

Innovative niches for sustainability transitions

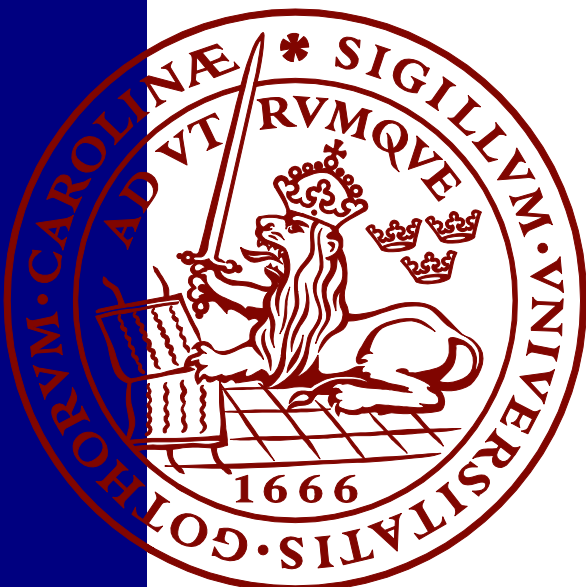
How social agriculture and food start-ups can transform the food system

A case-based research study from Germany

Lena Germscheid

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Abstract

To stay within our planet's limits and reach the United Nation's Sustainable Development Goals, there is an urgent need to rethink our current and dominant systems. This thesis focuses on the food system, in particular, and explores how an overarching turnaround in the way we produce and consume food has the potential to trigger and steer a greater transition towards sustainability. However, this is a complex task, involving a multitude of actors on diverse levels. More concrete, I investigate the role of social start-ups in the German agriculture and food sector and identify the challenges they face when growing into the existing market. In a second step, this thesis reveals a set of best practice strategies to overcome these barriers.

In my qualitative research, I make use of socio-technical transitions frameworks that structure the intertwined actor-network. The Multi-Level Perspective is used to identify different levels of actors. It is complemented by the theory of Strategic Niche Management and the Power in transition framework, putting the empirical results from semi-structured interviews, document analysis, and a literature review into perspective.

My empirical findings reveal that the main barrier that the start-ups are facing is the reinforcing power of the regime, mainly economically in terms of financial resources, and politically in the form of legal restrictions and requirements. To overcome these, the interviewed start-ups are boosting their own innovative power and personal motivation. Collaborating with the regime actors, they combine the innovative and reinforcing power and thus trigger transformative processes in the food system. Ultimately, I develop further recommendations for niche and regime players that shall guide them in contributing to a sustainable transformation. The main recommendations are being proactive, communicating barriers clearly and transparently, offering and making use of physical and mental spaces, encouraging diversity and learning by doing.

Keywords: multi-level perspective, strategic niche management, power in transition, food production, empowerment

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I am grateful and proud for having such beautiful people by my side!

*Wie jede Blüte welkt und jede Jugend
Dem Alter weicht, blüht jede Lebensstufe,
Blüht jede Weisheit auch und jede Tugend
Zu ihrer Zeit und darf nicht ewig dauern.
Es muß das Herz bei jedem Lebensrufe
Bereit zum Abschied sein und Neubeginne,
Um sich in Tapferkeit und ohne Trauern
In andre, neue Bindungen zu geben.
Und jedem Anfang wohnt ein Zauber inne,
Der uns beschützt und der uns hilft, zu leben.*

*Wir sollen heiter Raum um Raum durchschreiten,
An keinem wie an einer Heimat hängen,
Der Weltgeist will nicht fesseln uns und engen,
Er will uns Stuf' um Stufe heben, weiten.
Kaum sind wir heimisch einem Lebenskreise
Und traulich eingewohnt, so droht Erschlaffen;
Nur wer bereit zu Aufbruch ist und Reise,
Mag lähmender Gewöhnung sich entrafen. [...]*

Hermann Hesse

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1 Introduction

1.1 The need to rethink our food system

While the exploitation of various resources has paved the way into the modern world as it is today, the Anthropocene is calling for a great change. Humankind is facing massive sustainability challenges, such as climate change and biodiversity loss. To overcome these, we need to stop transgressing planetary boundaries (Rockström et al., 2009; Schneidewind, 2019) and stay within the planet's limits (Raworth, 2012). This overarching transition towards a more sustainable and equitable society has to take place in all fields and on all levels of our complex cultural, technological, political, and economic systems. One of these fields in which a transition is urgently required is the way we produce and consume food. Sustainable food, land, water, and oceans are high on the agenda to achieve the United Nation's Sustainability Goals (SDGs) (Sachs, Schmidt-Traub, Mazzucato, Messner, Nakicenovic & Rockström, 2019; Schneidewind, 2019). The agriculture and food sector accounts for a quarter to a third of global greenhouse emissions, at least twice as many as all transportation combined (Foley et al., 2011; IPCC, 2014; IPCC, 2018) and most losses of biodiversity (Ramankutty et al., 2018). In Europe, about 30% of consumers' resource use can be traced back to nutritional purposes (Buhl, Liedtke & Bienge, 2017). Facing partly reinforcing developments such as globally increasing prosperity, growing world population, and shifting dietary habits, a ground-breaking turnaround is required to meet the world's future food security in a sustainable manner (Foley et al., 2011). We need to re-think our food system as it is now. According to Rockström & Sukhdev (2016), all SDGs are directly or indirectly linked to the production or consumption of food. Thus, global sustainability goals cannot be achieved without a transition in the agricultural and food sector.

Two main sustainability challenges in the agricultural and food sector can be identified. There is a techno-economic and a cultural-behavioral lock-in (Schneidewind, 2019). Firstly, the techno-economic lock-in is reflected in a productivity trap: a continuously increasing productivity driven by market liberalism which is ultimately causing the overexploitation of ecological resources (Jackson & Victor, 2011). Over the past centuries, agriculture and food production have progressed enormously. In particular, in the global north of the 21st century, most processes are automated and supported by the use of fertilizers and pesticides. Technological advancements have allowed farmers to grow and harvest food mostly regardless of climate and seasons. Simultaneously, the ecological consequences are becoming increasingly severe. The food system poses a significant threat on habitats, biodiversity, carbon storage, soil conditions and the water circle (Foley et al., 2011) through massive CO₂ emissions

from, for example, meat production and transport, groundwater contamination from fertilizers and pesticides, and monoculture farming (IPCC, 2019). Secondly, the cultural-behavioral lock-in is primarily manifested in our dietary habits that are deeply entwined with our personal identities, our cultural and social ties (Schneidewind, 2019).

To overcome these lock-ins it is, amongst other things, necessary to switch to alternative proteins, expand hydroponic and aquaculture farming, develop more high-precision farming mechanisms and expand regional and seasonal food production (Schneidewind, 2019). Additionally, new dietary identities and norms, that favor and value sustainably produced food options, need to be adopted. Therefore, actors along the whole food supply chain need to be involved in the process. Scholars have identified a set of key actors that have the potential to bring about incremental changes and trigger a transition towards sustainable food, land, water, and oceans. These actor groups that will ultimately be able to lead the way forward, are civil society, politicians, scientists, and entrepreneurs (Schneidewind, 2019).

1.2 Aim and research questions

In my research, I focus on entrepreneurial actors, in particular social start-ups (hereafter only referred to with the term 'start-up(s)'), and their role in driving and supporting the well-needed transition towards sustainability in the food and agricultural sector. Social start-ups do not primarily aim for economic success, i.e. generating profit, but do rather focus on the creation of social and environmental value (Levinsohn, 2014). The purpose is to solve social and environmental challenges and problems with an entrepreneurial approach (BMW, 2020a). The start-ups do so by creating so-called start-up ecosystems as partnerships and enabling environments for entrepreneurial action (Avelino et al., 2019).

Focusing on four examples of early-stage social start-ups on the German market, this thesis aims to identify how these start-ups are tackling the described socio-environmental challenges in the agriculture and food sector. The aim is twofold: I firstly aim at unpacking common challenges and barriers and secondly at synthesizing best practice strategies to successfully overcome these. These could serve any start-up in the German agriculture and food sector as a guideline. Creating an increased knowledge base and a better understanding, I contribute to the development of a more sustainable food system.

Hence, my research questions (RQ) are as follows:

- (1) What are the shared challenges that early-stage German social start-ups in the agricultural and food sector experience when seeking to grow into the existing unsustainable market?
- (2) What are their strategies to deal with the above-identified challenges?

1.3 Contribution to sustainability science

Sustainability science focuses on and seeks to understand “the dynamic interactions between nature and society” (Clark & Dickson, 2003, p.8059) and is characterized by its wicked problems and their complexities (Kates et al., 2001). These can best be understood and addressed through trans- and interdisciplinary approaches (Jerneck et al., 2011), “bringing together scholarship and practice, global and local perspectives from north and south, and disciplines across the natural and social sciences, engineering, and medicine.” (Clark & Dickson, 2003, p.8059). In this thesis, I contribute to the emerging field of sustainability science by seeking answers to two of the main questions within the field: “What shapes the long-term trends and transitions that provide the major directions for this century?” (Kates et al. 2001, p.19450) and “How can society most effectively guide or manage human environment systems towards a sustainability transition?” (Kates et al. 2001, p.19450). I look into the transitions that are needed in the food system and identify how entrepreneurs can guide these most effectively.

Combining the heuristic theories of Multi-Level-Perspective (MLP) and Strategic Niche Management (SNM) with a practical focus on four real-life examples from the field, I aim at applying systems thinking to create new scientific knowledge. Further, I contribute to filling the existing research gap around the potential of innovative agriculture and food start-ups to trigger a transformative change in the food system.

