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Niche innovations in Europe for the transformation of the food system - NEuropa

Collection of profiles

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Niche innovations in Europe for the transformation of the food system - NEuropa

Collection of profiles

by

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Abstract: Niche innovations in Europe for the transformation of the food system - NEuropa

The food systems of the various European countries are characterized by great diversity, stemming from the differences in history, geographical location and natural resources. From this diversity, numerous new niche innovations have emerged in recent years that have the potential to contribute to the necessary, more sustainable shaping of food systems. These niche innovations are presented in this publication as well as classified and evaluated with regard to their potential contribution to the transformation of the food system.

This investigation of European niches complements a study on niches in the German food system commissioned by the Federal Environment Agency. The present publication thus provides a first overview of the diverse niches of the food system in Europe. It presents 22 niche innovations in the form of profiles, which are not yet or only to a small extent practiced in Germany. The findings from this research on European niche innovations lead to an outlook that shows which next steps would be necessary to strengthen niche innovations in Germany and to transfer first positive experiences from other European countries to Germany. In particular, associations, federations, companies and public administration are to be encouraged by this project to implement the latest niches from Europe in Germany by means of knowledge transfer, networking and qualification.

Kurzbeschreibung: Nischeninnovationen in Europa zur Transformation des Ernährungssystems – NEuropa

Die Ernährungssysteme der Länder Europas sind von einer starken Vielfalt geprägt, bedingt unter anderem durch die Unterschiedlichkeit von Geschichte, geographischer Lage und natürlicher Ressourcenausstattung. Aus dieser Vielfalt heraus haben sich in den letzten Jahren zahlreiche neue Nischeninnovationen entwickelt, die das Potenzial haben, zu der notwendigen, nachhaltigeren Gestaltung der Ernährungssysteme beizutragen. Diese Nischeninnovationen werden in der vorliegenden Publikation vorgestellt und mit Blick auf ihren möglichen Beitrag zur Transformation des Ernährungssystems eingeordnet und bewertet.

Diese Untersuchung europäischer Nischen ergänzt eine Studie zu Nischen im Ernährungssystem Deutschlands, die im Auftrag des Umweltbundesamtes durchgeführt wurde. Die vorliegende Publikation liefert damit einen ersten Überblick über die vielfältigen Nischen des Ernährungssystems in Europa. Es werden 22 Nischeninnovationen in Form von Steckbriefen vorgestellt, die so in Deutschland noch nicht bzw. erst in geringem Maß praktiziert werden. Die Erkenntnisse aus dieser Desktoprecherche zu den europäischen Nischeninnovationen münden in einen Ausblick, der aufzeigt, welche nächsten Schritte erforderlich wären, um Nischeninnovationen auch hierzulande zu stärken und erste positive Erfahrungen aus anderen Ländern Europas nach Deutschland zu übertragen. Insbesondere Verbände, Vereine, Unternehmen und Verwaltung sollen durch dieses Projekt angeregt werden, mittels Wissenstransfer, Vernetzung und Qualifizierung, neueste Nischen aus Europa in Deutschland umzusetzen.

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List of abbreviations

EAKEN	European Agroecology Knowledge Exchange Network
EM	Effective Microorganisms
IALA	Instituto Latinoamericano de Agroecologia
IFOAM	International Federation of Organic Agriculture Movements
PGS	Participatory Guarantee Systems

1 Introduction

1.1 Background

The food systems of the various European countries are characterized by great diversity, stemming from the differences in history, geographical location and natural resources. Just as diverse is the wealth of ideas on how food systems can be brought into line with the goals of sustainability in different ways. This results in numerous new niche innovations and with them potentials for a more sustainable alignment of the food systems, which will be examined in this project.

Niches represent a network of actors who implement similar innovations parallel to each other in different places. These niche innovations can be products, practices, novel associations or a change in consumer behaviors, while they all pursue the goal of making the food system more sustainable. The more people adopt these sustainable niche practices, the more likely the niche has the potential to promote the shift towards a more sustainable food system. It is precisely major social trends, such as climate change, globalization, demographic change, etc., that are contributing to the search for other paths and new solutions, and that niches thus have a higher potential to find their way into the newly forming structures and thus possibly reach the mainstream. The more numerous the niches become and link up with other niches, the higher the chances are that they will bring about sustainable adjustments in the food system.[1]

Especially in other European countries numerous social, institutional and technical innovations are currently emerging, yet these are often little or hardly known until now in Germany. Many of these European niche actors are in little contact with German innovative niche actors or with German associations and federations from the environmental and nature conservation sector. On the one hand, active niches in Germany cannot grow and optimize themselves due to a lack of this exchange of knowledge and experience. On the other hand, such niche experiments cannot be initiated in Germany if social, economic and political actors in this country are not yet familiar with these approaches.

This publication should therefore also contribute to giving social, economic and political actors in Germany an overview of the new initiatives. This can open up new opportunities for German associations and federations to promote these important niches burgeoning in Europe for the necessary transformation of the German food system, and among other things to improve the national framework conditions in order to promote the experimentation and spread of such initiatives. This publication should also serve to break the isolation of niche actors in Europe and Germany and to provide incentives for new cooperations, which can boost the exchange of experiences and highlight the potential synergies of the niches and their actors.

The present project is the first to identify niche innovations throughout Europe. Taking German associations and federations into account, the aim of the project was to prepare/present these innovative approaches in such a way, that links can easily be established and that the new ideas

[1] According to the chosen definition and terminology delimitation in the research project TransfErn (cf. Haack, M., Engelhardt, H., Gascoigne, C., Schrode, A., Fienitz, M. & Meyer-Ohlendorf, L. (2020): Sozial-ökologische Transformation des Ernährungssystems: Nischen des Ernährungssystems. German Environment Agency, Dessau-Roßlau.; Geels, Frank W. (2002): Technological transitions as evolutionary reconfiguration processes: A multi-level perspective and a case-study. In: Research Policy 31(8/9), pp. 1257–1274.; Geels, Frank W. (2005): The dynamics of transitions in socio-technical systems: A multi-level analysis of the transition pathway from horse-drawn carriages to automobiles (1860-1930). In: Technology Analysis & Strategic Management 17(4), pp. 445–476.; Schot, Johan W. & Geels, Fran W. (2008): Strategic niche management and sustainable innovation journeys: theory, findings, research agenda, and policy. Technology Analysis & Strategic Management 20 (5):537–54. 36(3), pp. 399–417.; Grin, J. et al. (2010): Transitions to sustainable development. New directions in the study of long term transformative change. First issued in paperback. New York, London: Routledge). The terms 'niche' and 'niche innovation' are used synonymously.

ideally find their way into the work of these German associations. So far, only networks that promote one of the niches are active in Europe, such as URGENCI, the International Network for Community Supported Agriculture. However, links across and between niches are still not in place.

At the national level, the UBA-UFOPLAN project " Sozial-ökologische Transformation des Ernährungssystems: Nischen des Ernährungssystems (TransfErn)" [2], carried out by NAHhaft, already identified and evaluated niches in the German food system in terms of their sustainability and transformation potential.

The niches examined in the TransfErn project are[3] :

1. Aquaponics
2. Veganic agriculture
3. Organic and Slow Food restaurants
4. Land cooperatives/foundations
5. Food Policy Councils
6. Urban Farming
7. Meat substitutes
8. Food coops
9. Food sharing
10. Community gardens
11. Farm shares and sponsorships
12. In vitro meat
13. Commercial food rescue apps
14. Online direct marketing
15. Precycling
16. Regionalwert AG
17. Community Supported Agriculture
18. Vegan nutrition
19. Vertical farming
20. Distribution of non-marketable food products
21. Forest Gardens
22. Dual purpose chickens

Within the TransfErn project, the methodology for determining the transformation potential of the niches was further developed, which was initially elaborated by the Ecologic Institute in the previous study "Kriterien zur Erfassung und Bewertung des Nachhaltigkeits- und Transformationspotentials von Nachhaltigkeitsinitiativen und sozialen Innovationen"[4]. This knowledge and experiences from previous projects can be integrated by applying this methodology to the NEuropa project (see 1.3 Methodology). In order to avoid duplications, the

[2] Haack, M., Engelhardt, H., Gascoigne, C., Schrode, A., Fienitz, M. & Meyer-Ohlendorf, L. (2020): Sozial-ökologische Transformation des Ernährungssystems: Nischen des Ernährungssystems. German Environment Agency, Dessau-Roßlau.

[3] ibid.

[4] Wunder, S. et al. (2019): Kriterien zur Erfassung und Bewertung des Nachhaltigkeits- und Transformationspotentials von Nachhaltigkeitsinitiativen und sozialen Innovationen. Texte 33/2019. March 2019. German Environment Agency, Dessau-Roßlau.

niches of the TransfErn project, despite their sometimes widespread distribution in Europe, will not be examined again in this report[5].

This means that highly active and central niches in Europe, such as community supported agriculture and land cooperatives/foundations, will not be presented here again, as they have already been thoroughly examined in the TransfErn project mentioned above, and therefore already receive a certain amount of interest in Germany. In contrast, the focus within this report is on identifying innovative niches in Europe which are not yet or little known in Germany. Nevertheless, the German associations and federations, as well as representatives of the TransfErn niches already active in Germany, can learn from the other European examples by exchanging successes and failures. For this reason, the NEuropa online platform, which is intended to facilitate this cross-border networking, lists the niche profiles and individual initiatives of the TransfErn project as well as those of the NEuropa project on a cross-project basis (see 1.3 Methodology).

1.2 Aim and target group

The aim of the report is to provide an overview of European niche innovations that are largely unknown in Germany, and a systematic description of these individual niche innovations in fact sheets. This overview is intended to equip German environment and nature conservation associations and federations to initiate or promote niche innovations in Germany in accordance with their goals and objectives, as well as to improve their networking with the identified Europe-wide niche actors.

The project thus pursues two overarching aims:

1. Identification of Europe-wide niche innovations that are largely unknown in Germany and assessment of their sustainability potential
2. Presentation of niche innovations in the form of profiles both in a report and on the online platform, so that European niche actors can network and German associations and federations can support the dissemination of the niche innovations into the mainstream in Germany

The project looks for innovative niches, which i.e. have a particularly high and integrated potential to transform the existing food and agricultural system towards socio-ecological sustainability (see 2. Selection of niches). An open search for niches is meant to identify a great variety of unique initiatives that could be of interest to German associations and niche actors with the aim of exchanging knowledge, networking and further developing their own work. Hereby, also pressing social issues are to be addressed, for example by means of the targeted inclusion of low-income households and people with low food awareness, the integration of people with a migration or refugee background, initiatives with positive health effects as well as generational exchange through introductions and trainings on agricultural production cycles for young people.

The methodical presentation of the niche innovations in profiles, both in this report and on the online platform *foodsystemchange.org*, gives associations and federations in Germany the opportunity to broaden their work by including new fields of activity and cooperations. For this purpose, the first online platform to date with a systematic overview of niche actors and niche

[5] One exception is veganic agriculture. This niche has already been investigated within the TransfErn project. However, with the niche "biocyclic vegan farming" it found its way once again in this study, as there are many successful examples in Europe, whose effects have been proven by studies and which can play an important role for the further development and dissemination of the niche in Germany.

innovations in the food and agricultural system in Europe provides the foundation. Here individual initiatives, both within and across niches, are being connected, thereby allowing for exchange of experience. By getting to know, initiating or promoting new niche innovations and by entering into an exchange of experience and knowledge, German associations and federations from the environmental and nature conservation sector can significantly support the implementation of their respective goals. Niche actors in Germany are also given the opportunity to network with similar initiatives in other European countries, to learn from successes and failures and thus to optimise their own initiatives.

In the long term, new cooperations between German associations and niche actors in Europe can be established to strengthen the exchange of experience. At the same time niche innovations adapted to the German context can be initiated and promoted nationwide. This can contribute to improving the political framework conditions. At the same time, the isolated niche innovations gain in transnational reach and media presence through the dissemination and exploitation of potential synergies, in order to better effect the transformation of the food system towards more sustainability.

In addition to the non-profit associations and federations of environmental and nature conservation as the main target group, other civil society initiatives, professional associations, (especially non-profit and cooperative) enterprises, non-profit and political foundations, scientists, journalists and interested citizens can also obtain information on the niches via the online platform or this report. This way, they too can learn about new niche innovations, get in touch with them and initiate, optimise and disseminate them in Germany.

1.3 Methodology

In order to ensure a systematic approach involving diverse niches in the various countries of Europe, the project is being accompanied by two partner organisations, *Friends of the Earth Europe* (FoEE) and *Nyéléni Food Sovereignty Movement in Europe and Central Asia*, each of which can draw on broad Europe-wide networks. In the following, the methodology of the project is explained.

In a first step, criteria for the identification of niche innovations were defined in cooperation with the German Environment Agency and the partner organisations (see 2.1 Criteria for the selection of niches). These are based on the criteria developed within the TransfErn project. These criteria were specified in a call, which was issued to association and federation members from the environmental and nature conservation sector as well as to citizens in order to search for and identify sustainable initiatives. With the questions of the call being formulated very openly, the primary aim was to trigger a broad and open feedback of diverse initiatives. This call was distributed through Europe-wide networks and Europe-wide environmental associations with member organisations in various European countries (including the partner organisations Friends of the Earth Europe and Nyéléni Food Sovereignty Movement in Europe and Central Asia as well as other associations and networks). The feedback was collected via an online form, alternatively a Word document. More detailed information requested included: descriptions of the initiatives, activities, objectives, responsible persons, successes, difficulties, first assessments of the sustainability potential, similar initiatives in other countries and further literature references. On the basis of these contacts to niche actors and further in-depth literature research, information on a large number of niche innovations in Europe was collected.

On the basis of the established criteria (see 2.1 Criteria for the selection of niches), the project relevance of the individual niche innovations was assessed and a selection of niche innovations were determined within the consortium, which were to be examined and presented in detail within this project.

In a second step, information about the selected niche initiatives was systematically collected through in-depth desktop research, complemented by individual consultation with niche actors, and subsequently summarized in the form of profiles.

In a third step, the results were prepared for the online platform FoodSystemChange (www.foodsystemchange.org), which is to enable the digital exchange of information between niche actors throughout Europe. This website enables people from science and practice to share their new experiences and knowledge as well as to network. For a clear and quick overview, the profiles are presented on a new interactive map with possibilities for filtering niches, process stages and sustainability goals in German and English. Depending on the filter, the individual niche initiatives identified across Europe show up on the map with a link to their website. As mentioned above, the niches from the TransfErn project were also integrated here, in order to be as thorough as possible.

2 Selection of the niches

According to the purpose of this project a selection of niches has been made out of the research results of the desktop research and the Europe-wide call. In the following, the criteria that were used to assess the relevance of the initiative for the project are presented. The assessment of the sustainability potential will also be explained in detail. Finally, the results of the niche selection based on these criteria are presented.

2.1 Criteria for the selection of niches

In order to achieve a sustainable transformation of the multilayered and complex food system, niches are sought that tackle different points in the system and can thus have a broad scope of action. Four selection criteria were defined at the beginning:

The niches should

1. address different process stages along the value chain of the food system: intermediate consumption, production, processing, trade, consumption, waste and recycling;
2. have high and integrated sustainability potentials with regard to ecological, economic and social goals (see 2.2 Criteria for assessing the sustainability potential);
3. already have gained first practical experience and successes in the implementation; and
4. be unknown in Germany and have not been examined in detail in the TransfErn research project.

Thanks to these criteria, those niches that offer sustainable solutions for most of the above-mentioned stages and areas should be examined more closely.

2.2 Criteria for assessing the sustainability potential

The criteria for assessing the sustainability potential are based on the criteria established by Wunder et al. [6] and further developed by the TransfErn project. They are based on the three-pillar model, which distinguishes the sustainability goals through the three dimensions of environmental, economic and social. These can be interrelated or conflicting. The specific 19 sub-goals of these three dimensions are:

Ecological goals:

- **Biodiversity**
- **Soil**
- **Water**
- **Climate**
- **Air**
- **Resource efficiency in production and consumption**: helpful for the protection of natural resources
- **Promotion of regional, closed nutrient cycles**: helpful in maintaining local and ecological boundaries, which also includes the absorption capacity of ecosystems

[6] Wunder, S. et al. (2019): Kriterien zur Erfassung und Bewertung des Nachhaltigkeits- und Transformationspotentials von Nachhaltigkeitsinitiativen und sozialen Innovationen. Texte 33/2019. March 2019. German Environment Agency, Dessau-Roßlau.

Economic goals:

- **Poverty reduction**: creation and promotion of fair income opportunities and social inclusion as a way to fight poverty
- **Strengthening of regional economic cycles**: helpful for climate-friendly logistics
- **Support of activities with positive external effects**: helpful for the relief of the ecosphere
- **Increase of food security**: key socio-economic objective for the food system
- **Promotion of the recycling economy**: helpful for the efficient use of resources
- **Fair producer prices (on a national and a global level)**: helpful for fairness in the supply chain and reducing the pressure to externalize costs
- **Creation of transparency along the value chain**: helpful for better decision making and prevention of misconduct such as corruption and externalization of costs

Social goals:

- **Health**: Access to healthy food as a way to promote health
- **Participation**: Community building as a way to promote participation
- **Social justice**: Fair working conditions and income for smallholder producers and workers
- **Awareness / Education for sustainable nutrition**: central criterion for the socially just choice of goods and the design of nutrition
- **Animal welfare**: respectful treatment of animals as an independent goal of the understanding of sustainability on which this report is based, which at least grants dignity and intrinsic value to so-called farm animals[7]

In the next step, the addressed sub-goals for all niches were presented in a tabular form. This way, an overall impression of the scope of impact of the selected niches can be obtained. The effects on the various 19 sustainability goals were divided into direct and indirect effects. The different degrees of intensity were differentiated by color: direct effect (dark green), indirect effect (light green), no effect (colorless). A direct effect exists if the immediate aim of the niche is to positively influence the target parameter to be changed through its activities. An indirect effect exists if niches do not directly influence such target parameters, but also exert a positive effect on them through the impact of their activities in the second and third place.

For example, there may be niches that have a holistic approach, but direct effects might be only visible to one of the objectives. Here, the overall picture of the sustainability effect would not be adequately presented if only one sustainability objective is directly related to the activity. An example of this are the agroecology schools. Here, the main focus is on the exchange of knowledge between small-scale farmers. In the first instance, there is no ecological benefit from a higher level of knowledge. However, if the knowledge is applied in the second step and the sustainable goals of agroecology are put into practice, the niche as a whole has a strong effect on the environmental, the social and the economic sphere thanks to the indirect effects occurring in the second and third phases.

It should be noted that a direct effect listed here is not synonymous with a strong effect. An indirect effect may, under certain circumstances, be significantly stronger than a direct effect. In

[7] In principle, the concept of sustainability or sustainable development is open to various positions on the question of which natural beings possess an intrinsic value. (Ott, K. & Döring, R. (2011): Theorie und Praxis starker Nachhaltigkeit. 2011. 3. ed., Metropolis, Marburg. p. 172).

this sense, the table provides the assessment of which sustainability areas are affected by the niche, but not about the extent to which they have an impact.

It should also be noted that this overview is only an approximation and rough assessment by the authors. A more in-depth examination based on measurable variables, multi-stakeholder analyses, etc. cannot be carried out within the framework of this project and therefore this offers room to undertake further related research.

2.3 Results of the niche selection

Through the call for identifying niche innovations across Europe, which was disseminated through various Europe-wide networks, and via in-depth desktop research, a large number of sustainable initiatives were initially identified. Thanks in particular to the advice from the partner organizations and their Europe-wide networks, important niches with high sustainability potential were identified at an early stage, which would have been difficult to find through desktop research alone due to the lack of media coverage.

On the basis of the criteria presented above, 22 niches were selected which are most likely to have a systemic integrated sustainability potential, address as many process stages as possible and are already put into practice in many places (and are not isolated initiatives). In addition, also niches that in the media are being treated as promising innovations for a more sustainable system should not be missing in such an analysis, and are therefore examined herein (→Digital Farming). As possible negative effects of some recent innovations are not yet fully foreseeable (→Digital Farming and Effective Microorganisms), or vary from context to context and according to their application, these possible negative effects were critically subsumed in the category 'risks/disadvantages' in the profile.

