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Transforming the German Food System – How to make Start-ups great!

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Abstract: The food system represents a key industry for Europe and particularly Germany. However, it is also the single most significant contributor to climate and environmental change. A food system transformation is necessary to overcome the system's major and constantly increasing challenges in the upcoming decades. One possible facilitator for this transformation are radical and disruptive innovations that start-ups develop. There are many challenges for start-ups in general and food start-ups in particular. Various support opportunities and resources are crucial to ensure the success of food start-ups. One aim of this study is to identify how the success of start-ups in the food system can be supported and further strengthened by players in the innovation ecosystem in Germany. There is still room for improvement and collaboration toward a thriving innovation ecosystem. A successful innovation ecosystem is characterised by a well-organised, collaborative, and supportive environment with a vivid exchange between the members in the ecosystem. The interviewees confirmed this, and although the different actors are already cooperating, there is still room for improvement. The most common recommendation for improving cooperation is learning from other countries and bringing the best to Germany.

Keywords: start-up; innovation ecosystem; food system; transformation; Germany; food science; entrepreneurship; food technology; sustainable development goals; learning from other countries

1. Introduction

The food system faces significant challenges, from meeting the growing demand for food to reducing its environmental impact (1,2). Furthermore, these challenges will continue to rise, and the food system requires a transformation (3–8).

While many factors can positively impact the food system (9), this paper focuses on innovation as a possible facilitator to transform the food system. In this context, start-up companies are a “crucial driver for innovation, economic development and renewal” (10) as today's start-ups are tomorrow's mid-sized sector (11). Additionally, start-ups are often responsible for disruptive innovations. While there are many non-industry specific studies and country comparisons concerning start-ups, the current research concerning agriculture and food start-ups is still limited (12). Nonetheless, start-ups in the food sector experienced some momentum and major investments in the last few years (13).

This paper deals with innovation from the perspective of start-ups in Germany which can change or transform the current food system. It aims to identify how the success of start-ups in the food system can be supported and increased by current stakeholders in the innovation ecosystem in Germany. Therefore, the question is broken down into four aspects of (1) challenges of food start-ups with transformative innovations, (2) resources available to support the success of food start-ups, (3) identify current players in the innovation ecosystem and what they are doing to drive start-up success, and (4) what

measures need to be expanded or established to improve the innovation ecosystem for food start-ups in Germany. The result of this work is consequently an overview of challenges, actors, and resources as well as practical recommendations for improving the current innovation ecosystem and thus the potential success of start-ups in the food system.

2. Overview about current challenges

The current food system is not sustainable and the way food is produced, bought, and consumed needs to be changed in the future (14). Thus, the system is in need of a transformation (3–8). In the past, the food system evolved to meet the growing demand for food worldwide (1). However, this development was accompanied by severe and persistent problems. The system faces diverse sets of serious and interrelated challenges (see Table 1).

Table 1. Challenges of food systems.

Category	Challenge	Evidence
Natural resources	Greenhouse Gas Emissions	Food system is responsible for 21-37 % of total greenhouse gas emissions worldwide (15)
	Biodiversity loss	16.5 % of vertebrates and pollinators threatened with extinction (16)
	Water scarcity and pollution	Agriculture's share of water usage accounts for 70 % of global freshwater and is a major contributor to water pollution (15)
	Food loss and food waste	1.3 B tons yearly (17)
Demographics & Health	Population growth	Expected growth till 2050 to 9.7 B people from 7.8 B people in 2021 (18)
	Undernourishment	8.9 % of the world population are undernourished, i.e. 688 M in 2019 (15)
	Adult obesity	Over 13.1 % in 2016 (15)
	Childhood overweight and obesity	5.6% or 38.3 M children under five were overweight in 2019 (15)

The food sector is highly dependent on natural resources (19). It is the largest sector emitting greenhouse gases, has the largest influence on biodiversity loss, and is a massive consumer and polluter of freshwater (6). Additionally, 1.3 billion tons of food are wasted each year (17). Furthermore, there is an unfair distribution of food as, on the one hand, 8.9 % of the world population, amounting to 688 million people, are undernourished and, on the other hand, over 13.1 % adults and 5.6% or 38.3 million children under five are overweight (15).

These challenges are amplified by trends like demographic changes, e.g., a growing world population, climate change, urbanisation and consumerism (20) Thus, a growing population is not the main driver of demand but a combination of factors, including increasing per capita incomes, changing dietary preferences or cash-cropping (3). Finding reasonable solutions to these challenges is critical to achieving the targets of the Paris Climate Agreement and the United Nation's Sustainable Development goals (1). There is a need for sufficient, safe, healthy, and affordable food. Furthermore, this food has to be produced in ways that do not exceed the natural resources (21). It is essential to transform the food system to create a sustainable food system that ensures nutritious, safe, affordable, and sustainable food for everyone (22).

Incremental changes are not enough to transform the food system (3). Thus, this paper focuses on innovations that can potentially transform the food system or significantly improve the food system in one of the four areas of transformation, so-called

transformative innovations (23). It thereby concentrates on transformational innovations in contrast to other innovations in the food system, e.g., new flavour combinations.

3. Research method and Data sources

Expert interviews were used to determine how the German food innovation environment for transformative innovations, especially food start-ups, is structured and can be improved (24). The study was structured as follows, which is also corresponding to the chronological sequence:

The research field was specified based on the previous literature research and the research question. A qualitative research approach was chosen as an appropriate means to answer the research question of how food start-ups are possibly different from other start-ups, how far they need a specific support environment, and how the innovation ecosystem for transformative food innovations in Germany can be improved.

Qualitative data was collected using a semi-structured interview approach. For this, (1) an interview guide was created, (2) relevant experts were defined and contacted, and (3) interviews were conducted, recorded, and transcribed.

The written interviews were then analysed in a summarising content analysis with inductive category development using Mayring’s qualitative content analysis (25) with the of the tool MAXQDA.

The analysed and categorised interviews were then presented and structured along with the research questions. Lastly, a connection between the theoretical part and the analysed empirical research was made to answer the research questions and propose recommendations.

