms or the size of the area alone, which would neglect other actors in the overall development process. While it is known that there are neighborhood effects on the diffusion of organic farming at the municipal level (Bjørkhaug and Blekesaune, 2013), it is also known that the proximity to processing companies (Klein and Tamásy, 2016) and the proximity to markets is crucial (Ilbery and Maye, 2010). Further, various actors are ascribed disparate opportunities to exert influence, including with respect to the potential for enhancing the resilience of agricultural systems (Soriano et al., 2023). This shows the need to include the spatial distribution of multiple actors in order to understand the whole development process of the organic sector.

Depending on the scale, there may also be a lack of differentiation on a large scale due to a lack of data. By using certificates as a data source, some barriers could be overcome and targeted recommendations could be made to support rural development. The environmental impact of rural development measures can variously be assessed at different scales. Factors that may be considered successful at the national level may not at the regional level (Desjeux et al., 2015). Furthermore, due to the diversity in landscapes and regions, large-scale assessment should be given priority.

Organic certification data is useful for looking at large-scale patterns in the distribution of each control sector. In the case of Germany, data availability is given, but data collection is very time-consuming, as there are no collected data sets, or they are not freely available. The significant lack of digitalization in organic farming is visible and may hinder the future competitiveness of organic farming. Evaluations using certificate data extend the spatial assessment of organic farming beyond the number of organic farmers or the proportionate area. This added value is considered crucial because the development of organic farming is determined by the complex construct of the organic sector. An one-dimensional approach to development processes would not do it justice. What exactly makes up the organic sector and how it is influenced by different actors needs to be analyzed in the future.

5 Methodology

The data for this paper was gathered from the website of the 'Bundesverband der Öko-Kontrollstellen e.V.' (BVK) (Federal Association of Organic Control Bodies). In 2019, 15 of the 17 organic inspection bodies were represented in the BVK, which issue about 90% of all German organic certificates. In the process, 12904 certificates were recorded for all 2062 postal codes in the state of Bavaria (DeStatis, 2022b). This means that each certificate and the data it contains can be assigned to one of the 95 districts and district-free cities (Landkreise und kreisfreie Städte). The data recorded consists of the postal code, the city, the control sector(s) and the name of the organic inspection body. The date collection took place from February 2019 to June 2019.

The BVK offers on its website (http://bvk.oeko-kontrollstellen.de/de/aktuelles/) a query directory (https://www.oeko-kontrollstellen.de/suchebiounternehmen/SuchForm.php), which performs a query by entering the postal code or the company name (at least three letters) and returns all companies with the respective postal code or name. For each company the current, and if available the previous certificates, are provided. The total number of certificates per postal code cannot exceed 30 and according to the website, the limitation of the data output is justified as follows: "Please note that for privacy and data collection purposes, a maximum of 30 companies will be displayed. If you do not find the company you are looking for, please specify your search" (BVK, 2022). By specifying the search, it was still possible to obtain the certificates exceeding the 30 certificates.

In order to put the number of certificates into relation, the agricultural area in 1000 ha was used for each district or district-free city. These data were obtained from the Agricultural Structure Survey/Agricultural Census 2020. The same applies to the comparative map showing the percentage of organic farms to the total number of farms (DeStatis, 2022b). This is not the same year as the certificate data collection, but data at a regional depth for district and district-free cities only appear every four to six years (2010, 2016, 2020). These data and the map created based on it are still useful to show trends and concentrations, as the change within a year is negligible for general comparisons.

According to the information provided by the individual organic inspection bodies, the collected data have been standardized with regard to the terminology used in the control sector (main activity), as the exact choice of words is partly different depending on the organic inspection body. Each certificate has been added to one control sector; if multiple control sectors were certified, the certificate has been added to each control sector. As some farms were certified for several control sectors, 14728 controlled sectors could be assigned to the 12904 certificates that were recorded. For each control sector, the individual zip codes were then assigned to the corresponding district to obtain the number of certificates by control sector for all 96 districts. For each district, these values were then related to the agricultural area in 1000 ha. Although this leads to a stronger expression in the control sector of producers in regions with small-structured farms, the map with the share of organic farms in the total number of farms serves as a comparison. The tables that were generated for each of the control sectors were then uploaded into a geographic information system (GIS) (Esri ArcMap) and visualized. The resulting maps are shown in Figure 2-7. To put the values of the data into perspective,

Figure 8 and Figure 9 are presented. The location quotient (LQ) (Figure 9) is used to show spatial concentrations and provides a comparative value independent of the size of the district or district-free cities. However, the LQ can only be used for the number of organic farms, as it sets the ratio of organic farms in a district to the total number of farms in this district, which in turn is set in a ratio of the total number of organic farms in Bavaria to the total number of farms in Bavaria. A value above one indicates a higher concentration compared to the Bavarian average, while a value below one indicates the exact opposite (also see Läpple and Cullinan, 2012)

6 Results

6.1 Spatial distribution of organic sector participants in maps

The results, presented in the form of maps, are evaluated descriptively, since the aim is to display the different spatial distributions of the control sectors. This is done by describing how each of the eight maps distributes and exhibits distinct spatial patterns.

The distribution of certificates for the control sector producers (9278 certificates, Figure 2) clearly demonstrates a more pronounced distribution in the south and in the north. Almost the entire south has a high number of producers per area. The region around Nuremberg and southwest of it is a region with a proportionally lower number of producers. The western districts of Bavaria have the lowest number of producers. In the north there is a band of districts with a higher number of producers.

Among the processors (3501 certificates, Figure 3), there is a clear picture of high concentration within district-free cities that appear like islands in the surrounding districts, such as Munich or Nuremberg. Apart from these “islands”, there is a relatively high degree of homogeneity within Bavaria. However, there is a stronger distribution in the south. There are also many processors around Nuremberg and to the southwest of it, as well as in the far north. The districts with the lowest number of processors are located in the mid-west and in the east.

The spatial distribution of certified importers (trade with third countries, import) (292 certificates, Figure 4) is highly concentrated in the district-free cities. The largest cluster is in and around Munich. Apart from that, the distribution is very homogeneous, although there are a few districts throughout Bavaria in which no certificate has been issued for the control sector. The only district in the southwest that stands out is the district bordering Lake Constance.

The control sector for awarding to third party (520 certificates, Figure 5) requires some explanation. Two peculiarities should be mentioned. 1. It is always certified together with one of the other control sectors. These are companies involved in, for example, transport, processing or storage, which are also inspected as part of the certification process. It is not necessary for these companies however to have their own organic certification. 2. The company named in the certificate is not the service provider, but the client, which means that its address is also listed in the certificate. The geographical distribution of the certificates therefore does not represent the spatiality of the service provider. The distribution is very scattered. There is a stronger presence in the district-free cities, although there are also district-free cities without a certificate. There is a cluster around Munich and a smaller one around Nuremberg. The northwest also shows a stronger distribution, while the entire west has no or very few certificates. There are also districts in the south with no or very few certificates.

In the control sector for animal feed (119 certificates, Figure 6), i.e., companies producing or marketing animal feed (not being agricultural producers), there is a significant number of districts (42/96) that do not contain any animal feed certificate at all. There is a higher concentration in some district-free Cities. In eastern Bavaria there are many districts without a certificate, as well as in the central north and south. There are hardly any districts with a high number of certificates.

The control sector trade (1018 certificates, Figure 7) is for resellers who market products with reference to organic farming but are not producers. There is a high concentration of certificates in the district-free cities. In the south there are some districts with a higher concentration, while in the east of Bavaria there are districts with a lower number. There is only one district and one district-free city without a certificate.

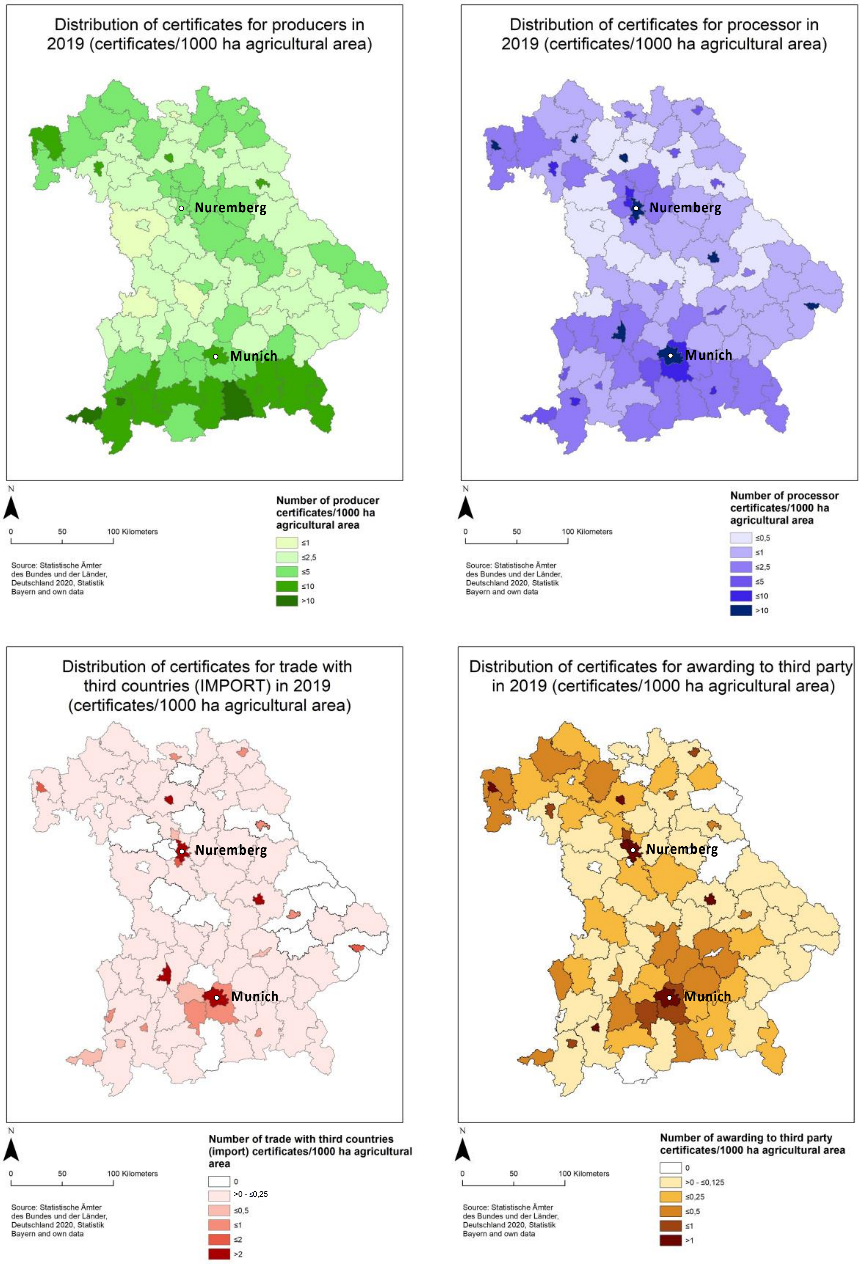

Figure 2-5: Maps showing the spatial distribution of the respective control sector (producers, processors, importers, awarding to third party) in Bavaria (source: Statistische Ämter des Bundes und der Länder, Deutschland 2020, Statistik Bayern and own data)

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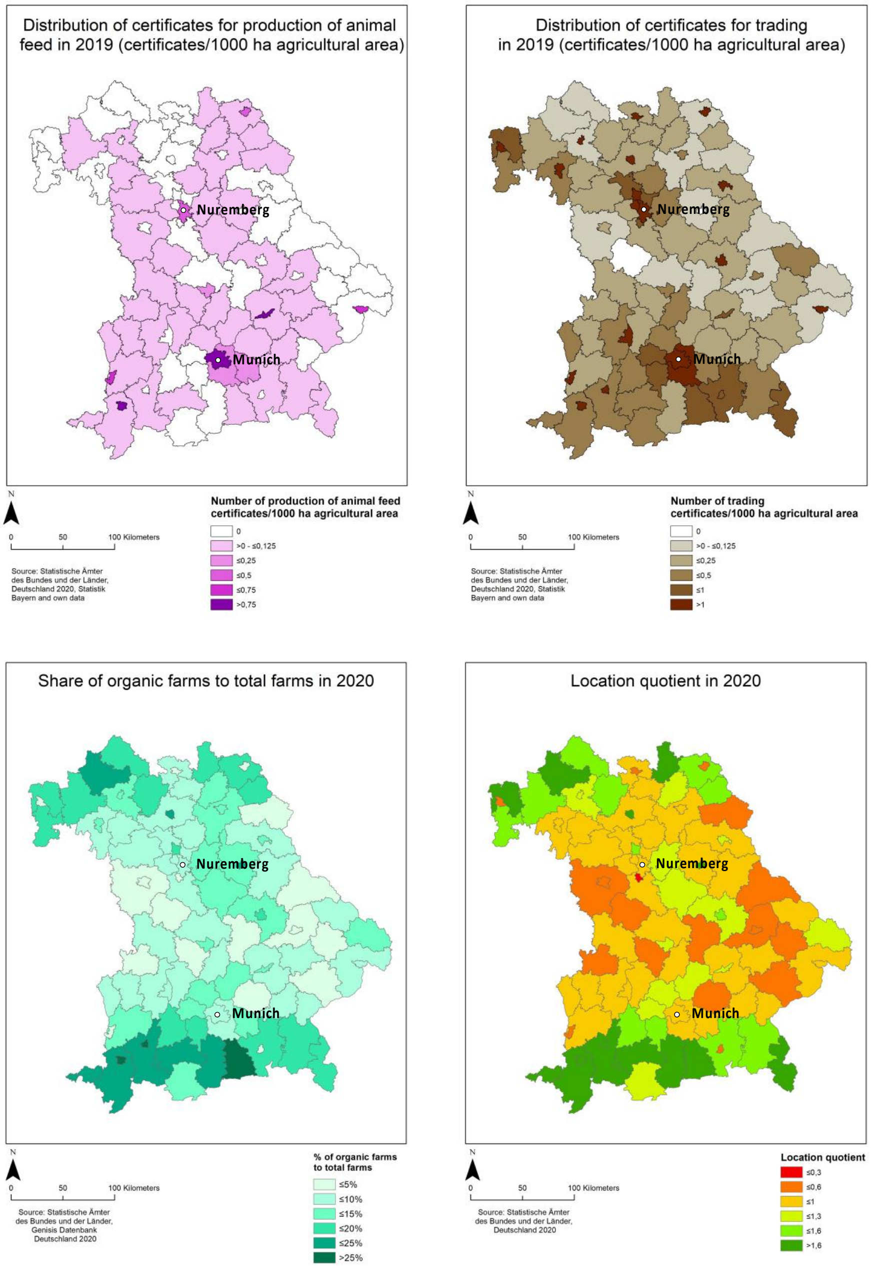

Figure 6-9: Maps showing the spatial distribution of the respective control sector (production of animal feed and trading) in Bavaria, the share of organic farms in 2020 and the location quotient in 2020

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Maps (Figure 8 and 9) serve as comparative maps. They display the share of organic farms in the total number of farms (Figure 8), the way as organic farming is commonly presented in scientific papers. This again emphasizes that such a one-dimensional representation of the organic sector is only marginally sufficient, since this is only a part of the organic sector and the spatial distribution of the different control sectors is sometimes very differing. Similarly, the location quotient map (Figure 9) points out a greater concentration of farms in the south and north and shows strong parallels to the maps in Figure 2 and 8 referring to the spatial distribution of the number of producers and the share of organic farms in the total number of farms.

6.2 Analysis of influencing factors for distribution

The individual maps show different spatial distributions and patterns. The reasons for these differences and patterns are diverse and can be attributed to a variety of influencing factors such as natural conditions, historical development, infrastructure, company size, proximity to markets, political influence, population structure, and so on. Because these factors cannot be considered in isolation, but rather interact with each other, the analysis of influence becomes even more difficult. However, there are some salient factors for each control sector that are listed here.

The high concentration of producers in the south, is due in part to the proximity of the Alps, where high rainfall creates permanent grasslands that can be classically used for dairy farming. The number of farms is favored by the small size and three of the four largest organic dairies in Germany (Statista, 2022), which facilitate the conversion decision as reliable processors. Northern Bavaria is also characterized by small farms. In addition, there are large urban centers such as Nuremberg and Frankfurt, which are good sales markets and thus could function as incentives for the conversion decision. It is also worth noting that the distribution of producer certificates (Figure 2) is similar to the distribution of the share of organic farms in the total number of farms (Figure 8). A strong distribution of organic farms in the south and north is also evident here. The map of producers also parallels the rather weak regions in the center, west and east. The data in Figure 8 are from the 2020 Agricultural Structure Survey, which covers 100% of all farms, but the spatial patterns are almost identical to Figure 2. Maps using data on the number of organic farms are analogous to those showing the number of producer certificates. This is obvious since the production of goods happen only at the farm level.