The selected niches are:

1. Agroecology schools
2. Agroforestry systems
3. Alternative packaging materials
4. Alternative protein feeds
5. Bio-District / Eco-Region
6. Biocyclic vegan farming
7. Digital farming
8. Effective microorganisms
9. Flowering meadows
10. Humanure
11. Insect food products
12. Market gardening
13. Mobile slaughterhouses
14. Open source manuals for farming tools
15. Open source seed banks and protection of seeds
16. Participatory evaluation and certification systems
17. Re-/Upcycling of food waste
18. Regenerative agriculture

19. Silvopastoral agroforestry systems
20. Social farming
21. Solidarity table
22. Sustainable water cycles

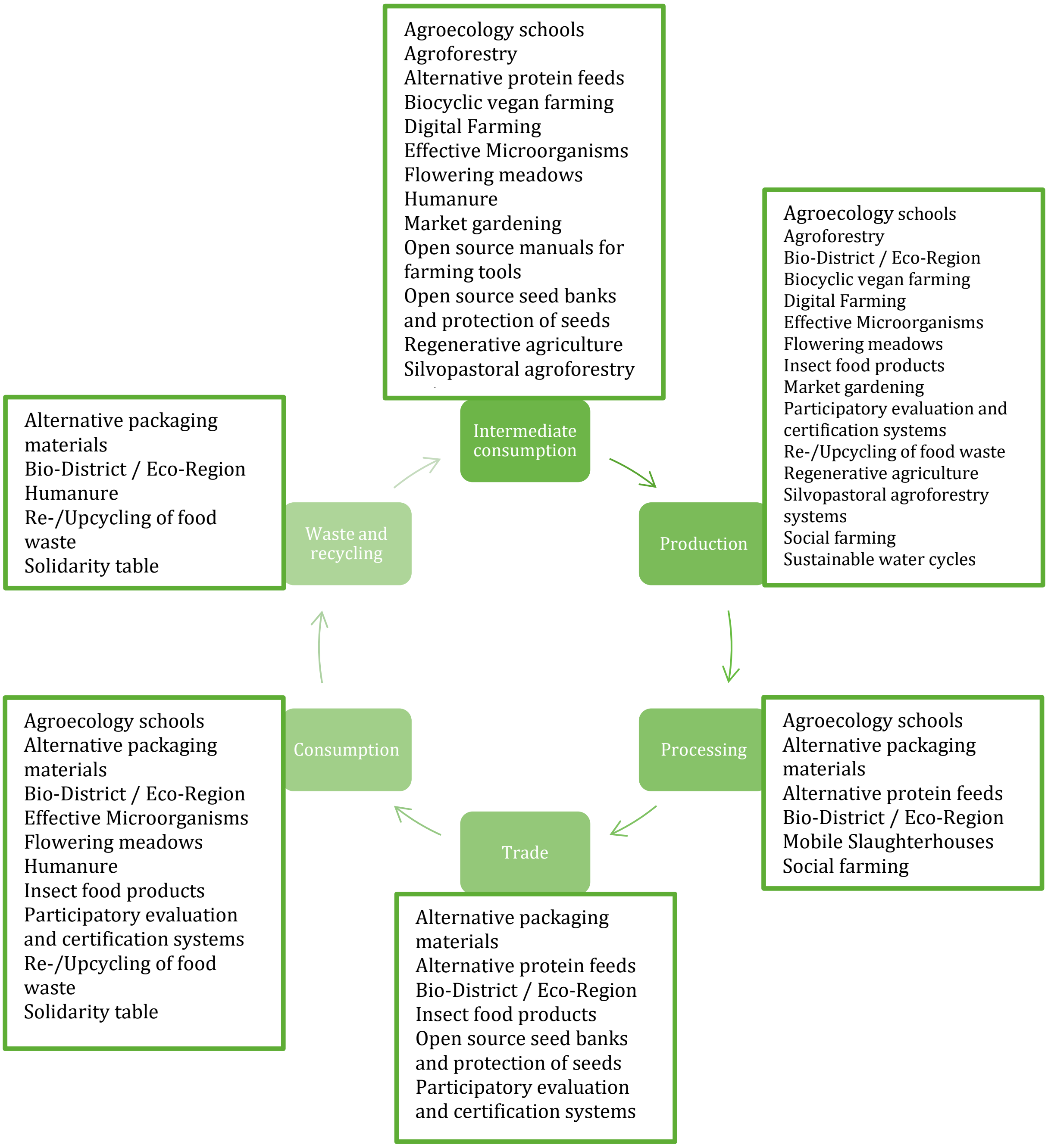
The totality of the selected niches covers all sustainability objectives and all process stages in order to have the broadest possible impact on the multilayered and complex food system. Figure 1 shows the distribution of the niches along the process stages of the food value chain.

Figure 2 presents the results of the assessment of the sustainability potential in a clear form. The wide range of differing sustainability goals addressed reflects the diversity of the approaches. Each target parameter is directly or indirectly influenced by at least one of the niches. Most niches do not pursue only one of the ecological, economic and social objectives listed here, but ideally pursue several in an integrated manner. Only the criterion 'fair producer prices (national and global)' is only affected by two niche innovations, which suggests that further action is needed for new niches.

The dimensions 'ecology', 'economy' and 'social affairs' are also largely balanced, apart from a slight tendency towards the ecological sustainability goals. From this it can be concluded that the niche innovations can support the fulfilment of all three dimensions of sustainability according to the three-pillar model.

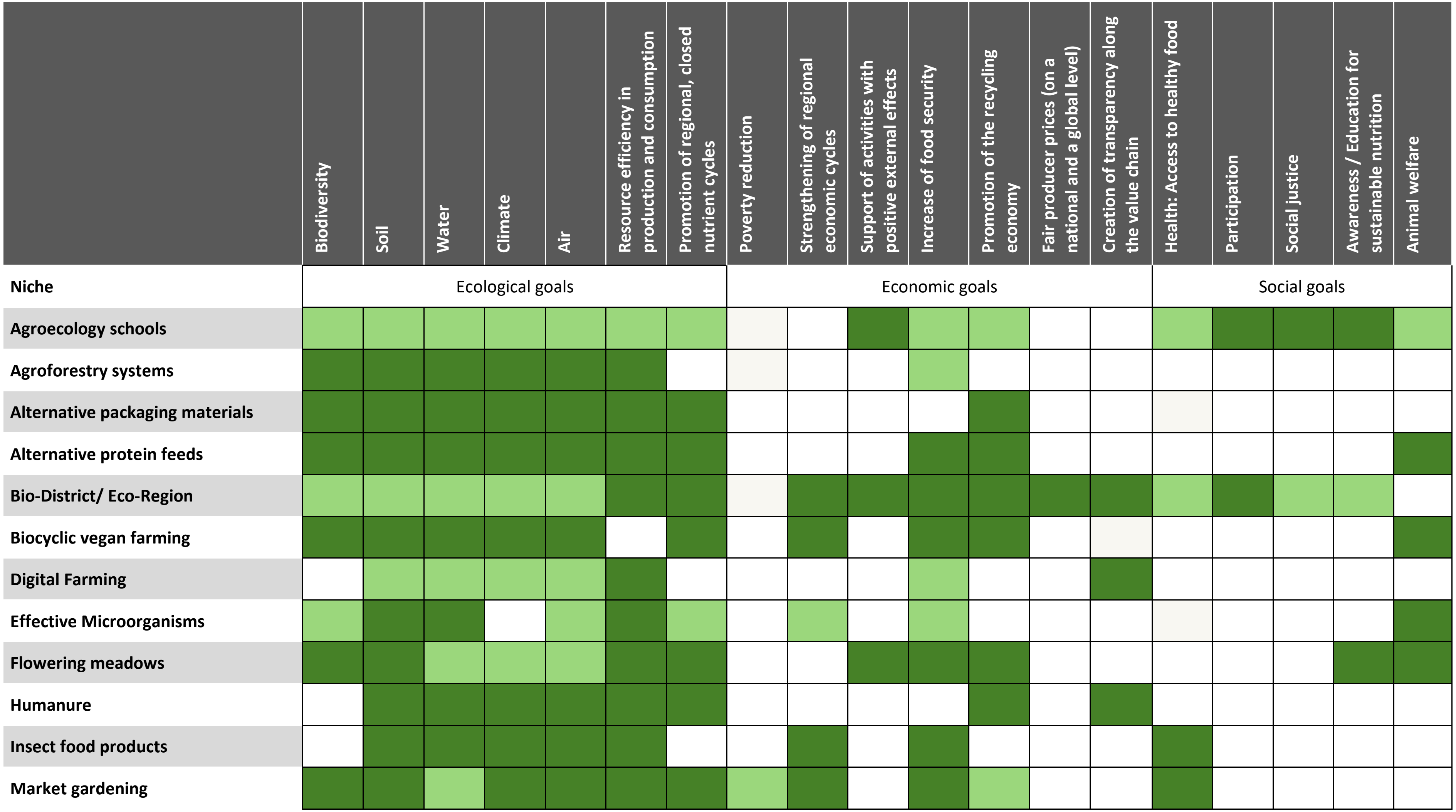
A comparison of the individual niches shows that Alternative Protein Feeds, Bio-District/Eco-Region, Market Gardening, Biocyclic Vegan Farming, Flowering Meadows, Regenerative Agriculture and Solidarity Table have a direct influence on almost half of the target parameters. However, this view does not yet include the indirect effects, which may well be relevant. For example, Agroecology Schools, Bio-District/Eco-Region and Participatory Evaluation and Certification Systems met a high number of criteria. If the direct and indirect sustainability potentials are added together, the niches Bio-District/Eco-Regions and Agroecology Schools are among the most comprehensive approaches.

Figure 1: Diversification of the niches along the process stages of the value chain



Source: Own illustration

Figure 2: Assessment of the sustainability potential of transformative niches



Niche	Biodiversity	Soil	Water	Climate	Air	Resource efficiency in production and consumption	Promotion of regional, closed nutrient cycles	Poverty reduction	Strengthening of regional economic cycles	Support of activities with positive external effects	Increase of food security	Promotion of the recycling economy	Fair producer prices (on a national and a global level)	Creation of transparency along the value chain	Health: Access to healthy food	Participation	Social justice	Awareness / Education for sustainable nutrition	Animal welfare
	Ecological goals							Economic goals							Social goals				
Mobile Slaughterhouses									Direct					Direct					Direct
Open source manuals for farming tools						Direct								Direct		Direct	Direct		
Open source seed banks and protection of seeds	Direct	Indirect	Indirect						Indirect		Direct			Direct	Indirect	Direct			
Participatory evaluation and certification systems	Indirect	Indirect	Indirect	Indirect	Indirect	Indirect	Indirect		Direct	Direct			Direct	Direct		Direct	Direct	Direct	Indirect
Re-/Upcycling of food waste						Direct						Direct							
Regenerative agriculture	Direct	Direct	Direct	Direct	Direct	Direct	Direct				Direct	Direct							
Silvopastoral agroforestry systems	Direct	Direct	Direct	Direct	Direct	Direct					Direct	Indirect							Direct
Social farming								Direct			Direct				Indirect	Direct	Direct		
Solidarity table						Direct	Direct	Direct			Direct	Direct		Direct	Direct	Direct	Direct	Direct	
Sustainable water cycles	Indirect	Direct	Direct	Indirect	Indirect	Direct	Direct				Direct	Direct			Indirect				

Source: Own illustration

Direct impact	**Indirect impact**	**No impact**

3 Presentation of the niche innovations (as profiles)

In this chapter the 22 niches are presented in the form of profiles. The following aspects are examined, based on the profiles of the TransfErn project: Description, aim and innovation, actors, age of the niche, state of development and current dynamics, examples from different countries, assessment of the sustainability potential broken down into ecological, economic and social goals as well as risks and disadvantages.

3.1 Profile: Agroecology schools

Category: Intermediate consumption, production, processing, consumption

Description: The term 'agroecology'[8] is used internationally to describe a science, movement and practice[9] that aims at a socially just and environmentally sustainable transformation of agricultural and food systems.[10] Agroecology challenges the system's inherent logics and power relations and offers an alternative to the industrial agricultural system by focusing on a peasant agriculture adapted to local ecosystems.[11] In German-speaking countries agroecology tends to be understood as a science[12]. In practice, the concept is based on the fundamental principles of organic farming, which primarily include the preservation of soil fertility, the cycle of soil-plant-animal and the human being as well as the independence of farms from external inputs.[13]

Agroecology combines traditional, local knowledge and local cultures with ecological science theories, working towards an overall more sustainable agricultural system[14]. Complex problems are solved by using local resources and involving the knowledge of local producers, artisanal processors, and consumers, who are central to the decision-making.[15]

Within the framework of agroecology, farmers' organizations establish and run agroecology schools or training courses that continuously create and reproduce agricultural knowledge through horizontal knowledge exchange ('farmer-to-farmer', 'fisher-to-fisher', consumer-producer, etc.) within and between different generations, sectors, cultures and traditions.

Aim and innovation: The aim of the niche is to preserve local agricultural knowledge and to reproduce it through participatory research. The basic idea is that producers have acquired the best possible holistic understanding of the local context through long-term experience with local conditions such as those of their soils, climate, plant varieties, animal species and rainfall, as well as local cultural and social knowledge. They are experts in their region and are therefore ideally suited to pass on knowledge about new successful techniques and technologies to other

[8] According to FAO, agroecology is based on the following 10 principles: Diversity, co-creation and sharing of knowledge, synergies, efficiency, recycling, resilience, human and social values, culture and food traditions, responsible governance, circular and solidarity economy (FAO Agroecology Knowledge Hub. The 10 Elements of Agroecology. http://www.fao.org/agroecology/knowledge/10-elements/en/ (20.02.2020)

[9] Wezel, A. et al. (2009): Agroecology as a science, a movement and a practice. A review. Agronomy for Sustainable Development 29, pp. 503-515.

[10] Von Massenbach, A. (2019): Agrarökologie stärken. Für eine grundlegende Transformation der Agrar- und Ernährungssysteme. Positionspapier. January 2019. INKOTA-Netzwerk: Berlin.

[11] Heinrich-Böll-Stiftung et al. (2017): Konzernatlas - Daten und Fakten über die Agrar- und Lebensmittelindustrie. 2017. Berlin. 29.12.2019. https://www.boell.de/de/konzernatlas (20.02.2020)

[12] CIDSE (2018): Die Prinzipien der Agrarökologie. Für gerechte, widerstandsfähige und nachhaltige Ernährungssysteme. April 2018. Brüssel.

[13] Von Massenbach, A. (2019): Agrarökologie stärken. Für eine grundlegende Transformation der Agrar- und Ernährungssysteme. Positionspapier. January 2019. INKOTA-Netzwerk: Berlin.

[14] Pretty, J.N. et al. (2006): Resource-Conserving Agriculture Increases Yields in Developing Countries. *Environ. Sci. Technol.* 2006, 40, 4, pp. 1114-1119. https://doi.org/10.1021/es051670d

[15] Weltagrarbericht (2019): Agrarökologie. https://www.weltagrarbericht.de/themen-des-weltagrarberichts/agraroekologie.html (20.02.2020)

producers and regions, which can then be adapted to the specific contexts. This knowledge of traditional farming techniques is i.e. threatened by the increasing issue of farm succession throughout Europe[16]. Therefore, knowledge exchange is as important as the exchange of seeds of old plant varieties (→Seed banks and protection of seeds) in order to enable an agriculture that is accessible and adapted to local environmental conditions and cycles as well as resistant to the consequences of climate change[17]. This knowledge is passed on horizontally in agroecology schools through an innovative, social methodology of popular education, which was developed to a major part by Paulo Freire[18]. These exchanges place a particular focus on integrating women and young people, as well as other people who show a particular interest in starting a farm.

Actors: Producers, artisanal processors, consumers

Age of the niche: Since the 1920s, scientists have used the term agroecology for the use of organic principles in agriculture[19]. From the beginning of the 1980s onwards, it was then considered a scientific discipline by ecologists, agronomists and ethnobotanists. Francis et al.[20] defined it as an "integrative research into the ecology of the entire food system, including its ecological, economic and social dimensions". The first agroecology school was founded in 2006 in Barinas, Venezuela[21]. It was soon followed by others in Brazil, Argentina, Paraguay, Chile, Colombia and Nicaragua, where they are called Instituto Latinoamericano de Agroecologia (IALA) in Spanish.

State of development and current dynamics: Worldwide the interest in horizontally oriented agroecology schools and training courses is growing. According to La Via Campesina there are already about 70 agroecology schools worldwide. The most institutionalized network of agroecology schools was established in South and Central America, namely the network of the *Instituto Latinoamericano de Agroecologia* (IALAs). In Europe, attempts have been made in recent years to establish a similar network, called the European Agroecology Knowledge Exchange Network (EAKEN)[22]. This network already lists 12 contact points for agroecology training. Newer forms of horizontal knowledge exchange are organized in the field of technology, where collectives provide open source manuals for farming tools and machinery as well as training for their replication and maintenance, thus entirely avoiding patents (→ Open source manuals for farming tools).

Examples: EAKEN network[23] (Scuola Contadina - Italy, Schola Campesina - Italy, AIAB FIRAB - Italy[24], L'Atelier Paysan - France, La Durette GRAB - France, EHNE Bizkaia - Spain, Sindicato Labrego Galego - Spain, Farm Hack - UK, Scottish Crofting Federation - UK, Torth Y Tir - UK, Farm Experience Internship, Eco Ruralis - Romania, North Bruk - Sweden), Polygon Dole – Slovenia, IALAs in South and Central America

[16] Access to Land (2019): Organising farm succession. https://www.accesstoland.eu/European-Farm-Succession-Conference (20.02.2020)
[17] IPES-Food (2016): From uniformity to diversity: A paradigm shift from industrial agriculture to diversified agroecological systems. http://www.ipes-food.org/_img/upload/ les/UniformityToDiversity_FULL.pdf
[18] Freire, P. (1973): Pädagogik der Unterdrückten. Bildung als Praxis der Freiheit. Reinbek Hamburg.
[19] FAO Agroecology Knowledge Hub (n.d.): Agroecology definitions. http://www.fao.org/agroecology/knowledge/definitions/en/ (20.02.2020)
[20] Francis C. et al. (2003): Agroecology: The ecology of food systems. Journal of Sustainable Agriculture 22, pp. 99-118. https://doi.org/10.1300/J064v22n03_10
[21] Friends of the ATC (n.d.): IALA. https://friendsatc.org/tag/iala/ (20.02.2020)
[22] European Coordination Via Campesina (2019): European Agroecology Knowledge Exchange Network. https://www.eurovia.org/eaken/ (20.02.2020)
[23] ibid.
[24] Schola Campesina – Sharing knowledge for food sovereignty. (n.d.). https://www.scholacampesina.org/ (20.02.2020)

Sustainability potential:

- **Ecological:** Biodiversity (indirect), soil (indirect), water (indirect), climate (indirect), air (indirect), Resource efficiency in production and consumption (indirect), Promotion of regional, closed nutrient cycles (indirect)
- **Economic:** Poverty reduction (indirect), support of activities with positive external effects, increase of food security (indirect), promotion of the recycling economy (indirect)
- **Social:** Health: Access to healthy food (indirect), participation, social justice, awareness/education for sustainable nutrition, animal welfare (indirect)

Risks / disadvantages: There is a risk that large-scale agricultural industry will at least partly appropriate the concept due to economic interests and that agroecology could thus be alienated from the actual purpose of the sovereignty of small producers. In addition, there is a risk that institutions may offer classical top-down agroecology trainings in order to exploit new market potentials, and thereby counteract the original key principle of horizontal knowledge exchange.

3.2 Profile: Agroforestry systems

Category: Intermediate consumption, production

Description: The term agroforestry system refers to a form of land use, in which trees and shrubs are combined with arable crops and/or livestock on the same land in order to benefit from the ecological and economic interactions[25]. There is a wide range of possibilities for different system designs regarding species composition and management. Agroforestry systems can be subdivided into Silvoarable Systems (woody plants with arable crops), Silvopastoral Systems (woody plants with animals, →Silvopastoral Agroforestry Systems) and Agrosilvopastoral Systems (woody plants with animals and arable crops) [26].

Aim and innovation: The idea of agroforestry systems is to make use of the potential synergies between the (now often strictly separated) land use forms of animal husbandry, animal feed production and arable farming, horticulture, viticulture as well as fruit growing, thus increasing yields and protecting the soil. At the same time, firewood, animal feed, fruit and construction timber should be produced on one and the same area.

Agroforestry systems provide positive external effects on the environment. One example is the inclusion of trees in cultivation systems, which can contribute to the purification of the groundwater by reducing nitrogen leaching into the groundwater[27]. In addition, agroforestry systems provide diverse habitats for animals, fungi and plants, and thereby increase biodiversity in agricultural regions compared to conventional farming systems[28]. The trees in the agroecosystems help to bind more carbon above and below ground in the long term (CO_2 sink), to promote humus formation and to provide protection against erosion by wind and water[29]. The increasing weather extremes caused by climate change can be compensated by agroforestry systems. For example, temperature extremes are reduced by shading. If agroforestry systems are not combined with organic farming practices, at least the use of agrochemicals and fertilizers can be greatly reduced, by improving nutrient utilization and closed nutrient cycles as well as by increasing resilience to pests[30].