To gain the best answers for the research questions, three types of experts were identified, (1) start-ups, (2) ecosystem network actors and (3) food system experts. The reasons why these three groups were chosen and the criteria for the selection of the experts are explained in the following. An overview of the specific profiles and information of the experts is provided in the following Table 3.

Since the focus of this study is on start-ups, most of the interviews were conducted with experts from this group. The identification (ID) is especially relevant for further analysis since all interviewees will be referred to with their anonymised ID.

The interview guide set up five topic blocks to get general compatibility. These topic blocks are (1) background information on the person and company, (2) transformative innovation, (3) challenges for start-ups, (4) support environment, (5) blind spots and lacks in the support environment. Start-ups were not asked about the third topic, transformative innovation, since they are assumed to be biased about their specific technology being transformative. Each topic block then had top questions as a starting point and sub-questions if the interview partner did not answer the questions holistically.

The interviews were then conducted with individuals and, in one case, with a pair, with the face-to-face interview being preferred. However, video interviews were also realised due to the still ongoing Covid-19 pandemic and the respective distance of the interview partners. An overview of the formalities of the interviews is summarised in the following Table 6.

Table 2. Overview of the interview experts and their selection criteria (own Table).

Category	Explanation	Selection Criteria
Start-ups	Personally involved Personal experience First-hand insights into challenges and support received	Location: Germany
		Start-ups in the beginning stage (< 3 years)
		Possibly a transformative innovation
		Range of start-ups covering the whole food value chain

		Founding member or involved since the beginning
Ecosystem Network Actors	Actively shaping the start-up environment	Working at a relevant ecosystem actor
	Deal with a wide variety of (food) start-ups	Ideally covering different areas in Germany
	Knowledge about challenges and criteria for start-up success or failure	>2 years of experience working with (food) start-ups
Food System Experts	Insights into specialities when dealing with food	Deal with innovation in the food system
	Broad overview of the general development in the industry	>5 years of experience in the German food system
	Up to date about latest innovations and trends	

The interviews were conducted in the period from 07.07.2021 to 09.08.2021. All interviewees agreed to record the interview to facilitate further analysis.

After the interview, all recordings were transcribed based on the content semantic transcription created by Dresing and Pehl (26). Before further analysis, the transcripts of the interviews were anonymised by replacing identifiable information with information that include the meaning and the relationship to the subject of investigation, marked by square brackets (27). The type and extent of anonymisation are adapted to the research objective of analysing the innovation ecosystem in Germany with its relevant actors, i.e., relevant actors and their location must still be identifiable (27).

Table 3. Overview of the profiles of the interview partner.

Category	Organisation	Gender	Position	Founding Year/ Time in Company/ Work with Start-ups	ID
Start-ups	Microplastic	Male	Founder	2019	ST1
	Fish	Male	Founder	2020	ST2
	Fruits	Female	Founder	Not yet incorporated, started in 2019	ST3.1
		Male	Founder		ST3.2
	Beer	Male	Founder	2019	ST4
	Ingredients	Female	Founder	2019	ST5
Food system	Plant-based dairy	Male	First Hire	2019 (founding June, joined in October)	ST6
	State initiative food	Male	Management	10 years	FS1
	Research Institute	Female	Management	12 years	FS2
	Research Institute	Male	Management	10 years	FS3
	Research Institute	Male	Director	15 years	FS4
Network partner	Food entrepreneur and start-up association	Male	Founder	Foundation of association in 2018, worked with start-ups before that	NET1
	Accelerator agriculture, food, digitalisation	Male	Project Manager	2 years	NET2

Research Institute	Female	Project Manager	Worked with start-ups for 6 years	NET3
Food Start-up Incubator	Female	Project Manager	Worked with start-ups for 3 years	NET4

Qualitative Content Analysis

The anonymised interview data was then analysed using the qualitative content analysis by Mayring (28). A summarising technique with an inductive category formulation approach is applied to interpret the results and material generated in the conducted expert interviews. Summarising the content means that the content is brought down to such an extent that only the most important aspects and essential components are retained (25). The approach follows the structure proposed by Mayring (28) and was executed using the analytical tool MAXQDA.

Table 4. Overview of the interview formalities.

Category	ID	Format	Language	Date	Duration (hr:min:sec)
Start-ups	ST1	Face-to-Face	English	07.07.2021	33:49
	ST2	Video Call	German	16.07.2021	37:23
	ST3.1/ST3.2	Face-to-Face	English	09.07.2021	30:33
	ST4	Video Call	German	26.07.2021	21:13
	ST5	Video Call	German	27.07.2021	39:39
	ST6	Video Call	German	28.07.2021	34:41
Food system	FS1	Face-to-Face	German	15.07.2021	43:21
	FS2	Face-to-Face	German	16.07.2021	27:28
	FS3	Face-to-Face	German	03.08.2021	41:19
	FS4	Face-to-Face	German	09.08.2021	55:41
Network partner	NET1	Video Call	German	13.07.2021	1:07:32
	NET2	Video Call	German	15.07.2021	27:49
	NET3	Video Call	German	03.08.2021	52:41
	NET4	Video Call	German	09.08.2021	35:01

4. Results

4.1. General state of the system

At the beginning of the interview, the food system and network experts were asked about the general state of the system and their assessment of it. They explained that the food system is complex (FS3, FS4, NET1) and that the value chain is continuously growing closer together as agriculture and food are going hand in hand (NET1). The experts agree that the food system needs a transformation because the current way of doing business is not able to satisfy future needs, for instance, nourishing a growing population or meeting the United Nations sustainable development goals (FS1, FS2, FS3, FS4, NET1, NET2, NET3, NET4). A systemic change is thus not only needed but also seen as inevitable (FS3, NET1, NET4). In terms of numbers, farmers and especially consumers are also the most significant drivers for a transformation (FS1, FS2) because “in the end, it [food products] need to be bought” (FS1).

Innovations are “certainly” a key factor in this transformation (FS3, NET1, NET4), and start-ups are often a driving force for creating innovations (FS4, NET1, NET2, NET3, NET4). This is due to the nature of start-ups as they are more explorative and not restricted by existing structures or maybe their image and consumer promise compared to more mature companies (NET2, NET3). Nonetheless, start-ups only represent a fraction of the food system, and innovations are also developed by the established industry (FS3). However, it is also important to note that, especially in the food industry, the level of investment in R&D is low (FS3).