For the processors, there is a partially different distribution of certificates. Here, too, there are strong clusters in the north and south, although the distribution of processors throughout Bavaria is more even and a different picture emerges from that of producers. However, the district-fee cities stand out, with a higher number of certificates for processors. Processor certificates fall into two categories. There are farms that are also certified as producers that have associated processing. The other type of processors are companies that specialize in further processing and then market these products directly or through an intermediary. The latter are often located in cities because of the large number of innovative companies that bring new products to the market. Infrastructure and purchasing power are also higher in cities, which is another reason for the high number of processing certificates in cities. However, size and revenue do not play a role in the data. Each certificate is valued equally. The similar pattern in the distribution of producers and processors supports the fact that farmers interested in conversion look around for possible buyers and processors in their area before to be able to operate in a secure economic situation. Ideally, the processors are located in places where there are a lot of producers.

The given infrastructure in cities simplifies logistics for importers. The importers are from EU countries or third countries. Unlike producers and processors, where there is a clear logical link, importers are usually in a unique position. However, there are also links to processors or traders. Pure raw material is often imported and used by processors. The importer acts as a kind of wholesaler. Importers are also responsible for meeting domestic demand through imports. The reason for the certification of an importer is rather to guarantee the organic quality of products from third countries and to be able to trace the flow of goods. This is also to protect the organic products from fraud. The flow of goods has to be registered online in an EU database, so that the flow of goods can be traced worldwide.

Unlike the other control sectors, certificates to third parties cannot be certified on their own. Therefore, the map of the distribution of certificates to third parties must be analyzed in a differentiated way since the organic enterprises are certified and thus located, which commission the third-party company. However, this company may be located elsewhere and not appear in the BVK database as a certified organic company. Due to this fact, it must be mentioned that a large number of companies working for and within the organic sector are not covered by certificates. These can also be 'conventional' companies, which nevertheless comply with the regulations as companies for the respective activity related to organic farming.

The control sector of feed producers has by far the lowest number of certificates with 119 and already a large gap to the next most common, import with 292 certificates. Feed producers seem to be unimportant for the organic farming's ideological approach, since organic farmers should produce most of the feed for the animals on their own mixed farm. However, purchasing feed is the rule rather than the exception. Therefore, for a farmer with livestock, in order to be able to buy regional products, feed producers play a crucial role. However, the extent to which the individual components of the feed actually originate from local, in this case Bavarian, production is not evident and must be inquired about by each farmer at the animal feed company. Thus, feed producers have a direct link to production (livestock farming) and play a critical role in sustainability issues through production, transportation, composition and regionality.

Again, due to infrastructure and demand, the spatial distribution for trade in Bavaria shows a higher concentration in cities and adjacent districts. Especially around the cities of Munich and Nuremberg there is a high number of traders. As a link in the agri-food chain, trade plays a crucial role as one of the ways to distribute the produced goods. Since this includes also products offered over the internet, they may be products that have no regional reference. The number of organic certifications for traders is the third most common after producers and processors in the control sector. This shows that, in addition to producers and processors, many traders of organic products have established themselves in Bavaria. Again, the size of the company or the amount of revenue it generates is not a factor in the distribution patterns.

7 Discussion

7.1 Limitations of approach presented

The paper criticizes the to date limited number of indicators used for measuring organic farming with the share of the number of farms. The fact that there is no further specification of the individual farms however is same in the maps produced for this work.

For example, the certificates do not differ by farm size, number of employees, or volume produced or traded. Thus, each certificate is equated to a producer, which does not take into account agricultural and business conditions.

The situation is similar for producers. It does not matter whether it is a farm that processes small quantities of one product and sells it in its farm shop, for example, or whether it is a large industrial company that processes large quantities and a large number of goods. This restriction applies to all control sectors. In addition, there are two limitations for the control sector awarding to third parties, as already mentioned in the results section for this control sector. First, the address given in the certificate is not that of the service provider, but that of the client. Second, the service provider is also inspected but not certified as part of the organic certification process.

Due to data availability, this work is based on 90% of all certificates issued in Bavaria in 2019. The process of data retrieval is also rather time consuming and therefore a limiting factor for rapid spatial analysis.

The challenge of map presentation is also limiting. The number of certificates must be in the same ratio for all maps. One could use other parameters such as population or district area. Since this work is basically about agricultural processes, the agricultural area was used as a parameter. This has limitations in the sense that some maps show a high concentration of certificates in the district-free cities. Since the agricultural area is usually very small there, this can quickly lead to a high ratio. On the other hand, it is important to note another parameter such as population might distort the map in another direction. The maps should therefore be considered and compared with each other. Nevertheless, in this work, the two comparative maps (Figure 8 and Figure 9) have been used to show the spatial distribution when using commonly used parameters such as number of farms or organic area. Here again, the location quotient (Figure 9) serves as a useful measure for assessing the proportional distribution of organic farmers.

Further analysis of the maps, which aim to describe the reasons for the distributions, must be conducted with great care and consideration, as it is exceedingly challenging to accurately represent the intricate nuances of the agricultural context. Additionally, it is imperative to recognize that the spatial presentation of actors provides only a limited insight into their connections to other actors.

7.2 Advantages of the approach

The approach in this paper is valuable for an in-depth, large-scale analysis of organic farming. It broadens the spatial understanding of other activities and actors in the organic sector. For a functioning and effective organic value chain, secure buyers for the produced organic products and proximity to processors are crucial. Thus, the spatial location of processors, i.e., control sector processors, is helpful in identifying patterns and possibly supporting the establishment of processors, thereby stimulating the conversion rate to organic farming. The processing companies should ideally be located close to where the raw material is produced, in order to also take into account sustainability aspects in transport or marketing. The influences of the individual control sectors on the large-scale structural development of organic farming must be investigated and understood in more detail in the future. This will enable recommendations to be made on how structurally weak regions can benefit from the organic commodity chain through targeted agricultural development measures and thus pursue sustainable regional development.

If this paper were to show the spatial distribution of organic farming based on data, as in the work of Ilbery and Maye (2010) or Blaće et al. (2020), it would look most like Figure 2, producer certificates, or Figure 8, share of organic farms to total farm, for Bavaria. The other control sectors, however, demonstrate different spatial distributions. These observations point to various networks between actors of different control sectors in distinct regional contexts. The spatial distributions also show different dynamics, which in turn are influenced by multiple factors, and thus can be considered individually, but due to the interconnectedness and interdependence within the entire organic sector must be considered in the context of the overall development. For future studies, it is necessary to identify the individual factors that determine the development of each control sector, which can further contribute to the discussion on the development of the organic sector.

The organic sector consists of a variety of actors and is an evolving social process shaped by the interwoven relationships between them. In addition to their detailed list of actors that constitute the organic sector for them, Darnhofer et. al. (2019) also call for a focus on the relationships between different actors and actor groups. The authors use this relational perspective on the basis of very influential groups and relevant and decisive actions. In doing so, they neglect the spatial perspective and its influence. However, this work shows that spatiality has an influence and that the spatial distribution of different actors, in our case along the value chain, is inhomogeneous and highly relevant. The connections and interactions between the different actors in each context will determine how organic agriculture develops in the future, rather than the individual actions of farmers or other organizations (Darnhofer, 2014). Similar markets and consumer preferences evolve together and actors, producers, sellers and consumers influence how they change (Spaargaren et al., 2012). Further projects should attempt to show the relationships between a very large number of actors. This would allow for a better understanding of the dynamics, influences, and barriers of the organic sector.

Through a better understanding of the organic sector and the spatial distribution of actors, spatially better targeted policies could be developed to exploit the benefits of organic farming for rural development. The common policy expectation that conversion to organic farming will automatically develop the entire organic sector is naïve and does not necessarily lead to the benefits for rural development. The challenges (data availability, digital accessibility, spatial distribution of actors, relationships between actors) for large-scale, multi-actor analysis need to be overcome in order to understand the future networks and pathways of influence of organic farming and to promote rural development in a targeted way.

8 Conclusion and Outlook

Organic farming has found its way into many political programs as a sustainable form of agriculture at the EU, member states and, in the case of this work, federal state level in Germany (Bavaria). Not only positive environmental characteristics are attributed to organic farming, but also socio-economic effects and added value for rural development. Organic farming can

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therefore be promoted within the framework of the CAP through environmental services as well as added value for rural development.

In this context, organic certificates play a crucial role as a regulatory instrument to ensure compliance with the standards in order to achieve the objectives of the programs. The impact of the policy is measured almost exclusively in terms of the share of organic farming in total agriculture, even though the associated strategies and the 'Action Plan for the Development of EU Organic Production' include a large number of measures with environmental, economic and social impacts. This is because the factors for the development of organic farming are manifold, as is the decision to convert to organic farming.

For an adequate assessment of the development of organic farming, including its influence on rural areas, as well as for a more comprehensive evaluation of its impacts, a spatial analysis of more actors than just producers is required. However, this is hampered by the availability of data, which is overcome in this work by using EU-organic certificates. This allows us to spatially map and show the distribution of several actors in organic agriculture, divided into their respective control sectors within certification.

The results are visualized in maps with different distributions of certified farms/enterprises depending on the control sector. While the number of producers is particularly high in the north and south of Bavaria, processors tend to be concentrated in urban areas. Traders, importers, and certificates for services are also mainly located in and near cities. The distribution of certificates for feed production does not show a clear pattern, although they also tend to be located in cities.

Such datasets make it possible to present spatial information from a larger number of actors and are therefore very useful for scientific studies. They also offer the opportunity to conduct more comprehensive impact analyses and thus to make more targeted, large-scale policy recommendations that take greater account of the interconnectedness and ramifications of the organic sector.

The targets set out in policy strategies cannot be adequately verified using the currently monitored indicators of the number of farms and the size of the organically farmed area. On the evidence of scientific research, we know that the overarching objectives pursued, such as biodiversity and habitat protection, rural development, the improved position of farmers in the agri-food system and the production of healthy food and other ecosystem services for EU citizens, are the result of a complex interplay of multiple components. The parameters that have been set for meeting the EU's objectives are in fact a shortcoming. These datasets are jumping short in relation to reality`s complexities of conversion processes and decisions and long-term farm success.

The flipside of the coin of policy strategies is financial support for rural development, farms/companies and nature conservation. The currently very rough data situation poses a massive difficulty in this regard, as the spatial allocation of data in large spatial containers does not allow for targeted and efficient support of rural areas. Besides insufficient data complexity, the access to data poses problems, as the data basis is collected and secured in innumerous segregated administrative bodies at the one hand and complicated to collect via digital ports on the other hand.

The EU Green Deal funding instruments leave flexibility to the subsidiary political decision-making units to set priorities for funding. This leeway, which from a rural development perspective appears reasonable, enables locally divergent circumstances to be balanced out in a targeted manner. This advantage can only be used efficiently if detailed data is available that can be spatially localized and differentiates between specific actors in the agri-food network. To date no data-based option to analyze the efficiency of these rural development policies is reasonable available which leads to a barrier for extensive evaluations.

The aim of this paper is, to make this kind of spatialized and differentiated data on the organically certified sector available for the German state Bavaria and thus, open up possibilities of further inquiry. Based on this data set, a range of follow-up studies are possible to be conducted. First of all, it would be desirable to generate comparable databases in other federal states in order to carry out comparative studies across federal states. Second, this data is relatable to other on district level existing data sets, e.g., soil type, inhabitants, or purchasing power in order to generate mappings. As research in relational economic geography reveals that besides geographical closeness also the quality of relationships are important conditioners of successful local economic value generation, these analyses give valuable information about the formation of local alternative food networks, decision making in conversion to organic sector and long-term farm development and economic success.

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Niche–Regime Interactions of Organic Model Farmers in Bavaria, Germany: Linking Activities of Individual Farmers

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Abstract: Organic farming is seen as a promising alternative in the transition to more sustainable agri-food systems. Within the multi-level perspective (MLP) framework for such transitions, the linkage between the innovative niche and the dominant regime is considered crucial. We explore the linkage activities of individual organic model farmers through farm webs that were created based on semi-structured interviews. As the agri-food transition's designated executing actors, individual organic model farmers must be understood as change agents. This research shows that these model farmers show high levels of linking activities, but each engages in a variety of linkages that are put together individually. This research reveals the reasons for choosing specific linkages, revealing the varying potential impacts of organic model farmers and their relevance in the transition process, and emphasizes the need for tailored policies that support farmers in adopting sustainable farming practices.

Keywords: agri-food system; multi-level perspective; niche–regime linking; organic farming; sustainability transition

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1. Introduction

Achieving greater sustainability in the agri-food sector is increasingly urgent and requires the transition of the socio-technical systems in agriculture. Multidimensional (political, cultural, normative, technical, and cognitive) change is required to achieve the transition to sustainability in agri-food systems, as agriculture is highly diverse and spatially peculiar [1,2]. The multi-level perspective (MLP) is the most frequently used [3] approach, offering a holistic and systemic approach to explain transitions based on a multi-scale perspective (niche innovations, existing regimes, and the broader societal landscape context). Niches are "protected spaces" (see Section 2.1), in which innovations can develop that ideally engage and affect the dominant regime. The landscape level provides an exogenous societal, economic, and political setting, offering windows of opportunity for the niche to break through [4,5]. When assessing sustainability in agriculture, three main aspects need to be taken into account, as follows: the economic, environmental, and social [6] aspects. By connecting these aspects with geographic differences, ecological characteristics, and the diversity of food systems, a variety of pathways for the agri-food system transition become possible [7–9].

The interaction between niches and regimes is considered one of the driving mechanisms to advance socio-technical transitions. Although the MLP has been subject to criticism regarding its lack of agency, ambiguity in levels, and neglect of politics and power [10], the basic idea of an interaction between niches and regimes, as described in the MLP, helps us to better understand transition processes. Understanding exactly how niche–regime interactions take place is therefore crucial [11]. Transitions in agriculture differ from other system transitions in that consumer and cultural aspects must be taken into account [7,12]. One approach to capture the linkage between niches and regimes is to use the notion of anchoring, distinguishing among technological, institutional, and network anchoring [13]. Sustainability transition was captured using anchoring in relation to organic farming (OF) in Egypt, where the possibility of OF in a reconfiguration pathway is highly dependent on political decisions [14]. Further research, conducted to expand the understanding of niche–regime linkage and interaction, has highlighted the role of knowledge systems in niche–regime interactions [15], the importance of niche–regime management to maintain niches [7], and the role of producer organizations as transition intermediaries [16]. Other researchers emphasize the importance of linkages between niches and several regimes [17,18], or how the enrolment of new actors and niche activities leads to a gradual reconfiguration of the regime [19]. The strategies that niche actors use to link to the dominant regime through hybrid actors have been gaining attention [20]. Ingram (2015) characterized the processes through which niches link to incumbent regimes as being reflexive and adaptive. This typology accounts for the complex and heterogenous processes that niche–regime linking entails [21].

OF can serve as a prototype for sustainable agriculture [22] within policy frameworks [23], because it combines principles based on environmental concerns with social and economic objectives. Farmers are the transition's executing actors and they have their own farm setups and trajectories, addressing sustainability issues individually, specifically, and by adapting them to their circumstances, reflecting the variety of possible agri-food transition pathways [7,24]. Recent research on OF and agricultural transition has been conducted with foci on the production type, geography, and transition state [14,22,25–28]. Scrutiny of the niche nature of OF is important due to its different local circumstances and spatial development [29,30]. In this research, OF is seen as a strong, developed, and influential niche that, to certain extents in several sectors, has already reconfigured the dominant regime (see Section 2.2).

However, to date, all the contributions that have dealt with either niche–regime linking or OF in the context of the agri-food transition process fail to show the linkages of individual farmers. In most cases, only the circumstances that led to the linking are discussed. In addition, although the hierarchical classification of the MLP is broken down and different actors, processes, and values within the linking process are identified, the authors hardly address basic linkages. The focus on farmers in transition, the largest group of actors in the agri-food system, is the specificity and originality of this article. A first attempt is made to identify the basic linkages of organic model farmers (OMFs) in Bavaria, Germany, with the organic niche, the dominant agri-food regime, and other regimes. The Bavarian government designated OMFs as model farmers in a policy measure (see Section 3.1), thereby officially recognizing them as potential change agents [31,32], which leads to the following two research questions: (1) What connections and linkages do model farmers use to interact with the organic niche, the dominant regime, or other regimes? And (2), What are the rationales and justifications for these linkages? This provides an opportunity to capture the potential of OMFs as change agents in the transition process and contributes to the discourse on niche–regime interactions. This article aims to contribute to the theory by highlighting the fundamental interactions of niche actors from the MLP, using OF as an example of a transformative niche, emphasizing the crucial role of individual model farmers as change agents within agri-food transition processes.