By allowing trees to break down nutrients that arable crops would not be able to break down on their own[31], agroforestry systems achieve higher overall productivity through these synergy effects and thus higher yields per hectare compared to monoculture systems[32]. The product range is expanded (also in comparison to the →Forest Garden concept[33]) and thus, for example, wood can be sold as a sustainable energy feedstock. A particular advantage of including trees in

[25] Nair, P. K. R. (1985). Classification of agroforestry systems. In: Agroforestry Systems, 3(2), pp. 97–128. https://doi.org/10.1007/BF00122638

[26] Toensmeier, E. (2016): The Carbon Farming Solution - A Global Toolkit of perennial Crops and Regenerative Agriculture Practices for Climate Change Mitigation and Food Security

[27] Brown, S. E. et al. (2018): Evidence for the impacts of agroforestry on agricultural productivity, ecosystem services, and human well-being in high-income countries: A systematic map protocol. Environmental Evidence, 7(1), p. 24. https://doi.org/10.1186/s13750-018-0136-0

[28] Reeg, T. et al.(2009): Agroforstsysteme aus Sicht des Naturschutzes. In: Anbau und Nutzung von Bäumen auf Landwirtschaftlichen Flächen, pp. 301–311. https://doi.org/10.1002/9783527627462.ch27

[29] Quinkenstein, A.et al. (2009): Ecological benefits of the alley cropping agroforestry system in sensitive regions of Europe. Environmental Science & Policy, 12(8), pp. 1112–1121. https://doi.org/10.1016/j.envsci.2009.08.008

[30] ibid.

[31] Smith, J. (2010): Agroforestry: Reconciling Production with Protection of the Environment A Synopsis of Research Literature.

[32] Brown, S. E. et al. (2018): Evidence for the impacts of agroforestry on agricultural productivity, ecosystem services, and human well-being in high-income countries: A systematic map protocol. Environmental Evidence, 7(1), p. 24. https://doi.org/10.1186/s13750-018-0136-0

[33] Haack, M., Engelhardt, H., Gascoigne, C., Schrode, A., Fienitz, M. & Meyer-Ohlendorf, L. (2020): Sozial-ökologische Transformation des Ernährungssystems: Nischen des Ernährungssystems. German Environment Agency, Dessau-Roßlau.

agriculture is the aesthetic effect of this cultural landscape. This plays a major role in promoting the social acceptance and appreciation of the system. [34]

Actors and stakeholders: Agricultural/forestry producers

Age of the niche: Agroforestry systems are among the oldest forms of land use worldwide. Based on pollen findings, agroforestry systems can be dated back to as long as 1300 years ago.[35] Traditional economically important forms of land use, which have been widely used in Europe (and in Germany), include, for example, lopping fodder trees for the production of animal feed, hollow log beekeeping for the production of honey, pannage (rearing pigs in woodland areas), the combination of fruit growing and pasture, as well as hedgerow management systems such as the North German 'Knicks' [36]. While the specialization of land use has increased since then, it was only about 40 years ago that these agroforestry techniques found their way from traditional indigenous knowledge into science, and are thus increasingly gaining appreciation[37]. Modern agroforestry systems were only developed in the 1970s and 1980s in response to environmental and food crises[38].

State of development and recent dynamics: Agroforestry is practiced worldwide on approximately 1 billion hectares in a wide variety of forms[39]. The spectrum includes Forest Garden systems and Shifting-Cultivation in the tropics, aquacultures in mangrove forests and energy wood systems, which are particularly widespread in Central Europe[40]. Agroforestry systems are generally considered in the EU regulation concerning the 'Common Agricultural Policy'. However, they are not yet clearly recognized and defined as an independent form of land use in German legislation. As a result, only a few forms of agricultural subsidies following the EU regulation are available in Germany. These forms are 'orchard meadows with grassland use', 'landscape features' or 'short rotation coppice'[41].

Examples: Mazi Farm - Greece[42], AFINET Agroforestry Innovation Network[43], Dehesa Farms - Spain, The World Agroforestry Centre[44], Kääpä Forest - Finland[45]

Sustainability potential:

- **Ecological:** Biodiversity, soil, water, climate, air, resource efficiency in production and consumption
- **Economic:** Poverty reduction (indirect), increase of food security (indirect)
- **Social:** -

[34] Brookfield H. and Padoch C. (1994): Agrodiversity. Environment 36(5): 7-11, pp. 37-45.
[35] Konold, W., & Reeg, T. (2009). Historische Agroforstsysteme in Deutschland. In: Anbau und Nutzung von Bäumen auf Landwirtschaftlichen Flächen pp. 313–324. https://doi.org/10.1002/9783527627462.ch28
[36] ibid.
[37] Brookfield H. and Padoch C. (1994): Agrodiversity. Environment 36(5): 7-11, pp. 37-45.
[38] Nair, P. K. R. (2009): An Introduction to Agroforestry.
[39] Nair, P. et al. (2010): Carbon Sequestration in Agroforestry Systems. Advances in Agronomy, 108, pp. 237–307. https://doi.org/10.1016/S0065-2113(10)08005-3
[40] Gruenewald, H. et al. (2007): Agroforestry systems for the production of woody biomass for energy transformation purposes. Ecological Engineering, 29(4), pp. 319–328. https://doi.org/10.1016/j.ecoleng.2006.09.012
[41] Böhm, C. et al. (2017): Wie können Agroforstsysteme praktikabel in das deutsche Agrarförderrecht ein-gebunden werden? In: Böhm, C. Bäume in der Land(wirt)schaft – von der Theorie in die Praxis. Tagungsband mit Beiträgen des 5. Forums Agroforstsysteme. Senftenberg, BTU Cottbus, pp. 7-16.
[42] Mazi Farm—Farming for the Future (2018). https://www.mazifarm.com (20.02.2020)
[43] AFINET - Agroforestry Innovation Networks (n.d.). http://www.eurafagroforestry.eu/afinet/ (20.02.2020)
[44] World Agroforestry | Transforming Lives and Landscapes with Trees (2019). http://www.worldagroforestry.org/ (20.02.2020)
[45] Kääpä Forest (n.d.). https://www.kaapaforest.fi (28.01.2020)

Risks / disadvantages: With regard to existing disadvantages, advocates of agroforestry systems point to the higher costs required for its establishment and management[46]. The amount of work involved is also higher than in other systems. The long-term capital tie-up due to the slow-growing trees and shrubs can be a problem. The joint use of resources (light, nutrients, water) of woods and arable crops as well as the shared space for growth can have negative effects on plant growth apart from the advantages described above.

The low acceptance of agroforestry systems by conventional farmers to date may disadvantageously impact their expansion. Little knowledge of the agroforestry systems and a lack of trust in their productivity are some of the hurdles for its application by farmers[47]. Awareness raising and conversion support for farmers may be necessary.

[46] Agroforst (2018): Pro und Contra Agroforst. 06.12.2019. https://agroforst-info.de/chancen/ (20.02.2020)
[47] Kaeser, A. et al. (2011): Agroforstwirtschaft in der Schweiz. 2(3), pp. 28–133.

3.3 Profile: Alternative packaging materials

Category: Processing, trade, consumption, waste and recycling

Description: Alternative packaging materials are based on sustainable (renewable) or secondary raw materials, are low in residues, edible and easier to compost. They can serve for situations where a complete avoidance of packaging, as the primary goal, is not possible. They are not only an alternative to packaging made of plastics based on fossil fuels and natural gas, but also to packaging made of environmentally harmful 'bio-based and biodegradable plastics' (also called 'bio-plastics').[48]

Aim and innovation: Food production is one of the areas with the highest plastics consumption[49]. Plastics are the most popular packaging material for food because of their resistance to biodegradation processes. In addition to the much-discussed accumulation of plastics in the oceans, also inland waters, the drinking water, the air and the soil as the basis of agricultural production are contaminated with plastics. [50] The general aim is to avoid this packaging material consumption as far as possible. If packaging is needed, more sustainable alternatives should replace environmentally harmful plastics.

The so-called 'bio-based and biodegradable plastics' release less climate-damaging CO_2 than plastics based on mineral oil, but in the overall picture they are not necessarily more environmentally friendly. [51] Depending on the material, fossil fuels can indeed be reduced, but out of the 0.6% share of bioplastics in the total global plastics production capacity, only 36.3% are partially biodegradable and 63.7% are bio-based (meaning non-biodegradable). [52] The bio-based plastics mostly consist out of industrially grown starch- and cellulose-rich crops such as corn and sugar cane, some of which are genetically modified and whose cultivation is causing serious environmental damage. This can be a higher potential for acidification and eutrophication as well as a potentially higher demand for fertilizers, pesticides and fuels for agricultural machinery. The additional land requirements could lead to competition for land with the food production sector, or ecological compensation and forest areas could be reduced.

New promising alternatives to environmentally harmful bio-based plastics for inevitable packaging requirements are, inter alia, plastics made of paper, straw, fungi, algae and bran. For example, the Finnish company 'Kotkamill' produces entirely recyclable paper packaging that is treated with a special process to make it waterproof[53]. The German start-up 'Landpack' uses straw (and hemp) as a base material for insulating packaging, which can be used like polystyrene[54]. The American company 'Ecovative' also produces a degradable alternative to polystyrene. It consists of fungi and organic waste[55]. The completely compostable material 'Notpla' from the start-up of the same name is primarily based on brown algae, which can be used as transparent and elastic packaging for liquids[56]. In Austria, the company 'NaKu' has

[48] Beier, W. (2009): Biologisch abbaubare Kunststoffe. German Environment Agency. August 2009: Dessau-Roßlau. p. 3

[49] Chemnitz, C. & Rehmer C. (2019): Ernährung - Ein unappetitlicher Kreislauf. In: Heinrich-Böll-Stiftung sowie Friends of the Earth Germany Plastikatlas 2019. Daten und Faken über eine Welt voller Kunststoff. 2.ed., pp. 20-21.

[50] Busse, L. et al. (2019): Kunststoffe in der Umwelt. German Environment Agency. April 2019: Dessau-Roßlau. pp. 14-22.
Moun, D., Flood, C., & Wefers, H. (2019): Abfallentsorgung: Hinter den Kulissen der ungelösten Plastikkrise. Heinrich-Böll-Stiftung. https://www.boell.de/de/2019/05/27/abfallentsorgung-hinter-den-kulissen-der-ungeloesten-plastikkrise (20.02.2020)

[51] German Environment Agency (2019): Biobasierte und biologisch abbaubare Kunststoffe. April 2019. https://www.German Environment Agency.de/biobasierte-biologisch-abbaubare-kunststoffe#textpart-3 (20.02.2020)

[52] Burgstaller, M. et al. (2018): Gutachten zur Behandlung biologisch abbaubarer Kunststoffe. TEXTE 57/2018. June 2018, German Environment Agency, Dessau-Roßlau, p. 31.

[53] Kotkamills (n.d.): Kotkamills. https://kotkamills.com/ (20.02.2020)

[54] Eschenlohr, P. (2019): Landpack—Ökologische Isolierverpackungen für Lebensmittel. https://landpack.de/ (20.02.2020)

[55] Ecovative Design LLC. (2019): Ecovative Design. https://ecovativedesign.com (20.02.2020)

[56] Notpla Limited. (2019): We make packaging disappear. https://www.notpla.com/ (20.02.2020)

developed bottles made out of a material derived from lactic acid as well as sunflower husks as a waste product of oil production[57]. Although tableware should primarily be reusable, there is an interesting approach to avoid waste when needing disposable products: edible tableware. The Polish company 'Biotrem' processes bran as a waste product of wheat production into a material that serves as the basis for edible tableware and cutlery[58].

Actors: Producers of alternative packaging materials, consumers, suppliers

Age of the niche: Until the 1930s, plastics were almost exclusively produced from renewable raw materials[59]. The massive spread of plastic packaging based on fossil, non-renewable raw materials only began after the Second World War[60]. The latter displaced other packaging materials and advanced into all areas of life. Today, 99.4% and 98.7%[61] of the plastics used worldwide are based on fossil fuels[62]. The excessive consumption of plastics (also known as the 'plastic boom') continued for a long time. However, issues in waste management and increased awareness about the limitations of fossil fuels and greenhouse gases pushed for the development of environmentally sound solutions in the 1980s and 1990s. [63] On the one hand this led to the avoidance of packaging materials and on the other hand to research and development of alternative packaging materials. [64]

State of development and current dynamics: The above-mentioned change in awareness to reduce or avoid the use of plastics has especially in recent years been given particular importance in the media. It is also increasingly manifesting itself in political actions[65]. An EU directive of 2015[66] promotes the gradual reduction of plastic bags, which has been until now through the agreed cost obligation of plastic bags successfully implemented in Germany. Another example is France, which bans plastic tableware and cutlery from 2020 on.[67] The EU issued a similar ban on plastic cutlery, plates and straws earlier this year[68]. All over the world, 'zero waste' movements such as the global movement 'break free from plastic' are currently forming, working towards the avoidance of plastic in everyday life, developing solutions and strengthening the public presence of the agenda.[69] In response to the problems, many young companies are working towards developing edible or fully compostable packaging materials that provide a more sustainable alternative for unavoidable packaging needs.

[57] Naku. (2019): Ökologische Trinkflasche aus Biokunststoff. NAKU AUS NATÜRLICHEM KUNSTSTOFF. https://www.naku.at/flaschen/ (20.02.2020)

[58] Biotrem (2016): BIOTREM. http://biotrem.pl/de/ (20.02.2020)

[59] Beier, W. (2009): Biologisch abbaubare Kunststoffe. August 2009, German Environment Agency, Dessau-Roßlau, p.3.

[60] Caterbow, A. und Speranskaya, O. (2019): Geschichte. Durchbruch mit drei Buchstaben. Heinrich-Böll-Stiftung and Friends of the Earth Germany. Plastikatlas 2019. Daten und Faken über eine Welt voller Kunststoff. 2.ed., pp.10-11.

[61] European Bioplastics (2017): Bioplastics. Facts and Figures. Berlin.

[62] Burgstaller, M. et al. (2018): Gutachten zur Behandlung biologisch abbaubarer Kunststoffe**.** TEXTE 57/2018. June 2018, German Environment Agency, Dessau-Roßlau, p. 31.; Unmüßig, B. und Weiger, H. (2019): Vorwort. Heinrich-Böll-Stiftung and Friends of the Earth Germany Plastikatlas 2019. Daten und Fakten über eine Welt voller Kunststoff. 2.ed., pp. 6-7.

[63] Beier, W. (2009): Biologisch abbaubare Kunststoffe. August 2009, German Environment Agency, Dessau-Roßlau. p.3.

[64] ibid.

[65] ibid.

[66] Richtlinie (EU) 2015/720 zur Änderung der Richtlinie 94/62/EG betreffend die Verringerung des Verbrauchs von leichten Kunststofftragetaschen. 29. April 2015.

[67] Tagesspiegel (2016): Frankreich verbietet ab 2020 Plastikbesteck. 20.09.2016. https://www.tagesspiegel.de/gesellschaft/panorama/umweltschutz-frankreich-verbietet-ab-2020-plastikbesteck/14575298.html (20.02.2020)

[68] Europäisches Parlament (2019): Wegwerfprodukte aus Plastik: Parlament stimmt für Verbot ab 2021. Pressemitteilung. 27 March 2019. https://www.europarl.europa.eu/news/en/press-room/20190321IPR32111/parliament-seals-ban-on-throwaway-plastics-by-2021 (20.02.2020)

[69] Unmüßig, B. und Weiger, H. (2019): Plastikatlas 2019. Daten und Fakten über eine Welt voller Kunststoff. In: Heinrich-Böll-Stiftung and Friends of the Earth Germany. 2.ed., pp. 6-7.

Examples: DoEat[70], Kotkamills[71], Biotrem[72], Two Farmers[73], Lyspackaging[74], Greenway[75], Ecosoul[76], Landpack[77], Notpla[78], Biotrem

Sustainability potential:

- **Ecological:** Biodiversity, soil, water, climate, air, resource efficiency in production and consumption, promotion of regional, closed nutrient cycles
- **Economic:** Promotion of the recycling economy
- **Social:** Health: Access to healthy food (indirect)

Risks / disadvantages: As described above, bio-plastics cannot keep the promise of being more sustainable than plastics based on fossil fuels. For many reasons, it is more likely a shift in unsustainable environmental impacts than a solution.[79] The overall best solution is still to completely avoid or reduce the use of environmentally harmful packaging materials along the value chain from production to consumption.

The alternative packaging materials presented here serve only as substitutes for more environmentally harmful materials when packaging is required. Although they are comparatively (faster) renewable (e.g. brown algae), more rapidly degradable (e.g. straw, algae, bran), or are generated as waste products during production (e.g. sunflower husks, bran), they are not all unlimited and available at all times. In some cases, the cultivation can also be in conflict with food or animal feed production.

[70] Do Eat (2015). http://www.doeat.com (20.02.2020)
[71] Kotkamills (n.d.): Kotkamills—Plastic-free for daily life. Kotkamills. https://kotkamills.com/ (20.02.2020)
[72] BIOTREM (2016). http://biotrem.pl/de/ (20.02.2020)
[73] TWO FARMERS CRISPS (2018). https://twofarmers.co.uk/ (20.02.2020)
[74] Lyspackaging, T. (2019): Lyspackaging fabrique votre bouteille compostable végétale. https://lyspackaging.com/ (20.02.2020)
[75] Green Packaging Group (2019). https://greenpackaginggroup.com/industry-experts/bags/100-recycled-100-american-100-affordable/ (20.02.2020)
[76] Ecosoul (n.d.). https://www.ecosoul.ch/ (20.02.2020)
[77] Landpack GmbH (2020): Landpack—Ökologische Isolierverpackungen für Lebensmittel. Landpack. https://landpack.de/ (20.02.2020)
[78] Notpla (2020): We make packaging disappear. https://www.notpla.com/ (20.02.2020)
[79] German Environment Agency (2019): Biobasierte und biologisch abbaubare Kunststoffe. April 2019. 25.11.19 https://www.German Environment Agency.de/biobasierte-biologisch-abbaubare-kunststoffe#textpart-3

3.4 Profile: Alternative protein feeds

Category: Intermediate consumption, processing, trade

Description: Alternative protein feeds comprise raw materials used as an alternative to typical concentrated feed bases such as maize, soya and wheat for the feeding of farm animals.

Aim and innovation: The basic idea of alternative protein feeds is to produce and import less protein feed such as soya worldwide. Today, about half of the protein crops grown globally such as soya end up as concentrated feed in the troughs of chicken, pigs and cattle that are bred for maximum performance[80]. The production of this protein-rich fodder is accompanied by the expansion of agro-industrial areas, the over-fertilization of agro-ecosystems and the greenhouse gas emissions caused by land-use changes, the deforestation of large areas of land and the loss of biodiversity[81]. By reducing soya imports, the land earmarked for feed production could be used for the cultivation of food and thus contribute to securing food sovereignty[82].

Since in countries that import animal feed, conventional regional protein sources cannot meet the large demand of industrial animal husbandry[83], much research is currently being conducted into alternative protein animal feeds. Some of those being currently discussed are microorganisms, algae and insects.

The technology for producing a protein powder out of microorganisms that can be fed to animals was developed in aerospace. Microbes such as bacteria, yeasts and fungi are cultivated and processed in industrial plants. The production is cost-effective and has a favorable ecological balance. An analysis of the potential of microbial protein for feed production showed positive results. It could be concluded that the global area under cultivation, greenhouse gas emissions and nitrogen losses can be greatly reduced.[84]

Microalgae such as spirulina with its protein content of up to 70% and high nutrient density have the advantage that they grow rapidly and can be produced in a closed system with high output.[85] Insects have low demands on their environment and on their food and can also be bred on waste. This means that breeding could also be beneficial for waste recycling. In a study at the Faculty of Agricultural Sciences in Göttingen, both raw materials were subjected to a sample. Pigs and broilers were fed with dried ground larvae of the black soldier fly and spirulina powder. The experiment showed that both feedstuffs brought valuable protein qualities and were well accepted by the animals.[86]

[80] Potsdam-Institut für Klimafolgenforschung (2018): Astronautennahrung für Kühe: Industriell gezüchtete Mikroben könnten Rinder, Schweine und Hühner mit weniger Umweltschäden ernähren. https://www.pik-potsdam.de/aktuelles/pressemitteilungen/astronautennahrung-fuer-kuehe-industriell-gezuechtete-mikroben-koennten-rinder-schweine-und-huehner-mit-weniger-umweltschaeden-ernaehren (20.02.2020)

[81] Mottet, A. et al. (2017): Livestock: On our plates or eating at our table? A new analysis of the feed/food debate. Global Food Security, 14, pp. 1–8. https://doi.org/10.1016/j.gfs.2017.01.001; Steinfeld, H. et al. (2006): Livestock's Long Shadow: Environmental Issues and Options.