Furthermore, changing the food system cannot happen from one day to another but will probably be “in many small steps” (FS2). For instance, from a simple production perspective, it would not be possible to provide only plant-based proteins to the current population if everyone would decide tomorrow that they do not want to eat animals anymore (FS3, FS4, NET1). Trends and content fields, according to the experts, include alternative proteins or less animal-based and more plant-based products (FS1, FS4, NET1, NET3, NET4), health aspects like personalised and functional foods (FS1, FS3, NET1), possibly new and more sustainable technologies (FS1, FS4, NET3), circularity (NET1, ST4), more digital approaches (FS2, NET1, NET3), a more decentralised way of producing foods (FS1) and food safety (FS3, NET4).

4.2. Challenges for Start-ups in the Food System

The challenges are structured along the five broad sub-challenges (1) external stakeholders and market, (2) consumers and customers, (3) people aspect, (4) structure and regulations and, (5) start-up and product. Each of the sub-challenges has a varying number of specific challenges, each of which falls into one of the sub-categories. An overview of the category challenges with its sub-categories and particular challenges can be seen in Table 5. The number in the right column provides an overview of how often a specific aspect was mentioned during the interviews. If an aspect was mentioned multiple times during an interview, it was also marked multiple times, indicating the importance of the aspect.

Table 5. Overview category challenges.

Challenge: Market and external stakeholders	Investors	6
	Food system	7
	Market listing	8
	Right support, network	11
	Traditional industry	11
Challenge: Consumers and customers	Market, market fit, market need	12
	Informing customers, users	7
	Consumer changes	8
Challenge: People Aspect	Customers	12
	Courage to fail, solving customer needs	2
	Personnel	5
	Being a founder, allocation of attention	6
Challenge: Structure and regulations	Knowledge exchange	10
	Structure of support system	4
	Legal requirement, contracts	4
	Protecting idea	6
	Administration	10
Challenge: Start-up and product	Food regulations	20
	Sustainability	3
	Toll manufacturers	5
	Balance marketing and product development	6
	Business model, business development	6
	Distribution, logistics, packaging	6
	Scalability of solution	12
	Product development	14
	Production	17
	Monetary aspects	32

4.2.1. Challenge: Market and external stakeholders

One aspect that was named challenging was investors (NET1, ST2). There is a power imbalance as start-ups are dependent on the investors, and investors often have more knowledge of the contracts and start-up valuation due to the sheer number of deals they are making (NET1, ST2). As a result, start-ups may be exploited and sometimes abused only to generate more capital for the investors (NET1). The food system itself can also be demanding (FS1, FS2, FS3, FS4, NET1, ST3) as it is a market with “extreme competition over “low margins” (FS2) which provides products where “the quality is right, the price is right, [and] the security is right” (FS4). Another challenge for food start-ups is getting a market listing and remaining listed (FS1, FS3, FS4, NET1, ST4).

Furthermore, start-ups explained that it could be difficult to “get a network of people that support you” (ST3) and “that you need to find the right programs” (FS1). Furthermore, the traditional industry provides some challenges as they, on the one hand, are dependent on innovations for the future of their business (NET3) and, to a certain degree, innovate themselves (FS3, FS4). On the other hand, the established players also feel threatened by new technologies, which can slow down start-ups as they prevent certain processes, try to imitate, or buy up innovative start-ups or ideas (FS1, FS4, NET3, ST1, ST2). Lastly, the biggest challenge in the sub-category market and external stakeholders is finding the right market, a market fit or a market need (FS1, FS3, FS4, NET2, NET3, ST1, ST3). This includes finding the right partners (ST1, ST3, ST6, NET3), the right investors (FS1, NET1) or the right programs (FS1, ST3).

4.2.2. Challenge: Consumers and customers

Consumers buying food are more critical than those buying cosmetics or new technologies, especially when possibly new processing techniques or ingredients are involved (FS3, NET1). They need to be informed about the benefits of processing technologies or about how new products provide benefits to their diet. For instance, start-ups working with algae need to show consumers the benefits while providing a product that is easy to prepare and not considerably different from what they know (NET1). Additionally, consumers and users need to be persuaded that they can make a difference and change something with their choices, even with a basic commodity such as food (FS1, FS2, FS3, NET4). Start-ups should understand their customers, talk to them, and, if needed, be willing to adapt their products and services accordingly (FS1, NET1, NET3, NET4, ST1, ST4, ST5).

4.2.3. Challenge: People Aspect

People need to have the courage to establish a company (FS3, ST2). Secondly, finding and attracting the right personnel for your start-up (ST2, ST6) and creating a diverse team with expert knowledge in key areas (NET1, NET3) can be challenging.. Furthermore, being a founder (ST2) and allocating your time and attention to the right aspects is a challenge by itself (FS3, FS4, NET3, ST3, ST4). This shows, for example, when start-ups would like to attract investors and pitch their ideas but do not yet have evaluated the market need and their specific target group (NET3). Lastly, knowledge divergence and the need for knowledge exchange provides a challenge (FS1, FS3, FS4, NET1, NET3, NET4, ST2, ST3). This means that often, founders have a great idea but do not know how to implement it properly. This is the case for scientists who do not know about the business side (ST2, ST3).

4.2.4. Challenge: Structure and regulations

Aspects that are challenging for all start-ups is the structure of support systems which corresponds to the federal system and includes many programs that are not self-explanatory and mainly focus on the support of start-ups in general (FS1, ST1). Furthermore, legal aspects such as which contracts have impacts (ST2) and what needs to be respected from a legal perspective for founding or investing matters (FS1, ST2) can be challenging. This can also mean that even if a product is legally admitted in the EU, producing in Germany is not admitted while selling is allowed (FS3).