1.4 Outline

This thesis sets off by explaining the theoretical frameworks used to conceptualize dynamics and structures under study in Chapter 2. Chapter 3 sets the scene and gives a brief introduction of the German agriculture and food sector and the start-ups within. In Chapter 4, I introduce my research philosophy, the methodology that the research process follows, and some limitations. Chapters 5 and 6 present my empirical findings and answers to my research questions while Chapter 7 further develops these and establishes guidelines. Finally, in Chapter 8, I come to conclude this thesis, present an overall summary, and give recommendations for future studies.

2 Theoretical frameworks

This research builds on two theoretical frameworks, popular in sustainability sciences, that are capable of breaking down the complex, intertwined and multidimensional facets of agriculture and food systems: the Multi-Level Perspective (Geels, 2011) on socio-technical transitions (Geels, 2005) and the Strategic Niche Management approach (Kemp, Schot & Hoogma, 1998). I combine these theories and hence frame disruptive innovations, originating from start-ups, as a possible solution to successfully managing a transition towards a sustainable food system.

2.1 Socio-technical transitions

Socio-technical transition theory is an umbrella term encompassing different heuristic models and theories for sustainability transitions. The socio-technical transition approach was introduced by Arie Rip and René Kemp (1998) and later refined and developed with the empirical work of the Dutch researchers around Frank Geels (2005). A central theme is the recognition of the co-evolutionary development of technologies, institutions, and social and economic subsystems.

2.2 Multi-Level Perspective

The Multi-Level Perspective (MLP) is a heuristic framework that focusses on prospects and dynamics of broader transition processes and a variety of innovations. It is concerned with successfully implementing transformative societal processes. To assist the understanding of socio-technical transition, the MLP differentiates between three analytical levels: the **landscape** (macro-level), **regimes** (meso-level), and **niches** (the micro-level). As outlined in Figure 1, the MLP explains transitions as the interplay of stabilizing mechanisms at the regime level, combined with a destabilizing pressure from the landscape and radical innovations at the niche level (Geels, 2011; Markard & Truffer 2008). The breakthrough of innovations on the bottom, the niche level, is, in particular, dependent on a multitude of processes in the wider context of regimes and the landscape (Geels & Schot, 2007).

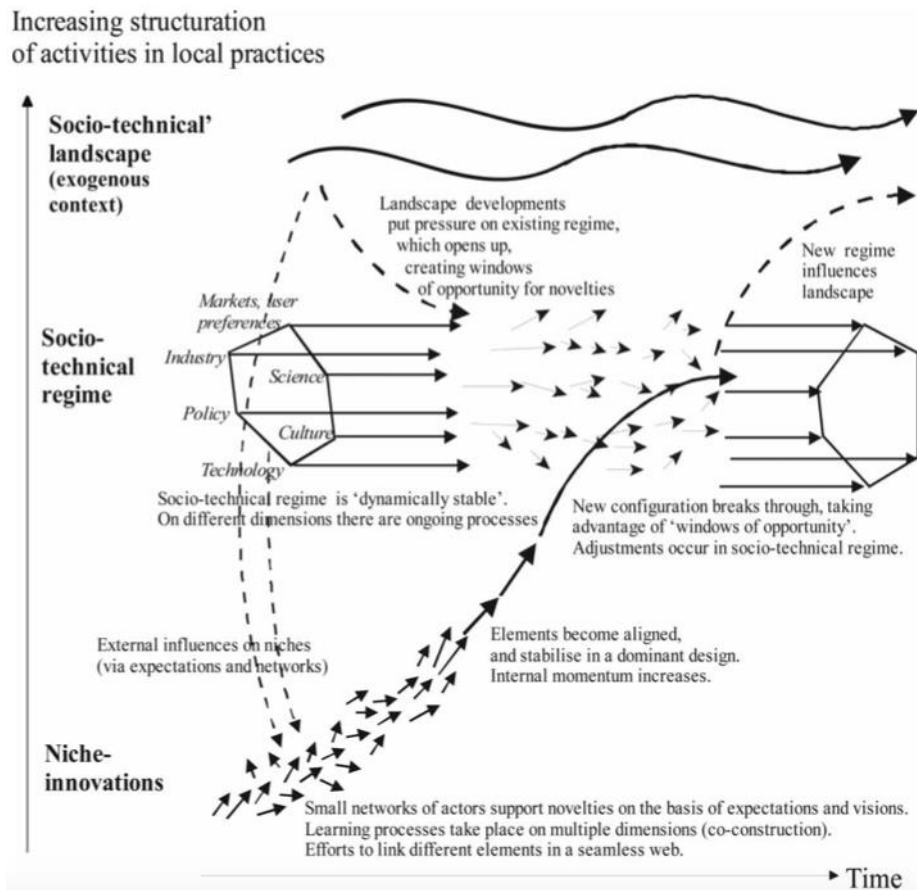


Figure 1: Multi-Level Perspective framework. A socio-technical transition starting as an innovation at the niche level, making up its way into the socio-technical regime and finally influencing the landscape level. (Schot & Geels, 2008).

The **landscape** is the overall setting that encompasses the dynamics of deep cultural patterns, macro-economics, and macro-political developments that make up the exogenous environment or context of socio-technical transitions. Overarching structural trends and changes at the landscape level occur more slowly than at the regime level (Geels, 2011). Examples for such trends are economic crises, cultural norms, and values, environmental degradation, or the development of underlying infrastructures. The landscape is the basis for the regime and niche levels. It stimulates and exerts power on the socio-technical regime and the niches and thus plays an important role in promoting socio-technical transitions.

The **regime** level comprises the structures that represent current practices and routines, including the dominant rules and technologies that provide stability and reinforcement to the prevailing socio-technical systems, such as providing food, energy, and mobility. According to Geels (2011), it consists of the following dimensions: scientific knowledge, policies and regulations, markets and user preferences, technologies, cultural values, and the industry structures. These dimensions are strongly interrelated and stabilize the dominant regime structures. Thus, socio-technical regimes serve as

selection and retention mechanism which may lead to lock-ins or path-dependency, a systemic resistance to change (Elzen, Geels & Hofman, 2002). In this way, the regime level can be interpreted as a barrier to change, and new technological and social innovations. It is argued that although the regime level is already much more flexible than the landscape level, its structures are still reasonably stable and hence give little opportunities to the occurrence of major changes (Geels, 2011; Twomy & Gaziulusoy, 2014). For this study, in particular, the regime is the conventional agri-food system in which conventional, large-scale farmers, international corporations, and retail chains hold a major stake (Bui, Cardona, Lamine & Cerf, 2016).

The **niche** level creates space for experimentation and radical innovation. It is more loosely structured than the regime and landscape levels and is less subject to market and regulation influences. Hence, it allows for the emergence of new interactions between actors that may support innovation (Geels & Schot, 2007). The niche level is a “breeding space” (Kemp et al., 1998, p.185) for innovations, protected from market forces. Therefore, niches are innovative socio-technical configurations, considered to be seeds for systemic regime change (Wiskerke & Van der Ploeg, 2004). However, also the timing is crucial for niche innovations. “When ongoing processes at the levels of the regime and landscape create a window of opportunity” (Geels, 2002, p.1262), radical innovations can make their way up into the regime. In this research project, the studied niches are early-stage start-ups in the agricultural and food sector that have developed disruptive and sustainable innovations that they want to establish and bring into the regime.

Geels (2002) hints at the important role that niches play in transitions towards a more sustainable regime. This potential is especially addressed by the strategic niche management approach complementing the MLP (Kemp, Rip & Schot, 2001). It facilitates the identification of key pathways to break through from protected niche spaces and into the regime. Such a breakthrough is a necessity for innovations if they aim at transforming the food system, for instance.

2.3 Strategic Niche Management

One core assumption of the Strategic Niche Management (SNM) approach is that sustainability innovations can be facilitated by providing artificially created, protected spaces that allow for nurturing and experimenting with the coevolution of technology, user practices, and regulatory structures preventing the exposure to incumbent technologies and the market (Raven, 2012). As Figure 2 represents, this process is taking place on and in-between two levels: the local and the global level (Geels & Deuten, 2006). Their interaction and exchange are crucial.

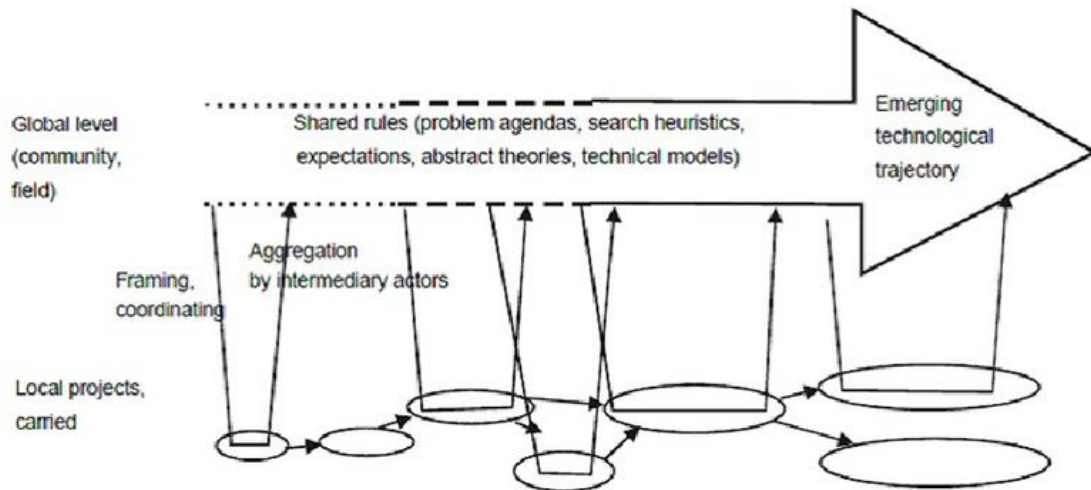


Figure 2: Strategic Niche Management. Local-global interaction within niche formation. Lessons learned on a project level (niches) are aggregates and transferred to their wider setting. (Geels & Raven, 2006).