In what follows, the MLP approach as a conceptual framework for the analysis is outlined, including OF as a niche, the possible agri-food system transition pathways, and niche–regime interactions. With the help of dependency diagrams, the production chains, interactions, cooperation, and dependencies within and outside the farms are identified. The results are then discussed and the potential is shown by categorizing the rationales for the linkages. This paper concludes by identifying four justifications for the choice of linking partners, each with its own constraints on the partner choice.

2. Conceptual Framework

2.1. Multi-Level Perspective

The MLP is a heuristic device used to understand socio-technical transitions, including in the agri-food sector. The MLP can be used to frame an analysis of the change from one socio-technical regime to another. The non-linear transition process occurs through the interaction of three analytical levels. At the niche level (here, OF), radical innovations emerge and develop. Participants develop rules and techniques based on common visions and ideas, addressing problems facing the dominant regime. In these "protected spaces", actors work on these novelties in such a way that they can be used in the dominant regime or even replace parts of it. The socio-technical regime describes the meso level (here, the high-input agricultural regime), which contains tangible (markets, artifacts, and regulations) and intangible (cognitive beliefs and shared rules) elements that maintain the socio-technical system and is characterized as both "path-dependent" and "locked-in", implying barriers to change and challenges for anyone aiming to alter it. The third level is the socio-technical landscape, comprising long-term exogenous trends, which include both slow-changing developments (e.g., demographics, cultural repertoires, societal concerns, geopolitics, and macroeconomic trends) and external shocks (e.g., wars, financial crises, accidents, and oil price shocks) [33]. The pressure created here, on the dominant regime, to address sustainability issues opens up windows of opportunity to change or even replace the dominant regime using niche innovation [4]. Socio-technical transition involves far-reaching and multifactorial (e.g., technological, political, institutional, cognitive, normative, and market) change and is a process that includes the interaction of multiple actors (e.g., companies, scientists, stakeholders, policymakers, and interest groups) [5,34]. The MLP is frequently used in studies on agri-food transitions; however, because it has several weaknesses (e.g., its bias towards bottom-up change; agency conceptualization; neglect of politics, governance, and power; ethics; normativity; and the politics of transitions), it is frequently combined with other transition frameworks to explain agri-food transitions (see El Bilali, 2020, for an overview), reflecting the complexity of this endeavor. Nevertheless, researchers generally consider niche–regime interactions as being key to transition making, as it integrates new practices and rules into the regime [19]; yet, it still lacks a "theory of linking" [35].

2.2. Agri-Food Transition Pathway

Diverse research projects aim to capture the different influences in agri-food transition pathways. Ingram (2018) shows the importance of knowledge and its transfer in reconfiguring the system, the influence of the niche knowledge system on the dominant knowledge system, and the boundaries between them [15]. El Bilali and Allahyari (2018) visualize the use of information and communication technologies along the entire food chain and their assessment reveals how specific actors are connected and the changes that need to be initiated [36]. Runhaar et al. (2020) use the example of Dutch dairy farming to show how different logics (market logic, sustainability logic, and cultural identity) influence endogenous regime change, thereby illustrating the importance of the semi-coherence of a regime on its transition pathway. In particular, lock-in mechanisms influence transition [37]. Kuokkanen et al. (2017) contend that these should not be taken for granted simply because they exist throughout the whole agri-food system [8]. Agri-food markets also play crucial roles in the transition process to increased sustainability [38]. Here, it is important not to neglect economic institutions when researching present markets and economics and to assess different capitalist configurations [39,40]. Political decisions can accelerate the transition to sustainable agriculture, but they can also counteract it, as has been shown by the varying spread of OF in the European Union [28]. Certain blocking mechanisms in the transition process of agriculture are crucial and maintain lock-in mechanisms, as shown in the example of the nature-inclusive agriculture in Dutch dairy farming [41]. To overcome lock-in mechanisms, an interdisciplinary approach to the transition process in the agri-food system is needed [2,42].

2.3. The Organic Niche

The best-known alternative to the dominant agri-food regime is OF. The use of the term "agri-food regime" is deliberate here, as using "agricultural regime" would not do justice to the sustainability claim and its importance, nor to the fact that a transition is needed from farm to fork [43]. As the term "niche–regime interaction" implies, there are alternative counterparts to the dominant agri-food regime, which are still at the niche level but address several aspects of sustainable agriculture [44]. The niche nature of OF is highly spatially dependent, showing multiple stages of development and influential levels on the dominant regime. Research shows that OF in the Global South is one of many niches in the transition to sustainability, with a low level of institutional, political, and societal embedding [14,16,25]. In contrast, studies in the Global North treat OF as a niche, even though it enjoys widespread support (e.g., societal and consumer demand, as well as political and institutional recognition) [26,28]. While restricted by rules and regulations, there is still a high level of heterogeneity in OF, represented by the research on the conventionalization debate [45–47]. Looking at the numbers, OF is still a niche. Even in Europe, OF accounts for only a small fraction of the agricultural area [48]. Furthermore, the fact that OF is referred to as an innovation in the literature [33,49] reflects the stage of its development and reinforces the assumption that the organic sector is still a niche. OF is more than a collection of methods and practices, as it conveys values, visions, attitudes, social innovations, and a sense of togetherness, making the organic niche more than just a site of technical innovation. Darnhofer concludes that "how OF develops will be the result of the dynamic interaction between the actors and the context in which OF is embedded, i.e., farmers' associations, processors, retailers, policymakers, etc. Markets and user practices are co-constructed, changing as new options and new practices arise" (p. 446) [22]. Organic farmers, as a group of actors, occupy a special position in the organic niche due to their numbers, activities, and individual characteristics. Actors in the organic niche interact with organic farmers in different ways. If there is a need for a bottom-up transition of the agri-food sector, farmers are a crucial group of actors that should be strongly considered.

However, the transition process requires joint interaction between producers (farmers), retailers, and consumers, as well as interactive actions and time [50]. In this context, Darnhofer calls for a comprehensive understanding of the niche–regime interaction between OF and the dominant regime and contends that "for OF to be a prototype of sustainable agriculture, it not only needs to show that it can effectively address a range of sustainability concerns, but it also needs to show that it can successfully work with the dominant agri-food regime" (p. 446) [22]. In Bavaria, OF accounted for around 12.8% of the total agricultural area in 2021. The high status of organic agriculture in Bavaria is reflected in political programs; institutional apparatuses, including an umbrella organization for organic agriculture in Bavaria; and social action, such as the citizen initiative "Save the Bees". Moreover, the interactions, influences, and impact chains of Bavaria's organic sector spill over its state borders. Nevertheless, organic agriculture is still a niche in Bavaria.

2.4. Niche–Regime Interaction

In order to prevent OF from remaining just one of several alternative niches, it must work with and transform the dominant regime. The influence between the niche and regime is reciprocal, whereby the niche influences the regime and its actions, views, and approaches to solving emerging problems, but the regime also influences the niche and forces it to change its trajectory [22]. Mylan et al. (2019) support this reciprocity by showing the importance of the bidirectional analysis of niche–regime interactions [12]. How niches and regimes interact is crucial [11], as this is one of the driving mechanisms of transition that is occurring in multiple dimensions (e.g., markets, regulations, technologies, and cultural meanings) [51]. Niche–regime interaction is not simply the adaption of a niche technology to the regime, but is also a complex and messy process that includes technologies, visions, values, and practices relevant to agri-food sustainability. There is no clear separation between niche and regime networks, as there are also hybrid actors who have their own ambivalent strategies [7]. Furthermore, the complexity of transition processes fragments the interaction process. To understand how, Diaz et al. (2013) distinguished between domains, sub-regimes, and governance levels [20]; Hebinck et al. (2021) focused on the interaction between niches and several regimes [17], while Dumont et al. (2020) took socio-technical configuration into account [52]. Elzen et al. (2012) introduced the notion of (technological, institutional, and network) anchoring, which is now frequently used to assess how niches interact with regimes [13]. To better understand niche–regime interactions, we need to consider not only the fact that there is an interaction, but also the individual processes behind it. Knowledge and its transfer are of immense importance not only in agriculture, but also in the transition process. In addition to practices and technologies, knowledge also transfers values, attitudes, social responsibility, and visions [15]. Farmers and the knowledge they transfer are important because they produce and reproduce discourses and norms. Farmers are agents in innovation processes and knowledge transfer can empower them [53].

3. Materials and Methods

3.1. Organic Farmer Selection

The eight farmers chosen in this research are all labeled "organic model farmers". They are all members of the BioRegio Betriebsnetz, a network of 100 Bavarian model farms that serve as a contact point for farmers willing to convert others and for education, research, and trade groups interested in viewing organic farms to gain information regarding potential conversion [54]. The Landesanstalt für Landwirtschaft (LfL) (State Office for Agriculture) supervises the BioRegio Betriebsnetz, which was created within the political program BioRegio Bayern 2020. The 100 model farms were selected by an expert panel comprising the LfL, Staatsministerium für Ernährung, Landwirtschaft und Forsten (State Ministry of Food, Agriculture, and Forestry), Landesvereinigung für den ökologischen Landbau in Bayern e.V. (State Association for Organic Farming in Bavaria), and four organic farming associations (Bioland, Biokreis, Demeter, and Naturland) active in Bavaria.

In order to obtain a heterogeneous picture of the farmers, a pre-selection was made among different farm types (e.g., arable farming, dairy farming, beekeeping, sheep farming, and vegetable growing) and among farms from regions with varying levels of OF expansion (low: 0–6%; medium: 7–15%; high: 16–30%). Based on this, 19 farms were contacted with the help of the LfL. Of these, the farmers of eight farms agreed to be interviewed (Figure 1).

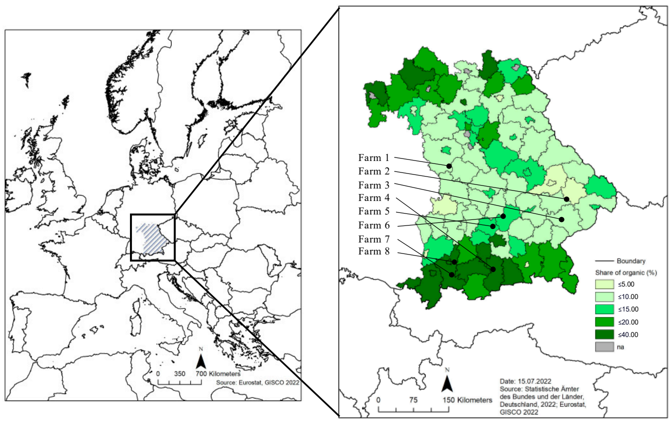

Figure 1. Map of the study area in Bavaria, in the European and German context, with the share of OF in 2020 and the eight farms serving as case studies (authors' own maps based on data from Statistische Ämter des Bundes und der Länder Deutschland and Eurostat GISCO).

3.2. The Interviews

Qualitative data for the analysis were collected using semi-structured interviews. The interviews took place in April and May 2021, with six in-person interviews (Farms 2, 3, 4, 5, 7, and 8) and two online interviews (Farms 1 and 6). The questions specifically targeted the issues of cooperation, connections, linkages, and dependencies. The guidelines for the interviews, as a form of data collection, were chosen to obtain a deeper insight into the characteristics, peculiarities, and trajectories of the individual farms and farmers. In this way, the conditions, attitudes, and motivations of the farmers could be better understood and their sensitivities to certain topics could be better captured. From the interviews, the characteristics of each farm's linkages were sketched in.

3.3. Data Analysis

The data analysis was based on qualitative content analysis [55]. The interviews were first recorded and then transcribed. The texts were then searched for the issues of cooperation, connections, linkages, and dependencies, and these were then grouped. This resulted in the following six linkage fields: the commodity chain; additional tasks and cooperation; external services; additional services; additional purchases; and farm development. The interviews were then coded based on the linkage fields. The individual farms were treated as case studies, which provided an opportunity to better understand the specifics and to conduct a deeper analysis of each farm. Contextual knowledge was captured, allowing for insights about the farm and the farm managers' motivations, attitudes, practices, objectives, and interactions. Using the data collected from the interviews and the general information on the farms provided by the LfL, dependency diagrams were created. Referred to as farm webs in this paper, the diagrams illustrate the connections and dependencies of the individual farms (see Figure 2).

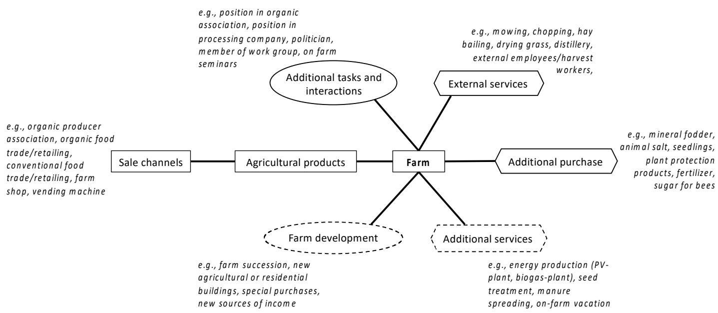

Figure 2. Template for creating the farm webs for the case studies with the six linkage fields (authors' own figure).

For each farm, a diagram was created based on the six linkage fields previously identified to illustrate the collaboration, linkages, dependencies, and specific characteristics of each farm. Care was taken to not only map the commodity chains, but to also consider social and environmental components, which included the additional functions, cooperation, and interactions of the farmers. The diagrams also map the additional external and internal services and purchases for the farms.

4. Designated Change Agents

The notion of model farmers is mostly used in the context of agricultural extension in the Global South [56,57]. Therefore, the designation of farmers as model farmers in the Global North is a peculiarity, which, at the same time, highlights the status of the farmers. These farmers are change agents because they have the potential to influence other actors or farmers.

The eight farms have unique farm trajectories, farm branches, and specifications (Table 1). They cover a variety of farm types, cropping patterns, and other characteristics. The sizes of the farms vary, as do the structural compositions of the cultivated land. In addition to classic arable or livestock farms, the model farms also include rarer farm types, such as a sheep farm (Farm 3) and a beekeeping farm (Farm 8). All eight farms are part of the BioRegio Betriebsnetz; thus, the farmers are willing to serve as sources of knowledge and to pass on their region- and cultivation-specific knowledge, as well as their associated experience, which should supplement the work of the state and the organic farmers' association advisory services. Furthermore, the farmers of these excellently managed farms bring an intrinsic motivation to the table, due to their ideological attitudes towards OF. This suggests that these farms are models not only in terms of their cultivation and economic situations, but also in terms of the farmers' OF social interactions. Each of the eight farmers is a member of an organic farmers' association, although the length of membership varies considerably (from 17 to 63 years). The long affiliation to OF underlines the farmers' extensive experience and historically grown and ideological attitude towards the organic sector. Certainly, each of these farms has its own specific farm trajectory and the farmers show a high commitment to organic principles and can be described as "beyond organic" [45].

Table 1. Eight Bavarian organic farms from the BioRegio Betriebsnetz (data from the Bayerische Landesanstalt für Landwirtschaft (LfL), 2021 and authors' own data).

Farm	Farm Branches	Special Activities	Total Area Used for Agriculture (ha)	Arable Land (ha)	Permanent Pasture (ha)	Forest (ha)	Orchard (trees)
1	Arable farming; special crops (organic elderberry); dairy farming.	Organic farming demonstration farm; wet nurse for calf rearing; spokesman for the Schrozberg dairy association.	52	32	20	4	40 trees
2	Field vegetables	Foil tunnels; own delivery and logistics; green waste compost and horse manure.	99	97	2	12	-
3	Sheep farming	Direct marketing of wool and hides; farm labor divided into two parts (father shepherds, while son takes care of the farm).	180	70	30	2,3	-
4	Grassland; orchard; forestry; dairy farming.	Milking robot; slatted-floor robot; wood-chip heating; mown litter meadows as bedding; farm vacations.	96	-	96	30	25 trees
5	Arable farming; indoor calf husbandry; laying hens.	Biogas plant; seminar room; heat supply.	210	180	30	13	-
6	Arable farming; seed production; fruit growing; vegetable growing; suckler cow husbandry; free-range pig husbandry.	Direct marketing and organic biogas plant.	332	315	15	492	80 trees
7	Grassland; orchard; dairy farming (full grazing with seasonal autumn calving).	Direct marketing (meat, schnapps); distillery; calves; yogurt drinking; genetically hornless bull for young cattle; red manure.	54	-	54	2,5	27 trees
8	Bees	Stand beekeeping and rentable bee colonies.	-	-	-	-	-

5. Results

First, the linkages of the eight farms are explained and farm webs for Farm 2 and Farm 5 are presented as examples (see Appendix A for all the farm webs). Figure 2 summarizes the framework used to map the interactions within the niche or with the regime or other regimes for each farm. Second, interactions with the organic niche or dominant regime in specific linkage fields are reported (Table 2). Subsequently, interactions with other regimes are identified.

Table 2. The most dominant interactions of the eight farms within the organic niche, with the dominant agri-food regime, and with other regimes (OPA: organic producer association; OFT: organic food trade; OFR: organic food retailing; CFR: conventional food retailing). Added further interactions that go beyond the direct connections of the farm are in italics.