Coming to more food-specific challenges, it is tough to protect the ideas of food start-ups. “Recipes or new ingredient cannot be protected” (FS1). Food start-ups are thus reliant on good contracts making it more difficult to steal or copy an idea (NET1). New technologies can be protected, but they may need special approvals that can be costly and time-consuming (see food regulations). Another general challenge for start-ups is the administrative effort in Germany (FS2, ST1, ST4, ST5, ST6). Lastly, almost every interview partner mentioned food regulations as a key challenge for start-ups (FS1, FS2, FS3, FS4, NET1, NET3, NET4, ST3, ST6).

4.2.5. Challenge: Start-up and product

One challenging aspect is being sustainable, finding sustainable solutions such as packaging and staying true to your goal of sustainability in every business aspect (NET4, ST3, ST4). Finding a toll manufacturer that can (1) produce your product, (2) at an appropriate amount, (3) an affordable price, and is (4) not stealing your idea in the process is also demanding (NET1, NET4, ST6). Furthermore, it is not enough to create a product. Still, you also need to balance your marketing and product development activities as both aspects are essential for the success of your later product (FS4, NET1, NET2, NET4, ST4). “Then everyone is happy that they are on sale, but they forgot about marketing.” (NET1), and nobody is buying the product or knows about the brand. Equally challenging is creating and developing the business model (ST3, ST4, ST5). This can be the fact that your start-up needs to produce the products themselves (ST3), should grow sustainably (ST4) or iterate the business model (ST5). The challenge of distributing the product and finding the appropriate logistics and packaging is identically decisive (NET1, NET4, ST4). This aspect can be found, for example, in the compliance with cold chains (NET1, NET4), finding the suitable packaging as not every packaging can be used for every product (NET4), or the storage of (rescued) products (ST4). An additional challenge, especially for food start-ups, is the scalability of a solution (FS1, FS4, NET1, NET4, ST1, ST4, ST6).

4.3. Support Offering and Actors in the German Innovation Ecosystem

As diverse as the challenges faced by start-ups are, so are the support services provided in the German innovation ecosystem. This category is divided into four sub-categories (1) support selection process, (2) support actors, (3) support structure, and (4) support offer (see **Error! Reference source not found.**).

4.3.1. Support selection process

The support selection process describes the underlying conditions necessary for choosing or excluding an available support offer. An exclusion factor was when the programs took equity, especially if the start-up still was at an early stage (ST1, ST5). The decision for or against a specific type of support is a very individual choice for the start-ups. Still, guidance can include recommendations from other start-ups or their network (ST1, ST6), the reputation of a specific program (ST1) and if the start-up stage matched the support offered (ST5). It was also essential that the program added value either in monetary support, expertise or that the program could teach something new (ST1, ST5). The most crucial selection factor, according to the mentions, was the region and the topic of the support program (ST1, ST3, ST5, ST6). While some ensured that the program's location was accessible and that it fit thematically (ST1, ST3, ST5), others applied all over the world, especially for digital offerings (ST1, ST3, ST5).

Table 6. Overview category support.

Support selection process	Giving away equity	3
	Guidelines	8
	Added value	8
	Region and topic	10
Support actors	Government	12

	Established industry	13
	Accelerator program	14
	Investors, VC, business angels	14
	Support network	15
	Incubator program	16
	Universities and research institutes	16
Support structure	Specific vs open support	4
	All actors are valuable and need to cooperate	7
	Regional vs cross-regional vs national	9
	Most/most minor important actor	15
Support offer	Creating a local innovation ecosystem	3
	Equipment, product development, production	5
	Finding the right support	5
	Criticism: Investors	6
	Access to experts, industry	9
	Monetary support	13
	Network, Collaboration, Mentoring	18
	Providing mentoring and knowledge	18

4.3.2. Support actors

The players who offer the services or support start-ups independently or in programs are diverse. All actors named during the interviews were counted to evaluate if the identified actors were relevant. As all actors serve start-ups, the innovation ecosystem actor start-ups were not counted. Both specific actors, such as Edeka, and a whole group of actors, such as corporates, were filtered. For each interview, an actor was counted only once, even if it appeared several times, to get a broad overview (see **Error! Reference source not found.**).

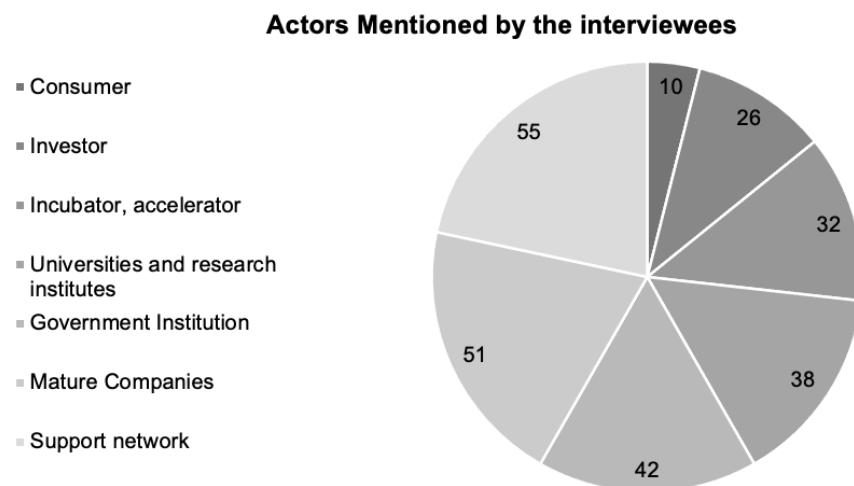


Figure 1. Actors mentioned by the interviewees.

A simple count of which actors were named in the interviews with the corresponding assignment to the main actors in the innovation ecosystem, thus, revealed that the support network played an important role and was mentioned 55 times with different supporters, such as experts or mentors from various fields, start-up centres. The group of support actors is also where the most diverse actors can be classified. However, it is also easy to see that all actors can be considered relevant, and, in addition, consumers have also been identified as significant actors in the innovation ecosystem.

Whilst **Error! Reference source not found.** shows the variety and number of different actors in the system according to the six main innovation ecosystem actor groups, and it

also makes sense to look at the specific cooperation partners in the system to see which actor was primarily used for which support. **Error! Reference source not found.** provides an overview of which partners were mentioned as cooperation partners for the different interviewees.