The local niche level can be understood as an accumulation of individual projects where innovation experiments responding to local demands and challenges are conducted by a multitude of actors. Studying these projects through a socio-technical lens enables the unraveling of the manifold external factors (social, technical, economic, political, and organizational) that have either contributed to the success or have caused failures.

The global niche level emerges when multiple local projects are aggregated and interlinked by networks and other intermediary actors applying the technology (Seyfang, Hielscher, Hargreaves, Martiskainen & Smith, 2013). Lessons learned on a local project level are accumulated and “gradually become more articulated, specific, and stable” (Schot & Geels, 2008, p.543). This process can only partly happen organically and thus requires some additional support from external actors, such as the ones in start-up ecosystems, providing resources to apply new ideas and proven concepts. The aim is to generate “generic lessons and cognitive rules” (Geels & Raven, 2006, p.378) which can be transferred and applied to the global level. There, the generic rules can be more broadly adopted and ultimately be used for the design of projects that are replicating successfully proven components and avoiding poor practices.

SNM conceptualizes the niches and their dynamics as a cyclical pattern of internal processes: (1) articulating expectations and visions, (2) building social networks, and (3) consolidating cognitive rules (Schot & Geels, 2008). The formulation of expectations and visions is needed for niche projects to gain attention and legitimize support. For a successful niche development, expectations should be shared amongst various niche actors, specific and concrete enough, and continuously reflected upon and adapted. Further, visions may function as a narrative for future development, as a promise for the

future, and thus foster cooperation (Hoogma, Kemp, Schot & Truffer, 2002; Kemp et al., 1998). Learning processes are especially essential regarding technologies, industry dynamics, market and user preferences, infrastructures, cultural meaning, legal regulations, political factors, and social and environmental impacts. Not only should these learning processes be experienced as first-order learning (accumulation and presentation of facts), but also as second-order learning, enabling the reflection on facts and changes in cognitive frames (Geels, Hekkert & Jacobsson, 2008; Hoogma, Kemp, Schot & Truffer, 2002; Kemp et al., 1998). Being tightly related to learning processes, social network formation is of high importance for creating a customer base and providing resources, by encouraging interactions between and with stakeholders especially customers and suppliers (Hoogma, Kemp, Schot & Truffer, 2002; Kemp et al., 1998). It has been shown that a heterogeneous set of actors and the integration of outsiders are beneficial and a source of second-order learning (Hoogma & Schot, 2001).

2.4 Power in transition framework

Flor Avelino (2017) has complemented the MLP framework and SNM approach with her Power in transition (POINT) framework on power and empowerment in transformative change processes towards sustainability. Studying, in particular, the system on the regime and niche level, she defines power as the “capacity of actors to mobilize resources and institutions to achieve a goal” (Avelino, 2017, p.507). Three different types of power are distinguished: reinforcing, transformative, and innovative power (Avelino, 2017). Reinforcing power is an agency-based notion of power and refers to the reproduction of existing structures and institutions. It describes the power exercised on the regime level. Transformative power is located in the space between the regime and niches (niche-regime) and is related to the capacity to develop new structures and institutions or to significantly challenge the old by altering them (e.g. legal structures, physical infrastructure, economic paradigm). Ultimately, innovative power describes capacities to create new resources that make actors more independent on existing resources and thus less dependent on existing structures and dominant actors. Innovative powers are related to the niches of the MLP.

On the niche and niche-regime level, Avelino differentiates between two kinds of power, namely moderate and radical power. Moderate power describes a form of power that “goes along with macro trends” (Avelino, 2017, p.511). Hence, moderate niches and niche-regimes exercise their innovative or transformative power in ways that support the regime and landscape level and build synergies (reinforcing). In contrast, radical power is understood as explicitly challenging the dominant regime and landscape dynamics by supporting countertrends such as collectivism.

Additionally, Avelino points out what it entails to empower actors in her framework. Empowerment “refers to a person's belief that they can direct [...] events towards desired ends” (Elmes & Smith, 2001, p.34). In the context of the MLP, empowerment is a process through which actors gain the capacity to mobilize resources and institutions to achieve a goal. This capacity can be gained by access to resources and institutions, by new strategies to mobilize these or by the willingness to do so.

3 Setting the scene

3.1 The German agriculture and food sector

To answer the research questions, it is crucial to understand the wider context and to map out the German agriculture and food sector. Who are the main actors, and what is their role and the role of new market entrants in addressing the sector’s main sustainability challenges?

The agricultural and food sector is Germany’s fourth-largest industry and hence a key component of its economy. Being deeply integrated into global food supply chains, it ensures stability, prosperity, and employment in all regions of the country (BVE, 2020; PwC, 2014). In 2018, goods with a total value of 58,8 billion Euros have been produced (DBV, 2019). PricewaterhouseCoopers (2014) describes the market as strongly regulated, saturated, and highly competitive with established market players taking up the major share of revenues (TradeDimensions, 2019). Its main challenges are volatile commodity and energy prices and a lack of financial investments. However, in 2018, Germany was the third-largest exporter of agricultural goods, globally (DVB, 2019). Main trade partners are the Netherlands, Italy, France, the United Kingdom, and Austria. The country benefits from its long agricultural history, a great reputation, high-quality standards, appropriate climate conditions, drinking water supply, and excellent infrastructures (PwC, 2014).

Parallel to the supply chain that is depicted in Figure 3, the industry can be roughly divided into four main stages: Farming and post-harvest, packaging and processing, distribution and wholesale, retail, and gastronomy.

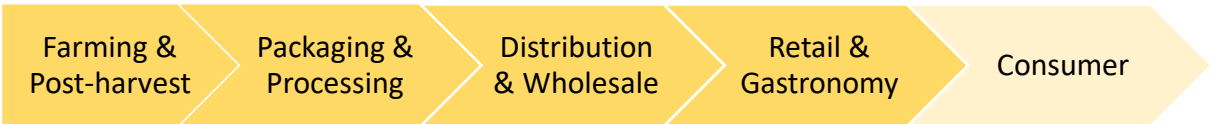


Figure 3: Overview of the five main stages of the food supply chain. (Own illustration).

Currently, the German agriculture and food sector is undergoing some substantial changes due to five overarching megatrends that it will have to adapt to demographic change, urbanization, technological progress, scarcity of resources, and economic growth in countries of the global south (PwC, 2014). Following these trends, regulations and requirements are simultaneously getting increasingly diversified. The variety of products rises. Consumers are, for example, demanding more convenient, healthier, and more sustainably produced food. Every year, 40,000 new innovative products are introduced into the market, only 32% of these are proving themselves successfully in the long-term (DBV, 2019). Some central fields and aspects that the industry will have to address in the coming years

have been identified by market analysts (PwC, 2014). Along the entire supply chain (i.e. greenhouses, transport, cooling, etc.) processes need to be designed more environmentally friendly and less resource-intensive. Recycling of products that cannot be sold and consumed is another crucial aspect. In recent years, consumers have shown an increasing willingness to pay higher prices for healthy and safe food. For example, in 2008 organic food products only accounted for 3.8% of revenues in the industry, whilst this share increased to 6.1% in 2018 (BÖLW, 2020; Statistisches Bundesamt, 2019). A similar rise of revenues is to be reported for vegetarian and vegan food items on the German market. Within two years, from 2017 to 2019, revenues increased by 65% from 736 million to 1.2 billion Euros annually (Nielsen, 2019). Consumers are increasingly paying attention to products' origin and processing throughout the supply chain. In particular, consumers are demanding more transparency from food producers and suppliers. Additionally, more responsible handling of resources in procurement, production, and packaging is demanded (PwC, 2014). Through effective stakeholder management, future needs and requirements of the sector can be identified and solutions can be developed. Ultimately, the industry's competitiveness on the global market needs to be strengthened to ensure profitability. Campaigns such as the Federal Ministry's "Wie schmeckt die Zukunft?" (translates to: What will the future taste like?) are meant to boost innovations (BVE, 2019).

It is also important to hint at the fact that the German market for food items is strongly driven by prices. Germans only spend about 10% of their income on food (groceries and eating out) while in other European countries people spend more than 20% of their income (Eurostat, 2017). After freshness, the price is the most important decision-making factor that Germans consider when buying food. Sustainability criteria, such as seasonality, regionality, organic, etc., rank relatively low (Statista, 2017). These consumer preferences are a big challenge for market players, especially for new market entrants such as start-ups, which cannot produce in bulk and thus cannot benefit from scale economies.

3.2 Sustainability aspects of the agriculture and food sector

Having pointed at the social and environmental implications of the food system, in the introduction (Chapter 1) I want to further engage with the main sustainability challenge. Global environmental impacts of the sector are seen to be either caused by expansion or intensification (Foley et al., 2011). Agricultural expansion is the reason for a large number of clearances, converting natural habitats into croplands and pastures for food production causing approximately 98% of total CO₂ emissions from land clearing (DeFries & Rosenzweig, 2010; Foley et al., 2011). Agricultural intensification is not only drastically driving the use of fertilizers, such as nitrogen, but is also causing increasing levels of water

degradation, freshwater withdrawal for irrigation, energy use, and pollution (Foley et al., 2011; IPCC, 2019). Thus, Foley et al. (2011) deem the agricultural and food sector to be a major contributor to global climate change, being responsible for more than 35% of global CO₂ emissions. Large amounts of greenhouse gases are, for example, coming from deforestation, livestock, rice cultivation, transportation, or unnecessary food waste (Foley et al., 2011; Niles et al., 2018).

However, environmental sustainability in food production *can* be enhanced whilst securing global food security. To do so, we need to stop agricultural expansion, increase resource efficiency, shift our diets, and reduce waste (Foley et al. 2011). These missions have to some extent been taken up by the industry. Especially, by innovative agriculture and food start-ups.