Farm	Interaction within Organic Niche	Interaction with Dominant Agri-Food Regime	Interaction with Other Regimes
1	• Farm > dairy (board member) > OFT (whole product range available in OFR) • Rye > OPA • Elderberry juice-to-gummy bear producer • Seminars, farm visits	• Dairy (board member) > CFR (selected products available in CFRs depending on region) • Rye > OPA > processors > CFR • Seminars, farm visits • Agricultural service providers	• Energy regime (PV plant, solar system)
2	• Logistics > OFT/OFR • Animal dung	• Logistics > CFR • Animal dung • Foreign harvest workers	• Energy regime (PV plant, wood-chip plant) • Transportation regime (logistics)
3	• Farm > products > producer association > OFR • Farm > meat > organic butchery	• Farm > products > producer association > CFR	-
4	• Farm > delivery cooperative > dairy > products > OFT	• Farm > delivery cooperative > dairy > products > CFR	• Tourism (on-farm vacation) • Energy regime (PV plant, wood-chip regime)
5	• Farm > products > OPA (Presidium member) > processors > OFT • Farm > products > OFT, direct marketing	• Grains > OPA (Presidium member) > processors > CFT/CFR • Member of Green Party, second mayor • Agricultural service providers • Substrate for biogas plant	• Energy regime (PV plant, biogas plant)
6	• Farm > seed treatment • Farm > products > OPA > processors > OFT/OFR	• Farm > products > OPA > processors > CFR • Farm > products > close hotel (castle) • Agricultural service providers	• Energy regime (PV plant, biogas plant) • Owned by Munich Re
7	• Farm > dairy (hybrid dairy) > OFT • Farm > products > OFR	• Farm > dairy (hybrid dairy) > CFR • Farm > products > CFR	• Energy regime (PV plant, heat recovery)
8	• Farm > products > OFR	• Farm > beehives	-

Eight Model Farms and Their Linkages

For each of the eight farm webs, the individual linkages are specified and classified to indicate whether they are interactions with the organic niche, the agri-food regime, or another regime. Some interactions were made by nearly every farmer (e.g., visits to the farm, purchases for production, and hiring trainees/permanent employees) and are, therefore, not included in the summaries (Table 2). Each farm has its own special characteristic linkages.

Farm 1 has a wide range of income sources. Above all, the new elderberry juice processor shows the flexibility of the company. The farmer (Demeter) mostly interacts with the organic niche, which is also due to his ideological attitude, but he does not shy away from contact with the dominant agri-food regime. Above all, his position as a dairy board member shows that his commitment to the organic sector goes beyond the borders of his farm.

The special interaction of Farm 2 is its own logistics, which also allows the farm to interact with the transportation regime (Figure 3). This strong specialization also leads to a small number of revenue streams, with products being sold through both organic and conventional distribution channels. The high dependency on harvest workers due to the labor-intensive production branch of fine vegetables/field vegetables poses increasing problems (the availability of workers and rising costs and salaries) for the company.

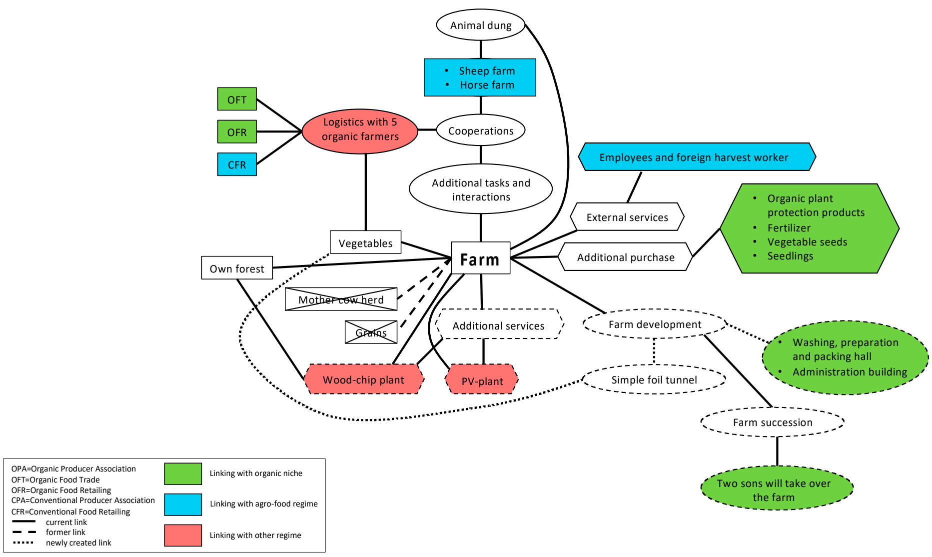

Figure 3. Farm web of Farm 2 with its special interaction of providing its own logistics (authors' own figure).

Sheep farming makes Farm 3 distinctive. During the summer months, the son runs the farm, while the parents herd the sheep 150 km away. This special niche offers relatively little competition, but the demand for lamb/sheep products is declining and meat prices are stagnating. The farmer functions as a representative of interests and this means that he interacts with the agri-food regime due to lobby work.

Farm 4 is a dairy farm and the farm's supplier community is emphasized, as, here, the farmer interacts socially and economically with the organic niche. The link with the "Urlaub am Bauernhof" (on-farm vacation) is also special, allowing the company to interact with the tourism industry.

What is particularly striking about Farm 5 is the large number of interactions with the organic niche, regarding agricultural products (Figure 4). Due to a strong diversification of the farm by the farm successors, the farm is in a good financial position. This is mainly due to the biogas plant, which supplies a nearby school and kindergarten and, thus, creates a link with the energy sector. What is special is the senior farmer's political activity, which leads to interaction with the dominant regime on a political level.

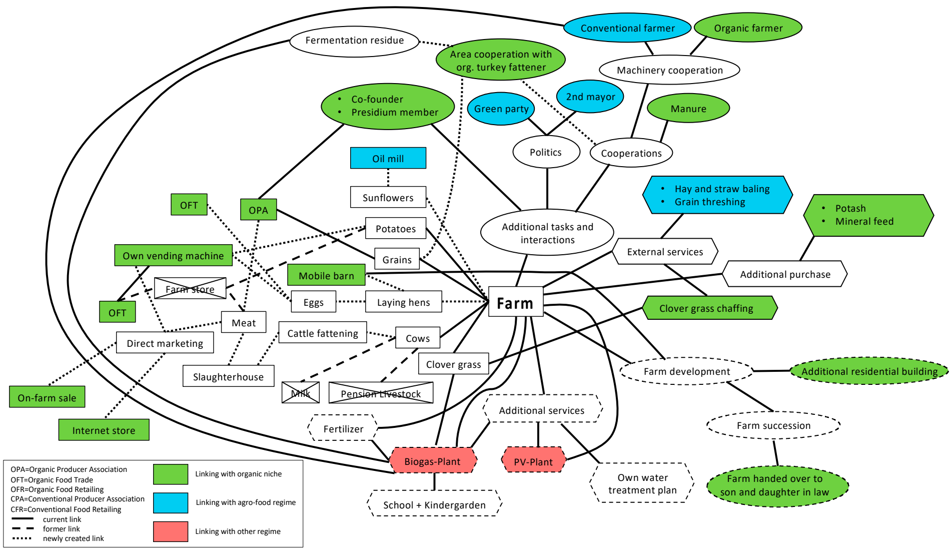

Figure 4. Farm web of Farm 5 with its high degree of diversification and the special political interaction with the agri-food regime (authors' own figure).

Farm 6's seed processing makes it an important part of the organic niche. The ownership structures are special, as the business interacts with the affiliated hotel, which, like the agricultural business, is owned by reinsurance. The farm succession is, thus, regulated by reinsurance and subject to different conditions and interactions than classic farm successions.

In Farm 7, two connections stand out. The specialization in hay milk is a niche within the organic niche. The development of another source of income (dog food) is created in strong cooperation within the organic niche. Participation in the Ökomodellregionen (organic model regions) program shows the intrinsic motivation to advance the organic sector.

Beekeeping sets Farm 8 apart from the other farms and this shapes its linking activities. Small numbers of other beekeepers limit the cooperation possibilities. The farm mostly remains in the organic sector due to its small selection of products, but propolis and wax production also leads to distribution channels within the dominant agri-food regime. The interaction with other organic farmers happens mainly through the pollination performance of the bees.

6. Organic Farms as Nodal Points: Multiple Linkage Possibilities

6.1. Linking along the Commodity Chain

As farms produce commodities, each farm has interactions along the commodity chain, whether within the niche or with the dominant regime (Table 2). It turns out that despite the farm managers' idealistic attitudes towards OF, there is no reluctance to touch the dominant regime and, much more often, there are attempts to change it by supplying organic products. The potential for linkages depends on the type of commodity, its quantity, and the proximity to markets. Demand varies from commodity to commodity and, in price negotiations, quantity is a key factor in determining whether it is economically viable for the farmer. If a farmer does not sell directly to a supermarket, but rather to organic producer associations, which, in turn, negotiate with supermarket chains, the quantity and, thus, the bargaining position changes. At the same time, the outsourced logistics increase the reach and, thus, the potentials of the linkages. Influence is achieved by supplying both organic and conventional retailers and wholesalers. The former strengthens the organic niche and the latter influences the dominant regime, as the majority of organic food in Germany is sold through conventional supermarkets [58]. In addition to German organic supermarket chains, conventional supermarket chains are now also cooperating with organic producer associations (Edeka/Lidl with Bioland; Edeka/DM/Globus/Tegut/Kaufland with Demeter; Rewe with Naturland). How long the cooperation lasts mainly depends on the sales figures. The potential influence of an organic producer association increases with the number of participating farms. Because all farmers have to distribute their goods in some way, the greatest potential for change is found in the linkages along the commodity chain. Each method of distributing organic products has an impact, either by strengthening the niche or by influencing the regime. For each distribution channel, the economic factors should be paramount; otherwise, the farm may switch from OF back to conventional farming.

6.2. Linking through Additional Tasks and Cooperation

What all farms have in common is the social interaction in their local communities. This basic way of interacting happens with organic and conventional farmers alike. Depending on the region, the spread of OF and the interactions and collaborations with other organic farmers vary. There is no shying away from face-to-face conversations or machinery or manure collaborations. The influence of the eight farmers on their neighboring colleagues in terms of acquainting them with and converting them to OF is clearly visible, but by no means imposing. They want to convince their colleagues by setting an example and proving the feasibility of OF. This exact attitude was expressed by one of the farmers: "I don't want to force it on anyone, but whoever is interested in organic is welcome to come to me". As members of the BioRegio Betriebsnetz, all the farmers are willing to share their knowledge and act as change agents. The primary target group is conventional farmers interested in conversion, but there is also the opportunity for vocational schools, agricultural schools, and other interested groups to visit the model farms. Experiencing practical implementation on a farm can have a positive impact on its visitors. The social contact with food production has been lost due to the dominant agri-food regime [59]. Educating people, especially the younger generation, can have a positive feedback effect on OF as a whole. Furthermore, the farmers hold positions in processing companies, organic farmers' associations, organic producer associations, and political parties. This allows them to exert their influence at a higher institutional or political level. In Bavaria, the members of an umbrella organization of the four OF associations lobby politicians and society. They try to directly influence decisionmakers in politics, the economy, and trade. The potential for influence through social interactions or collaboration with various agricultural stakeholders is significant, but difficult to measure. OF generally faces a strong and influential conventional agriculture lobby. It requires the tireless and constant efforts of all actors, from farmers to politicians, to influence and drive the transition process. Direct social contacts have the potential to influence sustainability.

6.3. Linking through External and Additional Services and Purchases

External services play a major role in the production of agricultural goods. The outsourcing of several services can be economically viable for farms. In most cases, this involves large agricultural machinery, which is rented for harvesting, mowing, threshing, and chopping. Here, organic farmers are in the same market as conventional farmers, which leads to competition. It must be assumed that the contractors offering these services do not only serve organic farmers based on ideological visions, but also based on economic factors. The influence of the individual farmer on a contractor is low, as the contractor usually deals with bottlenecks, especially at harvest time and, thus, it is likely that no distinction is made between organic and conventional farmers. This is confirmed by the statement of one of the farmers, as follows: "it is still cheaper to get one combine harvester less than to buy one yourself". Only in process steps that require a strict separation of organic and conventional goods can the individual farm make a difference for the contractor, due to economies of scale and the distances traveled. Depending on its setup, each farm can carry out different additional services. These services can range from production methods (such as seed processing, manure distribution, beekeeping, and boarding livestock) to services such as on-farm vacations and energy production through PV systems and biogas plants. With the services in the field of production methods, farms achieve interactions within the organic niche, which strengthens them and helps them to maintain sound techniques and specialized knowledge. With services such as energy production, a farm establishes a link with another regime, the energy regime and, by doing so, becomes an actor within the energy sector. The setting is somewhat different for additional purchases. The small amount of additional goods purchased is striking here. Mostly, they are small quantities of mineral feed or salt stones or a means for increasing the fertility of the soil. The organic farmers have their own market when it comes to feed, fertilizers, and seeds. The individual farms link within the organic niche but, in most cases, there are only a few employees to maintain compliance. Some of the farmers complained about the origin of the feed through wholesalers and would like to see regional producers. The influence of the individual organic farm is, thus, small. If it were to develop economies of scale, the organic niche would be able to strengthen itself and increase the offer of regional goods. The potential impacts vary widely, as each farm requires and provides different external and additional services. The frequent diversification of farms creates linkages among the different actors in the niche or regime.

6.4. Farm Development and Resulting Linkages

Farm succession is a well-known factor that has a decisive influence on rural development. A farm that is well positioned for the future, economically, production-wise, and construction-wise, is a farm that is likely to find a successor. Each of the eight farms is well positioned for the future, although there are differences depending on the production directions and related problems. Through regulated succession, organic farms are maintained and thereby strengthen the organic niche, ensuring that there is another generation of OF representatives who can connect with the new generation of conventional farmers in their society. The following quote from one of the farmers underpins the resistance of older farmers to OF: "Some are just waiting for their father to pass, and then they can switch to organic". Young farmers are often more open to this, but the structural conditions on a farm can make it difficult to convert to OF. A modern, future-oriented farm with a secure succession has great potential, even though it is a slow but steady potential that unfolds over a long period of time.

6.5. Interaction with Other Regimes

The eight farms also interact with other systems. Consideration of these linkages is seen as an important building block in the debate on the sustainability transition of the agri-food system [17]. Most of the eight farms interact with the transport sector when transporting their products and animals from the farm and transporting fodder, animals, or machinery to the farm. Most of the transport companies are engaged by the processors as service providers. Individual farmers have little chance of influencing sustainability impact factors, such as the emission impacts from trucks, based on the fuel type or distance driven. Proximity to the processor is decisive, but the farmers' hands are often tied here due to the limited number of processors to choose from. More farms growing organic produce would bring economies of scale, reduce the distance driven by the trucks, and reduce costs [60]. Farm 2, which grows fine vegetables, has taken a different approach. Together with several other vegetable growers from the region, the farmer has set up her own logistics strategy, with the aim of better compensating for the relative distance from the market. The interaction with the transport sector is more intense here, as the farmer is able to choose the type of trucks independently and, thus, make a direct decision regarding their emissions. However, here, the group confronted a limiting factor, whereby few suitable vehicles are on the market; battery- or hydrogen-powered trucks have not yet reached market maturity and remain future technologies. Because farms are also economic enterprises, the economic aspect is in the foreground in their logistics, despite the farm managers' ideological commitment to ecological agriculture. The interaction with the transport regime is given, but the expected impact of individual farms is low.

Many of the farms produce their own electricity with PV systems or biogas plants. Heat is generated by wood-chip plants or by heat recovery from the farm. In these ways, the farms create independence, save electricity and heat costs, and, in some cases, generate additional income by feeding electricity into the grid. While the energy generated on organic farms fits with the farmers' ideas about sustainability and helps produce green and decentralized energy, they installed the plants due to high subsidies, now profiting from rising energy prices, and interact directly with the dominant energy regime [61]. Depending on the operational constellation, the energy production can generate up to half of their income, as stated by one farmer. In this case, nearby facilities (schools and kindergartens) are supplied by the energy generated in the biogas plant on the farm. One farmer stated that it is more profitable to grow energy maize for PV plants than other arable crops, as high energy prices mean more earnings per hectare. The development of green and decentralized electricity production through biogas plants is important for a more sustainable energy sector. However, consequences of more biogas plants include higher lease prices and, therefore, the subsequent extinction of small, unspecialized farms, which is associated with cultural landscape and diversity losses on farms. In addition, there is environmental damage due to the increased cultivation of silage maize, which, in turn, influences feed prices.