[82] Rehmer, C. (2018): Flächenbindung: Grenzen für Nutztier. Heinrich-Böll-Stiftung, Bund für Umwelt und Naturschutz Deutschland & Le Monde Diplomatique. Fleischatlas 2018 – Daten und Fakten über Tiere als Nahrungsmittel. pp. 20-21

[83] Benecke, C. (2019): Klee statt Soja? Bei Kleegras denkt man als Erstes an Futter für Kühe. Aber das Eiweißfutter ist auch für Schweine interessant. DLG-Mitteilungen 2/2019, p. 71.

[84] Pikaar, I. et al. (2018): Decoupling Livestock from Land Use through Industrial Feed Production Pathways. Environmental Science & Technology. 52(13)., pp. 7351–7359.https://doi.org/10.1021/acs.est.8b00216

[85] Conde-Petit, B. et al. (2019): How can we find the protein mix for 2050? Bühler Whitepaper. p.3.

[86] Göttinger Tierfutter-Forschung (2018): Schweine fressen Algen und Insekten. https://www.hna.de/lokales/goettingen/goettingen-ort28741/goettinger-tierfutter-forschung-schweine-fressen-algen-und-insekten-9608525.html (20.02.2020); Reiter, W. & Rützler, H. (2018): Insekten: Alte und neue Nützlinge. Heinrich-Böll-Stiftung,

As organic livestock farming aims at a closed operating cycle, clover grass plays an important role as animal feed and soil improver/green manure (as an alternative to chemical fertilizers). Fresh or ensiled, clover grass is used in dairy cattle feeding as protein supplement feed. In Denmark, a technical process has recently been developed to break down proteins from clover grass in order to produce pig feed thereof. It is interesting to note that, according to the authors, the protein composition is more suitable for pigs and poultry than that of soya. The advantages of clover grass even extend beyond its nutritional qualities. Clover grass requires less fertilization than grains and soya, contributes to the building-up of humus and leads to lower nitrogen leaching and need for plant protection. The protein yield is essentially higher than with grains.[87]

Traditional, long forgotten and rarely used feedstuffs such as foliage can also be considered as alternatives.

Actors: Feed industry, producers with livestock

Age of the niche: Before the industrialization of agriculture, woody plants formed an important basis for fodder production. Pigs, for example, were driven into forests for so-called 'forest grazing', where they ate roots and fruits of the trees. The introduction of industrial fodder at the end of the 19th century was accompanied by the decoupling of production stages in animal husbandry as a result of the industrialization of agriculture. In the first half of the 20th century, the production of industrial animal feed increased rapidly, resulting in today's industrial livestock farming and high soya imports from South America. Microorganisms, algae and insects as alternative protein feeds have only recently been discussed.

State of development and current dynamics: Alternative protein feeds are advancing into the discourse due to the generally growing awareness of environmental problems by the agricultural industry. There is great interest in Europe to reduce the need for importing soya. The implementation is still failing because of legislation[88]. While algae proteins are permitted in the EU, insect proteins may only be used in aquaculture since 2017[89].

Examples: ACRRES - Netherlands[90], EnAlgae[91], Green Protein Biorefinery - Denmark, Inseckt, Ynsect[92]

Sustainability potential:

- **Ecological:** Biodiversity, soil, water, climate, air, resource efficiency in production and consumption, promotion of regional, closed nutrient cycles
- **Economic:** Increase of food security, promotion of the recycling economy
- **Social:** Animal welfare

Friends of the Earth Germany & Le Monde Diplomatique. Fleischatlas 2018 – Daten und Fakten über Tiere als Nahrungsmittel. pp. 44-45.

[87] Benecke, C. (2019): Klee statt Soja? DLG-Mitteilungen 2/2019, p. 71.

[88] The Novel Food Regulation 2015/2283 regulates the health assessment of novel foods, such as algae, insects and microorganisms, before they can be approved and placed on the market.

[89] Weka Business Medien GmbH (2018): Insekten und Algen: Proteinquelle fürs Tierfutter. https://www.labo.de/news/nachhaltigkeit-in-der-tierzucht-insekten-und-algen--proteinquelle-fuers-tierfutter.htm (20.02.2020); Reiter, W. & Rützler, H. (2018): Insekten: Alte und neue Nützlinge. Heinrich-Böll-Stiftung, Friends of the Earth Germany & Le Monde Diplomatique. Fleischatlas 2018 – Daten und Fakten über Tiere als Nahrungsmittel. pp. 44-45

[90] Acrres (n.d.): Acrres. http://www.acrres.nl/ (20.02.2020)

[91] W. C. (2020): Home. EnAlgae. http://www.enalgae.eu/index.htm (20.02.2020)

[92] Ynsect, Premium Natural Feed. (n.d.). http://www.ynsect.com/en/ (20.02.2020)

Risks / disadvantages: The approaches presented here for obtaining protein feed from microorganisms, algae and insects are highly industrialized processes. Their breeding will most likely only be carried out on a large scale in Germany, as industrial facilities are required for cultivation and processing. For this reason and because of the many regulations, insect breeding will most likely not be a solution for small-scale agriculture in Germany, unlike in East Asia. At present, it is also not permitted in Europe to feed bred insects with organic waste.[93] Certain risks include unknown insect diseases that can be transmitted to humans, heavy metal contamination and ethical issues. It also remains questionable whether the approved sources of feed for insects would be sufficient in quantity to serve the today's high number of livestock in intensive agriculture.

This is linked to the overarching question of the extent to which the niche of alternative protein feeds puts intensive industrial livestock farming into question. The niche merely replaces a product or a raw material in the intermediate consumption. Since a continuous high consumption of resources can still be assumed, the food system gets thus adapted rather than transformed. In order to reduce the climate-damaging industrial meat production and ethically questionable animal husbandry, it requires a profound change in the consumption patterns.

[93] German Environment Agency et al. (2019): Trendanalyse „Fleisch der Zukunft“. Umweltpolitische Handlungsoptionen für die Gestaltung von pflanzenbasierten, insektenbasierten und In-vitro produzierten Fleischersatzprodukten. Input paper for the expert workshop „Fleisch der Zukunft“ on the 17.9.2019 in Berlin. 27. September 2019. p.13.

3.5 Profile: Bio-District / Eco-Region

Category: Production, processing, trade, consumption, waste and recycling

Description: The Bio-District (or Eco-Region) is an area where local farmers, consumers, authorities, training and research centers, associations and tour operators conclude an agreement on the sustainable management and use of local resources based on (agro-)ecological principles and practices in order to exploit the ecological, economic and socio-cultural potential of the area.[94]

The names of these communities vary according to their reference to regions, states, counties, towns and villages. On an international level, the names Bio-Districts, Eco-Regions, Bio-Villages and Eco-Villages are used predominantly. On the German level, they are promoted under the denominations Bio-Cities, Eco-Cities, Eco-Model Regions, Bio-Model Regions (as the Eco-Model Regions in the German state Baden-Württemberg are called) and Eco-Model States. To be distinguished from these are →Food Councils[95], which are regarded as a niche in their own right.

Aim and innovation: The goal of Bio-Districts is to boost a sustainable, integrated, participatory, and (depending on the region) climate-neutral territorial development with a holistic approach, which binds various actors in the region or community to these goals through an innovative formal agreement. The specific goals and principles set out in this agreement vary greatly from community to community.

The holistic approach can include the following ecological, social and economic objectives: In the ecological dimension participatory landscaping and the introduction of agro-ecological system solutions at field level are promoted. From an economic point of view, the local closed value chains are strengthened by creating solid and fair local markets, which are accessible for organic producers. In addition, authorities boost rural employment by local public procurement. Furthermore, organic certification systems for producers should be simplified, and access to land for the younger generations made easier. At the same time, consumers benefit from greater transparency regarding the origin of their food and will be able to purchase fresh, local, organically grown products at local markets, events and public institutions.[96] Social inclusion projects aim to integrate people with disabilities, prisoners, drug addicts and migrants into the local community. In addition, food sovereignty, environmental awareness and cultural identity of local communities are promoted across all actors. [97]

Actors: Local authorities, associations, producers, consumers, local training centers and tour operators, gastronomy, schools, artisanal organic food processors, research institutes

Age of the niche: The first Bio-District was founded in 2009 in Cilento, Italy. Since then, the Italian state has supported the establishment of about 50 further bio-districts, of which 27 bio-districts in 18 regions had already been established in 2017[98]. Due to this high density, a special draft law on Bio-Districts and organic farming has been in place since 2017 in Italy[99]. From there, the Bio-District movement has expanded to Europe and Africa, where further Bio-Districts

[94] FAO (2017): The experience of Bio-districts in Italy. http://www.fao.org/agroecology/database/detail/en/c/1027958/ (20.02.2020)

[95] Haack, M., Engelhardt, H., Gascoigne, C., Schrode, A., Fienitz, M. & Meyer-Ohlendorf, L. (2020): Sozial-ökologische Transformation des Ernährungssystems: Nischen des Ernährungssystems. German Environment Agency, Dessau-Roßlau.

[96] Biostädte (n.d.): Ziele des Netzwerks. https://www.biostaedte.de/ueber-uns/aktuelles/67-was-biostaedte-und-oeko-modellregionen-verbindet.html (20.02.2020)

[97] FAO (2017): The experience of Bio-districts in Italy. http://www.fao.org/agroecology/database/detail/en/c/1027958/ (20.02.2020)

[98] ibid.; Grandi, C. & Triantafyllidis, A. (2010): Organic Agriculture in Protected Areas. The Italian Experience. FAO. Rome.

[99] Senato della Repubblica (2018): Legislatura 18[a] - Disegno di legge n. 988.

in France, Austria, Switzerland, Hungary, Slovakia, Portugal, Albania, Tunisia, Senegal and Morocco gained first experiences. In Germany, they take the shape of Eco-Model Regions respectively Bio-Model Regions or Bio-Cities and Eco-Cities or Bio-Villages/Eco-Villages. The latter can be distinguished from the Bio-District by their less comprehensively institutionalized approach with varying application levels of organic farming. There are numerous Eco-Model Regions throughout Germany. The German state of Hesse even wants to become the first Eco-Model State, as many districts are already Eco-Model Regions. Compared to Bio-Districts in other countries, especially in Italy, such models in Germany tend to focus on the promotion of the value added cycle of organic products. Additional ecological and social objectives vary from community to community. Overall, there exists a high potential for further development through the exchange of similar experiences in Europe.

State of development and current dynamics: In order to promote an exchange between the different communities, various networks have been set up over the past ten years: The International Network of Eco Regions (IN.N.E.R.) is linking Eco-Regions across Europe. The Global Ecovillage Network has evolved from the exchange between different Bio-Villages/Eco-Villages and first Europe-wide conferences have been held[100]. Next to other founding organizations[101], the German network 'Bio-Städte'[102] was involved in the foundation of the 'Organic Cities Network Europe' in Paris at the beginning of 2018, which counts already nice city members[103].

Examples: Cilento Bio-District - Italy[104], Bio-Distretto del Chianti - Italy, Biovallèe - France[105], Mühlviertel - Austria[106], Valposchiavo - Switzerland[107], Eco -Region Kaindorf - Austria[108], Bio-Cities Augsburg, Bremen, Darmstadt, Erlangen, Freiburg, Hamburg, Karlsruhe, Landshut, Lauf / Pegnitz, Leipzig, Munich and Nuremberg - Germany; numerous Eco-Model Regions in Germany

Sustainability potential:

- **Ecological:** Biodiversity (indirect), soil (indirect), water (indirect), climate (indirect), air (indirect), resource efficiency in production and consumption, promotion of regional, closed nutrient cycles
- **Economic:** Poverty reduction (indirect), strengthening of regional economic cycles, support of activities with positive external effects, increase of food security, promotion of recycling economy, fair producer prices (on national and global level), creation of transparency along the value chain

[100] One example is the European Ecovillage Conference, which took place in July 2019.

[101] Bio Forschung Austria, Città del Bio Italien, Eco-Estonia, Milan Center for Food Law and Policy

[102] At present, 14 cities (Augsburg, Bremen, Darmstadt, Erlangen, Freiburg, Hamburg, Karlsruhe, Landshut, Lauf / Pegnitz, Leipzig, Munich and Nuremberg) are part of the German network of Bio-Städte, which began to maintain exchanges in this form in 2010. In order to become part of the network, a cooperation agreement was signed by the founding cities: Bio-Cities, municipalities and districts have a corresponding council resolution; pursue self-defined goals; implement projects, actions, measures and appoint a responsible body or contact person. (Biostädte (n.d.): Mitmachen. https://www.biostaedte.de/ueber-uns/kooperationsvereinbarung.html (20.02.2020))

[103] The cities are Correns (France), Lauf (Germany), Milan (Italy), Nuremberg (Germany), Paris (France), Porec (Croatia), Seeham (Austria), Växjö (Sweden) and Vienna (Austria).

[104] Cilento (Campania) – BIO-DISTRETTO (2014 - 2019). http://biodistretto.net/bio-distretto-cilento/ (20.02.2020)

[105] Association des Acteurs de Biovallée (n.d.). Biovallée website: https://biovallee.net/ (20.02.2020)

[106] BioRegion Mühlviertel (n.d.): BioRegion Mühlviertel—Miteinander für ein gutes Leben. https://www.bioregion-muehlviertel.at/ (20.02.2020)

[107] 100 % Valposchiavo (2016): Regionale Produkte aus dem «Bio-Tal». https://www.graubuenden.ch/de/regionen-entdecken/geschichten/100-valposchiavo-regionale-produkte-aus-dem-bio-talc (20.02.2020)

[108] Verein Ökoregion Kaindorf (2018). https://www.oekoregion-kaindorf.at/ (20.02.2020)

- **Social:** Health: Access to healthy food (indirect), participation, social justice (indirect), awareness/ education for sustainable nutrition (indirect)

Risks / disadvantages: The holistic and sustainable character of a Bio-District requires complex knowledge for its implementation, since many different fields of action are involved. Communication with a large number of actors is therefore seen as the key to success and the unlocking of potential synergies. At the same time, it can also be very challenging, especially when the newly created models encounter established structures.[109] Here, good communication becomes even more important to highlight the advantages of the models. Another challenge can be the often small number of existing local artisanal processing businesses. As industrialization increased, these often had to give way to less pricy competitors. Thus in the beginning, there might be a lack of processing structures, recording and logistics facilities for small, locally-traded product quantities.

[109] Biostädte (n.d.): Was Biostädte und Öko-Modellregionen verbindet. https://www.biostaedte.de/ueber-uns/aktuelles/67-was-biostaedte-und-oeko-modellregionen-verbindet.html (20.02.2020)

3.6 Profile: Biocyclic vegan farming

Category: Intermediate consumption, production

Description: Biocyclic vegan farming (also known as 'bio-vegan farming' or 'veganic farming' - as a combination of 'vegan' and 'organic') does completely renounce animal husbandry and the use of animal or synthetic inputs in the organic cultivation of vegan food. This means that, for example, no manure, dung, slurry or slaughterhouse waste is used as fertilizer.

Aim and innovation: The majority of farms use animal or synthetic fertilizers in the production of vegan food. Organic farming is also often associated with livestock farming. In the case of the organic association Demeter, the keeping of roughage eaters is even obligatory and can only be dispensed with in exceptional cases[110]. Animal husbandry causes massive environmental damage worldwide, ranging from increased land requirements, damage to soil and groundwater, to negative effects on the climate. According to a study by the FAO, over 14 percent of the global greenhouse gases caused by humans are attributable to animal husbandry[111].

At the same time, the demand for vegetarian and vegan products is also measurable in Germany. According to the data of the Allensbach Institute for Public Opinion Research, 7.6% of consumers are "vegetarians or people who largely avoid meat"[112]. Another 1.1 % are "vegans or people who largely avoid animal products". Frequently these consumers of vegan food are not aware that these foods are also predominantly non-vegan in the narrower sense. Industrial supplies of animal origin such as blood, horn, hair, feather or bone meal are frequently used. There are considerable health concerns about these organic fertilizer pellets. They can be contaminated with germs, antibiotics and heavy metals. In the case of biocyclic vegan cultivation, no animal manure or inputs of animal origin are used at all.[113] Instead, great importance is given to a targeted humus formation on a plant basis, which can be achieved by composting in combination with green manure and mulching. If the plant residues used for the humus formation originate from the same farm, community or region, this also results in shorter transport distances. Soil fertility is also being promoted by a varied crop rotation, mixed crops and the cultivation of legumes such as clover-grass, lupines or peas.

A field test in Greece has shown that in the long term the nitrogen content as well as the content of other plant nutrients increased in the humus soil resulting from olive pomace compost[114]. As the nutrients in the humus soil are no longer water-soluble, they are completely available to the plant without causing over-fertilization, says Dr. Johannes Eisenbach, member of the board of directors of the Förderkreis Biozyklisch-Veganer Anbau e.V.[115] (Association for the Promotion of Biocyclic vegan Farming). A study on tomato cultivation confirms these observations. Tomato plants that grew in humus soil yielded up to 45% more than plants that were not treated at all or

[110] Demeter e.V. (n.d.) Richtlinien 2020. https://www.demeter.de/sites/default/files/richtlinien/richtlinien_gesamt.pdf (20.02.2020) p. 54.

[111] Gerber, P.J. et al. (2013). Tackling climate change through livestock – A global assessment of emissions and mitigation opportunities. Food and Agriculture Organization of the United Nations (FAO), Rome. p. 15.

[112] INSTITUT FÜR DEMOSKOPIE ALLENSBACH (n.d.). AW A 2016. Allensbacher Marktanalyse Werbeträgeranalyse CODEBUCH. https://www.ifd-allensbach.de/fileadmin/AWA/AWA2016/Codebuchausschnitte/AWA2016_Codebuch_Essen_Trinken_Rauchen.pdf (20.02.2020) p. 80.

[113] Vegconomist (2019): Im Interview mit dem Förderkreis Biozyklisch-Veganer Anbau e.V. über die Bio-vegane Landwirtschaft. 31.October 2019: https://vegconomist.de/interviews/im-interview-mit-dem-foerderkreis-biozyklisch-veganer-anbau-e-v-ueber-die-bio-vegane-landwirtschaft/ (20.02.2020)

[114] Biocyclic Park Kalamata, IFOAM ABM 2017. (2017). https://www.youtube.com/watch?time_continue=14&v=_HPCm-5acI0&feature=emb_logo (20.02.2020)

[115] Barkham, P. (2019): Rise of the vegan vegetable: The farmers who shun animal. In: The Guardian. https://www.theguardian.com/lifeandstyle/2019/jan/12/were-humus-sapiens-the-farmers-who-shun-animal-manure (20.02.2020)

were treated with inorganic fertilizer[116]. In addition, plant health is improved and more carbon can be bound in the soil through the humus.[117]

Actors: Farms, associations of producers, networks, consumers

Age of the niche: In Germany, organic farming without livestock was already discussed at the end of the 19th century. While animal husbandry is fundamental to biodynamic agriculture according to Rudolf Steiner, the land reform movement rejected animal husbandry because of its vegetarian principles.[118]

In Great Britain, the Vegan Organic Network[119] was founded in 1996 to promote the spread of vegan farming methods. Végéculture[120] has been providing a platform for people interested in vegan organic farming in the French-speaking world since the mid-2000s. In Europe, the Förderkreis Biozyklisch-Veganer Anbau e.V. provides information and educational work and supports farms in the conversion process. In 2008, the Veganic Agriculture Network[121] was founded in Canada to promote plant-based agriculture in North America.