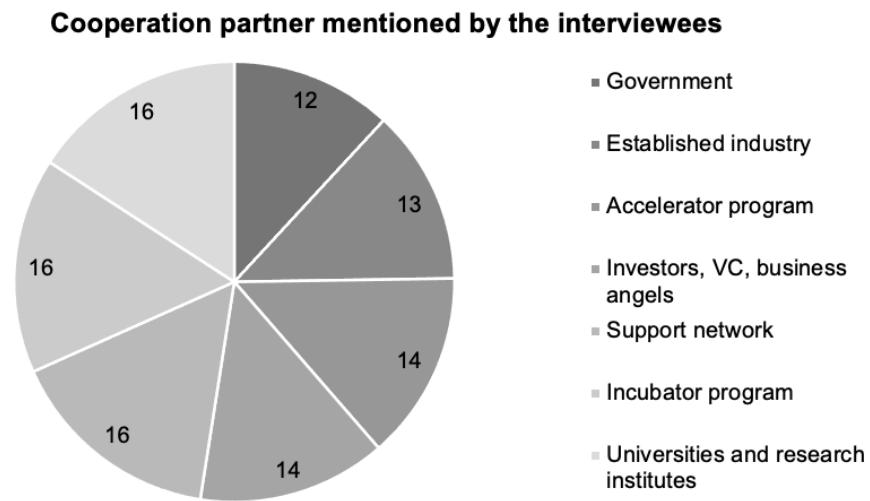


Figure 2. Cooperation partner mentioned by the interviewees.

Universities and research institutes were mentioned as a breeding ground for talents and ideas (FS4), for providing technical infrastructure and expertise (FS4, ST3, ST6), and as a partner for cooperation (NET3, NET4, ST4, ST5). Incubator programs were mentioned as some start-ups participated in incubator programs (ST3, ST5, ST6), and interview partners offered incubator programs (NET3, NET4), especially those that provide infrastructure knowledge about topics like food technology, entrepreneurship or market discovery, and basic monetary support.

The support network was specified as a valuable actor for knowledge, mentoring, and a broad support network (NET1, NET3, NET4, ST1, ST3, ST6). Another critical source, mainly for money and support and their network (ST2), is investors, VCs or business angels (FS1, FS4, NET4, ST1, ST2, ST6). Even if ST3, ST4 and ST5 are not yet cooperating and working with investors, they plan to do so in the future. Accelerator programs were also seen as an advantageous actor was, which like incubators, provided workshops, knowledge, network, and some monetary support (NET2, NET3, ST2, ST3, ST5, ST5).

Additionally, the established industry proved helpful and accommodating as a co-operation partner (NET2, NET3, NET4, ST1, ST2, ST3, ST4, ST5, ST6). In this context, the established industry is relevant for exchange (ST2, ST4), for knowledge sharing (ST1, ST5, ST5), as customers and suppliers (ST1, ST5, ST6), or even strategic partners (ST4). The established industry and mature companies provide financial support and a network (NET2, NET, NET4). Lastly, the government was mentioned (FS1, FS4, NET4, ST2, ST3, ST4, ST5, ST6), providing financial support, e.g., EXIST grants (ST5, ST6), a legal framework and interest group to set the issues on a political agenda (ST2, ST4).

4.3.3. Support structure

According to the interviewees, the most and least important actors provided a wide range of different actors. For NET2 start-ups are the most important actors, NET3 mentioned that the most important actors are also the EIT Food consortium partners due to the nature of the structure. While NET4 evaluated that the government and politics are the most important factors, FS4 argued that both are the least important of all the actors. For ST6 and ST2, investors were crucial, although they both suggested that it would have been possible without them but much more difficult. Some interviewees expressed that it is difficult to name the most important actor as all players are valuable (FS2, FS4, ST3, ST5,

ST6). “You need all the actors for different aims[s] or different help. And if one of them is missing or lacking, then you have [...] a problem” (ST3).

A distinct structure, i.e., regional and national and transnational offerings, and a mix of industry-specific and industry-open support is also vital for a diversified offering. For example, industry-open support provides help on the hard facts for start-ups, such as start-up founding or funding application processes, and industry-specific assistance is helpful for the specific issues and characteristics of an industry (NET3).

4.3.4. Support offer

The support offered by the actors covers a wide range of different aspects. With their offering, the network actors try to benefit start-ups and create and improve the local innovation ecosystem of their respective areas (NET2, NET3). Equipment and test kitchens for small scale productions are provided (NET4, ST6), and the support actors help start-ups find the proper assistance they currently need (NET1, NET2, NET3, NET4). To do this, they refer start-ups to other players who have the required support (NET3), open doors for the start-ups in their network (NET1, NET2), and help with project applications (NET4). However, the support provided by investors was also criticised by NET1, ST2 and ST4 as investors can exploit start-ups and their unawareness concerning some aspects. Thus, investors and the conditions of their contracts need to be scrutinised. Additional support provided by the actors is access to experts and industry, either by the support actors themselves or through experts in their network, coaches, and workshops (NET2, NET3, NET4, ST5, ST6). To a certain extent, monetary support is also provided during programs and by actors in the innovation ecosystem (FS1, NET2, NET3, NET4, ST2, ST4, ST5). However, while getting capital is not as easy in Germany as it may be in other countries, there is still a lot of monetary support available (FS1). Crucial support given to the start-ups is the network, fostering collaborations with and within the network and mentoring start-ups (NET1, NET2, NET3, NET4, ST1, ST3, ST4, ST5).

Generally, the interviewees agreed that the support already available in Germany is pretty good, and the possibilities to get help are numerous (FS1, FS3, FS4, NET1, NET2, NET3). This was also substantiated by the start-ups, which agreed that they received valuable support and could get into helpful programs (ST1, ST2, ST6). Beyond that, the support system is also developing and is “definitely driving in the right direction” (NET2) with their development (FS2, FS3, NET1, NET2, NET3, NET4, ST1, ST3, ST5). However, the evaluation also shows that there is still room for improvement and that, generally speaking, there are not as many food-specific support programs (ST6).