While the potential impact of individual farms on the transport sector is relatively small, the interaction with the energy sector is much greater. The level of sustainability of the energy sector is highly dependent on politics. High compensation for energy would certainly drive more farmers towards more sustainable energy production (biogas and PV energy) and, thus, the generation of additional income. The most common ideal scenario is an energy-autonomous farm that can still supply surrounding households or facilities with electricity. The farms interact directly with the energy regime and influence it to transition to a more sustainable state. The fact that the production of agricultural goods is still the focus of the farms makes the farms' energy production a byproduct. The farms participate in the energy market, which is still dominated by energy companies working under regulations related to coal, gas, and nuclear power. The interaction between multiple systems increases the complexity of transitions, as they are compartmentalized and not integrated [62].

7. Categorizing Linking Activities

The results show that each farmer enters into a variety of linkages due to, among other things, the characteristics of the farm, the structures that have evolved, or their own individual characteristics. In addition to showing the kinds of linkages that are entered into and with whom, we now also present the reasons for the linkages.

7.1. Reasons for Entering Linkages

There are certain linkages that every farmer enters into. In particular, the linkages along the commodity chain are unavoidable for a farmer. However, to whom the goods produced on the farm are sold varies. Other linkages are only entered into by some farmers and, in some cases, for different reasons. The rationales for the different linkages were mostly mentioned in passing in the interviews, without much justification, although the rationales for the linkages can be crucial.

One reason given for linkages was the need to comply with organic standards, which we phrase as "compliance lock-in". The linkages here are largely within the organic niche. For example, in order to comply with the regulations, the farmer has to buy feed for OF from certain suppliers. Depending on the livestock and region, there are usually only a few suppliers. The origin of the feed cannot be influenced by the individual farmer. As a result, sustainability can take a back seat, as one farmer explained, as follows: "I would like to see more crop farmers convert so that I can also get my concentrated feed from the region. I only have to buy concentrates, but regionality is also important to me". Because of the restrictions placed on this type of linkage, it occurs due to compliance lock-in. However, it can also involve services such as transportation or storage. In these cases, the respective service company has to be considered by the certification body within the framework of the certification process (control area: awarding to third parties), whereby the service company does not necessarily need a certificate for OF. In this case, there are linkages between the niche and other regimes, such as transportation.

Another reason for linkages can be summarized under the term "routine lock-in", which involves linkages that are continued without questioning the reason. In most cases, these are historically developed linkages (e.g., with neighboring farmers with whom a farm has shared equipment for several generations). Linkages can take place both within the niche and with the dominant regime, as long as compliance is ensured. Above all, the rationale for social linkages in the local community is mostly routine lock-in. Linkages based on routine lock-in tend to be characterized by a greater reluctance to end them because of the emotions involved.

A third category of reasons for linkages is referred to, here, as "no-alternative lock-in". Here, the key rationale for the linkage is a lack of alternatives. Similar to compliance lock-in, there is little or no choice of linkage partners. However, no-alternative lock-in differs from compliance lock-in, in that it is a linkage that is not necessary for OF. Here, the two decision factors of profitability and sustainability play crucial roles. At what point is a farmer willing to enter into a much more expensive linkage in order to be more sustainable? For a long time, farmers have justified this decision by saying that there is no real alternative and they have no other choice. This is illustrated by the following statement from one farmer: "We only have one slaughterhouse left in the district. It will close soon. Then we'll just have to take the animals to the nearest one, because we have no other choice".

The final category of reasons for linkages is called "impact choice". This category includes all linkages that are made due to selectable influences that are explicitly chosen by the farmer. The authors recognize that each decision is already biased by various circumstances, but the driving factor is the farmer's conscious choice. The drivers of farmer linkages can be categorized as economic, sustainability, social, political, and technological drivers. In the case of free choice, farmers decide to join a linkage for economic reasons. By doing so, they hope for certain influences in the future that will have a positive impact on their profitability. If sustainability factors are in the foreground, it is possible that the farmer will make a less profitable economic decision, in the hope of achieving a higher level of sustainability. In the case of social linkages, farmers are primarily concerned with interacting with other stakeholders to gain benefits. The decision of with whom to enter into a linkage is multifactorial, but it is always with the aim of gaining benefits from the relationship. Linkages entered into because of political factors are, in the context of this work, linkages with the purpose of gaining a certain political influence. This does not have to happen explicitly, with a politician, but can also happen in the form of other positions that advocate organic agriculture. The technological factor refers to technologies such as PV systems and biogas plants. The reasons for the decision cannot usually be considered in isolation but are due to a combination of factors. As can be seen in the example of the biogas plant, the primary factor is technological, although the economic and sustainability factors also play decisive roles.

These types of linkages and the rationales for them are derived from the eight case studies presented in this work. The linkage potential of OMFs is higher than that of "normal" organic farmers, because these farmers are designated change agents. They are each characterized by long experience, large networks, and an attitude towards promoting organic agriculture. This, combined with their expertise in production technology and their economic know-how, has already qualified them for the BioRegio Betriebsnetz, as participating model farmers and knowledge disseminators.

7.2. Translating Linking Activities of Individuals

The sheer number of farmers in the agri-food system makes their influence in the transition process potentially important and, perhaps, the basis for change. OMFs take on several roles that contribute to the transition to sustainability. They act as change agents and offer knowledge transfer and learning processes through their various additional tasks. They provide advice, training, and education [16] and may serve to increase the conversion rate, which is highly dependent on knowledge and innovation transfer [27]. These roles also enable them to change the regime's agricultural knowledge system and influence the transition pathway [15]. Additional roles (e.g., in policy) provide the opportunity to embed OF into the policy context and thereby strengthen the niche and the potential to reconfigure the regime [8,63]. They also manage to combine the strengths of other niches with those of OF through the different distribution channels they choose, which leads to individual flexibility and adaptability [7]. This flexibility testifies to a critical attitude towards the current economic system [39] and a determination to become more independent, which also conveys the attitude and values of OMFs.

Because individual OMFs have what Vermunt et al. (2020) call a "spatially sticky character" [9], they address problems individually and adapt to specific spatial situations. Thus, despite their limited capital and resources compared with other actors in the agri-food sector, OMFs gain a new dimension of influence through their adaptability, flexibility, and individual approaches to solutions. Linking with other regimes, they expand their competence areas, amplify their statuses, and create multi-regime influence [64]. This article shows that the reasons that OMFs enter into interactions are diverse and that not every individual has the same preconditions.

The linking of individual farmers within and beyond the organic niche shows that there is potential for transition in these processes. More research is needed to understand the influence of individuals and their impacts on the linkage actors. How does the linkage change their views, behaviors, or processes? Future research needs to pay more attention to this two-sided analysis to assess the transformative processes of individuals and situate them within the transition process. Furthermore, it is important to be wary of overgeneralization in the agri-food sector and to consider the diversity and unique regional conditions of farmers. Indeed, far from being definitive, the case studies reported in this article illustrate a variety of OF transition possibilities, constraints, and potentials. Whether OF as a prototype for sustainable agriculture can sufficiently reshape the dominant regime remains to be seen [22].

8. Conclusions

In the transition process towards sustainability in the agri-food sector, the literature considers niche–regime interactions to be crucial. Although the research is inclusive of a variety of actors from different niches, there remains a lack of focus on farmers, the largest group of actors. This research addresses this shortcoming by assessing the linking activities of eight individual organic model farmers who have been officially designated as change agents. Research into the model farmers' linkages provides crucial insights into both the variety of possibilities in agriculture and the extent of the niche–regime linkages, suggesting that these linkages might reshape the dominant regime. This research further recognizes the importance of farmers as actors in the transition process, which highlights the need for a reorientation of policy support for farmers in the adaptation of sustainable agricultural practices.

The analysis of the interview data revealed six main linkage fields, as follows: the commodity chain, additional tasks and cooperation, external services, additional services, additional purchase, and farm development. The resulting farm webs for each farm reveal numerous economic and social linkages that are tailored to the unique circumstances and requirements of the farm. They interact with the organic niche, the dominant regime, and other regimes. The rationales for entering into linkages are justified and are, thus, influenced in different ways. The reasons limit the choice of linking partners, leading to the following four different categories: compliance lock-in (the linkage is necessary to meet organic compliance); routine lock-in (the linkage is not questioned because it has always been this way); no-alternative lock-in (the linkage is entered into due to a lack of alternatives); and impact choice (the linkage is entered into due to a desired impact). The variety of linkages indicates the potential of organic model farmers to influence the transition process and the reasons for the linkages include certain lock-ins that influence this potential.

This research contributes to a more comprehensive understanding of the linkages between the organic sector and the dominant regime. The rationales behind these linkages (compliance lock-in, routine lock-in, no-alternative lock-in, and impact choice) are identified and categorized. This helps to understand how and why change agents within a niche can or cannot influence the agri-food regime. In the agri-food sector's chaotic and complex transition process, individual farmers are a small piece of the puzzle. This work presents eight case studies that offer a glimpse into the diverse possibilities inherent in agriculture. These possibilities represent the beginning of a better understanding of the potential and impact of farmers on the transition process. By understanding the specific barriers to and facilitators of effective linkages, policymakers can better unlock the potential of OMFs through targeted programs and support. Future research should aim to capture the influences of individual farmers and their impacts on their counterparts. Specifically, how do linkages change their views, behaviors, or processes?

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Institutional Review Board Statement: Ethical review and approval were waived tor this study due to following reasons: The study included communication through the Landesanstalt für Landwirtschaft (Bavarian State Institute for Agriculture) to ensure that farmers were well informed about the research objectives and to secure informed consent through an established public authority. The participating farmers are part of the BioRegio Betriebsnetz, indicating their openness to share and acquire knowledge about organic farming. Their role in the study was to provide insights and experiences in line with the network's goal of promoting knowledge exchange on sustainable agriculture. Non-invasive structured interviews were used to collect data, focusing on professional practices in organic farming without delving into personal or ethically sensitive areas. Despite the lack of formal ethics committee or IRB approval, the research was conducted with strict adherence to ethical principles. These include ensuring informed consent, respecting the privacy of participants, and ensuring the non-invasive collection of information. We also followed all relevant institutional and national research ethics guidelines.

Informed Consent Statement: The consent of the interview participants was obtained through their confirmation for an interview.

Data Availability Statement: The raw data supporting the conclusions of this article will be made available by the authors on request.

Conflicts of Interest: The authors declare no conflicts of interest.

Appendix A

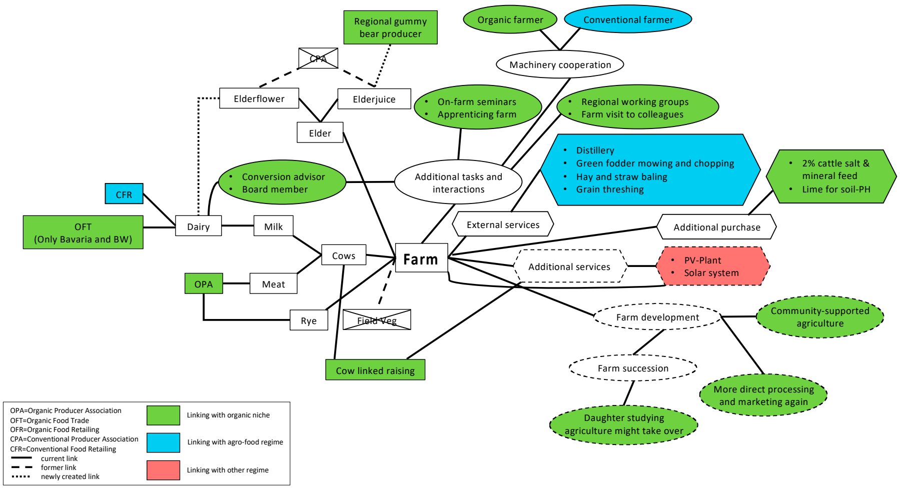

Figure A1. Farm web of Farm 1 with its diverse sources of income and high degree of interactions within the organic niche (own figure).

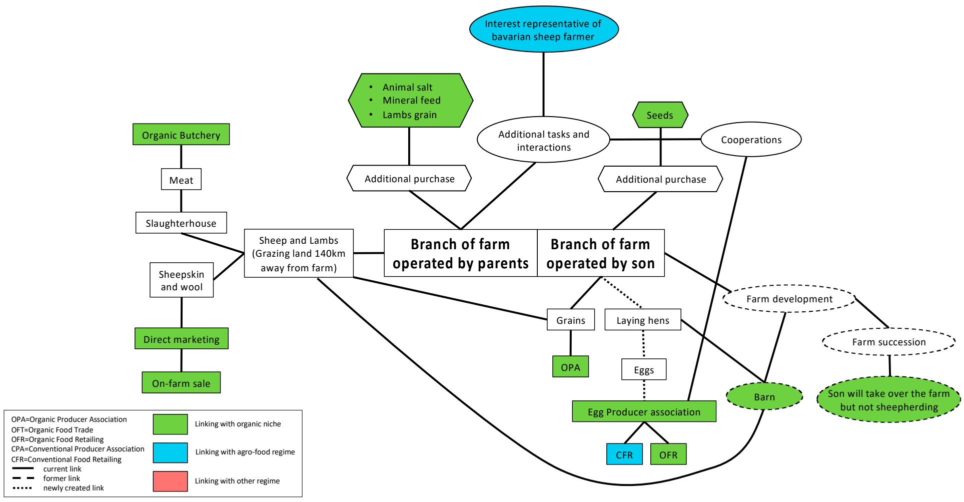

Figure A2. Farm web of Farm 3 showing the division of the farm and the rare animal husbandry of sheep (own figure).

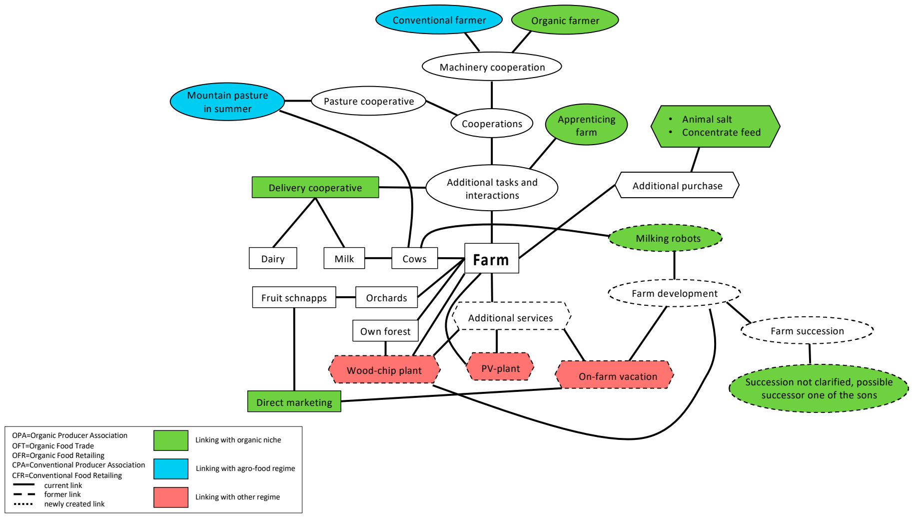

Figure A3. Farm web of Farm 4, visualizing the focus on dairy and the linking with tourism by "Urlaub am Bauernhof" (own figure).

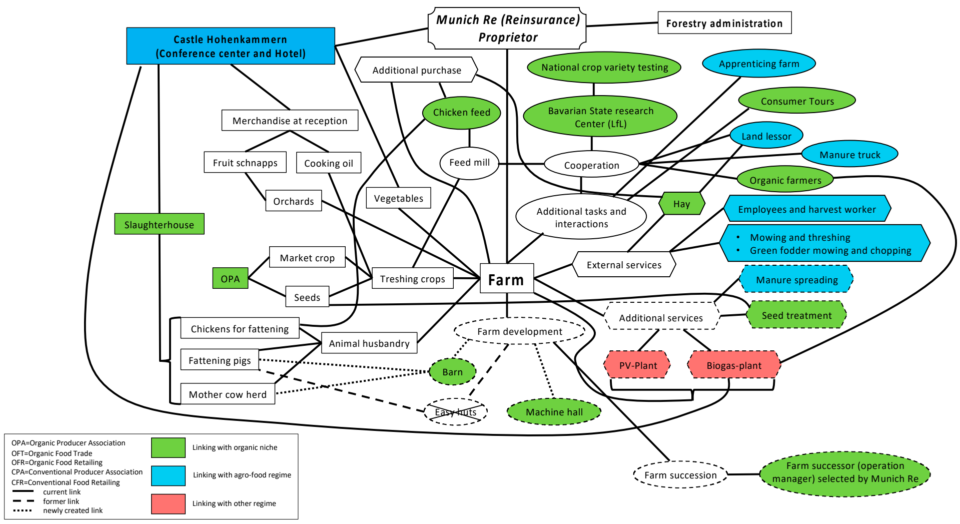

Figure A4. Farm web of Farm 6, showing the high diversification of the farm and the special ownership structure (own figure).