State of development and current dynamics: Biocyclic vegan farming methods are developing in different variations in many countries around the world. They are often combined with other niches, such as →forest gardens, permaculture or horticulture. By now, especially the Förderkreis Biozyklisch-Veganer Anbau e.V. tries to promote the use of the term "biocyclic vegan farming" instead of "bio-vegan farming", as the latter is often used in the food sector to indicate that the ingredients are vegan and the cultivation is organic, but this often does not refer to the fertilization. Since 2017, there has been a seal of approval for biocyclic vegan farming in order to guarantee consumers transparency along the value chain[122]. For the first time, the seal provides information about the fertilization methods used and thus whether the cultivation of food has been vegan overall. The guidelines are recognized by IFOAM (International Federation of Organic Agriculture Movements) and have been included in the Family of Standards. As around 25 % of organic farms in Germany currently operate without livestock, it is assumed that there is a high potential for conversion to biocyclic vegan farming by replacing the animal or synthetic inputs. Especially for the market of vegan food products, such as plant-based milk, an increasing demand for a consistently vegan cultivation method can be expected. Other areas, such as wine production, can also switch to biocyclic vegan farming, as the first winegrowers in France have already shown.[123]

Examples: Biocyclic Park PC[124], OIKI BIO (Makrochóri Verías) [125], Ballyroe[126], Château La Rayre[127]

[116] Eisenbach, L. D. et al. (2019): Effect of Biocyclic Humus Soil on Yield and Quality Parameters of Processing Tomato (Lycopersicon esculentum Mill.). Bulletin of University of Agricultural Sciences and Veterinary Medicine Cluj-Napoca. Horticulture, 76(1), pp. 47–52. https://doi.org/10.15835/buasvmcn-hort:2019.0001
[117] Biozyklisch-Veganer Anbau e.V. (2018): FAQ zum biozyklisch-veganen Anbau. https://www.biozyklisch-vegan.de/wp-content/uploads/2018/11/FAQ_20180423.pdf (20.02.2020)
[118] Vogt, G. (2001): Geschichte des ökologischen Landbaus im deutschsprachigen Raum – Teil I*. p. 48. https://orgprints.org/1110/1/1110-vogt-g-2001-geschichte.pdf (20.02.2020)
[119] Vegan Organic Network (n.d.). https://veganorganic.net/ (20.02.2020)
[120] Végéculture (n.d.). https://www.vegeculture.net/ (20.02.2020)
[121] Vegan Agriculture Network (n.d.): History. https://goveganic.net/article4.html?lang=en (20.02.2020)
[122] Förderkreis Biozyklisch-Veganer Anbau e.V. (n.d.): Gütesiegel - Aus biozyklisch-veganem Anbau. https://biozyklisch-vegan.org/guetesiegel (20.02.2020)
[123] Chateau La Rayre (n.d.). http://www.chateau-la-rayre.com/gb/vignoble.htm (20.02.2020)
[124] BIOCYCLIC PARK (O.M.E.N. 7) (n.d.). http://www.biocyclic-park.com/ (20.02.2020)
[125] Οικο Βιο (n.d.). https://www.facebook.com/OikoBioGr/ (20.02.2020)
[126] Ballyroe (n.d.). http://homepage.eircom.net/~ballyroe/apprenticeship.html (20.02.2020)
[127] Chateau La Rayre (n.d.). http://www.chateau-la-rayre.com/gb/vignoble.htm (20.02.2020)

Sustainability potential:

- **Ecological:** Biodiversity, soil, water, climate, air, promotion of regional, closed nutrient cycles
- **Economic:** Strengthening of regional economic cycles, increase of food security, promotion of the recycling economy, creation of transparency along the value chain
- **Social:** Animal welfare

Risks / disadvantages: Depending on the method used, the conversion to biocyclic vegan farming can take quite some time.[128] The autonomous formation of humus soil takes about 2-4 years. Another challenge is the protection against pests. So far, this has been envisioned by promoting the balance of biodiversity, in particular by attracting predators of these pests.[129]

The amended German fertilizer ordinance ("Düngeverordnung") with its three-year nitrogen limit for compost could be an obstacle, as large quantities of biocyclic humus soil are essential for biocyclic vegan farming. Thanks to long storage times, the biocyclic humus soil does contain nitrogen, however 80% of it remains in the soil, where it contributes to improving the long-lasting humus. Although this is also subject to a gradual long-term decomposition process, only 1-2% of the nutrient and permanent humus is mineralized here per year.[130] The water-soluble nutrient and here in particular nitrogen compounds contained in this humus soil are therefore very low, and thus do not represent a nutrient leaching risk for the groundwater.[131] In order to ensure that biocyclic-vegan cultivation is not disadvantaged by this nitrogen upper limit and thus quantity restriction for the water-protecting humus soil, the biocyclic humus soil should ideally be excluded from the fertilizer ordinance and the compost ordinance or be specifically defined and differentiated.[132]

[128] Manson, J. (2020): Will 2020 be the breakthrough year for 'veganic' agriculture? In: Natural Products Global. https://www.naturalproductsglobal.com/environment/will-2020-be-the-breakthrough-year-for-veganic-agriculture/ (20.02.2020)
[129] Pacific Roots Magazine (n.d.): Podcast Episode V: Dr. agr. Johannes Eisenbach, Panhellenic Biocyclic Vegan Network. http://pacificrootsmagazine.com/podcast-episode-v-dr-agr-johannes-eisenbach-panhellenic-biocyclic-vegan-network/?fbclid=IwAR3WfUIHsBu42evRDBabwPq66_hiignL22Q-Ec47XRcCi5ycyk9chWcE76g (20.02.2020)
[130] H&K (2015): Humusdünger. Humuswirtschaft & Kompost. 8/9, 2015. https://www.kompost.de/fileadmin/user_upload/Dateien/HUK_aktuell/2015/H_K-8_9-2015.pdf (24.02.2020)
[131] ibid.
[132] Biozyklisch-Veganer Anbau e.V. (2018): FAQ zum biozyklisch-veganen Anbau. https://www.biozyklisch-vegan.de/wp-content/uploads/2018/11/FAQ_20180423.pdf (20.02.2020)

3.7 Profile: Digital Farming

Category: Intermediate consumption, production

Description: The terms Digital Farming, Smart Farming and Agriculture 4.0 describe the use of digital information and communication technologies in agriculture. The digitalization of agriculture is also called the 'Third Green Revolution'.

Aim and innovation: The digitalization of agriculture aims at a more efficient use of resources for the protection of the environment and animals as well as at an increasing economic profitability.[133] Through a targeted use of digital technologies, farmers can be supported in their operational decisions. More information can be collected and also made available externally.

Digital Farming can be structured around three key areas:

1. Management of information systems: These are systems for collecting, processing, analyzing, storing and communicating data for further use in subsequent processes. For example, field record software enables farmers to digitally control and manage all farm processes, which can lead to reduced workload.
2. Precision Farming: This refers to methods that adapt the input for working agricultural land to the different soil conditions within a field. The input includes inter alia fertilizers, seeds, plant protection products and fuel for soil cultivation. This way, negative environmental impacts can be reduced and resources saved[134]. For example, the amount of fertilizer required can be reduced with a combination of satellite-controlled application and soil samples (soil probes).
3. Agricultural automation and robotics: This involves the application of artificial intelligence at various stages of agricultural production, including robots (e.g. milking robots, farmbots) and drones. Field robotics stands for the use of light, unmanned vehicles for tillage, seeding and weed control with the aim of avoiding soil compaction by heavy vehicles. In pest management, drones have been used for some time now. In corn fields, for example, the drones drop eggs from beneficial insects, which act as an antagonist to vermin and contain their spread.

Actors and players: Producers, technology providers

Age of the niche: Precision Farming and Smart Farming methods have been applied in practice extensively for more than two decades (status 2018)[135]. Precision Farming is considered the most significant innovation in U.S. agriculture, introduced in the mid-1980s[136]. However, its spread has sometimes been relatively slow due to the high initial costs[137].

The benefit of Precision Farming to reduce the risk of pesticide leaching to groundwater in sandy soils was first investigated in 1996 in American field trials[138]. A key innovation for the development of digital technologies, such as steering systems, was the invention of GPS, which was developed for military purposes in the late 1970s[139].

[133] Bundesministerium für Ernährung und Landwirtschaft (2018): Digitalisierung in der Landwirtschaft. Chancen nutzen - Risiken minimieren. p. 21.
[134] Mulla, D. und Khosla, R. (2017): Historical Evolution and Recent Advances in Precision Farming.
[135] Bundesministerium für Ernährung und Landwirtschaft (2018): Digitalisierung in der Landwirtschaft. Chancen nutzen - Risiken minimieren.
[136] Napier, T. L.; Robinson, J. und Tucker, M. (2000): Adoption of precision farming within three Midwest water-sheds.
[137] Mulla, D. und Khosla, R. (2017): Historical Evolution and Recent Advances in Precision Farming, p. 22.
[138] ibid, p. 20.
[139] Larsen, W. E. et al. (1988): Field navigation using the global positioning system (GPS).

State of development and current dynamics: In the US, digital farming tools are already used by an estimated 20-80% of farmers[140]. In Europe, on the other hand, the use is estimated at 0-24%[141]. It is a rapidly growing sector, where new technologies are constantly being developed and mainly applied on large farms. Currently, there is a trend for large corporations to focus on big data, which includes the data collection of soil fertility, plant stress and climate[142].

Examples: BoMill - Sweden[143], System Cameleon from Gothia Redskap - Sweden[144], senseFly - Switzerland[145], Hummingbird - United Kingdom[146]

Sustainability potential: The sustainability potential of the various technologies, which are summarized herewith under Digital Farming, differs greatly from one another. The following values should be understood as average figures. Single innovations may differ significantly from these.

- **Ecological:** Soil (indirect), water (indirect), climate (indirect), air (indirect), resource efficiency in production and consumption
- **Economic:** Increase of food security (indirect), creation of transparency along the value chain
- **Social: -**

Risks / disadvantages: Prerequisites for the digitization of agricultural processes are an able-bodied rural infrastructure, access to these modern technologies on farms and, in particular, tech-savvy employees on farms. Instead of the frequent patenting of modern technologies, open source solutions can be promoted to ensure the cost-effective access for small farms. In addition, this would promote a faster and more participatory further development of the technologies.

A number of risks and disadvantages are associated with the various digital farming techniques. According to scientists at the Thünen Institute, it is assumed that jobs will tend to be lost over the next ten to fifteen years as a result of the digitalization of agriculture, especially in the area of low-skilled jobs[147]. The application of Digital Farming is mainly economical viable for larger farms by creating high-tech jobs.[148] Michelsen of INKOTA-netzwerk e.V. points out that, among other things, vertical mergers of companies at different process stages driven by digitization can lead to a concentration of power[149]. Mooney, working in the field of international cooperation, also sees dangers for small-scale farming structures when technologies encounter unequal societies[150]. Small farmers in particular could be disadvantaged: "For example, almost half of all agricultural research by the private sector is concentrated on a single crop, maize. As a result, the interest of plant breeding companies in the 7,000 food crops grown by small farmers (in conditions where robots have not yet set foot) is negligible. This could urge governments to

[140] Kernecker, M. et al. (2018): D2.4 Peer-reviewed paper. Smart AKIS. Smart Farming Thematic Network. https://www.smart-akis.com/wp-content/uploads/2019/01/Peer-reviewed-paper.pdf
[141] ibid.
[142] Mulla, D. und Khosla, R. (2017): Historical Evolution and Recent Advances in Precision Farming. p. 24.
[143] Bomill (n.d.). https://bomill.com/ (20.02.2020)
[144] Gothia Redskap (2018). https://www.gothiaredskap.se/c (20.02.2020)
[145] SenseFly (2020): SenseFly—The Professional's Mapping Drone of Choice. https://www.sensefly.com/ (20.02.2020)
[146] Hummingbird Technologies (2019). https://hummingbirdtech.com/ (20.02.2020)
[147] Bundesministerium für Ernährung und Landwirtschaft (2018): Digitalisierung in der Landwirtschaft. Chancen nutzen - Risiken minimieren. p. 21.
[148] ibid.
[149] ibid.
[150] Mooney, P. & ETC Group. (2018): Blocking the chain. Industrial food chain concentration, Big Data platforms and food sovereignty solutions. INKOTA, ETC Group, Glocon & Rosa-Luxemburg-Stiftung. https://webshop.inkota.de/node/1551

further discriminate against this plurality of species, and instead create sufficient markets for more 'commercial' plants"[151]. In addition, small farms are now increasingly threatened by large corporations' takeovers, as the application of the new technology makes even small fields economically interesting for large corporations. At the same time, the competitiveness of small farms is decreasing, as they cannot keep up with the cost-intensive equipment[152]. In order for new technologies to benefit small farm structures as well, it should be ensured that their needs are taken into account in the development of the technologies, that they are given access to the technologies, for example in the form of open source, and that they possess their data themselves[153].

Defective technologies and algorithms can also have negative effects. If a wrong decision is made due to the technology, entire harvests can be destroyed[154]. Also the risk of confidential internal company data being passed on to third parties cannot be ruled out either.

[151] ibid. p. 28.
[152] ibid. p. 31.
[153] Michelsen, L. (2018): INKOTA-Infoblatt Welternährung 17: Digitalisierung. INKOTA-netzwerk e.V. https://webshop.inkota.de/node/1555
[154] ibid. p. 29.

3.8 Profile: Effective Microorganisms

Category: Intermediate consumption, production, consumption

Description: Effective microorganisms, or 'EM' for short, is a purposefully compound mixture of naturally occurring microorganisms, sometimes used to inoculate plants and soils to improve soil quality and plant growth. EM are composed of many microbial species. Among the most important are photosynthetically active bacteria, lactic acid bacteria and yeasts[155]. These microorganisms live symbiotically, which means they support each other.

Aim and innovation: The use of EM aims to stabilize the microbial environment in general and to shift it in a direction that is ideal for the respective purpose of application. For example, microorganisms such as putrefactive agents are very important in nature for degradation and conversion processes, however they are undesirable in the storage of food products. In that case, different species in EM solutions can contain the spread of putrefactive agents and suppress other pathogens. In the field of plant production or soil remediation, EM can enrich the diversity of organisms that, among other things, break down nutrients in soil so that they can be more easily absorbed by plants. In numerous studies, an increase in yield and quality in plant production[156] as well as an increase in soil quality through a higher vitality of soil life[157] have been observed after inoculation of EM. Also in the field of animal husbandry, EM is sprayed to relieve odors, germs and rot, as well as to enhance the value of the manure already in the barn. Other new areas of application are cosmetics, personal hygiene, food supplements and drinking water purification[158].

Research results on the qualities of EM as an organic fertilizer are already made available, from which a positive fertilizing effect can be derived[159]. One EM application also known in the Western cultural area is Bokashi. *Bokashi* means fermented potpourri[160], which in Japan consists mainly of rice bran, oil mill press cake or fish remains. This is fermented with EM. By doing so, an improved soil quality could be observed in some experiments[161].

Actors and participants: Producers (e.g. vegetable growers) in almost all areas with high hygiene standards

Age of the niche: The term EM and the concept of 'good microorganisms' was coined in the 1980s by the Japanese horticulture professor Teruo Higa. Originally, he developed EM as a soil additive that can be used to reduce mineral fertilizers and pesticides. In the beginning EM spread throughout Japan, the country of origin, and some countries of the Global South like

[155] Higa, T., & Parr, J. F. (1994): Beneficial and effective microorganisms for a sustainable agriculture and environment. International Nature Farming Research Center; Iwahori, H. and T. Nakagawara (1996): Studies on EM application in nature farming V. Applying methods of EM bokashi in vegetable culture. Annual Meeting of Japanese Society of Soil Science and Plant Nutrition. Tokyo.; Iwashi, p. (1994): Effects of EM bokashi on various paddy-rice varieties. Annual Meeting of Asia-Pacific Nature Agriculture Network.; Suzuki, Y. (1985): Effects of effective microorganisms on yield and quality of gin-seng herbs. Symposium of Applied Soil Microbiology. November 22, 1985, Urazoe, Okinawa.

[156] Asia-Pacific Natural Agriculture Network (1995): EM application manual for APNAN countries. M. Shintani. Asia-Pacific Natural Agriculture Network, Bangkok, Thailand.

[157] Higa, T., & Parr, J. F. (1994): Beneficial and effective microorganisms for a sustainable agriculture and environment. International Nature Farming Research Center.

[158] EMIKO Handelsgesellschaft mbH. (n.d.): EMIKO Online Shop. https://www.emiko.de/shop/ (20.02.2020)

[159] Shokouhian, A.A. (2019): The effect of application of EM Bio fertilizer and Urea on Strawberry (Fragaria ananassa cv. Paros) for Sustainable Agriculture. Journal of Water and Soil Conservation, Vol. 26(2), 2019; DOI: 10.22069/jwsc.2019.14138.2886

[160] DIMIKRO GmbH. (n.d.): Bokashi Eimer—Organischen Bokashi Dünger aus Bio-Abfall selbst herstellen. https://www.em-kaufhaus.de/Bokashi (20.02.2020)

[161] Noparatraraporn, N. (1996): Thailand collaborative research on evaluation of EM and EMproducts, their feasibility testing and effects of their uses on agriculture and environment. Open Symposium: Present Situations and Prospects of Microorganismsas Agricultural Materials. August 1996, Tokyo.

Thailand and Brazil, where it was included in the production of Terra Preta. In the past twenty years, EM has found its way to Europe.

State of development and current dynamics: A digital global EM community has established itself on the Internet and generates a lively exchange of knowledge. This has opened up a large number of new areas of application in addition to improving soil quality, such as applications for humans (drinking water treatment, intestinal cleansing, food supplements), in animal husbandry (stable and cage cleaning, animal care, feed supplements, appetite stimulants, infection treatment, wound healing), in water (natural cleaning of ponds and lakes), in waste management (odor prevention) and in the household (care and cleaning products). Due to the good networking of the worldwide EM community, there is a large number of instructions and seminars on the making and growth of EM. In many countries, newly founded companies with their own EM brands are on the rise. In Germany, too, there are already research projects[162] and some companies offer a wide range of EM products. There is still plenty of scope for the exchange of experiences between players from Germany and Europe.

Examples: Emiko[163], TriaTerra[164], Dimikro[165], EM e.V. - Gesellschaft zur Förderung regenerativer Mikroorganismen[166], EMRO, Agriton[167]

Sustainability potential:

- **Ecological:** Biodiversity (indirect), soil, water, air (indirect), resource efficiency in production and consumption, promotion of regional, closed nutrient cycles (indirect)
- **Economic:** Strengthening of regional economic cycles (indirect), increase of food security (indirect)
- **Social:** Health (indirect), animal welfare

Risks / disadvantages: A frequent criticism is that EM experiments are not easily replicable by non-professionals, due to the complex knowledge required regarding the composition of EM.[168] In addition, despite various research projects with first positive results, there remains a lack of multi-year studies that can reliably prove a positive effect. However, there is also a lack of studies which could prove the contrary- a risk to humans, animals or the environment deriving from the use of EM. In contrast to EM as soil additives, the majority of EM solutions for body treatment and drinking are not yet legally approved in Europe. Doctors in particular tend to view them with skepticism.

The purpose of using EM solutions to increase the feed intake of animals should be treated with caution in light of the underlying monetary incentive[169] for livestock farmers. Excessive use in that case could lead to negative health consequences for farm animals.

[162] BBIB (2019): Vielfalt in der Uckermark. Forschungsprojekte 2015-2018. University of Potsdam. Free University of Berlin. Leibniz Centre for Agricultural Landscape Research (ZALF). June 2019: Brunswick. pp. 34-39.
[163] EMIKO (n.d.): EMIKO. https://www.emiko.de/ (20.02.2020)
[164] TriaTerra (n.d.). https://www.triaterra.de/ (20.02.2020)
[165] Effektive Mikroorganismen (n.d.): Effektive Mikroorganismen—EM Produkte, Infos & Beratung. https://www.em-kaufhaus.de/ (20.02.2020)
[166] EM e.V. (2020). https://emev.de/ (20.02.2020)
[167] EM Agriton (n.d.). http://www.agriton.be/ (20.02.2020)
[168] Higa, T., & Parr, J. F. (1994): Beneficial and effective microorganisms for a sustainable agriculture and environment. International Nature Farming Research Center. pp. 7-8.
[169] Rackl, C. (2006): Praktische Erfahrungen mit effektiven Mikroorganismen (EM) in Pflanzenbau und Tierhaltung. Fachhochschule Weihenstephan. p. 87.

3.9 Profile: Flowering Meadows

Category: Intermediate consumption, production, consumption

Description: Seeds of wild flowers and herbs are scattered on the roadsides[170], public areas, parks, gardens, and meadows, as well as between fields and in settlement areas, in order to create living habitats for wild insects. While doing so, regional seeds of wild flowers and herbs are being used that are adapted to the soil type and local conditions.

Aim and innovation: Due to intensive agriculture, the habitat of wild insects, especially wild bees, has been severely restricted. In agricultural landscapes, the population has already decreased significantly due to pesticides, large-scale monocultures and edges of fields that have been systematically converted into arable land[171]. Already half of the approximately 560 wild bee species native to Germany are threatened by extinction.[172] As a result, crop plants are also less frequently pollinated, which is directly related to our ability to secure agricultural yields and thus to guarantee overall food security[173].