3.3 Start-ups in the German agriculture and food sector

Start-ups in the agriculture and food sector are those who are directly and/or indirectly involved in the production and sales of agricultural and food products. This may take place in upstream (e.g. agricultural machinery industry, supplier) or downstream processes (processing industries, food wholesale, and retail), the agricultural production itself, or as a provided service (Huchtemann & Theuvsen, 2018). Agricultural and food start-ups can be categorized in different functional areas such as plant production, livestock production, agricultural technology, management and administration, processing, recycling, marketing and sales, and warehousing, and logistics (Start-Up Nation Central, 2017).

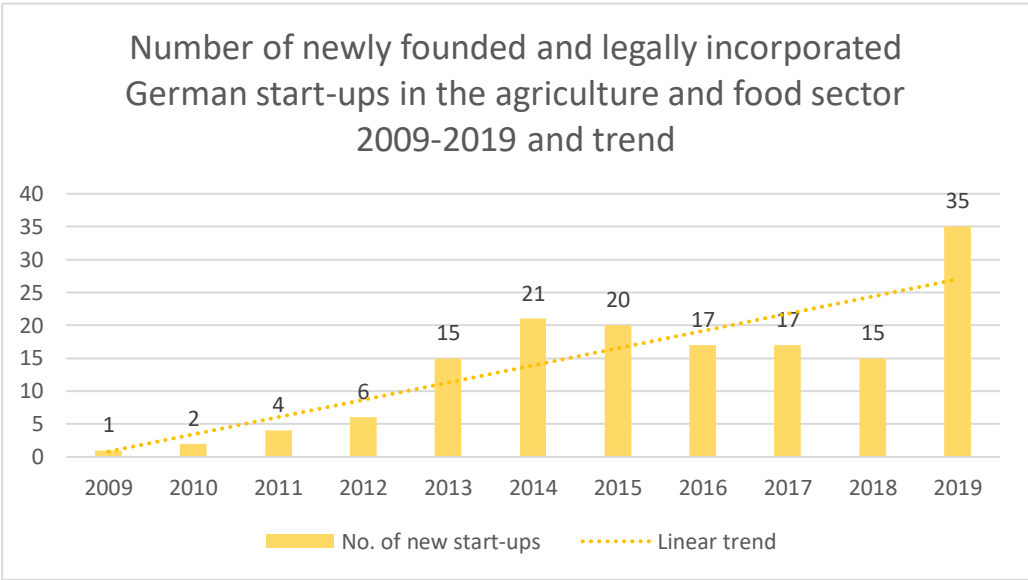


Figure 4: Number of newly founded and legally incorporated German start-ups in the agriculture and food sector 2009-2019 with an increasing trend. (Own illustration, based on Huchtemann & Theuvsen, 2018; Kollmann, Hensellek, Jung & Kleine-Stegemann, 2018; Kollmann, Hensellek, Jung & Kleine-Stegemann, 2019).

Looking at German agriculture and food start-ups, in particular, it becomes clear that the sector has been growing in the course of the last decade. Figure 4 demonstrates this growth. While there was only one newly founded agriculture or food start-up in 2009, 35 new start-ups in the same sector have been founded in 2019. This is equivalent to an average annual increase of approximately 55% (Huchtemann & Theuvsen, 2018; Kollmann, Hensellek, Jung & Kleine-Stegemann, 2018; Kollmann, Hensellek, Jung & Kleine-Stegemann, 2019). Their innovations are manifold, reaching from artificial intelligence systems for urban hydroponics, to alternative proteins (insects) to new marketplaces and food waste solutions.

Similarly, an analysis of print and online media on the topic (Huchtemann & Theuvsen, 2018) observed a rise of public events such as congresses and conferences, a growing number of accelerators and incubators. This momentum is created by dynamic networks of businesses and universities and political support. While establishing a thriving ecosystem for and around themselves, agriculture, and food start-ups are gaining significance in Germany. For example, in February 2020, the Federal Ministry of Food and Agriculture (BMEL) announced financial support for artificial intelligence research projects run by start-ups in the fields of agriculture, food supply chain, healthy nutrition, and rural regions to boost agricultural and food start-ups in Germany (BMEL, 2020).

4 Methodology

As this paper seeks to generate new knowledge on the topic of sustainability transitions in the German agriculture and food sector a qualitative research study is considered to be the most suitable research design. Qualitative research is in particular well-suited for the exploration of complex issues (Ritchie & Lewis, 2003) - such as the ones in the intertwined agriculture and food systems.

4.1 Research philosophy

In my research, I take an ontological position of critical realism, recognizing that reality is independent of our experiences and perspective. The way reality is perceived and described is partly constructed. As in the MLP framework, critical realists acknowledge that there are various layers of reality, viewing the problem from different angles or perspectives. Critical realists try to gain a better understanding of their complex research topics but are aware that there is no singular true and objective understanding of reality (Moses & Knutsen, 2012). Epistemologically, I recognize, that my research cannot unravel all the aspects relevant to my research questions. However, analyzing German early-stage agriculture and food start-ups and examining the three levels of the MLP respectively, I will gain a better understanding and move closer to reality.

4.2 Data collection

For my data collection, I made use of the triangulation approach, which “is defined as the mixing of [three different] data [sources] so that diverse viewpoints or standpoints cast light upon a topic” (Olsen, 2004, p.103). It further extends inferences drawn from the data and helps to check the integrity and validity of the claims made. Thus, triangulation adds credibility to the findings and provides a fuller picture of complex phenomena (Bryman, 2012). However, this picture is not necessarily a clearer one (Olsen, 2004; Ritchie & Lewis, 2003). In my thesis, I draw from data generated through interviews, documents, and a literature review.

4.2.1 Interviews

As a central element of my research, I collected case-based qualitative data via semi-structured interviews. The aim was to incorporate views from various actors in the German agriculture and food start-up scene. I used a purposive heterogeneous sampling strategy (Etikan, Musa & Alkassim, 2015) with a sample comprising of interviews with five experts which are summarized in Table 1 below. Based on their expertise, I decided to interview one expert from a food accelerator as well as four founders of start-ups from the German food and agricultural sector (see more detailed information in Table 1).

All of these start-ups can be described as early-stage start-ups, roughly two years old, and acting as niche representatives. Whilst they are all tackling sustainability challenges in the same sector, their business activities relate to different parts of the food supply chain presented in Chapter 3.1. For example, one case is concerned with large-scale farming and the production of food, alternative proteins to be specific, while another case directly addresses consumers by developing a smartphone app that enables them to grow their own food in urban contexts. Additionally, the selected cases are geographically spread throughout the country. This selection of cases allows me to identify commonalities for early-stage start-ups in Germany but also enables me to see how the respective stages of the supply chain and the locations may influence the businesses. The selection of interviewees was not random but rather deliberate and due to their qualities. In addition to their knowledge and experience, the participants' availability and willingness to participate was a decision criterion. Hence, the results are rather illustrative than representative. It is to be acknowledged that in purposive heterogeneous sampling the researcher's ability to draw inferences may be impeded by her/his subjectivity and bias in choosing the subjects (Etikan et al., 2015).

The method of semi-structured interviews does not only enable interviewees to answer standard questions but also opened the conversations to new ideas that came up during the interviews.

Table 1: Categorized interview partners (Own illustration).

Start-up/ organization	Business activity	Addressed sustainability challenge(s)	Located in the supply chain	Position interviewee	Short- form
INOVA Protein	Alternative proteins: Farming systems for mealworms	Livestock farming, meat consumption	Farming	Founder & CEO	S1
Completeorganics	Fermentation of organic food	Conventional farming	Processing & Retail	Co-Founder & CEO	S2
Roots Radicals	Zero-waste cuisine	Food waste	Gastronomy	Founder & CEO	S3
Alphabeet	Smartphone app enabling urban citizens to grow their own food	Urban-rural divide, alienation from food production	Consumer	Founder & CEO	S4
Food accelerator	-	-	-	Scale-up enablement manager	F1

To help focus on the topics of interest and to enable the analysis of the outcomes, an interview guide that was informed by the theory of MLP and SNM was used. They also made it possible to pick out key trends, commonalities, and differences. I developed interview guides, made up of seven to fourteen open-ended questions that were individualized to each participant with regards to their position and affiliation and their responsibilities. Starting with rather broad introductory questions (e.g. about the start-ups' vision and mission), I continued with questions about the challenges and barriers they are confronted with and guided the interviewees towards talking about the strategies they apply to address and overcome these. In most interviews, an unstructured element was included that allowed the interviewees to talk about issues they felt were of particular relevance (Kvale, 2018). The majority of the interviews took place in the form of video calls. Two interviews were conducted by telephone. I conducted three interviews in German and two in English. All interviews were recorded and fully transcribed to facilitate a systematic and effective analysis. Before the interviews, the interviewees were introduced to the study and its contents and purpose. They agreed to the interviews being recorded and transcribed at a later stage. They were made aware of their rights to ask questions or demand clarifications at any point.

4.2.2 Documents

Ultimately, documents and archival sources were reviewed and analyzed to supplement the interviews and put preliminary findings into their contexts. Relevant sources included online news articles, press releases, public documents, reports, and websites. Detailed descriptions of these documents can be found in the Appendix.

4.2.3 Literature review

My whole research process was continuously accompanied by literature searches on LUB search, Scopus, Google Scholar, and further academic literature found through a snowball search technique. Reviewing literature in an iterative mode, I did not only acquire my initial understanding of the topic but was also able to enhance these ideas at later stages deepening my knowledge and supporting my arguments with other relevant findings. This process was started by online searches with the aforementioned search engines using keywords such as: "Socio-technical transitions", "Multi-Level-Perspective", "Strategic Niche Management", or "Innovation food and agriculture".

The data collection ceased when a saturation point was reached in each context. It was followed by the qualitative content analysis.