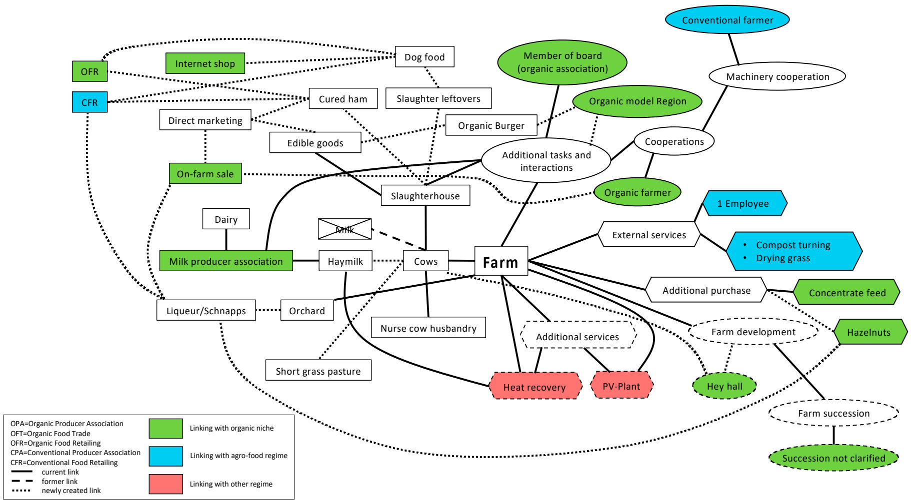

Figure A5. Farm web of Farm 7, presenting the specialization of the farm to haymilk and the additional source of income through an internet shop selling dog food (own figure).

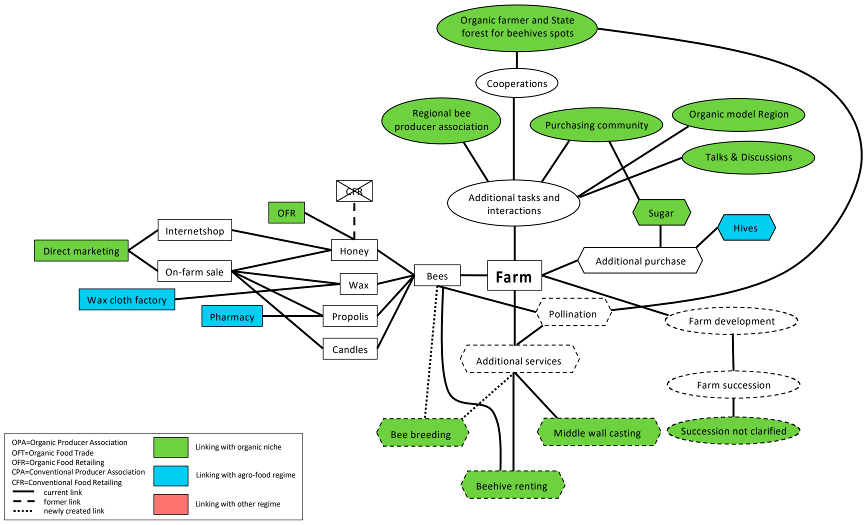

Figure A6. Farm web of Farm 8 shows a beekeeper and the high degree of interaction within the niche (own figure).

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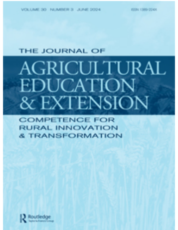

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Dissemination of organic farming knowledge through model farmers: exploring the BioRegio Betriebsnetz in Bavaria, Germany

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ABSTRACT

Purpose: This study explores the BioRegio Betriebsnetz (BRB) in Bavaria, a unique policy-initiated, farmer-based knowledge provider network that disseminates knowledge on organic farming and complements agricultural advisory services (AAS). This study aims to identify the characteristics and attributes critical to the successful implementation of knowledge provider networks and make recommendations based on the findings.

Design/Methodology: The data are based on background information from the state and an online questionnaire completed by 22 BRB farmers. Based on the questionnaire results, further in-depth interviews have been conducted among eight of the model farmers.

Findings: Farmers are generally satisfied with the BRB, noting the low amount of extra effort required to participate, which aligns with the network's purpose. The excellent organization of the supervising authority and possibility of exchanging knowledge with other farmers in the BRB are deemed positive. The results have shown little demand for farmer-to-farmer talks.

Practical implications: Networks such as the BRB require thoughtful selection of model farmers, low levels of bureaucracy while providing good support, and consideration of the local agricultural context.

Theoretical implications: The paper presents an expanded view of knowledge transfer through model farmers in the context of farmer-to-farmer talks. It also identifies the necessary factors for the successful introduction of a knowledge provider network.

Novelty/Significance of the study: The BRB is unique in its design and structure, providing new insights into building knowledge provider networks.

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Organic farming; agricultural advisory services; political program; model farmers; knowledge dissemination; knowledge provider network

1. Introduction

The EU has recently announced a target to reach 25% organic farming by 2030 (European Commission 2021). However, this endeavor is challenging because farmers' motivation to adopt organic farming is multifactorial (e.g. environmental motives, economic efficiency,

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farm structure compatibility, secure markets) (Darnhofer, Schneeberger, and Freyer 2005; Koesling, Flaten, and Lien 2008). Further, organic farming is an innovative practice (Padel 2001; Unay Gailhard, Bavorová, and Pirscher 2015), significantly influenced by the production and distribution of related knowledge (Rogers 2003) while being knowledge-intensive and often non-prescriptive, in addition to exhibiting environmental, agronomic, and socioeconomic complexity (Cristóvão, Koutsouris, and Kügler 2012). Farmers primarily obtain knowledge directly from other farmers (peers) (Garforth et al. 2003), making on-farm demonstrations (OFDs) involving peer-to-peer contact an important instrument for the transfer of agricultural knowledge (Sutherland and Marchand 2021). Consequently, OFDs, which are deeply anchored in agricultural advisory services (AAS) as an advisory method, have garnered attention as an effective instrument for the exchange and transfer of knowledge, technology, and best practices (EU SCAR AKIS 2019); the number of EU OFD programs is growing (Ingram et al. 2021). The characteristics of knowledge transfer in the context of OFDs have been extensively studied in Europe through several FarmDemo projects (see Sutherland and Marchand 2021).

AAS, a part of the Agricultural Knowledge and Innovation System (AKIS), play an essential role in innovation and knowledge dissemination at the individual-farm level (Labarthe 2009; Piñeiro et al. 2020), involving different actors and structures for organic farming (Österle et al. 2016). AAS are diverse, with several service providers within the EU (public, private, farmer-based, non-governmental organizations) (Knierim et al. 2017). In previous research, Klerkx (2020) underscored the need to elucidate the diversity inherent in advisory systems and existing sub-systems, and Cristóvão, Koutsouris, and Kügler (2012) highlighted the need for innovative approaches in extension/advisory services, emphasizing the importance of knowledge brokers and participatory processes as well as providing extension-process experiences. As organic farming is observation-, knowledge-, and learning-intensive (Röling and Jiggins 1998), requiring that unique measures for innovation and knowledge transfer be applied to specific regions (Leeuwis and van den Ban 2004), its development also depends on AAS. Adapting measures for extension/advisory services is needed to promote the spread of sustainable agriculture and requires the involvement of diverse stakeholders to promote social learning as well as the use and dissemination of innovations (Brunori et al. 2013; Cristóvão, Koutsouris, and Kügler 2012; Moschitz et al. 2015).

This work presents a case study of the unique BioRegio Betriebsnetz (BRB) (BioRegio farm network), a novel, adapted advisory approach to AAS, along with its characteristics, implementation, and analysis based on a policy-initiated knowledge network consisting of 100 organic model farms distributed throughout Bavaria from 2012 onwards. The BRB offers model farmers as knowledge providers who transfer their comprehensive knowledge and act as a point of contact for farmers considering the conversion to organic farming as well as for individuals or groups seeking in-depth understanding of organic farming practices. Knowledge transfer occurs during prearranged meetings called farmer-to-farmer talks, herein called OFD, at the model farm.

The objectives of this study were to assess the setup and operating principles of the BRB and conceptualize it in relation to OFD and network structure. Furthermore, the BRB's practicality was assessed from the perspective of BRB model farmers. This approach is unique, as the BRB reveals new aspects for successful implementation of agricultural knowledge provider networks as political instruments. Previously, the knowledge provider's perspective has been disregarded; therefore, it is expressly considered in this study. The study findings inform recommendations for future implementation of similar networks aimed at promoting organic farming.

The remainder of this paper is organized as follows. Chapter 2 discusses knowledge transfer within OFDs through peer-to-peer contact and the classification of knowledge types and knowledge networks in agriculture. Chapter 3 presents the BRB case study, followed by evaluation of the state. The results show the characteristics and peculiarities of the BRB and reveal its conceptualization based on OFDs and network structure. Chapter 4 discusses the perspectives of BRB model farmers, and Chapter 5 presents the applicability of the identified networks and summarizes the conclusions drawn from this study.

2. Theoretical background

2.1. Peer-to-peer learning through on-farm demonstrations

Through FarmDemo, the EU has funded projects demonstrating structural and procedural success factors for OFDs (Sutherland and Marchand 2021). The OFD combines three important aspects of agricultural knowledge transfer: (1) contact with peers who have similar attitudes and farming styles (Morgan 2011), being the most important source of knowledge (Garforth et al. 2003); (2) roadside farming and the assessment of skills and management abilities based on other farmers' fields and practices, an established medium of knowledge transfer (Burton 2004); and (3) contact with spatially close model farmers, as local experiential knowledge is highly valuable (Šūmane et al. 2018). These mechanisms are used by OFD actors to disseminate tacit and explicit knowledge through peer-to-peer conversation. Within OFDs, farmers are taught agricultural techniques applicable to their own farms (Knapp 1916). Using model farms to facilitate this knowledge transfer is a known method (Burton 2020) that not only demonstrates the farmer's expertise but also builds the trust of those seeking knowledge (Rust et al. 2022). The BRB farmer-to-farmer talks combine these characteristics and can be referred to as OFDs.

Today, model farmers are primarily used in the context of agricultural extension in the global south, where they teach other farmers improved agricultural methods (Franzel et al. 2013; Hailemichael and Haug 2020; Taylor and Bhasme 2018). As illustrated by the evaluation of the BRB for organic farming in the present study, there is renewed interest in model farmers in the global north. This relates to model farmers being described as 'change agents' through peer contact and knowledge transfer of region- and production-specific knowledge (Van Poeck, Læssøe, and Block 2017) and by providing knowledge of holistic, sustainable farming practices based on agro-ecological processes, organic farming methods and values, and the social function of organic farming (Verhoog et al. 2003).

OFDs are an important medium for knowledge exchange among multiple actors in agriculture, contrasting with the classical top-down medium of knowledge transfer from extension agents/researchers to farmers. These new learning conditions shift the responsibility of knowledge acquisition and organization from the teacher to the knowledge seeker while the teacher may also benefit from reciprocal flow of knowledge (Cooreman et al. 2018). Cooreman et al. (2021, 714) identified OFDs as transformative learning spaces and suggested increased effort to ensure that 'the on-farm demonstration is relevant to the situation of the attendees and into application in real-life contexts and incorporation of hands-on experience by attendees.' Recent studies have revealed that relevance, objectives, audience, and setup are critical aspects of the OFD (Adamsone-Fiskovica et al. 2021; Alexopoulos et al. 2021; Ingram et al. 2018; Pappa et al. 2018) and that OFD peer learning is dependent on several factors (Pappa et al. 2018; Sutherland and Marchand 2021). The transfer of knowledge among peers is highly dependent on the complexity, diversity, and context of the OFD. The demonstrator, who may be a farmer, researcher, advisor, or other certified specialist, is also crucial (Alexopoulos et al. 2021), as their characteristics are fundamental to successful OFDs (Adamsone-Fiskovica et al. 2021; Franzel et al. 2015; Kumar Shrestha 2014). Therefore, demonstrator characteristics have made OFDs an advisory method fundamental to many AAS; however, OFDs should not be considered in isolation but always in an adaptive interrelationship with the prevailing AAS, thereby making new approaches to OFDs, as in this study, highly relevant (Ingram et al. 2021).

In FarmDemo projects, researchers distinguish the enabling level (setup of advisory landscape and AKIS) and operational levels (practical implementation for successful OFDs) within OFD programs. For the enabling level, the number of demonstrations varies across the EU. Ingram et al. (2021) reported that in the context of AKIS, countries with well-funded AAS particularly have more integrated and extensive OFD programs. They also found that hosting OFD programs provides an opportunity for increased AKIS integration through collaborative work. Reliance on government funding imposes certain constraints on the choice of OFD topics and demonstrator. In contrast, relatively pluralistic AKISs were characterized by more flexible approaches to OFD that could easily respond to emerging needs but were fragmented.

The operational level captures the 'success factors' for organizing successful OFDs, summarized by Adamsone-Fiskovica et al. (2021) as the 'nine Ps,' identified in an analysis of 24 case studies from the PLAID (Peer-to-peer Learning: Accessing Innovation through Demonstration) project, also part of FarmDemo. The nine Ps are included in the conceptual framework for OFDs developed by the FarmDemo collaboration (Sutherland and Marchand 2021), identified as purpose, problem, place, personnel, positioning, program, process, practicality, and post-event engagement (Table 2) (Adamsone-Fiskovica et al. 2021, 644f.)

2.2. Knowledge and knowledge networks in agriculture

The most recent classification of knowledge transferred in the context of OFD has emerged from FarmDemo. In contrast to Polanyi's (1958) most common division of knowledge transferred in agriculture into tacit (implicit) and codified (explicit) knowledge, or Lundvall and Johnson's (1994) division into knowing 'what,' 'why,' 'how,' and 'who,' FarmDemo authors link knowledge to learning type. This classification method distinguishes experiential (gaining tacit and explicit knowledge), transformative (changing behaviors and perspectives), and network learning (social interaction and relationship building). Such forms of learning at the operational level are considered 'peer learning' and are reflected in the FarmDemo conceptual framework of OFD (Sutherland and Marchand 2021). Therefore, the authors have shown the potential of peer contact in OFD programs.

The field of agriculture is complex and diverse, characterized by various aspects aligning with specific network structures. Smedlund (2008) and Sutherland et al. (2017) reported three primary network types: centralized, distributed, and decentralized. Centralized networks constitute a central node through which all knowledge flows. This structure is the most effective for routine problem solving where explicit, standardized knowledge, such as advice on general regulatory issues, is required. Codified knowledge, representing 'why' and 'what,' is mainly transmitted within this type of network. Knowledge sources such as agricultural advisors serve as central nodes in this context, as they can channel information. This can be individual interactions of farmers with an advisor, who, in turn, interacts with other advisors in their own or different organizations. Conversely, distributed networks are dense conglomerations of links where mostly tacit knowledge is exchanged, equated to 'communities of practice' where peers exchange knowledge. They are highly reliant on social capital, meaning the combination of shared norms, values, and understandings that facilitate cooperation within or among groups. The close nature of these relationships tends to foster incremental sharing of innovation and knowledge, driven primarily by experiential knowledge. For example, one network might involve a farmer primarily connected to other farmers. Lastly, decentralized networks have multiple nodal points, connecting various individuals. Decentralized networks foster the exchange of diverse knowledge, often from outside the immediate peer group (weak ties), and are typically associated with the gathering of potential knowledge on future or cutting-edge innovations (Smedlund 2008). An example is one farmer with local and distant ties to a broad range of actors (Sutherland et al. 2017). However, as Klerkx and Proctor (2013) pointed out, the distinctions of these three network types are often blurred. Advisors and farmers alike draw on both decentralized and distributed networks to stay informed. Thus, the potential for hybrid networks is demonstrated, as revealed in this paper. In addition, this paper highlights the dynamic nature of knowledge transfer within the agricultural field, reflecting the adaptive and responsive strategies employed by those within the sector.

3. Materials and methods

For the BRB case study, a mixed-methods approach was utilized, including collecting background information from state documents, an online questionnaire with BRB model farmers, and in-depth interviews with eight BRB model farmers. The purpose of this approach was to gain a comprehensive understanding of the characteristics and processes involved as well as to capture both the state's view and farmers' perceptions of the BRB.

Background data were extracted from brochures, reports, and documents from Bayerisches Staatsministerium für Ernährung, Landwirtschaft und Forsten (Bavarian State Ministry of Food, Agriculture, and Forestry; StMELF) and analyzed to provide supplementary information on the BRB framework, special features, and characteristics. Through email and telephone correspondence with Landesanstalt für Landwirtschaft (LfL) (the State Institute for Agriculture) members responsible for the BRB, further background information on BRB implementation and processes was gathered and comprehension was clarified. In particular, the following topics were discussed: scheduling of visits, process and remuneration of visits, documentation/bureaucracy, selection of farms, network changes, and challenges/limitations. Two calls occurred in January 2020 and June 2023; the first was recorded and transcribed, and the second was noted and supplemented by memory log.