The aim is to create a vital habitat and natural equilibrium in potential meadow areas by providing sufficient food for wild insects such as mason bees, bumblebees, butterflies, leaf-cutter bees and stingless bees. By not cultivating, mowing or grazing these flowering meadows, nesting opportunities and food plants can develop, which thus provide the wild bees with a long-term food supply of nectar and pollen up into the winter[174]. In addition, the flowering meadows contribute to soil fertility and biodiversity, as birds, reptiles and small mammals get also attracted.[175] As a result, 80% of all flowering plants worldwide that are pollinated by insects (of which 85%, mostly fruit trees, are pollinated by honey bees) can ensure their reproduction.[176]

Actors: District councils, schools, gardeners, farmers, all people

Age of the niche: It is assumed that (wild) bees already lived during the Cretaceous period about 100 million years ago and since then, together with flowering plants, have developed their symbiotic function of food and reproduction.[177] Due to the globalized and industrialized land use, a widespread colony collapse disorder of the western honeybee occurred worldwide, particularly in the 1990s, which triggered a strong resonance in the media.[178] As a consequence, the interest, especially in Western urban regions[179], to create new habitats for honey bees has

[170] Norfolk, O. (2019): How roadside flowers and makeshift meadows are saving our struggling bees. The Independent. https://www.independent.co.uk/environment/roadside-wildflowers-meadows-bees-uk-a8998866.html (20.02.2020)
[171] Garibaldi, L. A., et al. (2013): Wild Pollinators Enhance Fruit Set of Crops Regardless of Honey Bee Abundance. Science, 339(6127), pp. 1608–1611. https://doi.org/10.1126/science.1230200
[172] Fürsten-Reform Dr. med. Hans Plümer GmbH & Co. KG. (2019): Bienen als Bestäuber. BIHOPHAR HONIG. https://www.bihophar.de/de/bienenparadies/bienen-als-bestaeuber.html (20.02.2020)
[173] Garibaldi, L. A., et al. (2013): Wild Pollinators Enhance Fruit Set of Crops Regardless of Honey Bee Abundance. Science, 339(6127), pp. 1608–1611. https://doi.org/10.1126/science.1230200
[174] NABU Mecklenburg-Vorpommern. (n.d.): Wildbienen - NABU Mecklenburg-Vorpommern. .https://mecklenburg-vorpommern.nabu.de/tiere-und-pflanzen/insekten-und-spinnen/bienen-und-co/wildbienen/index.html (20.02.2020)
[175] Soliveres, S. et al. (2016): Biodiversity at multiple trophic levels is needed for ecosystem multifunctionality. Nature, 536(7617), pp. 456–459. https://doi.org/10.1038/nature19092
[176] Schwartauer Werke (2019): Die Bienen und unsere Ernährung. Bee Careful. http://www.bee-careful.com/de/initiative/der-einfluss-von-bienen-auf-unsere-taegliche-ernae/
[177] Michael S. Engel (2000): A New Interpretation of the Oldest Fossil Bee (Hymenoptera: Apidae). American Museum Novitates. Band 3296, 2000. pp. 1–11.
[178] Van Engelsdorp, D. & Meixner, M.D. (2010): A historical review of managed honey bee populations in Europe and the United States and the factors that may affect them. Journal of Invertebrate Pathology. January 2010, 103, pp. S80-S95, doi:10.1016/j.jip.2009.06.011
[179] Stadtbienen (n.d.): Kurse. https://www.stadtbienen.org/kurse/ (20.02.2020)

grown significantly. As a consequence the bee populations did too.[180] However, to protect the biodiversity of wild plants and cultivated plants, a high proportion of wild bees, bumblebees and butterflies is also required, as some plant flowers can only be pollinated by certain insects due to evolution, such as the tomato, field beans and peas from the bumblebee.[181] So if more species were to die out, certain wild and cultivated plants would no longer exist, even if the honeybee is better and better protected. Moreover, studies show that wild bees pollinate plant flowers twice as efficiently as honey bees, regardless of the farming system and crop.[182]

State of development and current dynamics: In Europe, more and more initiatives are emerging from the general public to organize joint sowing on meadows (e.g. with seed bombs or ›beebombs‹[183]).[184] In the *Honey Highway* project in the Netherlands[185], elementary school children and students help with the sowing on the sides of the highway. This practical activity is a good educational opportunity to develop awareness of natural cycles and sustainable action at an early age. In France, initiatives and competitions for flowering meadows[186] are in place all over the country, which, according to studies, have already had a positive effect on biodiversity. [187] In the UK, a few local councils decided to sow flowering meadows instead of mowing, which in turn has the advantage of saving funds of the community for the mowing.

Examples: Honey Highway - Netherlands[188], Concours des prairies fleuries - France, United Kingdom

Sustainability potential:

- **Ecological:** Biodiversity, soil, water (indirect), climate (indirect), air (indirect), resource efficiency in production and consumption, promotion of regional, closed nutrient cycles
- **Economic:** Support of activities with positive external effects, increase of food security, promoting of recycling economy
- **Social:** Awareness/ education for sustainable nutrition, animal welfare

Risks / disadvantages: There are no risks involved as long as there are no attempts to breed the wild insects. Breeding wild insects carries the risk of viruses and parasites to spread as soon as there is a high concentration of otherwise wild insect species on a small area, as seen with the

[180] Deutscher Imkerbund e.V. (2007-2019): Deutscher Imkerbund e. V.. Imkerei in Deutschland Zahlen-Daten-Fakten. https://deutscherimkerbund.de/161-Imkerei_in_Deutschland_Zahlen_Daten_Fakten (20.02.2020); Quarks (2018): Darum sind Wildbienen wichtiger als Honigbienen. https://www.quarks.de/umwelt/tierwelt/darum-sind-wildbienen-wichtiger-als-honigbienen/ (20.02.2020)

[181] Garibaldi, L. A., et al. (2013): Wild Pollinators Enhance Fruit Set of Crops Regardless of Honey Bee Abundance. Science, 339(6127), pp. 1608–1611. https://doi.org/10.1126/science.1230200; Das Hummelhaus (2019): Hummeln als Bestäuber – Das Hummelhaus. https://www.das-hummelhaus.de/einleitung/wirtschaftliche-bedeutung-von-hummeln

[182] ibid.

[183] Beebombs (n.d.): Beebombs. https://www.beebombs.de/ (20.02.2020)

[184] An example here is the ›CSA Natural Farm and Public Food Forest‹ in Tunceli, Turkey. (Cetingulec , M. (2018). Turkey's first 'communist' grocery chain goes global. In: Al-Monitor. https://www.al-monitor.com/pulse/originals/2018/11/turkey-first-communist-grocery-chain.html#ixzz5tUs5s1gs)

[185] Honey Highway (n.d.): Dauerhaftes Paradies für Bienen. https://www.honeyhighway.de/ (20.02.2020)

[186] EUROPARC France (2019): Flowering Meadows Contest in France. https://www.europarc.org/case-studies/flowering-meadows-contest-france/ (20.02.2020)

[187] Technische Universität München (2016): Flowering meadows benefit humankind. https://www.tum.de/nc/en/about-tum/news/press-releases/details/33330/ (20.02.2020); Fleury, P. et al. (2015): Flowering Meadows. A result-oriented agri-environmental measure: Technical and value changes in favour of biodiversity. Land Use Policy, 46, pp. 103–114. https://doi.org/10.1016/j.landusepol.2015.02.007

[188] Honey Highway (n.d.): Dauerhaftes Paradies für Bienen. https://www.honeyhighway.de/ (20.02.2020)

example of bumblebee breeding for pollinating tomato flowers.[189] These diseases can then also spread to other wild species outside the breeding area, thus posing a risk to their populations and to general food security.[190]

[189] Arbetman, M.P. et al. (2013): Alien parasite hitchhikes to Patagonia on invasive bumblebee. Biological Conservation.March 2013. 15:3. pp. 489–494. https://doi.org/10.1007/s10530-012-0311-0
[190] Sheila R. Colla et al. (2006): Plight of the bumble bee: Pathogen spillover from commercial to wild populations. Mai 2006. 129: 4. pp. 461-467. https://doi.org/10.1016/j.biocon.2005.11.013

3.10 Profile: Humanure

Category: Intermediate consumption, consumption, waste and recycling

Description: Humanure, as an ecological sanitation system, provides for the recycling of human faeces and urine to meet inter alia open nutrient requirements in agriculture. In doing so, secondary resources are recycled by composting or technically processing the human waste into fertilizer, animal feed or fuel.[191]

Composting human faeces is similar to composting ordinary food leftovers or leaf litter. The fermentation system with an appropriate storage time is a simple form of composting toilet that promotes the composting of human faeces and organic carbon materials. Composting at a high temperature eliminates the possible germ load by destroying pathogenic organisms. There are different methods of mechanized or manual composting (see below the stage of development and current dynamics).

Aim and innovation: Due to the spread of liquid manure from industrial livestock farming on intensively farmed areas, many antibiotic residues get into the groundwater. In addition, hormones, drugs and chemicals in the wastewater of hospitals and the (pharmaceutical) industry also cause a high input of trace substances, which are transported in the form of sludge from sewage treatment plants back into the agriculture and thus into the water cycles. The treated water from sewage treatment plants is also increasingly causing eutrophication of water bodies.

Ecological sanitation through dry/compost toilets or through container systems saves the high drinking water wastage of flush toilets of an average of 35 liters per person per day. Instead, valuable nutrients and carbon are returned into the soil in order to restore soil fertility. Moreover, the cultivation of carbon in the soil causes less harm to the climate. Furthermore, energy consumption for sewage disposal and fertilizer production is reduced. [192]

The `innovative' aspect of Humanure is the paradigm shift to also use human feces for fertilizing growing foods, and instead of treating them as a human 'waste', they are perceived as valuable products that can be recycled to meet important nutrient balances for soil, water and climate.

Actors and stakeholders: Consumers, public sewage systems, wastewater treatment plants, producers, suppliers

Age of the niche: The use of human faeces and urine for fertilization goes back a long time in history. Already more than 7000 years ago, the indigenous population of the Amazon enriched the fertility of the rainforest soil with the help of the so-called 'Terra Preta', which is composed of plant remains, dung, coal, clay fragments, bones and human faeces. A first type of compost toilet was invented in the middle of the 19th century by the English clergyman Henry Moule[193], after cholera killed about 10,000 people in London. At the same time similar systems were developed in the USA, in which a bucket was placed under a chair, which, after being used, was given a layer of ashes, earth or similar material to reduce odors. Since the 1990s, there has been a wide range of compost toilets available for purchase in Europe.

[191] Krause, A. et al. (2015): Kohlenstoff- und Nährstoffrecyling mit Bioenergie- und ökologischer Sanitär-Versorgung. Conference Paper: Workshop "Biokohle im Gartenbau - Verwertung von organischen Reststoffen zur Schließung von Energie- und Stoffkreisläufen", Volume: Book of Abstracts, Botanical Garden, Berlin, pp. 47-50

[192] Nana (2012): Permakultur: Klima wandeln mit Menschenmist. Klimaschutz. https://reset.org/blog/permakultur-klima-wandeln-mit-menschenmist (20.02.2020)

[193] Öko-Energie (2018): Komposttoiletten—Sauber und umweltfreundlich! https://www.oeko-energie.de/produkte/komposttoiletten/index.html (20.02.2020)

Stage of development and current dynamics: In many places, especially since the publication of Joseph C. Jenkins' book 'The Humanure Handbook' in 2013, compost toilets are being built by individuals who carry out the composting and fertilization in the garden themselves, as it is a cost-effective and self-constructible system in addition to the positive environmental influences. Through centrally organized collection, transport and treatment, entire residential complexes in urban areas could also convert to compost toilets with a system of replaceable faeces cartridges. Some companies are experimenting with building decentralized sewage treatment plants with microorganisms and plants on their roofs. As an organized form, there are also many (technical) approaches in countries of the Global South, especially in order to counteract the difficulties in densely populated regions without sewage connections[194].

Examples: Compost toilets, compost toilet suppliers (e.g. Nature's Head, EcoLakay toilets, etc.), Sedron Technologies[195], City of Zurich - Switzerland[196], Clivus Multrum - Sweden[197], Separett AB - Sweden[198]

Sustainability potential:

- **Ecological:** Soil, water, climate, air, resource efficiency in production and consumption, promotion of regional, closed nutrient cycles
- **Economic:** Promotion of recycling economy, creation of transparency along the value chain
- **Social**: -

Risks / disadvantages: Due to toxic bacteria such as coliform bacteria, composting toilets can, depending on the system used, pose a higher risk of infection than classical toilets[199]. Proper composting can improve sanitation and reduce coliform bacteria content by more than 99% according to a study[200]. Also when fertilizing with human excrement, proper storage and handling is important to minimize risks. [201]

The situation is different for the input of pollutants into the environment, which is known from the use of sewage sludge in agriculture. This way heavy metals and organic pollutants can enter the environment[202]. "Open questions in sewage sludge assessment concern the contamination of sewage sludge with persistent organic pollutants, the spread of antibiotics causing resistance

[194] Technology systems are being developed to counteract the shortage of drinking water and the parallel lack of sanitary facilities, especially in countries of the Global South. Human excrement, which consists of 85% water, is heated to a high temperature, so that the resulting water vapour is filtered and cooled in the next step to produce distilled drinking water. The remaining dry excrement is reused as an energy supplier for heating. In this process, additional electricity is generated, which can be supplied to the local electricity systems. It also offers the possibility to use waste as fuel. (Sedron Technologies (n.d.): Janicki Omni Processor. https://www.sedron.com/janicki-omni-processor/how-it-works/ (20.02.2020)).

[195] Sedron Technologies. (n.d.). https://www.sedron.com/ (20.02.2020)

[196] Hohler, S. (2019): Ein WC-Sitz aus Bambus, eine Spülung mit Holzspänen. Tages Anzeiger. https://www.tagesanzeiger.ch/zuerich/stadt/ein-wcsitz-aus-bambus-eine-spuelung-mit-holzspaenen/story/17725677 (20.02.2020)

[197] Clivus Multrum—Composting Toilets (2020). http://www.clivusmultrum.eu/ (20.02.2020)

[198] Separett—Waterless toilets (n.d.). Separett website: https://www.separett.com/en-gb/ (20.02.2020)

[199] Nakagawa, N. et al. (2006): Application of microbial risk assessment on a residentially-operated Bio-toilet. Journal of Water and Health, 4(4), pp. 479–486. https://doi.org/10.2166/wh.2006.0031; Stenström, T.A., Seidu, R., Ekane, N., Zurbrügg, C. (2011). Microbial exposure and health assessments in sanitation technologies and systems - EcoSanRes Series, 2011-1. Stockholm Environment Institute (SEI), Stockholm, Sweden. p. 103ff

[200] Hertel, C. (2017): Nutzung von Komposttoiletten auf dem Stuttgarter Kirchentag 2015 als praktisches Beispiel von Nachhaltigkeits-kommunikation in den Bereichen Ressourcenschonung, Stoffstrommanagement, Kreislaufwirtschaft und Klimaschutz des deutschen Kirchentags. p. 30.

[201] Winker, M. et al. (2009): Fertiliser products from new sanitation systems: Their potential values and risks. Bioresource Technology, 100(18), pp. 4090–4096. https://doi.org/10.1016/j.biortech.2009.03.024

[202] Oliva, J. et al. (2009): Klärschlamm – Materialien zur Abfallwirtschaft. Umweltbundesamt, Klagenfurt, Wien. p. 55.

and the safety of sewage sludge with regard to epidemics"[203]. These questions have also not yet been clarified with regard to the use of Humanure.

In order for compost toilets to be widely used in urban areas, numerous hurdles still have to be overcome. These include social acceptance, legal requirements and knowledge gaps regarding the design and handling of the toilets[204].

[203] ibid, p. 56.
[204] Anand, C. K., & Apul, D. S. (2014). Composting toilets as a sustainable alternative to urban sanitation – A review. Waste Management, 34(2), pp. 329–343. https://doi.org/10.1016/j.wasman.2013.10.006; Branstrator, J. (2014). The Barriers To Adopting Composting Toilets Into Use In Urban And Suburban Locations In The United States. Open Access Theses. https://docs.lib.purdue.edu/open_access_theses/304 (20.02.2020)

3.11 Profile: Insect food products

Category: Production, trade, consumption

Description: Insect food products can replace traditional meat as a source of protein and are less resource-intensive and harmful to the climate. In practice, for example grasshoppers, crickets, mealworms and other insect larvae are processed.

Aim and innovation: Different motives are pursued with the production of insects as an alternative protein source. These include increasing sustainability[205] by reducing resource consumption, promoting regional sources of protein[206], reducing climate-damaging greenhouse gases and reducing water consumption[207]. Insects have a very high protein content and provide important nutrients such as iron or magnesium, while they require only a fraction of the resources (land, feed and water) needed for conventional animal husbandry.[208] Moreover, greenhouse gas emissions are significantly lower than those of conventional meat production: Compared to pig farming, mealworms produce ten to a hundred times less climate-damaging gases per kilogram of body mass"[209]. Their resource efficiency also makes insects interesting as feed for conventional meat and fish production (→Alternative protein feeds).

Actors: Food producers, consumers, gastronomy, food retail

Age of the niche: While insects (and algae) are traditionally used as food in other parts of the world, in Europe their processing, trade and consumption is still quite young[210]. This is partly due to the recently changed EU food regulations[211], but also to the cultural perception of insect food products in Western countries[212].

State of development and current dynamics: At the latest with the new EU regulation, a new dynamic has also emerged in Europe. Research, product innovations and gastronomy offers in the field of insect food can be observed in many European countries such as the Netherlands, Denmark, Belgium and France. Thereby insects are often added as a processed ingredient - for example in the form of flour products.

Examples: Kriquet[213], Wurmfarm - Austria[214], ZIRP[215], SENS[216], , Griidy[217], Savonia Grasshopper[218], micronutris[219], Insectarium[220]

[205] Sensbar (2018): Why Crickets? SENS Cricket Flour Bars. https://www.sensbar.com/en/why-crickets (20.02.2020); ZIRP Insects. (n.d.): Wieso Insekten essen? https://www.zirpinsects.com/wieso-insekten/ (20.02.2020)

[206] Die Wurmfarm (2019): Mehlwurmzucht in Österreich. https://www.diewurmfarm.at/ (20.02.2020)

[207] Kriket Blog (n.d.): Crickets. https://kriket.be/crickets (20.02.2020)

[208] Rempe, C. (2014): Hui oder pfui: Insekten in der menschlichen Ernährung. Ernährung im Fokus 14(07-08), pp.198–202

[209] ibid.

[210] Smith, R. & Barnes, E. (2015): PROteINSECT Consensus Business Case Report 'Determining the contribution that insects can make to addressing the protein deficit in Europe'. Minerva Health & Care Communications Ltd. http://www.proteinsect.eu/fileadmin/user_upload/deliverables/PROteINSECT_CBC_FINALv1.pdf p. 16ff.

[211] Novel Food Regulation (EU) 2015/2283

[212] Van Huis, A. et al. (2013): Edible Insects: Future Prospect for Food and Feed Security. FAO, Rome. p. 35.

[213] Kriket (n.d.). https://kriket.be/ (20.02.2020)

[214] Die Wurmfarm (2019): Mehlwurmzucht in Österreich. https://www.diewurmfarm.at/ (20.02.2020)

[215] ZIRP Insects (n.d.): Insekten, die schmecken. https://www.zirpinsects.com/ (20.02.2020)

[216] SENS (2018). https://www.sensbar.com/en/ (20.02.2020)

[217] Griidy (2018). Let's get Greedy! https://griidy.com/ (20.02.2020)

[218] Sirkkoja (n.d.). https://sirkkoja.fi/ (20.02.2020)

[219] Micronutris (n.d.): Les insectes comestibles de qualité biologique. https://www.micronutris.com/fr/accueil (20.02.2020)

[220] Insekterei (2019): Insekterei—Die erste Grillenfarm der Schweiz: Klimaschutz mit Biss. https://insekterei.ch/ (20.02.2020)

Sustainability potential:

- **Ecological:** Soil, water, climate, air, resource efficiency in production and consumption
- **Economic:** Strengthening of regional economic cycles, increase of food security
- **Social:** Health: Access to healthy food

Risks / disadvantages: Insect food is particularly problematic from an ethical point of view. Even if there is no evidence of the ability of insects to feel pain[221], insect food is used to keep and kill considerably more living beings than is necessary to produce comparable quantities of classic meat. The standards which will be valid for insect breeding with regard to animal welfare are yet to be negotiated[222].