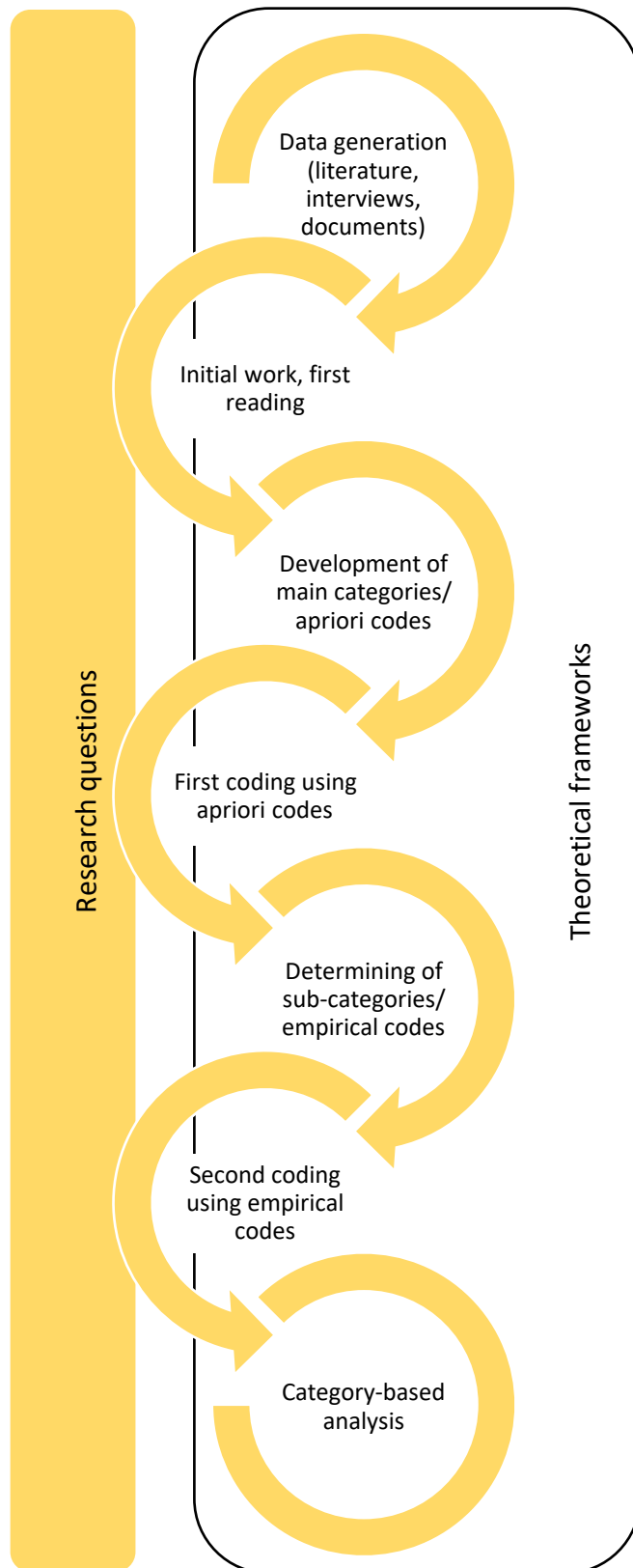


Figure 5: Overview of the iterative research process and the qualitative data analysis. (Own illustration, adapted from Kuckartz, 2014).

4.3 Data analysis

Marshall and Rossman (2000, p.154, as in Gibson & Brown (2009)) define qualitative data analysis as “a search for general statements about relationships and underlying themes”. Here, theoretical frameworks can be used as a tool for analysis that enables researchers to work with their data in a structured and guided way (Gibson & Brown, 2009). The theories of MLP and SNM provided the baseline and guidance in this process which is visualized in Figure 5.

The identification of dominant and broad themes in qualitative data analyses is based on the creation of codes. Initial apriori codes, derived from top-down theory and the research questions, can function as code families or general analytical categories (Gibson & Brown, 2009). The apriori codes used in my research have been informed by Geels’ (2005) socio-technical framework, the MLP, the SNM approach, and the POINT framework. Hence, the developed analytical apriori codes based on this are: organizational, social, technical, economic, and political. In a second step, these categories are divided into the levels of the MLP and POINT framework (landscape, regime, niche-regime, and niche). Thirdly, these apriori codes are complemented by empirical codes that arise from exploring the data collected.

Table 2: Extract from coding table. Partly translated from German. (Own illustration).

Apriori code		Empirical code
Economic	Landscape	Setbacks like now, we have somehow worked for a year towards this gardening season and with our partners. We have been able to make it a success story. And now this virus comes around the corner and destroys everything. (S4)
	Regime	It is hard to get access to private investment unless you have already validated a certain need in the market. And that's why we are so happy about this funding from the foundation. (S4)
	Niche-regime	They tend to think that the humanitarian sector and the social impact sector cannot be treated as a business or don't have to think about a revenue model. Or see their project using profit and loss lens. (F1)
	Niche	And yet you can also be a fair company, and I think that part of being a fair company is that you make a product that helps people, but also that you pay employees fairly and treat partners fairly. (S4)

For my study, the NVivo 12 computer software was used for the qualitative data analysis of interviews and documents. The program allowed to “uncover and systematically analyze complex phenomena hidden in the textual [and visual] data” (Leary, Schaube & Clementi, 2019, pp.161-162). Newly emerging themes from primary data analysis resulted in empirical codes that are closely related to and hence have individually been assigned to an apriori code. Drawing on Mayring’s (2014) inductive

category formation and deductive category assignment, the development of codes was an iterative process. Going back and forth between theoretical background knowledge and qualitative data, a deep exploration was enabled. The results were organized in a coding table. An extract of the coding table is presented in Table 2.

4.4 Potential limitations

Finally, I have to acknowledge a set of potential limitations lying within my conducted research methodology. Firstly, different modes of inquiry (two phone and three video calls), different languages (two in English and three in German) used and varying lengths of the interviews (12-35 minutes) are factors that potentially have an impact on the data and ultimately on the results. However, different preferences and schedules of the interview partners, as well as their geographical allocation, legitimize these inconsistencies (Oltmann, 2016). Secondly, for the interview analysis, I am not considering intonations, voice, or body language. These are not deemed important for my study and therefore not included in the transcripts. Thirdly, in a directed content analysis, such as the one at hand, there is always a risk of a researcher bias. Naturally, the researcher is more likely to find supporting data rather than data not-supporting data his/her hypothesis (Chenail, 2011). This limitation was considered throughout the whole research process to minimize the bias and produce results as objectively as possible. Finally, since this research is qualitative, the number of conducted interviews and other data collected and analyzed was limited. Hence, to make transferences of my particular findings to other cases or contexts caution is required. While this thesis follows an iterative approach of inductive and deductive data analysis, it does ultimately not aim at generalizing findings, but rather at deeply understanding the chosen cases (Ritchie & Lewis, 2003).

5 Shared challenges experienced by the start-ups

This chapter presents the key findings of my research study informed by academic literature, interviews, and documents. I find answers to my first research question (RQ 1) and identify shared experienced challenges of early-stage German social start-ups in the agricultural and food sector by applying the qualitative data to the theoretical frameworks presented in Chapter 2 (MLP and POINT framework). I aim at understanding the subjective experiences of start-ups and actors interviewed and putting them into perspective. After briefly introducing the four interviewed start-ups from the German agriculture and food sector that are positioned at different stages of the food supply chain, I structure the findings following the three levels of the MLP which guide the following subchapters. However, it remains to be acknowledged that there might not always be a clear and distinctive line between the MLP levels and the analytical apriori codes (organizational, social, technical, economic, and political).

INOVA Protein (S1) is concerned with the production of food. They develop alternative protein sources (mealworms) for animal feed and human consumption. They aim to support the protein shift and offer alternatives to meat consumption and livestock farming. *INOVA Protein* was founded as a university spin-off.

Completeorganics (S2) is located in the processing and retail part of the supply chain. They produce fermented vegetable salads and juices from completely organically sourced vegetables and sell them online and in-shelf at supermarkets and shops. *Completeorganics* is addressing the unsustainabilities of conventional farming and processing by only sourcing organic ingredients and locally and manually producing and packaging their products.

Roots Radicals (S3) deals with the sustainability challenge of food waste by offering a zero-waste cuisine to its customers. Much of the ingredients are surplus food that would otherwise go to waste. The aim is to make use of all parts of the ingredients (e.g. turn potato peels into chips) so that no additional food waste is being produced.

Alphabeet (S4) is developing a smartphone app, a digital patch planner, that enables urban citizens to grow their own food. *Alphabeet* directly addresses consumers and aims at counteracting the alienation from the food production of urban dwellers by inspiring them to become gardeners and by guiding them step by step through the seasons.

5.1 The reinforcing power structures of the regime

Comprising the structures that represent current practices and routines, including the dominant rules and technologies that provide stability and reinforcement to the prevailing socio-technical systems, the regime level consists of dimensions such as scientific knowledge, policies and regulations, markets and user preferences, technologies, cultural values, and the industry structures. The regime level can represent a barrier to change for start-ups since its structures are reasonably stable and give little opportunities to the occurrence of major changes (Geels, 2011; Twomy & Gaziulusoy, 2014). Avelino (2011; 2017) describes this capacity to reproduce stabilizing structures and institutions as a reinforcing power dynamic. How the current regime is exercising its reinforcing power in the investigated cases is outlined below.

In a nutshell, the identified barriers on the regime level are rather structural and to be predominantly located in the 'economic' and 'political' sphere. The reinforcing power tends to be enacted passively (Avelino, 2011).

Economic: Limited availability of funding and dependency on established market players as a barrier to transformation

One fundamental requirement for early-stage start-ups is access to a so-called seed funding (F1). There are primarily two pathways that the investigated cases take to acquire an initial starting capital that they need to materialize their ideas, plans, and strategies: either through public funding and grants or by finding a private investor.