4.4. Success Factors for Start-ups and Support Actors

According to the experts, success factors provide insights into the support and resources the interviewed start-ups used or needed. Thus, success factors give valuable findings to evaluate the innovation ecosystem and find possible improvements. The success factors are categorised into (1) people aspects, (2) hard, and (3) soft success factors (see Table 7).

Table 7. Overview category success factors.

People success factors	Focus and long-term commitment	5
	Personal experience, knowledge, skills	8
	Personal interest in mission and success	8
	Willingness to learn and inform yourself	8
	Access to experts	10
	Team	12
	Network, personal and industry connections	26
Hard success factors	Cooperation and exchange	38
	Access to tools, technical infrastructure	5
	Infrastructure and location	7

	Monetary support, financing	9
	First customers	3
	Transparency and honesty	3
Soft success factors	Diverse involvement	4
	Creating awareness and traction	5
	Luck and chance	8
	Available support	14

4.4.1. People success factors

When it comes to the support provided by people, it is vital that they are interested in the long-term success of the start-up (FS3, NET3, ST5). This also means that the start-up should be thinking long-term and focusing on its efforts (ST1, ST2). Furthermore, it proved to be much more valuable if the people working with and supporting a start-up are personally involved and want the start-up to succeed because they believe in the idea and the mission behind it (NET2, ST2, ST4, ST5, ST6). Knowledge and skills of the founder, the founding team, or generally the start-up team are also crucial (ST2, ST4, ST6). For instance, personal knowledge about specific food retailing or business processes is much more valuable than getting the support third hand (ST2, ST4). Furthermore, if certain knowledge or skills are not currently present in the team, the willingness to learn, research and acquire certain skills or even personnel can be essential for the start-up's success. This also means that you have access to people and experts (NET3, ST1, ST2, ST3, ST6) to “get [...] the ground reality” (ST1) from people that know what they are talking about. Another success factor is the team itself, with its composition and working atmosphere (NET1, NET2, ST2, ST3, ST4, ST5). Like a successful IT team that needs an IT expert, a thriving food start-up probably needs a food technologist (NET1). The network, including personal and industry connections, plays a role as well (FS1, NET1, NET2, ST1, ST2, ST3, ST4, ST5, ST6). There is plenty of help available, and your network can work “like a snowball, the more you know, the more suggestions you are getting” (ST3). Lastly, all interviewees agreed that cooperation and exchange is the key success factor for start-ups (FS1, FS2, FS3, FS4, NET1, NET2, NET3, NET4, ST1, ST2, ST3, ST4, ST5, ST6).

4.4.2. Hard success factors

Food start-ups' first hard success factors are access to tools and technical infrastructure to test out ideas and develop the product (FS1, NET1, ST4, ST6). Going in the same direction, access infrastructure and the location of the start-up are also decisive factors for success (FS2, NET4, ST2, ST5). Infrastructure refers to aspects such as the availability of living and working space or fast Internet (FS2), but also access to production facilities in the immediate vicinity (NET4, ST2), or the possibility of working in coworking spaces in general (NET4, ST5). Lastly, monetary support and financing possibilities are key success factors (NET2, NET4, ST1, ST2, ST4, ST5, ST6) because without money, “you cannot execute” (ST1)“ This monetary support can be provided in the form of grants, price money, or by favouring payment terms.

4.4.3. Soft success factors

The soft success factors include getting your first customer that is using the technology which, if a product is truly disruptive, can spread like a “sure-fire success” (FS1). “Honesty and transparency, for instance, towards partners regarding when the product will be ready (ST2), between cooperation partners about what can be achieved (NET3), or towards your customers (ST4), is also a key for success. A diverse involvement, meaning getting “a lot of support from different sides and directions” (ST1), can also be a driver for success (FS3, NET4, ST1, ST6). Furthermore, creating awareness and traction for your start-up is vital for the success of your start-up (FS1, ST1, ST2, ST4). This can happen, for example, by bringing the problem you are solving to the attention of politicians (ST2, ST4), but also when using social media trends (FS4) or getting attention by winning a contest

(ST1). Another factor that cannot be influenced as easily but was also frequently mentioned is luck and chance (FS1, ST2, ST3, ST5, ST6). Often, the start-ups feel lucky that certain circumstances have led them to a great business partner or coach (ST2, ST3, ST5, ST6), and once a company is established and running, many things fall into place on their own (FS1). Lastly, the available support was also mentioned as a success factor (NET2, NET3, ST1, ST2, ST4, ST5). In particular, the EXIST scholarship was highlighted as valuable for the initial stage (ST5, ST6). The availability and participation of programs were deemed to be vital for the success (NET2, NET3, ST1, ST2), and even if the start-up did not participate in programs, they still advocated for the available support (ST2).

4.5. Improvements for the Support of Food Start-up

The possible improvements were filtered out of the interviews as answers to what may be missing, frustrating, or improved in the current system. The category improvements are divided into the four sub-categories (1) infrastructure and support offer, (2) structural improvements, (3) cooperation improvements and (4) cultural improvements. As for the previous categories, it is also a mixture of general improvement that could help all start-ups and specific improvement for food start-ups. The following Table 8 presents an overview of the category improvements.

Table 8. Overview category improvements.

Infrastructure and support offer	Access to right experts, network	5
	Market	6
	Expanding support	7
	Technical support	8
	Monetary support, financing decision	19
Structural improvements	What you learn in school	4
	Using and improving established structures	7
	More manageable and more official network	8
	Less bureaucracy, administration	9
	Revising regulations	9
Cooperation improvements	Better connected ecosystem actors	4
	Cooperation between actors	8
	More transparency	8
	Learnings from other countries, thinking across borders	18
Cultural improvements	Stronger support of female entrepreneurs	2
	Establishing founding mentality from a young age	6
	Innovation culture	19