Due to strict food safety standards, it is currently not permitted in the EU to recycle organic residues, former food or catering returns for feeding insects. If these conditions were to change in the coming years, this could have a positive effect on a closed nutrient cycle and the overall environmental balance.[223]

Insect food can also pose a risk, if its production is located abroad. In those countries, higher demand and price increases resulting from Western consumption can attack local markets and impair the traditional diet of the local population[224]. In addition, the production abroad can be accompanied by the common issues such as the exploitation of workers, land grabbing and an increased resource use due to the transport.

[221] Erens, J. et al. (2012): A bug's life: Large-scale insect rearing in relation to animal welfare. Wageningen University. p. 37.
[222] ibid, p. 51.
[223] German Environment Agency et al. (2019): Trendanalyse „Fleisch der Zukunft“. Umweltpolitische Handlungsoptionen für die Gestaltung von pflanzenbasierten, insektenbasierten und In-vitro produzierten Fleischersatzprodukten. Inputpapier für den Expertenworkshop „Fleisch der Zukunft“ am 17.9.2019 in Berlin. 27. September 2019. p.13.
[224] Müller, A. (2018): Insekten essen, um den Kapitalismus zu retten? https://www.ernaehrungswandel.org/informieren/artikel/detail/insekten-essen-um-den-kapitalismus-zu-retten (20.02.2020)

3.12 Profile: Market Gardening

Category: Intermediate consumption, production

Description: Market Gardening or 'micro farming' (in German 'biointensive Landwirtschaft', in French 'maraîchage') refers to certain organic farming systems that produce vegetables on the smallest possible area with simple technology and high efficiency per area. In Market Gardening methods are used that simultaneously increase yields as well as maintain and increase soil fertility[225]. As the term *Market Gardening* indicates, it is based on two approaches. The 'market approach' describes the business model of selling the staple food in the most direct way to nearby consumers. The 'gardening approach' indicates the large diversity of crops and the high degree of manual labor involved when growing healthy food through this productive agroecosystem.

Aim and innovation: Market Gardening is a reaction to the growing demand for regionally grown vegetables worldwide and throughout Germany. The World Agriculture Report 2008 inter alia emphasizes the need for small-scale farming structures and regional food trade to ensure food security for the world's population.[226]

The compact area dimensions of Market Gardens vary from 0.5 to 3 hectares. This allows the focus to be entirely on the efficiency of a small area. At the core of this approach is also the avoidance of tractors and other heavy agricultural machinery. Instead, new and traditional handy gardening tools are used for the diverse manual work. This way less soil is compacted and less fuel burned. Without the use of large machinery, planting and sowing can be done at much shorter distances, creating an optimal microclimate for the plants and protecting the soil from drying out. The beds are not walked on during the year of cultivation and the soil is only worked superficially in order to disturb soil life as little as possible. Market Gardening understands the health of the agro-ecosystem as the basis for the intergenerational profitability of a farm. Compared to a traditional system, a Market Garden can grow four times the amount of vegetables in one year[227]. However, due to the lower level of technology, the required amount of manual labor is much higher[228]. Market Gardening can strengthen food sovereignty, and the concept can be well combined with direct marketing[229].

Actors: Market gardeners, young farmers, producers, start-ups, new entrants in agriculture

Age of the niche: The roots of this cultivation method lie in numerous cultivation concepts of different cultures. For example, similar approaches are used in China for about 4000 years, in Greece for about 2000 years and in Latin America for about 1000 years[230]. A source of inspiration were also the French vegetable farmers (maraîchers) who, in the 18th and 19th centuries, ensured on limited ground in the outskirts of Paris the supply of vegetables to the Parisian population[231]. The Organipónicos could be regarded as the Cuban counterpart, which

[225] BioNica – Grow the Soil / Seed Network. (n.d.): Best Practices in Sustainable Agriculture—Biointensive Agroecology. http://bionica.org/ (20.02.2020)

[226] Herzog, F. & Pfiffner, L. (2016): Agrarökologie und Biodiversität. In: Freyer, B.. Ökologischer Landbau. Grundlagen, Wissensstand und Herausforderungen. pp. 613-625.; IAASTD (2009): Agriculture at a Crossroads Global Report. International Assessment of Agricultural Knowledge.

[227] De Carné Carnavalet, C. (2018): Agriculture, filières et sécurité alimentaire
des territoires. « Biodynamic French Intensive Method » https://docplayer.fr/85705546-Biodynamic-french-intensive-method.html (20.02.2020)

[228] ibid.

[229] Fortier, J.-M. (2017): Bio-Gemüse erfolgreich direktvermarkten: Der Praxisleitfaden für die Vielfalts-Gärtnerei auf kleiner Fläche. Alles über Planung, Anbau, Verkauf.

[230] John Jeavons (2017): How to grow more vegetables.

[231] ibid.

were established due to the limited land on the island and the simultaneous need for small-scale subsistence farming as a result of the political isolation after the end of the Soviet Union and the US embargo.

State of development and current dynamics: Market Gardening has enjoyed growing popularity in recent years, with millions of people worldwide working according to this concept[232]. Especially in Canada, Japan and the USA, it can be observed that the practice is becoming increasingly widespread. Here exists a close connection to →Urban Gardening and a great potential for synergies with →Community Supported Agriculture[233]. In Germany the method is very rare. At the present time, there are currently only about 20 such micro-enterprises in Germany[234].

Examples: Comunidad Biointensiva[235], Grow Biointensive[236]

Sustainability potential:

- **Ecological:** Biodiversity, soil, water (indirect), climate, air, resource efficiency in production and consumption, promotion of regional, closed nutrient cycles
- **Economic:** Poverty reduction (indirect), strengthening regional economic cycles, increase of food security, promotion of recycling economy (indirect)
- **Social:** Health: Access to healthy food

Risks / disadvantages: Market Gardening, as already mentioned, is characterized by an increased manual workload. The demands on the management are high, the planning of crop rotations, compost management and fertilization as well as the technique of soil cultivation and the optimization of plant distances require a lot of knowledge and experience[237]. With regard to the tropics, Binayak P. Rajbhandari comes to the conclusion that especially the low level of knowledge and commitment in the public and private sectors is hampering the spread of Market Gardening[238]. With regard to the diffusion in Germany, these obstacles can also be assumed, since the cultivation system is only gradually entering the public discourse.

[232] John Jeavons (2017): How to grow more vegetables.

[233] Haack, M., Engelhardt, H., Gascoigne, C., Schrode, A., Fienitz, M. & Meyer-Ohlendorf, L. (2020): Sozial-ökologische Transformation des Ernährungssystems: Nischen des Ernährungssystems. German Environment Agency, Dessau-Roßlau.

[234] Bundesanstalt für Landwirtschaft und Ernährung (2017): Oekolandbau.de https://www.oekolandbau.de/ (20.02.2020)

[235] Comunidad Biointensiva. (2020). http://biointensivistas.ning.com/ (20.02.2020)

[236] Ecology Action (n.d.): Home. 3.02.2020. http://www.growbiointensive.org/c (20.02.2020)

[237] Bundesanstalt für Landwirtschaft und Ernährung (2019): Biointensiver Gemüsebau. https://www.oekolandbau.de/landwirtschaft/pflanze/grundlagen-pflanzenbau/biointensiver-gemuesebau/ (20.02.2020)

[238] Rajbhandari, B. (2017): Bio-Intensive Farming System. Potentials and Constraints in the Context of Agroecology in the Tropics. In: Poyyamoli, G. (2017). Agroecology, Ecosystems and Sustainability in the Tropics. Studera Press. pp. 71-88.

3.13 Profile: Mobile slaughterhouses

Category: Processing

Description: Mobile slaughterhouses are designed to spare animals the long journey and the associated stress on the way to the slaughterhouse. Thanks to an anesthesia stall and a special EU-approved slaughter trailer, which enables the immediate bleeding of the carcass, part of the actual slaughter (killing and bleeding) is carried out on the animal's usual farm. This eliminates the stressful transport of live animals. In the next step, the animal carcass is transported to the slaughterhouse for conventional processing.[239]

Aim and innovation: According to the EU hygiene regulation, animals must be brought to the slaughterhouse alive. However, during these journeys to the slaughterhouse, animals suffer a great deal of stress, and if there is a large number of animals, the hygiene conditions are often inadequate. Comparatively less important, but nevertheless advantageous for addressing the demand, is the fact that the stress hormones released also negatively impact the quality of the meat.[240]

Mobile slaughterhouses allow the butcher to come to the animal instead of transporting the animals to the slaughterhouses. By keeping the animal in its accustomed environment and anesthetizing it during feeding, animal welfare is ensured, as the animal does not experience the stress, fear and awareness of the impending slaughter. While small, regional slaughterhouses are becoming fewer and fewer, a mobile solution of this kind makes it easier for small organic farms to manage the costs per slaughter.

Actors: Slaughter companies, organic farmers, farms using direct marketing

Age of the niche: Traditionally, butchers came to the individual farms to slaughter the animals intended for meat production in their accustomed environment (exception: home slaughtering for own consumption). Due to many regulations at EU level, this method is hardly practiced anymore. In order to be able to carry out a field slaughter (bullet shot in the field) nowadays in Germany, a special permit is required. Instead, the animals have to be transported to central slaughterhouses, possibly far away.

As early as the 1960s, the first mobile slaughterhouses for deer were developed in the United Kingdom[241]. In the 1990s further mobile slaughterhouses were approved for pigs, ostriches and chicken. Only recently, the first mobile slaughterhouses for cattle have been developed, whose development has been more challenging due to the size of the animals.

State of development and current dynamics: In Germany, mobile slaughterhouses for chicken already exist[242], and slaughterhouses for diverse species of livestock are currently being developed. Although the development of mobile slaughterhouses did not receive much positive response at the beginning, mobile slaughtering has by now become a highly valued slaughter method. The development of mobile slaughterhouses has not only been driven forward by the

[239] Hofmann, D. H. (2019): Mobile Weideschlachtung: Der Schlachter kommt zum Rind. https://www.wir-sind-tierarzt.de/2019/02/mobile-weideschlachtung-der-schlachter-kommt-zum-rind/ (20.02.2020)

[240] Greif, F. (2017): Wenn der Schlachthof zum Tier kommt. Österreichisches Kuratorium für Landtechnik. Land und Raum. Journal 3/2017. pp. 14-17.; Hessenschau (2019): Mobile Schlachtmethode: Wenn der Schlachter zum Tier kommt. https://www.hessenschau.de/panorama/mobile-schlachtmethode-wenn-der-schlachter-zum-tier-kommt,mobiler-schlachthof-102.html (20.02.2020)

[241] SANMO (1998): State-of-the-art mobile abattoir. EUREKA Project SANMO.

[242] Christa Diekmann-Lenartz, L. & F. (2018): Mieten Sie doch einen Schlachthof! https://www.agrarheute.com/landundforst/regionen/mieten-schlachthof-547576 (20.02.2020)

point of view of animal ethics, but also by the interest in improving the meat quality.[243]There is the potential of introducing mobile slaughterhouses as an extension to the operations of all regional slaughterhouses. However, this requires clear, binding and nationally valid regulations for licensing authorities in order to guarantee fair chances, rapid processing and positive decisions for all new applicants.

Examples: Mobile Schlachtsysteme - Austria[244], Mobile Schlachttechnik - Germany, Biohof Dusch - Switzerland[245]

Sustainability potential:

- **Ecological: -**
- **Economic:** Strengthening of regional economic cycles, creation of transparency along the value chain
- **Social:** Animal welfare

Risks / disadvantages: In general, the mobile slaughterhouse is an approach that significantly reduces stress and agony for the animals stemming from the sometimes long transport distances to the slaughterhouses. Exceptional cases are viewed critically, where the bolt shot does not lead to the desired anesthesia of the animal at the first trial due to the lack of secure fixation of the animal. In this case, it would have to be repeated several times, which reduces the probability of attainment of each bolt shot and increases the animal suffering. Overall, it should be noted that despite the partial alleviation of animal suffering, the animal is still slaughtered for human consumption, which limits the animal welfare. In order to avoid animal suffering altogether, animal slaughter would have to be completely avoided. So-called 'animal sanctuaries' have committed themselves to this goal by saving animals from death, poor keeping or physical and psychological abuse and offering them a final refuge.[246]

It should be noted that mobile slaughterhouses are designed for a small number of animals and therefore offer a solution for small organic farms rather than intensive livestock farming. In comparison, this method is more labor, time and cost intensive, resulting in higher end prices of the products. On the other hand, slaughterhouses can result in a good niche for farmers doing direct marketing, for whom animal welfare during transport and slaughter is of great importance.

[243] Dinter, A. (2016): Sanfter Tod: Mobile Schlachtung. PROVIEH. https://provieh.de/sanfter-tod-mobile-schlachtung (20.02.2020)
[244] Fahrender Schlachthof. (n.d.). http://www.mobile-schlachtsysteme.at/ (20.02.2020)
[245] Biohof Dusch. (n.d.). https://hof-dusch.ch (20.02.2020)
[246] Die Tierbefreier (n.d.): Lebenshöfe. https://tierbefreier.org/projekt/lebenshoefe/ (20.02.2020)

3.14 Profile: Open source manuals for farming tools

Category: Intermediate consumption

Description: Associations offer platforms, where smallholder farmers can create, exchange and obtain open source manuals as well as advice on how to construct and maintain one's own tools. Training courses (approx. 2-5 days), events and seminars on the production of tools and machines are also organized, where farmers can get advice (e.g. on metalworking) from people of the association as well as from other farmers while actually building their own tools (e.g. machines for soil cultivation).[247]

Aim and innovation: Thanks to this niche, smallholder farmers gain access to free innovative technologies adapted to agroecological practices, as well as the knowledge behind their construction and maintenance. These tools are often not available on the market, are patented and therefore costly, or comes along with a dependence on the agricultural machinery suppliers for further repairs and spare parts. The manuals for the tools and machinery are collectively developed by smallholder farmers, thus enhancing the autonomy of smallholder farmers through the acquisition of knowledge and skills. During the training courses, it is ensured that the participants not only build the tool, but also learn how to repair it and adapt it to their own needs. Especially young farmers, should be given the opportunity to learn from the experiences, including success and difficulties, of their elders. The open-source ethics promote sustainability by encouraging people to handicraft, invent, create, and repair old objects instead of throwing them away without any further use via recycling.[248]

Actors: Associations, farmers

Age of the niche: In 2009, L'Atelier Paysan was created in France, as a response to the high demand of innovative tools that a farm in the South of France created from recycled materials. In particular, young farmers in the region were attracted to the do-it-yourself approach.[249] First trainings on the production and use of these tools were organized and, after an ever increasing demand, for the first time manuals were standardized, suggesting materials that could also be purchased in retail stores in order to facilitate the implementation for everyone.[250] This led to the creation of the cooperative L'Atelier Paysan. A similar initiative called Farm Hack was founded in the USA in 2010 and, after showing successes and a high demand, has also been established under the same name in the United Kingdom and Scotland. Already before in history, knowledge of technology had been shared among farmers, but the Internet and the acquired ability to network with people with similar interests via the Internet has contributed to the innovative development of this open source platform.

State of development and current dynamics: The interest in the concept is growing. More people from other countries are registering for the training courses in France, the UK and Scotland, which indicates that similar foundations in Germany and other European countries can be expected. L'Atelier Paysan also offers advice on how to cover the costs of participation to the training courses, which are also supported by public funds for vocational training in agriculture from the French government.

[247] European Coordination Via Campesina (2018): Atelier paysan. https://www.eurovia.org/6108/ (20.02.2020)

[248] Farm Hack (n.d.): Tools. https://farmhack.org/tools (20.02.2020)

[249] Farm Hack (n.d.): Julien Reynier and Fabrice Clerc from L'Atelier Paysan on Self-Build Communities in Farming. 04.12.2019 http://blog.farmhack.org/ (20.02.2020)

[250] ibid.

Examples: Farm Hack UK[251], Farm Hack Scotland[252], L'Atelier Paysan - France[253]

Sustainability potential:

- **Ecological:** Resource efficiency in production and consumption
- **Economic:** Poverty reduction (indirect), creation of transparency along the value chain
- **Social:** Participation, social justice

Risks / disadvantages: There are still few such initiatives in Europe. A long-term development of a Europe-wide network of associations offering such training, similar to the network of the niche →Agroecology Schools in Europe, is desirable.

[251] Farm Hack (n.d.). https://farmhack.org/tools (20.02.2020)
[252] Farm Hack Scotland (2019). https://www.facebook.com/events/the-big-shed/farm-hack-scotland-2019/2334762136745072/ (20.02.2020)
[253] Gaillard, C. (n.d.): L'Atelier Paysan. https://www.latelierpaysan.org (20.02.2020)

3.15 Profile: Open source seed banks and protection of seeds

Category: Intermediate consumption, trade

Description: Seed banks, or seed libraries, refer to the collection and categorization of seeds of natural and agriculturally bred plant varieties as well as the collection of related data (e.g. location, botanical classification or genetic lineage).[254] Seed banks are widely spread and established worldwide. Nevertheless, innovative approaches are currently being developed, particularly with a view to protecting traditional crops, exchanging them and making them accessible. On the one hand, these are open source seed banks, which provide seeds with a free license and thus make them a protected common good. On the other hand, there are projects and initiatives emerging which (for example by revitalizing old varieties) seek to secure seeds of plants that harmonize well with changing climatic conditions or counteract climate change.

Aim and innovation: Originally, seed banks were used to secure seeds from the last harvest for the next sowing. Today, a variety of objectives are being pursued. Avoiding the loss of genetic material and safeguarding biodiversity are frequent reasons for establishing seed banks. The 'Svalbard Global Seed Vault' in Norway, which opened in 2008, is the world's largest storage facility. Its aim is to protect crop seeds from natural and man-made disasters and thus act as a 'backup' for all mankind[255].

Due to rapid changes in our climate, seed banks are now also being discussed from a food security perspective. In this sense, the revitalization of old varieties stored in seed banks can be used to adapt to the changing climate and its consequences by producing particularly robust crops[256].

The development of open source seed banks also aims to improve food sovereignty, to promote the participatory exchange of varieties and to protect seeds from privatization by granting an open source license. One example of this kind is the 'OpenSourceSeeds' initiative, which is only a few years old and based in Germany. The use of open source licenses intends to protect seeds as a common good for free use. The website 'Community seed banks' was also launched as a digital platform for connecting seed savers´, gardeners´ and farmers' networks throughout Europe with funds from the EU's Horizon 2020 programme. Projects can be registered online on a map. Particularly seed banks from Spain and Southern France are well represented.[257]

Actors: Associations, federations, food producers, (hobby) gardeners

Age of the niche: Seed banks have existed since the beginning of human civilisation, and back then served for renewed and habitat-appropriate re-sowing. Municipal seed banks, which are used to safeguard, reproduce, revitalize and improve especially local plant diversity, have existed for around 30 years[258]. Also, the exchange of local seeds from existing seed banks has existed for centuries in some parts of the world[259]. Innovative further developments such as exchange platforms supported by digital distribution channels and the introduction of open

[254] Nabors, M. W., & Scheibe, R. (2007): Botanik. Pearson Deutschland GmbH. p. 647.
[255] Svalbard Global Seed Vault (n.d.): Svalbard Global Seed Vault. https://www.croptrust.org/our-work/svalbard-global-seed-vault/ (20.02.2020)
[256] Dempewolf, H. et al. (2014): Adapting Agriculture to Climate Change: A Global Initiative to Collect, Conserve, and Use Crop Wild Relatives. Agroecology and Sustainable Food Systems, 38(4), pp. 369–377. https://doi.org/10.1080/21683565.2013.870629 (20.02.2020)
[257] The CSB Map / Community Seed Banks. (n.d.): The CSB Map. https://www.communityseedbanks.org/the-csb-map/(20.02.2020)
[258] Vernooy, R. et al. (2015): Community Seed Banks: Origins, Evolution and Prospects. Routledge.
[259] Lewis, V. & Mulvany, P.M. (1997): A Typology of community seed banks. Natural resources institute. University of Greenwich, Kent, UK.

source licenses for seeds are recent developments that have only existed for a few years and are growing due to high demand.

State of development and current dynamics: In recent years, two developments in particular have led to these further developments of classic seed banks: patenting, privatization and monopolization in the seed sector and climate change.

As a reaction to the EU's seed legislation proposals, an (information) exchange platform was organized for the first time in the Netherlands in 2010[260]. The aims of this regular event are to safeguard biodiversity, to oppose seed patents and to promote climate-neutral agriculture. Seed exchanges take place in various European cities. In 2016, a website[261] was launched in Germany that uses exclusively digital means for the exchange mediation.