It became apparent that there is a difference between agriculture start-ups and food start-ups when it comes to grants and funds issued by the government. In Germany, the availability of financial support seems to be higher in the agricultural sector (S1). Although there are grants available for the broader food sector as well, there seems to be a preference towards the agricultural start-ups (e.g. BMEL, 2020, Wochenblatt, 2017). Additionally, the amount and availability of public funding are dependent on the geographic location of the start-up (S1, S2, F1). Since the German system is based on federal states, these pursue different strategies and politics. To be specific, there is more support for agricultural activities in the predominantly rural states whereas the focus of the urban states is rather on tackling logistic issues or technologies (Wochenblatt, 2017). Whilst most German founders positively emphasize public funding, a downside of these public financial support mechanisms is that they require a lot of documentation, reporting, and bureaucratic effort that distract the start-ups from proceeding with their core business (S1). Further, some of the grants only cover a certain timespan (S1) which may compete with other interests of the start-up and further increases and pushes the pressure.

If start-ups decide to seek private investments, other barriers need to be considered. Investors giving such initial investments are often situated in the regime, and potentially pursue different long-term goals than the social start-up itself (S1, S4). Rather than maximizing the positive social and environmental impact, conventional investors tend to focus on their financial return of the investment. By investing in a start-up, the investors often also impose their own ideas and wishes. For example, not only producing and selling mealworms but also developing a franchise system by selling ready-made mealworm farms to other farmers who are interested in shifting their production (S1). This is attractive to investors since the scalability is higher, and hence the investment more profitable. Instead of linear growth, franchising allows for the exponential growth of the business. To avoid this kind of biases, start-ups need to find investors with aligned and matching goals and similar attitudes regarding their impact (S4).

Another barrier to receiving private investor funding is that they often require a so-called minimum viable product and a proof of concept (S1, S4) which is hard to obtain with no or very little money available in the first place. Before investing their resources into an idea, the investors would like to see a proof of the start-up addressing a market need. Further, they would ask for a prototype. For example, if asked to invest in the development of a smartphone app for urban gardening, the investor would like to see a beta version of the app, and how it is capable attracts users. Similarly, before investing in a production facility for mealworms, an investor would like to see a proof of a demand for products such as mealworm flour.

Further, the market entrants (start-ups) are also economically dependent on the established market and its players when it comes to the procurement of resources (S2). In particular, interview partners described the market for perishable food items, such as fruits and vegetables, as highly competitive and price-driven. While regime actors typically buy in bulk, the investigated cases are still developing their product and thus buy much less. They cannot benefit from any scale economics. Additionally, the sustainable standards (e.g. organic, local, seasonal, etc.) that the start-ups aspire to have, make their sourcing not only more expensive but also more time-intensive. It requires a lot of research and tests to ensure that the products comply with the sustainable standards (S2, S3).

Another challenge, that niche actors face when aiming at growing into the regime, is the fierce price competitiveness in the food industry, especially in Germany (S3). Although consumers show a willingness to pay a higher price for sustainably produced food products (organic, local, etc.), the start-ups cannot keep up and compete with the prices of the incumbent actors on the market (PwC, 2014).

Social: Reinforced food-culture and consumer habits limit the start-ups' innovations

The regime is also manifesting its power towards the consumers and thus builds a barrier for start-ups trying to newly enter the market. The regime players in the agriculture and food sector are seen to have a lot of control over what the consumer is eating (S3). The offered range of products and the way the products are marketed influences what consumers think about them and how likely they are to buy them. Convenience products are an example of the cultural-behavioral lock-in, having a major influence on the consumers' daily habits, on how much time they spend preparing food and eating and on how much they value the food. Well-known brands reinforce the current structures of the food system towards the consumer and society by the way they brand and advertise or design their products and prices. For some of the start-ups interviewed this is seen to be fierce competition which will be almost impossible to overcome in the short term. However, others do not understand the regime players to be competitors: rather they think of their products to be complementary or even alternative concepts addressing different kinds of consumers than the regime (S2, S3).

Political: Bureaucracy and legal restrictions as a barrier to change

Established market players such as the big corporations in food production, wholesale and retail, set up very strong guidelines for cooperation and collaborations with start-ups (S3). By having a big stake in decision-making processes and trying to influence and redefine the start-up' strategies, these incumbent actors exercise a form of reinforcing power. Often, collaborations seem to not be played out in equal terms. While the start-ups often have to adjust their concepts, the regime players can impose their plans (S3). On one side, they offer support to start-ups, for example by giving access to their customer base (S4), but on the other side, they tend to reduce the start-up's innovative power by interfering too strictly (S3). At times, this process of adjusting to the market requirements may diminish the chance of the start-up being truly transformative. Thinking differently than and collaborating with an incumbent market actor, poses a significant barrier (S3). Although the majority of start-ups are in favor of collaborations, my research discovered that there seems to be a certain 'fear' of losing their innovative potential when partnering with more powerful actors.

Another entry barrier, that the interviewed cases reported is the fact that start-ups often only gain public recognition and acceptance or can undergo certain steps once they are legally incorporated (S1, S3). A legal incorporation seems to function as a flag, signaling that the founders truly believe in their idea. This, however, requires a certain amount of capital (12,500- 25,000€) which is not necessarily available to any founder. It translates into some kind of chicken-and-egg dilemma: Without a legal

incorporation, there is much less acceptance of the niche player, but at the same time the start-up has not had the chance to generate revenues to pay for the incorporation.

Besides, there are legal barriers in the form of official requirements and statutes. Although it entails some bureaucratic processes, it is relatively easy to get a license to work with, produce, and sell food (S2). However, especially to start-ups that are new to the rather restrictive German market, these processes can seem rather complex and obscure. No clear guidelines are available which can lead to a lot of confusion, making the start-ups doubtful and losing their sense of empowerment (S3). When it comes to legal requirements for innovative products that are new to the German market (S1), the legal barriers are even higher. Compared to other European markets, the German legislation is slow in admitting new products. Currently, there are limited regulations in place (e.g. for organic production of mealworms) and new ones need to be established. This is a highly bureaucratic process, with many iterations. Further, it often requires some sort of lobby or consortium that requests such new regulations. One single start-up with an innovative idea is often not deemed relevant enough and thus subordinate to the incumbent structures (S1).

A barrier identified especially for foreign founders who aim at establishing a start-up on the German market is the language (S3). Even though Berlin is considered as an international hub and a European capital for start-ups, the majority of documents needed for legal incorporation, tax declaration, etc. are in German.

5.2 Innovative power in the niche

Creating space for experimentation and radical innovation, the niche level is more loosely structured than the others. As a “breeding space” (Kemp et al., 1998, p.185) for innovations, it allows for the emergence of new interactions between actors (Geels & Schot, 2007). According to Avelino (2017), creating new resources that reduce the level of dependency on existing resources and thus on prevailing structures, is an act of innovative power. Hence, innovative power is described as the capacity of actors to either invent or create and materialize new resources (Avelino, 2011; Avelino 2017). These resources can not only be monetary but also particularly human, mental, or ideational (Avelino, 2017). Innovative power is what makes a new idea original and visible to plural actors (Avelino 2011).

In a nutshell, the findings demonstrate that, opposed to the forces on the regime level, the drivers for the innovative power in the niche are rather individual, with a focus on the ‘social’ sphere. The power tends to be enacted more actively (Avelino, 2011).

Organizational: Innovative power from diversity within the team

Firstly, the innovative power in the niches seems to be linked to the transdisciplinarity of the start-ups' (founding) team. Coming from diverse academic and professional backgrounds with mixed expertise, the founders can make use of empowering synergies and their complementary networks that open up and enrich their opportunities (S1, S2, S4). Similarly, innovation can be driven by previous entrepreneurial experiences that help to understand certain market mechanisms of the regime (S4). Additionally, the willingness of the start-ups to make everything themselves and from scratch rather than relying too much on others and sourcing out is an indicator of their innovative power (S2).

Social: Innovative start-ups are driven by the founders' motivation to create a positive impact

Secondly, the founders' personal motivation to do something that is in line with their very own values strengthens their venture (S3). In the investigated cases, the founders and their deep beliefs can be understood as the backbone of a social start-up, in a sense. Thus, the innovative power identified here is driven by a vision of being able to contribute to and triggering a transformation towards sustainability in the food system. Rather than from seeing an economic or financial benefit, the innovation arises from personal interests in their topics (e.g. reducing food waste, offering alternative proteins, or empowering urban citizens to grow their own food) (S1, S3, S4). Another aspect that seems to play into their motivation and thus drives the innovative power is an intergenerational idea. Whilst the start-ups' products are new and innovative, the underlying ideas are often inspired by past generations. It seems to be a combination of 'going back to the roots' (being self-sufficient) and creating long-lasting value for the generations to come (saving resources). In particular, this holds true for the start-ups that are engaged in relocalizing food production and minimizing food waste (S2, S3, S4). Additionally, the founders of the investigated start-ups reported, that they want to take on responsibility for the lives of future generations by being a pioneer for high impact innovations. Especially since the teams of early-stage start-ups are considerably small, personal motivation goes along with the companies' goals which translate to creating an impact for the society as a whole and the environment (S4).

After having identified and started to implement their ideas, the start-ups do further experience and simultaneously enact innovative power by creating a certain niche dynamic, a wind of change that may open up "window[s] of opportunity" (Geels, 2002, p.1262).

Economic: Fair and sustainable principles guide innovations

Thirdly, the innovative power is also reflected in the way in which the start-ups are built and structured as a company. Their main goal is to follow principles of fairness, which includes not only the product that is being developed, but also how resources are procured, partners are treated, and employees paid (S4).

5.3 The wider settings on the landscape level

As the overall setting that encompasses the dynamics of deep cultural patterns, macro-economics and macro-political developments that make up the exogenous environment or context of socio-technical transitions, the landscape level is the place where overarching structural trends and changes occur. The landscape lays the basis for the regime and niche levels, stimulating socio-technical transitions - (Geels, 2011).