Data were collected by administering an online questionnaire and interviewing eight organic farmers from the BRB. In March 2021, the online questionnaire was sent to all 100 BRB model farmers via LfL, specifically tailored to capture the following information: level of satisfaction of model farmers with the network; effort put into the network; and value, disadvantages, and scope for network improvement. The online questionnaire, comprising three blocks, was adapted in close consultation with LfL and adjusted for feasibility. The first block, featuring general introductory questions, yielded an overview of farm characteristics as well as personal characteristics of the farmer and encouraged survey completion. The second block consisted of simple questions about the farms' BRB participation and implementation (e.g. length of BRB membership, number of farmer-to-farmer meetings held, and topics discussed at the meetings with a pre-selection informed by LfL). The third block determined the farmers' opinion of the BRB (satisfaction level, amount of additional work caused by the BRB, and suggested improvements). The reason for selection was asked in certain questions to understand the decision.

The obtained data were used to derive insights from the model farmers' perspective and to make inferences about the BRB. The online questionnaire addressed all 100 farms via a public email from BRB project coordination at LfL to achieve the highest possible response rate. As the online questionnaire was anonymized, whether it was completed by the eight model farmer interviewees is not known. The questionnaire was accessible online for four months, and the target respondents received a reminder after two months; 22 of the 100 BRB members responded. Two answer sheets were only partially completed, but the indicated questions were used. The author is aware that, due to the small number of responses, no claim to completeness can be made here.

Complementing in-depth data on the insights obtained from the online questionnaire were gathered via the eight semi-structured interviews with BRB model farmers. To ensure a comprehensive representation of farmer views, farmers from districts with varying rates of organic farming expansion, including low (0%–6%), moderate (7%–15%), and high (16%–30%) rates, based on data from 2019, were contacted. Fifteen farms from four administrative districts (Central Franconia, Lower Bavaria, Swabia, and Upper Bavaria) were contacted, resulting in the eight farm managers willing to be interviewed. The farms differed with respect to their basic setting, district, and types of farming and cultivation techniques used, and represented all four major organic farmers' associations (OFAs) (Bioland, Biokreis, Demeter, and Naturland). The interviews were conducted in April and May 2021. Seven of the eight interviews were recorded, but for one, recording was not permitted, and the interviewee's responses were manually recorded. The interviews were then transcribed. Next, all interviews were coded using MAXQDA as follows: satisfaction with the BRB, additional effort toward the BRB, strengths of the BRB, weaknesses of the BRB, suggestions for improvement, and other remarks regarding the BRB.

4. Introduction of the case study BioRegio Betriebsnetz (BRB)

The BRB lends itself to a single-case study design because of its unique nature (Yin 2018). The BRB was long considered unique in its approach and structure and was used as a template for ÖkoNetz BW in Baden-Württemberg, which was founded in 2023.

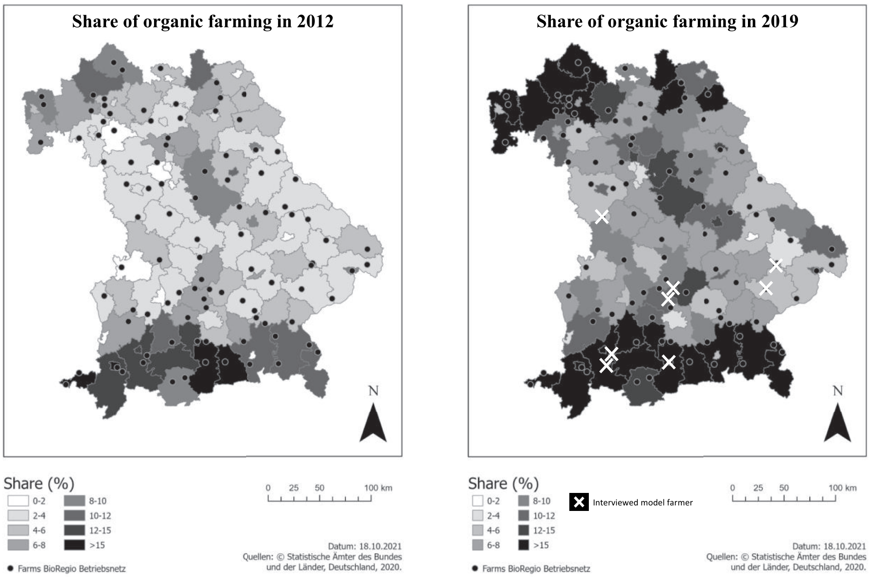

Figure 1. Spatial distribution of organic farming in Bavaria in 2012 (on the left) and 2019 (on the right). (Source: Statistische Ämter des Bundes und der Länder, Deutschland 2020).

4.1. Bioregio Betriebsnetz

The BRB network comprises 100 organic model farms distributed throughout Bavaria (Figure 1), an established measure in 2013 of the BioRegio Bayern 2020 program. The purpose of the BRB is to foster knowledge transfer to farmers interested in conversion to organic farming, intending to lower the barriers of engagement for conventional farmers by offering peer-to-peer contact in the form of OFDs from model farmers without obligations (StMELF 2017). Questions from those seeking knowledge can be answered and, if necessary and desired, clarified through demonstration and explanation of farm practice. The BRB complements state orientation advice and Verbundberatung in Bavaria (Figure 2), thus becoming part of the Bavarian AKIS, which is predominantly shaped by state organizations managed by StMELF. Within StMELF, the state departments of Food, Agriculture, and Forestry (Ämter für Ernährung, Landwirtschaft und Forsten, or ÄELF) coordinate agricultural advice and serve as the first contact point. ÄELF collaborates with accredited advisory partners (farmer-based organizations, non-governmental advisory organizations, and private organizations) called the Verbundberatung (Birke et al. 2021).

Advice for organic farming in Bavaria varies and is tailored for farmers interested in switching to or already practicing organic farming. According to LfL, farmers should seek advice when planning conversion to organic farming (LfL 2020). There are two phases during conversion and two corresponding AAS as follows: (1) 'orientation advice' offered by ÄELF (no cost), and (2) 'conversion- and production-related advice' offered by OFAs, which either entails a partially state-subsidized fee or is free for OFA members of Bioland, Biokreis, Demeter, and Naturland (Figure 2). The advice provided

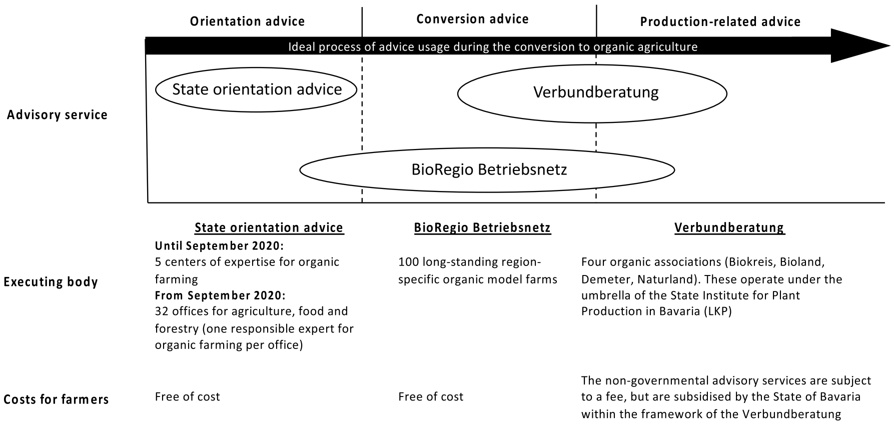

Figure 2. Agricultural advisory services (AAS) for organic farming in Bavaria for each phase in the conversion process (Source: LfL 2020).

by the OFAs is compiled in Landeskuratorium für pflanzliche Erzeugung (the State Board for Plant Production in Bavaria).

4.2. State's evaluation of the BioRegio Betriebsnetz

According to StMELF, the BRB is a successful part of the BioRegio Bayern 2020 program (Kaniber 2021). The LfL 2020 progress report stated that the BRB 'is a valuable instrument for supporting existing organic farms in the further development of their competitiveness and for enabling additional farms to convert to organic farming' (Sadler et al. 2020, 179). Kaniber (2021) and Sadler et al. (2020) revealed that the number of farm talks increased in the beginning and then plateaued. However, a declining trend was observed during the pandemic years as peer-to-peer contact was hindered. The approximate number of participants increased steadily. Notably, 'others' was the second strongest audience group, indicating a growing demand for information on organic farming from actors outside the agricultural sector. While visits of organic farming academies and organic farming colleges are to be expected, the BRB notably offers an introduction to organic farming for young people at agricultural and vocational schools (Table 1). The state expenditures for BRB farmer financial compensations declined from €24,887 in 2019 to €14,066 in 2020 owing to reduced demand. The BRB is generally positively portrayed, as concluded from figures on the development of organic farming and the demand for the BRB.

Statistical BRB data from 2012 to 2020 demonstrate approximately 86.6% growth in the land area of organic farming (Figure 1), whereas the number of organic farms increased by approximately 67.8%. The share of organic farming increased from 6.4% in 2012 to 12.1% in 2020, whereas, in the same period, the total utilized agricultural area declined by 1.5% (LfL 2020; DeStatis 2022). The spatial distribution of organic farming in Bavaria changed accordingly, with slight differences in all districts and district-free cities (Figure 1).

Table 1. Demand for farm visits and number of participants of the BRB from 2013 to 2020; the number of participants is only documented with active indication by the farmer, and each participant counts individually (Kaniber 2021; Sadler et al. 2020).

Audience	2013	2014	2015	2016	2017	2018	2019	2020
Agricultural schools (Landwirtschaftsschule)	2	29	20	26	23	19	23	11
Vocational schools (Berufsschule)	2	9	7	7	7	11	11	6
Higher farming schools/ technical schools (Höhere Landbauschulen/Technikerschulen)	0	2	1	4	3	3	2	6
Domestic science schools (Hauswirtschaftsschulen)	1	3	4	5	0	1	1	0
Universities (Universität/Hochschule)	0	3	2	3	3	7	2	4
Apprentices (Lehrlinge (überbetriebliche Ausbildung))	0	5	3	3	2	1	0	0
Organic farming colleges (Fachschulen Ökolandbau)	1	7	7	6	4	2	4	2
Organic farming academies (Akademien Ökolandbau)	0	5	6	5	9	5	6	1
Others	1	6	6	20	26	36	40	13
Farmer-to-farmer talks (OFDs)	12	62	98	139	109	89	102	47
Total talks	19	131	154	218	186	174	190	90
Total participants	?	~60	~65	~275	~358	~612	~1975	~853

5. Results

5.1. Background, processes, and implementation

The BRB model farms were selected based on OFA or supervising organic advisor recommendations; at that time, one person from each of Bavaria's five centers of expertise for organic farming suggested suitable farmers. In addition to the farmer's excellent agricultural and economic expertise, communication skills were crucial. The selection committee included individuals from StMELF, LfL, Landesvereinigung für den ökologischen Landbau in Bayern e.V. (the Bavarian Association for Organic Farming), and all four OFAs (Biokreis, Bioland, Demeter, and Naturland). In addition to the selection criteria, model farms were selected to ensure that, to the greatest extent possible, each of the 96 districts and district-free cities had one model farm and represented various farming methods, husbandry practices, and specialty crops.

Within the BRB, bureaucracy on both sides is minimized as follows. An appointment with one farm is arranged through the supervising institution, LfL. The model farms register their capacity for OFDs with LfL in advance, depending on the time of year and availability. LfL then schedules an OFD and informs the farm of the number of visitors. After the OFD, the farmer faxes or e-mails LfL a form with visitor names, if documented. During the second phone call, the LfL contact person stated that, depending on the preparation effort and number of participants, the model farm is compensated for the effort associated with tariff payments for master farmers (approximately €35–100). The tariff is paid from the Bavarian government's BRB project budget; however, the funding amount covers the entire BRB and not individual farms; therefore, certain farms conduct significantly more OFDs than others. The LfL contact also stated that there is a high variance in demand for individual BRB farms; some have a very high demand, and others have almost no demand at all. This can be explained by the characteristics of the farms, particularly the type of husbandry or cultivation, and the publicity of individual farmers in surrounding districts. In addition, LfL found that the rarer a type of husbandry, e.g. sheep, the more distant would be the inquiries, even from outside Bavaria. The only additional obligations for BRB farmers are the annual meetings organized by LfL, where all BRB farmers are informed about new findings and developments in organic farming. Owing to the diversity of farms, some topics at the meetings may not correspond to the farm profile, although an attempt is made to cover a wide range of topics. Neither the model farmers nor LfL document the personal data of visitors of OFDs within the BRB; thus, it is nearly impossible to analyze the effects experienced by the visitors.

5.2. Conceptualizing the BioRegio Betriebsnetz

5.2.1. On-farm demonstrations

In contrast to the FarmDemo OFDs analyzed by Adamsone-Fiskovica et al. (2021), who subsequently identified the nine Ps, based on the interviews with the farmers and LfL, the situation for OFDs under the BRB is different (Table 2). In the BRB,

Table 2. Nine Ps influencing the success of OFDs according to Ademsone-Fiskovica et al. (2021, 644f.) and the respective situation in BRB OFDs.

Success factor	Description	Success principle	Situation in the BRB
Purpose	Objective(s) implicitly or explicitly defined by organizers for the demonstration	Set a clear and jointly agreed upon objective at the outset	Objective is set by the knowledge seeker
Problem	Topic chosen for demonstration	Identify and frame a topic tailored to farmers' needs	Problems and topics are deliberately chosen by the knowledge seeker
Place	Geographical site of the event and profile of farm where the demonstration is held	Select a physically and socially accessible and credible site	Farms in the BRB are all suitable locations, but the knowledge seeker must choose the appropriate farm profile
Personnel	Profile of individuals involved in the organization and implementation of the demonstration	Ensure a motivated and trusted team of organizers and facilitators	BRB farmer is the organizer and facilitator
Positioning	Pre-event process of profiling the demonstration and recruiting potential visitors	Identify, address, and reach the target audience	Happens automatically through the knowledge seeker's choice of farm
Program	Structure of the event in terms of type, sequence, and timing of planned activities	Design a balanced set of formal and informal activities	Event structure is designed by the model farmer and activities are tailored according to specific circumstances of the farm
Process	Mix of means used to communicate the solutions demonstrated	Align form and content of communicated knowledge to different learning styles	Means of answering questions depends on farm conditions; by pre-selecting the farm, practical questions are illustrated
Practicalities	Practical issues must be addressed to cater for basic human needs and facilitate a good learning environment	Ensure provision of suitable infrastructure and limit distracting external conditions	Relatively low level of preparation causes disruptive factors; however, a good learning environment is guaranteed
Post-event Engagement	Communication and promotion of demonstration message(s) after the event	Reinforce demonstration message and follow up with the participants	No post-event activities planned, but farmers stay connected with teachers after the OFD

OFDs are not specifically designed for knowledge exchange between multiple actors with different backgrounds. Actor diversity is usually low (farmer to farmer or farmer to interest group with similar background), which also influences the type of knowledge transfer. In OFDs, knowledge flows primarily from the BRB farmer to the knowledge-seeking farmer although reciprocal knowledge exchange also occurs. In the case of interest groups, a teacher–student relationship exists in the exchange of knowledge from the farmer to the knowledge-seeking group, partly because the individual group member has less practical experience than the BRB farmer. In the BRB, the preparation of OFDs and means of knowledge exchange are simpler; however, this does not reduce the demonstration quality. For example, OFDs are not specially prepared, as problems and questions are only revealed to the BRB farmer during the OFD itself and must be handled spontaneously. Further, there is little need to prepare the locations, as communication virtually occurs in the 'everyday life' of BRB farmers. For group visits, relatively more preparation is needed to ensure adequate conditions for group knowledge transfer. The actual implementation is left to the BRB farmer, as they know the existing conditions best.