4.5.1. Infrastructure and support offer

Improvements in the infrastructure and support offer include access to the right experts and network (FS2, FS4, NET3). This refers to getting in touch with legal experts, especially food law (FS2), and that the start-ups think about industrial processes already at an early stage (FS4, NET3). Improvements could also be made at the market level by facilitating the market access, for instance, providing a real-world retail setting to test your product (ST6), a program that would ease the market entry and acceptance of products (NET1, ST1), but also improving the market itself by considering fairer prices and digitalising the German market (NET1). Furthermore, some support offers could also be expanded, focusing on a long-term impact rather than being opportunity-driven (NET3). Additionally, more programs should focus on aspects other than business, i.e., production, and grants or other government programs should be offered in all states (ST3, ST5). Especially the range of technical support, i.e., production facilities and test facilities, should be further expanded, and more technical experts should be advised early in the start-up process (FS4, NET4, ST1). Even though the Food Startup Incubator provides this support, NET4 would like “more opportunities to be able to produce your product more cheaply, so that [...] you have several production locations where you can simply try something out”. Lastly, accounting for almost all mentions is improving the monetary support (FS1, FS3, FS4, NET1, NET2, ST1, ST4, ST5). NET3 finds clear words here, because “more money is needed in the market, specifically significantly more venture capital. There is still far too little risk capital compared to abroad.” However, this money should be carefully invested, leaning on existing structures and not simply “thrown into the market” (NET2), especially if it is taxpayers’ money (NET2).

4.5.2. Structural improvements

The second sub-category are structural improvements. First, some interviewees would like to educate children earlier and improve what they learn in school, focusing on problem-solving skills, teaching the structure of the food system, including possible impacts on the system, and developing entrepreneurial skills in school (FS2, FS3, NET2). Second, FS2, FS4 and NET2 explain that improvements to the system can also be made by better using and connecting already established structures. Additions to the support system should thus be made by “always looking at what existing structures are already

there" (NET2). Networking is another specificity that could be refined (NET3, NET4, ST5, ST6). This could be in the form of, for instance, a program that brings together directors of established businesses with founders (NET3), but also by providing a more official and institutionalised way to get in contact with other start-ups and find partners (ST5, ST6)—for example, finding consultants in a more official and structured way than by luck (ST5) and sharing start-up experiences on a peer-to-peer level (ST6). Reducing bureaucracy and administration would serve all types of start-ups (FS1, FS2, FS3, NET1, NET4, ST4). This includes founding processes that "take far too long [...] especially if [you] want to get started right away" (NET2) but also processes such as writing application forms (FS2, NET4) which is currently very lengthy and in parts "made up out of thin air" (NET4). Equally mentioned was the wish for revising regulations (NET1, ST3, ST5, ST6). Whilst especially some food regulations processes and stricter consumer protection laws were criticised, especially the aspect of employee stock options was seen as an issue that could have a big impact on attracting talents (ST5, ST6). "In Germany, this [employer stock options] is taxed as income, 50 %, while the founders somehow only pay capital gains tax, 25 % of something like that, on what they take with them. In Great Britain, for example [...] this is equalised. [...] it makes it more difficult for start-ups to incentivise their employees because, with the low salaries that exist in start-ups, it plays a big role in terms of potential profits" as ST6 explains it.

Another challenging aspect for potentially transformative innovations is the 19 % value-added tax on vegan alternatives such as plant-based milk compared to 7 % for cow milk and other products considered basic needs (ST6).

4.5.3. Cooperation improvements

The following sub-category deals with improving the cooperation between the actors. While the specifications go in a very similar direction, they all deal with slightly different aspects. First, the ecosystem actors should be better connected (FS2, NET2, NET3, ST1) as the "ecosystem [is] developing food but still not everything is connected" (ST1). For instance, this applies to investors (FS2) and transdisciplinary connections, e.g., at the university level (NET2). Furthermore, more cooperation could be between the various ecosystem actors (FS1, FS2, NET3). Often the actors in the innovation ecosystem compete with each other, which partially leads to "demarcation and poaching "of start-ups]" (FS1) and a situation in which the various actors also like to steal a bit of the show from each other" (NET3). Thus, the player" in the innovation ecosystem should focus on providing the best support for start-ups and cooperation. This collaboration should also be honestly and transparently (NET3), which would improve the working atmosphere and provide more transparency to the start-ups, which then know where to go and what to expect.

Additionally, the general overview of the available support offerings could be refined by making it more transparent (FS3, NET1, NET3, ST2, ST5). There are a lot of offers, possible funding opportunities, different contract forms or company forms. Still, often the knowledge and the overview might be missing (FS3, NET1, NET3), and for example, "the general funding database that exists is confusing" (ST5). Lastly, it is also possible to learn from other countries and copy the things working well in other countries (FS2, FS3, FS4, NET1, NET4, ST2, ST4, ST5). Start-ups should be inspired by the ideas and products provided in other countries and copy them (FS3) like ST2, who got inspired by another start-up from the United Kingdom. As FS3 explains, we should think across borders as "there are innovations in other countries that are not so bad. There are smart people everywhere so that you can work with their ideas" (FS3). Countries also provide learnings and examples. For instance, the United States of America or Israel (NET4, ST2, ST4, ST5) were mentioned as an inspiration for a successful start-up innovation culture, including the availability of venture capital. Still, Austria (NET1), especially the region Vorarlberg, provides an example of the start-up scene, the support offer, and economic growth.

4.5.4. Cultural improvements

The last sub-category focuses on cultural improvements. Two women mentioned that they would like to see more support for female entrepreneurs (NET3, NET4), whilst none of the male interviewees found this aspect noteworthy. Another cultural aspect that could be improved is creating an innovation culture (FS1, FS2, FS4, NET1, NET3, NET4, ST2) and a founding mentality already from a young age (FS1, FS2, NET2, NET4, ST1). Failure should not be seen as something negative, and more people should “have the courage to fail” (NET4) and start doing. This applies to founders (FS1, FS2, ST2), but also to established companies, which should be open to innovations, and investors, putting their money into visionary ideas (FS1, FS4), being less risk-averse (NET1) and freeing themselves from the fact that failed founders should not be supported again (FS1).

The corresponding categories summarise the challenges, available support opportunities provided by the different actors, success factors to see where the support system is already well established and find possible blind spots for improvements of the system. As a basis, the scene is set with background knowledge, information about transformational innovations, and general remarks. Thus, the interviewees' statements were filtered and sorted to get an overview of the innovation ecosystem ultimately and to identify potential improvements.