Ultimately, the challenges identified for the meso and micro levels (regime and niche) are positioned in the wider landscape setting which is stabilizing the unsustainable structures of the regime and reinforces the lock-ins of our food system. On the one hand, the techno-economic lock-in (productivity trap) continuously driving productivity and thus the overexploitation of ecological resources. On the other hand, the cultural lock-in primarily manifested in dietary habits that are deeply entwined with personal identities, our cultural and social ties (Schneidewind, 2019).

My findings from the cases I investigated, support that what is apparent for the wider agriculture and food industry also holds for the experiences of early-stage start-ups in Germany. In particular, the rather conservative, cultural, and culinary patterns of consumers present a barrier to innovative start-ups (S1). However, from the cases, I have learned that there are also early signals of these patterns slowly changing and opening up towards more sustainable cultural identities, especially within the younger generation (S1, S3, S4). Such signals are for example an increasing acceptance of meat alternatives and plant-based diets or the increasing interest in local food production.

A more recent factor that also plays into the landscape level in the form of an exogenically introduced economic crisis, is the global spread of the coronavirus since the end of 2019. In the context of my research, it can be seen as a sudden and negative shock, a game-changer, interfering in the dynamics of the overall system with long-lasting and still unforeseeable effects (Avelino et al., 2019).

Although the basic food supply is guaranteed, the corona crisis has shown how vulnerable production processes in the food system are. For example, agricultural land cannot be tilled or harvested sufficiently, due to a lack of workforce. Partial lockdowns and other disruptions in the supply chain and

on the demand side lead to a sudden undersupply of specific goods that cannot be met (Fischedick & Schneidewind, 2020). The cases I examined, experienced this shock as especially economically threatening (S1, S3, S4, F1). Some reported an immediate and strong decline in revenues or stagnating production processes. Others face financial insecurities and are doubtful about future funding and sponsoring since the overall economy is facing a regression (f3, 2020a; f3 2020b). Additionally, processes in research and development have been slowing down (S1).

The qualitative data analysis reveals that a shock, such as the corona crisis, can be seen as a “window of opportunity” (Geels, 2002, p.1262) for existing but not yet fully supported innovations and ultimately a sustainable transition making the current system more resilient to external shocks (S1, S3, S4, F1). Facing the corona crisis, many businesses (including the interviewed start-ups) have been forced to rethink and adapt their strategies to the new circumstances. Starkly declining revenues have a significant impact on their liquidity, they have to learn to establish new patterns or make use of alternative options. However, this financial threat can also be seen as a positive game-changer. The shock of the corona crisis has the potential to change one’s perspectives and shed light on new ideas and thoughts (Avelino et al., 2019; Fischedick & Schneidewind, 2020). Here, start-ups are seen to have an advantage as they are more flexible than incumbent corporations. If these new ideas are directed sustainably, the corona measures can guide further future innovations and developments. In a broader sense, this is not only relevant for the food and agriculture sector but potentially for the whole economy. There are “hopes that humanity could emerge from this horror into a healthier, cleaner world” (Watts, 2020).

6 Identified best practice strategies: Evoking transformative power in the niche-regime through SNM

In this chapter, I present answers to my second research question (RQ 2). I identify existing best practice strategies to overcome the challenges introduced in Chapter 5. Hereby, I draw on the POINT framework and SNM. In particular, the emphasis is on combining the reinforcing power of the regime with the niches' innovative power. This can bring about synergies and trigger an overarching transformative power in the niche-regime that potentially goes along with a sustainable change in the German agriculture and food industry.

The niche-regime is the transformative space between the regime and the niche level. It is where new structures are developed and institutions, such as legal structures, physical infrastructure, or economic paradigms are significantly challenged and altered (Avelino, 2017). According to Avelino (2011), the transformative power in this space is the “capacity of actors to invent and develop new structures and institutions” (p.72) which is “changing how resources are distributed and valued” (p.72). Transformative power can be brought about and enforced by the innovative power coming from the niche and the reinforcing power coming from the regime. It needs both types of forces in combination, coming together to “enable the development of new institutions” (Avelino, 2011, p.74) and “facilitate the further development of this new institution” (Avelino, 2011, p.74).

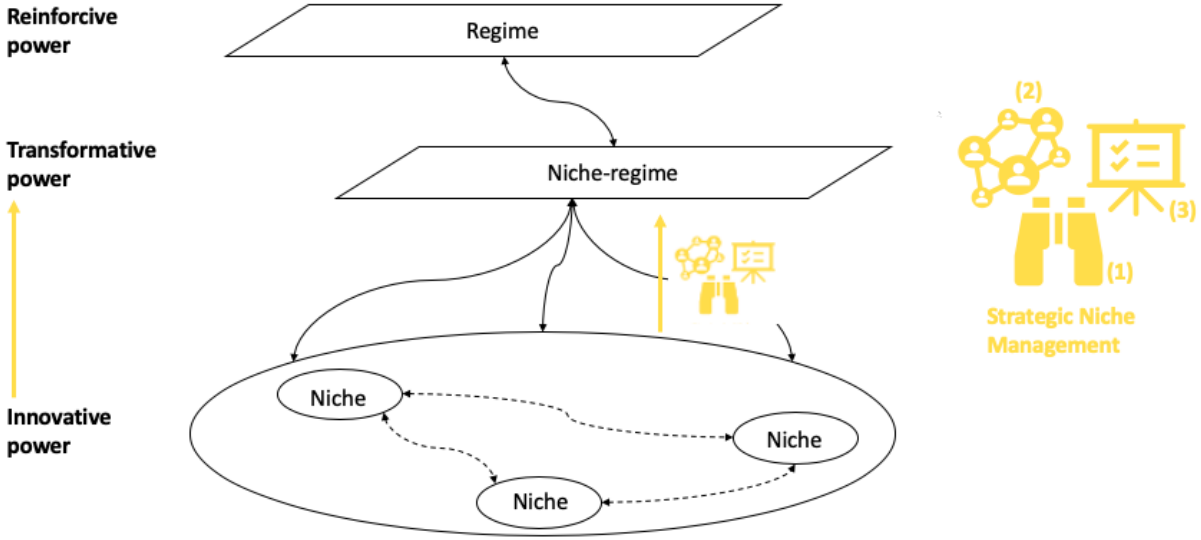


Figure 6: Strategic Niche Management in the Power in transition (POINT) framework. Arrows indicate shifting power dynamics. Focus on the transformative space of the niche-regime. (Own illustration, adapted from Avelino, 2017).

To bring these two forms of power together and to create transformative synergies, SNM can be a guiding approach. Figure 6 illustrates where SNM comes into play, connecting the niches' innovative

power with the regime's reinforcing power structures. To be concrete, the niche processes of SNM, (1) articulating expectations and visions, (2) building social networks, and (3) consolidating cognitive rules, are of particular relevance when aiming at triggering transformative processes (Avelino, 2017; Schot & Geels, 2008). In these internal niche processes, it is especially crucial to facilitate second-order learning by enabling reflection on facts (Geels et al., 2008; Hoogma et al., 2002; Kemp et al., 1998).

6.1 Articulating expectations and visions

Firstly, SNM builds upon the formulation of expectations and visions to be protected and supported in the process of growing into the regime (Hoogma et al., 2002). In this thesis, this relates to shared ideas about how a sustainable food system can look like in the future and how this change can be driven by entrepreneurial actors.

The qualitative data analysis I conducted, identified that start-ups who share their bigger picture and vision of a more sustainable and just future with other niche players, tend to have more transformative power (F1). For example, those start-ups who have been in contact and exchange with other sustainably-minded founders or collaborate with them, have a deeper belief in what they want to achieve. Their innovations are further empowered if the visions are embedded in a wider social network.

6.2 Building social networks

Secondly, social networks are deemed crucial in SNM to help the niche actors to grow towards the regime (Hoogma et al., 2002). For my study, this translates into an urgent need for social start-ups in the German agriculture and food sector to cooperate and collaborate with various other actors in the industry and across other sectors. An overarching sustainability transformation can only be achieved, when the powerful forces of various actors from civil society, politics, research, and businesses are joint and collectively working towards their goal (Schneidewind, 2019; Wittmayer, Avelino, van Steenberg & Lorbach, 2017).

My research indicates that those start-ups which collaborate with relevant stakeholders progress faster and stronger (F1). Being linked to other actors across the market enables them to make use of some of their resources and take advantage of their expertise. These stakeholders can either be from the niche or the regime. It builds upon the idea of start-up ecosystems that are meant to create partnerships and enabling environments for entrepreneurial action (Avelino et al., 2019). Rather than on competition, the focus is on cooperation, joining forces, and community building (S2, S3). For some

start-ups it can translate to working with a sponsor (F1), for others it can be cooperation with an established industry partner who lowers barriers to attain a wider range of customers (S2, S3). Another way to successfully build social networks, that was identified, is close collaboration with research institutes and universities (S1, S4). This can, for instance, be in the form of a spin-off (S1) or by hiring student assistants (S4). The start-ups' innovative ideas are supported by an incumbent regime actor with its resources (e.g. research labs, IT systems) and experiences and through the facilitation of more in-depth research. Further, the relation that the start-ups have to political decision-makers has been proven relevant in SNM. Having a strong bond with local politicians, for instance, has been reported to be beneficial (S1). The more diverse the social networks are, the better is the interlinkage of innovative and reinforcing power structures that are both needed to lower barriers and gain transformative power for regime establishment. However, it remains crucial that social networks do not create too strong dependencies. Neither mutual nor one-sided dependencies are facilitating transformative power (Avelino, 2011).

6.3 Consolidating cognitive rules

Finally, SNM is about so-called second-order learning processes. Niche actors should create and ultimately apply new knowledge through reflections and adjustments for instance in the area of technologies, market preferences, or political factors (Hoogma et al., 2002). In the context of this thesis, second-order learning processes are trials and tests that the start-ups conduct to develop and improve their innovation and make it transformative.