5.2.2. Knowledge provider network structure

BRB farmers have great knowledge and connections with various actors in agriculture because of their background and the criteria used to select them. Consequently, farmers' knowledge, whether categorized according to Lundvall and Johnson's (1994) typology or Sutherland and Marchand's (2021) type of learning, is extensively diverse. BRB farmers can answer questions that require knowledge on 'what,' 'why,' 'how,' and 'who,' while also engaging in and implementing experiential, transformative, and network learning. Even if they cannot answer a question, they likely know who to contact. The assessment of the knowledge network is similar in that different types of knowledge are associated with different networks. Because the BRB is not a 'naturally' grown network but a politically implemented network designed to transfer knowledge from model farmers to knowledge-seeking farmers, its network structure differs as a combination of known agricultural network types (Sutherland et al. 2017); thus, it is considered a knowledge provider network (for organic farming). The BRB has the characteristics of a distributed network because a high amount of tacit knowledge is transmitted, and the network is regarded as a 'community of practice' or 'network of practice.' However, the social capital on which such networks depend is limited in the BRB because it is based on close personal relationships, which are scarce among BRB farmers. Such relationships between BRB farmers and knowledge seekers do not exist but could emerge. Therefore, the BRB also has the characteristics of a decentralized network, as it has multiple nodes connecting different individuals. Over the years, the BRB model farmers have built their own knowledge network through different sources and thus also serve as knowledge nodes. Therefore, they rely on their own individual knowledge network to obtain needed information (Figure 3). As each farmer and farm is unique, the actors differ in their personal knowledge network. This facilitates the dissemination of different knowledge types and qualifies them as BRB model farms. The connections to other actors that BRB farmers gain through BRB activities also expand their personal network. It thus combines a distributed network structure with a decentralized network structure, allowing for diverse individuals (peers and groups) to

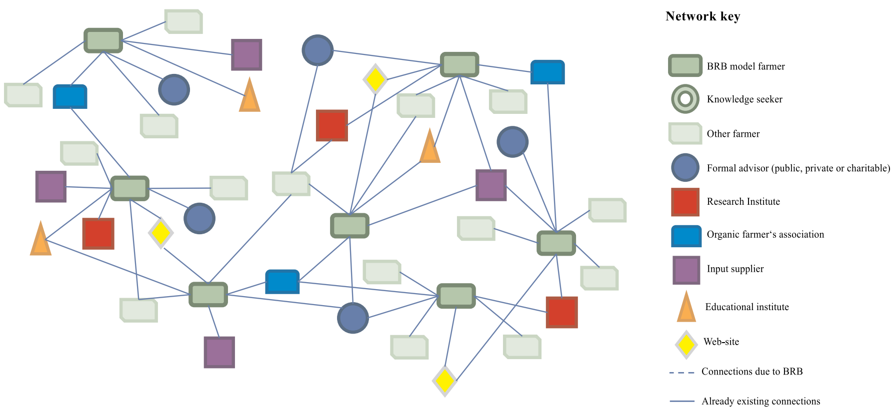

Figure 3. An abstract representation of knowledge networks of model farmers as it would have looked before the BRB was installed. Based on Sutherland et al. (2017).

connect (Figure 4). The evaluation and embedding of the BRB are necessary for its comprehensive elucidation and, based on this, for classifying and understanding the following findings. The uniqueness of the BRB provides the opportunity to capture additional aspects for the successful implementation of such a network as a policy tool.

5.3. Perspectives of BRB farmers

Insights into the BRB farmers' perspectives were obtained from 22 online questionnaires. The eight in-depth interviews provided additional insights.

The additional effort for model farmers as a result of the BRB is reported as being non-existent or low. No respondents perceived a high level of additional effort (Figure 5). The farmers mentioned that they allowed farm visits before the BRB and already served as an

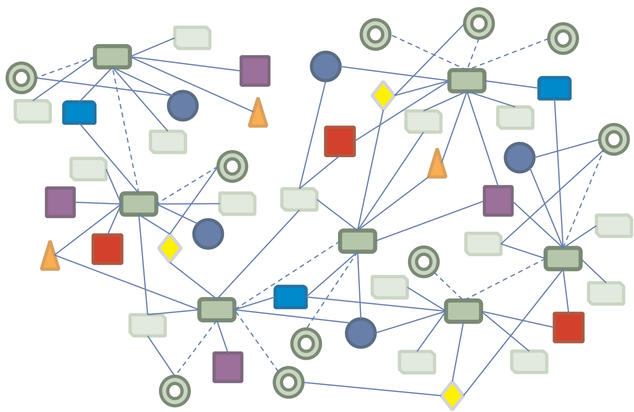

Figure 4. Structure visualization of the BRB, where knowledge seekers are added as actors. A knowledge provider network is created. Based on Sutherland et al. (2017).

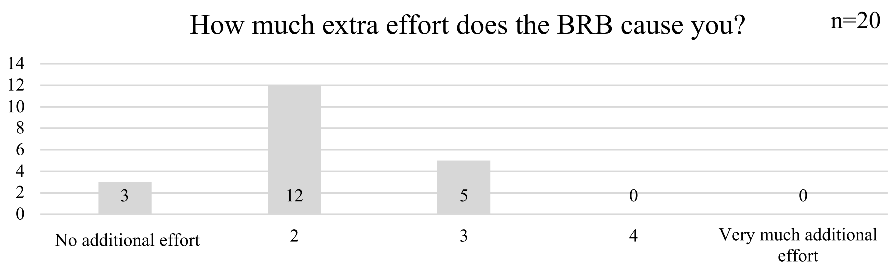

Figure 5. Amount of effort required by model farmers for participating in the BRB.

advisory contact point for farmers interested in switching to organic farming. 'I like to take the time for the farmer-to-farmer talks. They are always interesting conversations. You also learn something from others, even just little things,' stated one farmer, further demonstrating their open-mindedness and indicating that knowledge transfer is not exclusively unilateral.

Seventeen of 22 farmers stated that the ratio of additional effort to the benefit of the BRB is balanced; one denied this balance, and two were unsure. Most BRB farmers, therefore, did not consider their role as a knowledge resource in the BRB to be a waste of time.

Satisfaction among respondents varied widely between very satisfied, fairly satisfied, and satisfied (Figure 6). The farmers gave the following reasons for their choice. Among the very and fairly satisfied respondents, the reasons given were the excellent supervision of the BRB by LfL, the opportunity to interact with other BRB farmers, and that through OFDs from vocational and agricultural schools, future farm managers can obtain insight into organic farming. Among the satisfied respondents, the reasons included that they had previous experience as consultants, that the initial euphoria had been lost over the years, and that the BRB was seen more as 'just another network.' Unsatisfied farmers highlighted challenges such as animal welfare or biodiversity. The compensation for OFDs within the BRB is also important, as one farmer mentioned in an interview, 'it is about time we got paid for what we have been doing for so long.'

All eight farmer interviewees believed that the basic mechanisms and intentions of the BRB have been effectively implemented. One farmer said 'the transfer of knowledge should be the focus [of the BRB], and if you assume that, [the] BRB is ok.' In addition, based on the online questionnaire responses, the following topics were the most

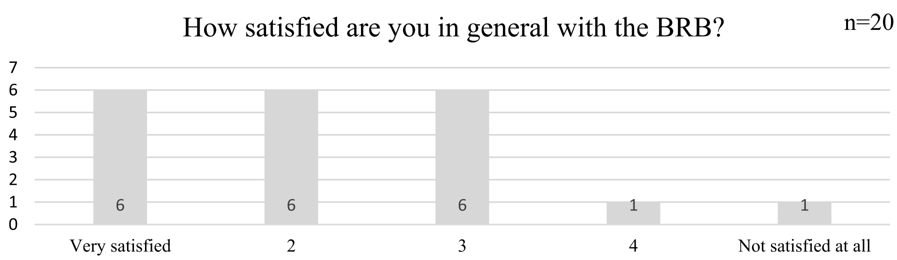

Figure 6. Level of satisfaction of model farmers with the BRB.

frequently addressed by the knowledge seeker: economic efficiency, cultivation methods, motivation to farm organically, production technology, and animal husbandry/stable construction requirements. When asked about the topics that farmers felt were important but never addressed, three were mentioned: social policy, animal welfare/biodiversity, and workload. According to data obtained from the online questionnaire and interviews, the production-specific knowledge of BRB farmers is highly practical because it is generated through personal experimentation and exchanges with organic-farmer colleagues. The questionnaire responses indicate that knowledge on topics beyond the farm is mostly obtained directly through OFA meetings at regional and local scales and supplemented by OFA circulars. Additionally, farmers mentioned using exchanges with advisors, print media, and the internet as sources of knowledge on organic farming and tacitly through their exchanges with other farmers.

Many interviewed farmers also hold positions such as board members at dairy firms, co-founders of producer rings, and OFA representatives and may also be involved in local politics. Such activities expand their network and knowledge, validating their qualification as model farmers. During the eight interviews, the idealistic attitude and willingness and intrinsic motivation of BRB farmers to support the development of organic farming were evident in the enthusiastic way they engaged in the interviews.

Although the inter-network exchange is not a goal set by the BRB, 12 of the 22 online questionnaire respondents stated that they benefit from the inter-network exchange. Three stated that they benefit from annual meetings, two from the support for public relations work, and one each of exclusive information and the Competence Center Organic Farming newsletter. Sixteen of the 22 BRB members stated their desire for more inter-network exchange. In addition, BRB farmers indicated they value each other's opinions and exchanges and can also be an inspiration, as one BRB farmer said: 'Demeter farmers are different and have different approaches. I always find that quite exciting.' This does not necessarily mean that they switch to Demeter agriculture, but it indicates their openness to other approaches and, thus, broadens their horizons of knowledge. Seventeen farmers stated that they are acquainted with more than 15 organic farmers within their district.

Additionally, although the online questionnaire results presented the BRB in a positive light from the farmers' point of view, the interviews revealed indifference among the farmers toward related policies. Although all were in favor of the BRB, they felt that the network's potential has not been exhausted but did not provide explicit suggestions for improvement. They generally expect more tools and support for the development of organic farming. In addition, the recently announced target of 30% organic farming in Bavaria by 2030 was described by certain farmers in the interviews as 'unattainable' if the policy continues to support organic farming at the current level; as one farmer said: 'I have to say, they [the state of Bavaria] will not achieve anything this way. That is why they will not reach their percentages. It will not work. Not a chance.' When asked how many farmer-to-farmer talks were held, the number ranged from 2 to 50, with the average of all (n = 19) being just over 17. However, low demand for OFDs was reported within the interviews.

Overarching tension and indifference among organic farmers with respect to politics, such as too little appreciation or preference for conventional farmers, was reflected in the enormous influence of Bavarian Farmers' Association (Bauernverband). Farmers complained about the lack of representation of organic agriculture; particularly, the need for structural change to reach the 30% target was mentioned. One farmer said, 'If I want more organic [farming], then more resources have to be used for it. For me that means 30% [staff] in government and other institutions.'

6. Discussion

The farmer's perspective adds value by showing the daily practical implementation and identifying the problems associated with the BRB. The evaluation of the network by the state (Kaniber 2021) has a political background, which means that the BRB is not questioned but only presented as a success; the figures in the report are not presented in perspective. Therefore, it is difficult to assess the BRB's actual impact and potential. The potential of the BRB is only indicated by the additional capacity for OFDs. This limitation calls for further research on the BRB.

The level of satisfaction of BRB farmers, identified in this work as a crucial aspect for a functioning BRB-type network, is predominantly high yet variable. Excellent organization and communication on the part of the supervising institution is therefore a basic prerequisite for a high level of satisfaction. However, the resulting exchange among farmers is an advantage for the farmers, which increases their satisfaction level. Therefore, certain farmers associate the level of satisfaction with a benefit they receive. It is speculative whether farmers would associate the exchange among themselves with the level of satisfaction if the general communication and organization were poor. However, extra work required to participate in the BRB, which was generally low, was not cited as a reason for the level of satisfaction. Therefore, as observed by Adamsone-Fiskovica et al. (2021), the pre-selection of farmers is important to identifying those interested in participating in knowledge transfer within OFDs, who may have previously done so in a similar way and who do not consider it to be much effort.

In addition to their various knowledge sources (meetings, media, advisors), their experience underscores the importance of the practical nature of knowledge for BRB farmers. This in turn highlights the value of organic farming experiential learning. In addition, farmers would like to see more interaction among themselves in the BRB, although they mentioned that they already benefit from interaction with other BRB farmers. Because exchange between BRB farmers is not a goal of the network, this would have to come from their own initiative.

One aspect that did not emerge from the questionnaire or the state's evaluation was the generally low utilization of the BRB, evident from interviewee responses. The variation in demand among model farmers, as reported by LfL, also complicates the estimation of the BRB's potential, as there is less demand for rare livestock or crop species. Nevertheless, there is capacity for increased demand for BRB farmers. In addition, the low budget of the BRB is a major advantage over other policy measures for AAS. Further analysis to assess spatial demand patterns, how often each BRB farmer is requested, or how the BRB visit affects the visitor's decisions is not feasible, as LfL does not record visitor information or the number of talks. Spatial analysis would provide reference for region-specific adjustments. However, further inquiry with LfL revealed that the documentation of each talk was too time consuming. The lack of detailed documentation by LfL limits the assessment of spatial in-depth performance of the BRB.

The low, although not atypical, response rate of approximately 20% should be considered. Although these farmers are open and interactive, one possible explanation for the low response rate could be a general aversion to questionnaires. Therefore, the question of representativeness must be raised. The results provide insights but may not reflect the full range of perspectives of BRB farmers. Despite the author's collaboration with LfL, the response rate was low. This is surprising, given the model farmers' interest in knowledge transfer. It can also be inferred from this behavior that there is a dislike for politics and institutions, as was also noted during the interviews. However, there was no aversion towards the BRB per se, because on the one hand, BRB is considered a means for organic farming and provides compensation, but on the other hand, the interference, i.e. coordination, of LfL is very low. Hence, the transfer of knowledge to other farmers or interest groups is not resisted.

Because of its uniqueness, the BRB complements studies on network structure and knowledge networks. Unlike Bailey et al. (2006), the value of information sources is not given, but similar networks for farmers are revealed (Bailey et al. 2006). Based on the network structures from the work of Madureira et al. (2015), the BRB structure integrates different characteristics from the networks. A clear demarcation of the networks in which farmers are integrated, as shown by the authors, is hardly possible owing to their multiple sources of knowledge and interactions in the real world (Madureira et al. 2015). The BRB is also unique compared with demonstration programs within the EU analyzed by Ingram et al. (2021). The on-demand OFDs provided by model farmers to promote organic farming in an increasingly pluralistic AAS, organized by a state institution, make the BRB a highly interesting and promising example for the future.

7. Realization and recommendations

The uniqueness of the BRB offers new insights into the successful implementation of knowledge provider networks. The responsibility of acquiring information is shifted to the knowledge seeker, such that the imparted knowledge is problem-specific and information is, thus, directly imparted. In this case, the success principles of OFDs (the nine Ps) differ from those reported by Adamsone-Fiskovica et al. (2021), requiring a reassessment of the BRB type of OFD.

The findings of the present study provide reference for the following five recommendations regarding the implementation of similar knowledge provider networks: (1) There is a need to understand local context; it is important to know the policy objectives, general barriers, and challenges with respect to regional organic agriculture. Involving different stakeholders in the agricultural sector and organic farming can help avoid upstream problems. (2) There is a need to assess the local AAS to identify shortcomings; depending on what is offered, a knowledge provider network such as the BRB may not fill this gap and may, therefore, be obsolete. Nevertheless, free knowledge by model farmers through easily arranged meetings is welcome. (3) Model farmers must be carefully selected; the selection process is essential. In addition to having excellent agricultural and economic skills, farmers must be willing to share their knowledge. (4) Institutional support is required to handle the coordination and bureaucracy associated with OFDs and compensation; less additional effort from farmers translates into less frustration, making OFD evaluation through feedback unfeasible. (5) Finally, public relations should be considered; without awareness of the knowledge provider network, it can hardly be used. Awareness should be promoted through print media, social media, the internet, and word of mouth. However, some of these approaches require funding, which may be insufficient depending on the budget.

8. Conclusion

This work highlights the importance of networks for the dissemination of knowledge for sustainable forms of agriculture by presenting a case study of the BRB knowledge provider network in Bavaria, established as a complementary building block for the agricultural advisory service of organic farming. The BRB primarily facilitates knowledge transfer among farmers (peer-to-peer) to support the process of conversion to organic farming and utilizes OFDs to offer the benefit of knowledge on organic farming from model farmers. The diverse knowledge base among BRB farmers and their extensive connections with various actors in the agricultural sector underscore their central role as knowledge disseminators for organic farming.

Data from the state demonstrated an increasing demand for the BRB. In line with the generally growing organic farm-land area in Bavaria, the government is developing a growing interest in organic agriculture and considers the BRB as an important building block for this development. Model farmers demonstrated a high degree of satisfaction with the BRB and, in combination with their intrinsic motivation to promote organic farming, the effectiveness of such knowledge provider networks for sustainable agriculture is highlighted.

However, the farmer perspective also revealed problems and weaknesses, indicating that demand for OFDs varies widely and is generally perceived to be low; moreover, the model farmers would like to have more interaction and exchange with each other. However, this is not provided for in the BRB, yet emphasizes the importance of knowledge exchange with peers. There is little resistance to the BRB in that it was regarded as a remarkable practice, yet general dissatisfaction was expressed with the policy agenda related to organic farming development.

Networks like the BRB play a crucial role in the evolving landscape of organic farming and increasing demand for sustainable agricultural practices. The success of such networks depends on integrating different knowledge types, effectively engaging stakeholders, and aligning with regional and national agricultural objectives. As the agricultural sector moves toward increasing sustainability, the findings of this study provide valuable guidance for policy makers, educators, and farmers.

Disclosure statement

No potential conflict of interest was reported by the author(s).

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