5. Conclusions

As established during the theoretical part, the innovation ecosystem in Germany already provides numerous support opportunities, and many actors are involved in the process. The empirical research supports this statement that cooperation and interaction of the different actors are crucial. All players identified in theory and, in addition, the public as a factor to be influenced have an impact on both the success of innovations and the change of the food system. However, as there were certain tendencies of one actor being more important, the different actors also had inclinations about which actors were the most important. For instance, for a program financed by a university, the university is the most important actor, or for an offer supported by members, those members are the most important actors, irrespective of whether these members are mature companies, universities, or research institutes.

Nevertheless, all actors, especially the variety of actors, are considered crucial for success as each actor has unique benefits that the start-ups need to flourish. These preferences are also highly dependent on the structure and financing of the support offer itself. For example, while investors can offer the necessary financing, especially long-term financing, universities, and research institutes can be considered a breeding ground for ideas and provide some basic instruments for realising the concept, and incubators and accelerators help shape and strengthen the concept by providing mentoring, basic financial support, or other resources.

Considering this, it is not surprising that the network, cooperation, and mentoring are the key success factors and the primary support provided. Thus, the actors set the success of the start-ups as their top priority and try to support them with their expertise or, if necessary and possible, with the expertise of partners from their network or connections to other networks. It also does not matter whether this kind of support comes from a network that the founder or start-up team has already built themselves, e.g., through their own work experience, or whether it is made possible by programs and other providers. However, it is important that the players focus on the needs of the start-ups, ideally in a flexible manner, and that they are interested in the long-term success, which does not necessarily entail a financial way, but also because they believe in the idea or the mission of the start-up.

Additionally, the current innovation ecosystem offers monetary support from various sides. First, minor financial funding is provided by accelerator or incubator programs or official calls for projects. Second, prizes provide some monetary benefits. Thirdly, cooperation partners such as mature companies or research institutes can offer financial support through grants or favourable financing terms. Lastly, investors, venture capitalists, or business angels offer financing support. While investors usually can offer more

financial resources and thereby potentially a faster growth of the start-up, the underlying motives of investors are not known. This, therefore, requires the support of affordable juridical help or knowledge about the potential upsides and pitfalls of investor-based financing. In the end, the right financing decision, e.g., whether strategy-determining financing or strategy fulfilling financing, depends on the start-up's specific circumstances and goals. There are no right or wrong choices as all options can be valuable.

Generally, the support available in Germany is excellent and extensive. This includes an industry open offer and industry-specific food offerings. Both offerings provide value to start-ups and promote the potential success of food start-ups. Most of the offerings are open and thus focus on the general foundation of a successful start-up or the business side. This is especially useful for all the first-time founders with no background in business, such as scientists or food specialists. However, the range of food-specific offerings is expandable, as, during the interviews, the same actors were repeatedly mentioned.

Additionally, this food-specific offering is crucial for founders who do not have a food background. Thereby, the knowledge and expertise on the market are plentiful. It is to a certain extent also dependent on the founders themselves, whether they acquire this knowledge, seek the exchange with experts, but are also put in contact with the right experts. Nevertheless, establishing these connections and trying to support start-ups as best as possible is part of the guidance offered by existing innovation ecosystem players.

The granted support is thereby as diverse as the start-ups, the products or services they contribute, and the needed assistance. It also does not matter which of the different actors offer the support if someone in the innovation ecosystem provides it. A mixture of regional and transregional offers is also valuable as regional offers provide direct feedback but cannot cover every needed expertise.

As the literature already emphasises, a successful innovation ecosystem is characterised by a well-organised, collaborative, and supportive environment with a vivid exchange between the members in the ecosystem. The interviewees confirmed this, and although the different actors are already cooperating, there is still room for improvement. The most common recommendation for improving cooperation is learning from other countries like United States of America and Israel and bringing the best to Germany. This includes suggestions for politicians, for instance, by looking at the Austrian region Vorarlberg, and suggestions for investors, e.g., by providing more capital, and for start-ups who should bring innovations from other countries to Germany. As stated in the previous section, the support available is extensive, especially for general industry support. Therefore, a more practical approach to improving the whole system is increasing the cooperation between the actors. This could be implemented by bridging the gap between industry-specific support, i.e., for food start-ups, and open industry support and cooperating to create even better support offers. Additionally, all the actors in the innovation ecosystem should collaborate more and not see other actors as competitors but rather as partners, providing the best support for start-ups. For instance, working transparently, sharing your competencies, and being honest about what you can or cannot offer.

The second improvement to the system concerns structural improvements. Especially when it comes to decreasing bureaucracy and administration, these changes are difficult to implement in the short term. However, an explicit recommendation of this paper is to revise tax regulations, especially concerning employee stock options, to reduce bureaucracy, e.g., founding processes, and to create structures that represent the reality. Food regulations should also be reconsidered, but this is even more of a challenge because, on the one hand, regulations apply equally to small and big companies and exemptions for small companies would create an unfair advantage, and, on the other hand, they also ensure the food quality and safety that we currently have. Thus, finding solutions for these changes probably requires more long-term approaches. However, immediate strategies to improve the system can be made by providing support concerning these issues, e.g., low-threshold and low-cost access to relevant experts. This could also imply creating more institutionalised or official networking options or platforms where like-minded people can meet, start-ups can exchange experiences, and experts or consultants can be found or

offer their help. This would also eliminate the success factor of luck to a certain extent since start-ups would no longer have to rely on others to find possible coaches and experts but would find the support they need themselves. Additionally, a more interwoven and connected support system would help in this aspect.

Lastly, a more complex aspect of change is creating a culture that favours and encourages innovation. Whilst culture is difficult to change, it is also a key aspect that the interviewees wished for. The actors wish more people would just go for it and think less about possible consequences and failures. In school, children should be taught about the basics of running a business, and teaching should be focused on problem-solving skills and independent thinking. In general, failure should not be seen as something bad but rather as an opportunity to learn. Fortunately, there is already a positive development in an innovation culture in Germany. There is ample support in the system that wants innovative ideas to succeed. Nevertheless, although some aspects are more difficult to change than others, an ecosystem is by design constantly evolving and adapting to new opportunities and circumstances, which means that the potential for changes in the system is high.

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