My research has shown that one of the most important learnings the start-ups have to make in their early stages, is the concrete problem definition that describes the underlying social or environmental problem they would like to tackle and thus build the basis for the product development (F1, S4). Developing a product (or service) that on one hand contributes to a more sustainable food system whilst also creating a big enough customer base, is a challenge. Further, start-ups need to understand that social ventures whose goal is to maximize their impact do also need a business plan. They have to learn to see their start-up through a profit and loss lens (F1). Another learning, that I identified in my analysis is the importance of the start-ups' geographical location (S1). Depending on where they are located, they have access to a different set of resources and networks and are subject to different legislation.

All in all, the three processes of SNM can be deemed to be a suitable approach that pushes the niches' innovative forces and thus evokes the transformative power of the niche-regime.

7 Practical implications for empowerment: Turning challenges into concrete transformative opportunities

This chapter sets out to complement the empirical findings and identified best practices with practical recommendations that I derived. The guidelines that are presented below aim at supporting agriculture and food start-ups to grow from the niche into the niche-regime by making use of their own innovative power and building synergies with the reinforcing power forces of the regime. This is seen to be the way forwards to sustainably transform the food system.

While the transformative processes in the food system may primarily be triggered by the innovative niche actors, the incumbent regime, too, needs to acknowledge that the food system needs to change if planetary boundaries shall no longer be transgressed. Chapter 6 has found SNM to be a suitable approach for bringing about transformative power from the niches. Based on my findings, it remains to be discussed how this process can be better supported and facilitated by the reinforcing regime structures. Can the three pillars of the concept of SNM also be considered for the regime level and can they be translated into Strategic Regime Management? Since the development of transformative power has been described as a two-sided process, this thesis has shown that (1) articulating expectations and visions, (2) building social networks, and (3) consolidating cognitive rules should be of similar importance on the regime level. The developed guidelines are presented in Table 3 below. It is indicated if the recommendation is relevant for and directed towards the niche level (N) and/or regime actors (R).

Table 3: Guidelines for bringing about transformative power in the niche-regime. (Own illustration).

No.	Recommendation	Relevant for	
		N	R
1	Be proactive	X	X
2	Communicate barriers clearly and transparently	X	
3	Offer (R) and make use of (N) physical and mental spaces	X	X
4	Encourage diversity	X	X
5	Learning by doing	X	

Firstly, transformative power and a shift towards a more sustainable food system can be triggered if niche and regime actors enact their power more actively. Rather than passively inventing new

resources, the niche should actively materialize and create these. For the regime, active exercise of power translates to using the existing structures rather than only reproducing them. If actors on both levels enact their power more actively, new transformative structures will evolve (Avelino, 2011). Secondly, it is crucial to make and communicate the faced challenges and barriers more clearly and transparently. To form an effective transformative agency, negotiate and be heard, the voices of the innovative start-ups need to be accumulated, for example in form of networks that can address the regime actor more powerfully than one start-up alone. Thirdly, spaces for physical and mental multi-stakeholder engagement are needed. These could be offered by and established by regime players who have the necessary resources. Examples for such transformative spaces that allow for experimentation and give support are start-up accelerators and so-called urban living labs. Further, start-ups on the niche level and incumbent actors of the regime should promote diversity. Since a heterogeneous set of actors and the combination and integration of various expertise is beneficial, diversity is crucial for transformation (Hoogma & Schot, 2001). Ultimately, learning by doing is a credo extremely relevant for start-ups on the niche-level. Only through trial and error, they can aggregate new knowledge and test practices.

In combination with the best practices identified from the case studies which can be summed up as cooperating, building synergies and staying independent, these guidelines are meant to empower the early-stage start-ups in the niche of the German agriculture and food industry. However, having identified and presented these guidelines, it remains to acknowledge that there are also critical perspectives on empowerment (Avelino, 2017). Empowerment can by no means be understood as a linear process of giving power to someone else. Power is rather a self-developing capacity that can only be enabled and supported. Besides, the attempt to empower others may have a paradoxical effect and can ultimately even disempower them, for instance by building up new dependencies. Further, the general criticisms of sustainability transition literature may also hold true here. The recommended guidelines do provide a rather simplified view of the power dynamics in sustainability transitions in the German agriculture and food sector. These limiting factors need to be kept in mind when designing empowering strategies for other cases based on them (Avelino et al. 2019).

8 Conclusion

This thesis aimed to identify how the chosen cases of German early-stage agriculture and food start-ups are tackling the manifold sustainability challenges of today's food system. More specifically, I firstly unpacked common challenges and barriers and secondly synthesized best practice strategies to overcome these. All in all, when aiming at growing into the existing unsustainable market, the main barrier that the start-ups are facing is the reinforcing power of the regime, mainly economically in terms of financial resources, and politically in form of legal restrictions and requirements. To overcome the barriers, the interviewed start-ups are boosting their own innovative power and personal motivation and combine this with the reinforcing power of the regime actors by collaborating with them and building synergies. This combination of innovative and reinforcing power is triggering transformative changes. Ultimately, I developed further recommendations for niche and regime players that should guide them in contributing to a sustainable transformation of the food system. The main recommendations are being proactive, communicating barriers clearly and transparently, offering and making use of physical and mental spaces, encouraging diversity and learning by doing

By answering the research questions, this thesis contributes to the field of sustainability science and sustainability practice. It guides towards a sustainability transition overcoming the lock-ins of the food system. The applied heuristic frameworks have been proven to be relevant and valuable for examining this thesis' topic and answering my research questions. They emphasize what remains to be done to trigger the necessary changes in the food industry. While the MLP and SNM are quite popular and often applied in sustainability science, the POINT framework has not yet gained as much attention. It has been shown that it complements the MLP and SNM, by not only identifying barriers but also guiding the process of developing empowering strategies that make transformations happen. However, an angle on how the regime actors can make use of their reinforcing power to steer transformations is missing. This could be further investigated in future research.

Future research could aim at making this thesis' findings generalizable by applying the research questions to a bigger amount of cases and conducting a quantitative analysis. This will allow for making inferences to other niche actors in the agriculture and food industry and eventually across other sectors as well. Another theme that will be relevant for future research is the corona crisis. It has been experienced as economically threatening, but this thesis has also shown how it can be seen as a game-changer or window of opportunity for sustainability transitions. It remains to be investigated in how far this crisis has the potential to further open up the barriers for niche innovations. The crisis calls for economic restructuring - but how can the economic structures be reshaped in ways that support

innovative niches and support them in sustainably transforming the (food) system? That is worth investigating!

I would like to end this thesis on a positive note, acknowledging how much innovative power social start-ups in the German agriculture and food industry have already enacted. They have shown that there is a much bigger, to some degree still untapped, potential for a transformed food system. If innovative niches continue collaborating with the regime, and vice versa, they will, hand in hand, empower each other and free the transformative spirit that lays in-between them.

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Appendix

Detailed description of documents

Title	Type	Reference	Relevance for study
Warum es Innovationen gerade in Krisenzeiten braucht	Online news article	f3 (2020a)	Gives context, supplements data, verifies findings
Marktbereinigung und „Post-Corona“-Chancen	Online news article	f3 (2020b)	Gives context, supplements data
Deutschland: (K)ein Gründerland?	Online news article	f3 (2020c)	Verifies findings
Warum es IoT-Pioniere in die Landwirtschaft zieht	Online news article	Gründerszene (2019)	Gives context, verifies findings
Bauernverband befürwortet stärkere Start-Up-Förderung	Online news article	Top Agrar Online (2018)	Gives context, verifies findings
Niedersachsen fördert gezielt Agrar-Startups	Online news article	Wochenblatt (2017)	Supplements data
Bekanntmachung zur Förderung der Künstlichen Intelligenz (KI) in der Landwirtschaft, der Lebensmittelkette, der gesundheitlichen Ernährung und den Ländlichen Räumen im Rahmen von Forschungsvorhaben	Press release	BMEL (2020)	Supplements data
Unternehmergeist-Wecker - Ideen und Anleitungen für kleinere und größere Unternehmergeist-Maßnahmen	Public document	BMWi (2017)	Gives context, verifies findings
In der Landwirtschaft müssen viele Prozesse regelmäßig in Frage gestellt werden, um eine optimale Lösung für Produzenten, Verbraucher und Umwelt zu finden	Public document	BMWi (2018)	Supplements data
Im Aufwind: Agrar- und Food-Start-ups	Public document	BMWi (2019)	Gives context, supplements data
Food & FoodTech Plattform	Public document	Deutsche Start-ups e.V. (2020)	Verifies findings

Landeswettbewerb ‚Innovationen und Start-ups in der Land- und Ernährungswirtschaft‘ gestartet	Public document	MLR Baden-Württemberg (2018)	Supplements data
BVE-Jahresbericht 2019	Report	BVE (2019)	Gives context, supplements data
Ernährungsindustrie.2019.	Report	BVE (2020)	Gives context, supplements data
DBV-Situationsbericht 2019	Report	DBV (2019)	Gives context, supplements data
Megatrends in der Deutschen Agrar- und Ernährungsindustrie	Report	PwC (2014)	Gives context, supplements data
Lebensmittelindustrie in Deutschland	Report	Statista (2020)	Gives context, supplements data
SDG 12 Forecast	Report	Valuer (2020)	Gives context, supplements data
Alphabeet	Website	Alphabeet (2020)	Gives context, supplements data
Social Start-ups	Website	BMWi (2020a)	Gives context
Gründerwoche Deutschland	Website	BMWi (2020b)	Gives context, supplements data
Completeorganics	Website	Completeorganics (2020)	Gives context, supplements data
INOVA Protein	Website	INOVA Protein (2020)	Gives context, supplements data
Roots Radicals	Website	Roots Radicals (2020)	Gives context, supplements data