Another novel development is *Plants for a future*, an online information database on edible and useful plants, which was initiated in the UK[262]. The database contains only information, no genetic material. Its focus is on free access to knowledge. Carbon farming (agricultural methods that aim to absorb more atmospheric carbon in the soil, roots, woods and leaves of plants) composes a separate section of the database.

Examples: La Troje[263], Reclaim the Seeds[264], OpenSourceSeeds[265], Plants For A Future[266], Saatgut tauschen[267]

Sustainability potential:

- **Ecological:** Biodiversity, soil (indirect), water (indirect), climate (indirect)
- **Economic:** Poverty reduction (indirect), strengthening of regional economic cycles (indirect), increase of food security, creation of transparency along the value chain
- **Social:** Health: Access to healthy food (indirect), participation

Risks / disadvantages: Private seed banks can pose a risk to health, whenever uncontrolled seeds are offered. Not all breeds are automatically suitable for consumption. Occasionally, hobby gardeners even die[268].

[260] Reclaim the Seeds (n.d.): Info about patents, seed laws, monopoly's, GMOs, alternatives and food sovereignty. https://www.reclaimtheseeds.nl/rts-achtergrond-engels.htm (20.02.2020)

[261] Saatgut tauschen (2016 - 2019): Saatgut tauschen - Tauschbörse für samenfestes Biosaatgut. https://saatgut-tauschen.de/ (20.02.2020)

[262] Plants for a future (1995-2019): About us. https://pfaf.org/user/AboutUs.aspx (20.02.2020)

[263] Asociación La Troje – Sembrando raíces, cultivando biodiversidad (2020). https://www.latroje.org/ (20.02.2020)

[264] Reclaim the Seeds (n.d.). https://www.reclaimtheseeds.nl/ (20.02.2020)

[265] OpenSourceSeeds (2020). https://www.opensourceseeds.org/ (20.02.2020)

[266] Plants for A Future (1996 - 2012). PFAF. https://pfaf.org/user/Default.aspx (20.02.2020)

[267] Saatgut tauschen (n.d.): Saatgut tauschen - Tauschbörse für samenfestes Biosaatgut. https://saatgut-tauschen.de/ (20.02.2020)

[268] Hillmer, A. (2015): Giftiges Gemüse: Das müssen Sie bei der Zucht beachten. Hamburger Abendblatt. 21. August 2015. https://www.abendblatt.de/ratgeber/wissen/article205588433/Giftiges-Gemuese-Das-muessen-Sie-bei-der-Zucht-beachten.html (20.02.2020)

3.16 Profile: Participatory evaluation and certification systems

Category: Production, trade, consumption

Description: Participatory evaluation and certification systems aim at directly involving the people who produce and/or consume food products into their assessment and certification processes, rather than using third party certification.

Aim and innovation: The classical objective of organic certification is, on the one hand, increased transparency and assurance on the consumer side regarding sustainable nutrition as well as responsible production and, on the other hand, improved market access for producers. The cost-intensive conversion, approval and inspections often represent a hurdle for small-scale farmers.[269] The investment for an organic label is often only worthwhile at a certain production volume.

Participatory evaluation systems aim to achieve a high degree of transparency through active participation by producers, consumers and other direct interest groups, and thus represent an alternative and supplement to certification by third parties. They are targeting local markets, short transport routes and value chains. Small-scale producers get together to jointly define and develop indicators of sustainability. On the basis of these criteria, they carry out agricultural activities, and according to the criteria evaluate and, if necessary, improve their own work instead of having to meet the criteria set by the various external organic certifiers.[270] A further new approach is that the quality control is also not carried out by third parties. Instead, producers check and support each other[271]. This on-site visit by one or more people from the peer group or by a consumer has the advantage that a direct practical exchange of knowledge about problems and solutions is maintained and a social network based on trust can be established.[272] Together they take decisions concerning certification and ensure the development and implementation of the overall certification procedure.

In addition, new initiatives, not only on the producer side but also on the consumer side, organize to jointly formulate criteria for sustainable products and marketing, which meet their own demands for sustainable action.[273] Thereafter as a result of this joint coordination, these are produced by affiliated farms at fair producer prices.[274]

Actors: Small-scale farmers, consumers

Age of the niche: The first European alternative certification methods, such as the PGS initiative Nature & Progrès in France, were founded in the 1960s[275]. The worldwide trend towards participatory certification of food products has gained ground in recent decades in parallel with the strong global growth of organic farming and production regulation through organic standards and organic regulations.

[269] Wageningen University & Research (2015): Certification for small-scale producers—Weighing up the pros and cons. https://www.wur.nl/en/newsarticle/Certification-for-smallscale-producers-weighing-up-the-pros-and-cons.htm (20.02.2020)
[270] FADEAR (n.d.): Réseau de l'agriculture paysanne.—Bienvenue dans l'agriculture paysanne. http://www.agriculturepaysanne.org/ (20.02.2020)
[271] An example here are the Participatory Guarantee Systems (PGS).
[272] IFOAM (n.d.): Participatory Guarantee Systems. IFOAM Organics International. https://www.ifoam.bio/en/organic-policy-guarantee/participatory-guarantee-systems-pgs (20.02.2020)
[273] La société des consommateurs (n.d.): « C'est qui le Patron ?! » – La Marque du Consommateur. https://lamarqueduconsommateur.com/ (20.02.2020)
[274] ibid.
[275] Nature & Progrès (n.d.): L'histoire de Nature & Progrès. https://www.natureetprogres.org/lhistoire-2-2/ (20.02.2020)

State of development and current dynamics: There is a growing trend towards participatory evaluation and certification systems as an alternative to traditional certification with quality control by third parties. While the range of organic labels is increasing, this also increases the pressure on organic small-scale farmers to opt for a certification in order to ensure sales. These certifications, however, are often associated with high costs and do not allow farmers to have a say in determining the sustainability criteria themselves. As a result, the demand for participatory, more cost-effective alternatives for small-scale agriculture continues to grow. However, the EU, USA and Japan do not recognize PGS as certification. Only farms that have been tested by third parties may refer to the 'organic' product labels. In countries of the Global South, such as Brazil and India, PGS is even (legally) considered equivalent to third-party certification on local markets.

Examples: FADEAR - France[276], C'est qui le patron - France, Nature & Progrès - France, Belgium[277], IFOAM-Participatory Guarantee Systems - Romania, France, United Kingdom, Turkey, Spain, Italy[278], InPACT Network

Sustainability potential:

- **Ecological:** Biodiversity (indirect), soil (indirect), water (indirect), climate (indirect), air (indirect), resource efficiency in production and consumption (indirect), promotion of regional, closed nutrient cycles (indirect)
- **Economic:** Poverty reduction (indirect), strengthening of regional economic cycles, support of activities with positive external effects
- **Social:** Fair producer prices (on national and global level), creation of transparency along the value chain, participation, social justice, awareness / education for sustainable nutrition, animal welfare (indirect)

Risks / disadvantages: Participatory evaluation systems depend on a lot of idealism, individual initiative and commitment of all participants. Moreover, participatory evaluation systems are susceptible to abuse. People who are only concerned about their own financial advantage could take profit from the trust in their labels and certificates and this way in the long run damage the reputation of certificates based on participatory evaluation systems. On the other hand, consumers, who do not participate, need a high degree of information (or trust) in order to develop an awareness of the sustainability criteria behind the respective certificates.

[276] FADEAR – Réseau de l'Agriculture Paysanne (2012): Bienvenue dans l'agriculture paysanne a. http://www.agriculturepaysanne.org/ (20.02.2020)
[277] Nature & Progrès. (n.d.): La bio associative et solidaire—Nature et Progrès. https://www.natureetprogres.org/ (20.02.2020)
[278] IFOAM - Organics International e.V. (n.d.): Participatory Guarantee Systems (PGS). IFOAM. https://www.ifoam.bio/en/organic-policy-guarantee/participatory-guarantee-systems-pgs (20.02.2020)

3.17 Profile: Re-/Upcycling of food waste

Category: Production, consumption, waste and recycling

Description: Re-/Upcycling of food waste covers a wide range of innovations dealing with the reuse of waste to create new products. The newly produced items range from shoe soles made out of old chewing gum to 3D-printed cups made out of orange peel and organic plastic made out of fish waste. (Other recycled products suitable for packaging as an alternative material to the more environmentally harmful bio-based and fossil-based plastics are grouped together under a separate niche →alternative packaging materials).

Aim and innovation: According to WWF, 313 kilos of edible food are disposed of in Germany every second[279]. The Food and Agriculture Organization assumed that in 2011 around one third of the food produced worldwide was thrown away, which corresponds to 1.3 billion tons per year. [280] On the one hand, the re-/upcycling of food waste includes innovations that deal with the reuse of waste products in food production. On the other hand, the niche includes innovations that aim to avoid food waste, which is caused by its unsaleability.

The aforementioned innovations can be regarded as prime examples of the sustainable cascading use: "A cascading use of biomass exists, when biomass that has been processed into a bio-based final product is used at least once more, either for material or energy purposes."[281] A higher efficiency of biomass use is to be achieved through cascading use.[282] This is the case, for example, with the Finnish company RENS, which produces shoes from coffee grounds. The company's declared aim is to produce sustainably and avoid the waste of valuable resources[283].

If the waste product is not a by-product of food production, (as is the case with the above mentioned coffee ground-based shoes) but the actual final product, the aim of the projects should not be to achieve a second or third use, but to promote the first use of the food by "saving" it from the garbage can. Hereby the unsaleable food is usually transformed into another product. This way, the Swiss company Damn Good Food & Beverages AG wants to prevent "the long journey from seed to crispy loaf of bread" from being in vain by processing unsold bread into beer[284].

Actors: Producers, consumers, innovative companies

Age of the niche: Re- and upcycling of food can hardly be described as novel. The production of breadcrumbs by using old bread and bread rolls or the use of mandarin peel as an addition to tea have long tradition in some places. In contrast, numerous innovations that belong to this niche, such as the processing of coffee grounds into sneakers, of orange peel into 3D-printed cups or of sour milk into textiles, are only a few years or months old.

State of development and current dynamics: The niche is undergoing major changes and shows a high degree of innovation. Novel approaches can also be found in Germany. For example, selo soda and Caté use the coffee cherry as a waste product of coffee production to make lemonade, and the University of Bayreuth is researching how the peel of the orange can be

[279] WWF Deutschland (2015): Das große Wegschmeißen, 2015, Berlin.
[280] FAO (2011): Global food losses and food waste. Extent, causes and prevention. Rome.
[281] Fehrenbach, H. et al. (2017): BIOMASSEKASKADEN. Mehr Ressourceneffizienz durch stoffliche Kaskadennutzung von Biomasse – von der Theorie zur Praxis. TEXTE 53/2017. February 2017, German Environment Agency, Dessau-Roßlau, p. 27.
[282] German Environment Agency (2019): Biobasierte und biologisch abbaubare Kunststoffe. April 2019. https://www.German Environment Agency.de/biobasierte-biologisch-abbaubare-kunststoffe#textpart-3 (20.02.2020)
[283] Rens Original (2019): Our Mission. https://rensoriginal.com/pages/our-story-rens-original (20.02.2020)
[284] Damn Good Food & Beverages AG (n.d.): Damm Good Bread Beer – Eifach #tamiguet. https://www.breadbeer.ch/ (20.02.2020)

used as a bio-based plastic[285]. Even if the niche as such is not unknown in Germany, the diverse European projects can serve as good examples which can demonstrate high potential for transformation.

Examples: Rens (shoes made from coffee grounds) - Finland[286], Gumdrop (products made from chewing gum) - United Kingdom[287], Gumshoe (shoe soles made from chewing gum) - Netherlands[288], breadbeer (beer made from old bread) - Switzerland[289], Feel the Peel (3D-printed cups made from orange peel) - Italy[290], MARINATEX (packaging material made from fish waste) - United Kingdom[291], Ananas Anam (leather made from pineapple leaves) - United Kingdom[292], Therese Mölk (liquors made from old bread) - Austria[293], Duedilatte (textiles made from sour milk) - Italy[294]

Sustainability potential: As the individual approaches differ greatly from one another, the sustainability potential indicated should be understood as an average value.

- **Ecological:** Soil (indirect), water (indirect), climate (indirect), air (indirect), resource efficiency in production and consumption
- **Economic:** Promotion of recycling economy
- **Social:** Animal welfare (indirect)

Risks / disadvantages: While some companies work with waste products that are by-products of food production, other projects focus on food waste that could be avoided from the beginning. While these companies can alleviate the symptoms of food waste, they have no influence on its causes. The reduction of food waste can lead to a situation where the polluters feel (morally) relieved and do not take further steps to avoid the waste in the first place. According to the German recycling legislation ("Kreislaufwirtschaftsgesetz")[295] the avoidance of waste is preferable to the reuse and recycling of waste, in order to minimize the unnecessary use of resources.

When assessing the sustainability potential of individual projects, it is important to weigh up whether the products created from waste are substitutes that can replace the consumption of less sustainable products, or whether they are new types of goods that increase the overall consumption. Although the latter products can promote the reuse of resources, they also increase the overall demand.

[285] Hauenstein, O., Agarwal, S., & Greiner, A. (2016): Bio-based polycarbonate as synthetic toolbox. Nature Communications, 7(1), 11862. https://doi.org/10.1038/ncomms11862
[286] Rens Original (2020): Rens Original - World's First Coffee Sneaker. https://rensoriginal.com/ (20.02.2020)
[287] Gumdrop Ltd. (n.d.). http://gumdropltd.com/ (20.02.2020)
[288] Gumshoe Amsterdam (n.d.). https://gumshoe.amsterdam/ (20.02.2020)
[289] Damm Good Bread Beer (n.d.). https://www.breadbeer.ch/ (20.02.2020)
[290] Duy, M. (2019): Zirkulärer 3D-Orangendruck: Feel the Peel von Carlo Ratti Associati—DETAIL - Magazin für Archi-tektur + Baudetail. In: Detail. https://www.detail.de/blog-artikel/zirkulaerer-3d-orangendruck-feel-the-peel-von-carlo-ratti-associati-34655/ (20.02.2020)
[291] MARINATEX (2020). https://www.marinatex.co.uk (20.02.2020)
[292] Piñatex (n.d.). https://www.ananas-anam.com/ (20.02.2020)
[293] Bäckerei Therese Mölk (n.d.): Bäckerei Therese Mölk—Pures Brot aus Tirol. https://www.therese-moelk.at/ (20.02.2020)
[294] Duedilatte (n.d.). https://de-de.facebook.com/Duedilatte/ (20.02.2020)
[295] Gesetz zur Förderung der Kreislaufwirtschaft und Sicherung der umweltverträglichen Bewirtschaftung von Abfällen (Kreislaufwirtschaftsgesetz - KrWG), § 6 Abfallhierarchie.

3.18 Profile: Regenerative agriculture

Category: Intermediate consumption, production

Description: Regenerative agriculture (also known as 'carbon farming'[296]) is an umbrella term for forms of land use and agricultural techniques whose common feature is to regenerate damaged soils while providing food, feed, raw materials, active ingredients and energy. The methods can be combined in a variety of ways and sometimes include reduced or 'ploughless' tillage, organic farming, agroforestry systems and perennial crops, although not all are suitable for every climate and soil[297]. Regenerative agriculture is a sub-sector of agroecology[298].

Aim and innovation: The agriculture is dependent on the condition of the soil and, in current industrial agriculture, contributes both to soil loss and degradation. The idea of Regenerative Agriculture is essentially to restore and improve damaged soils in urban and rural ecosystems by strengthening soil life and building humus[299]. This holds the potential to bind more CO_2 in the soil than is emitted by the use of the soil[300], and at the same time to produce food and other goods in the process[301]. According to the Rodale Institute, more than 100% of the CO_2 currently emitted each year can be fixed in the soil using simple, affordable, biological, regenerative methods, thus mitigating climate change[302]. Furthermore, cost-intensive inputs can be replaced by natural processes and fossil fuels can be saved[303].

A relatively new and widely used tool in regenerative agriculture for the past two decades has been conservation tillage[304] (also known as 'ploughless tillage'[305] or 'mulch sowing'[306]). This concept does not include the use of the plough[307]. Instead, the soil is not turned, which means that some of the crop residues on the arable land are preserved[308]. Due to this method, the soil life gets disturbed as little as possible, which helps to stabilize the topsoil and to build up humus[309].

Conservation methods that completely avoid the use of tillage before sowing are known as 'no-tillage farming' or 'direct sowing'[310]. A further method of regenerative agriculture is the year-

[296] Biswas, S. et al. (2017): Regenerative agriculture: Replenishing soil carbon under changing climate.
[297] Neely, C., Bunning, S. Wilkes, A. (2009): Review of evidence on drylands pastoral systems and climate change. FAO, Rome.; Hes, D., & Rose, N. (2019): Shifting from farming to tending the earth: A discussion paper.
[298] Von Koerber, H. (2018): Definition Regenerative Landwirtschaft - Ansätze, Verfahren, Initiativen.
[299] Beckhoff, J. (2018): Regenerativer Ackerbau. oekolandbau.de. https://www.oekolandbau.de/landwirtschaft/pflanze/grundlagen-pflanzenbau/regenerative-landwirtschaft/regenerativer-ackerbau/ (20.02.2020)
[300] Zukunftsstiftung Landwirtschaft (n.d.): Regenerative Landwirtschaft - Zukunftsstiftung Landwirtschaft. https://www.zukunftsstiftung-landwirtschaft.de/zukunftsstiftung-landwirtschaft/aktuelles/termine/regenerative-landwirtschaft/ (20.02.2020)
[301] Lal, R. (2010). Managing Soils and Ecosystems for Mitigating Anthropogenic Carbon Emissions and Advancing Global Food Security. BioScience, 60(9), pp. 708–721. https://doi.org/10.1525/bio.2010.60.9.8
[302] Rodale Institute (n.d.): Regenerative Organic Agriculture and Climate Change. A Down-to-Earth Solution to Global Warming. https://rodaleinstitute.org/wp-content/uploads/rodale-white-paper.pdf (20.02.2020)
[303] Biswas, S. et al. (2017): Regenerative agriculture: Replenishing soil carbon under changing climate.
[304] Beste, A. (2015): Intensivfeldbau: Industrielle Landwirtschaft mit Zukunftsproblemen. Heinrich-Böll-Stiftung. https://www.boell.de/de/2014/12/16/intensivfeldbau-industrielle-landwirtschaft-mit-zukunftsproblemen (20.02.2020)
[305] Verlag Emminger & Partner GmbH (2019): Konservierende Bodenbearbeitung - Pfluglos. https://www.pfluglos.de/konservierende_bodenbearbeitung (20.02.2020)
[306] Beste, A. (2015): Intensivfeldbau: Industrielle Landwirtschaft mit Zukunftsproblemen. Heinrich-Böll-Stiftung. https://www.boell.de/de/2014/12/16/intensivfeldbau-industrielle-landwirtschaft-mit-zukunftsproblemen (20.02.2020)
[307] Verlag Emminger & Partner GmbH (2019): Konservierende Bodenbearbeitung - Pfluglos. https://www.pfluglos.de/konservierende_bodenbearbeitung (20.02.2020)
[308] ibid.
[309] Biswas, S. et al. (2017): Regenerative agriculture: Replenishing soil carbon under changing climate.
[310] Derpsch, R. (2008): No Till erfolgreich umsetzen - Pfluglos. https://www.pfluglos.de/beitraege/articles/no-till-einfuehrung (20.02.2020)

round greening of arable land, which can be made possible through nurse crops and catch crops. The idea behind this approach is to cover the soil for as long as possible, thus reducing leaching losses and protecting soil life[311]. Other tools include the use of organic fertilizers, adapted crop rotations and compost systems[312].

Examples: Grüne Brücke (Dietmar Näser)[313], New Forest Farm (Mark Shepeard)[314], Rodale Institute[315], SoilCapital[316], Ökoregion Kaindorf[317], Bio-Gemüsehof Dickendorf

Actors: Farmers

Age of the niche: The idea of regenerative agriculture is not new. From the research of indigenous forms of land use, it can be concluded that sustainable, humus-increasing land management is an ancient practice that was displaced by the development of industrial agriculture[318]. The term 'regenerative agriculture' was first mentioned in the early 1980s in writings of the Rodale Institute in Pennsylvania, which had already begun to focus on regenerative methods in the 1970s[319].

State of development and current dynamics: Due to the growing awareness of soil degradation as a consequence of industrial agricultural practices, regenerative practices are gaining increasing popularity globally[320]. While regenerative agriculture is considered to be consolidated in America, it has so far been a rare practice in German-speaking countries. In Germany it is applied to an estimated area of 50,000 hectares[321]. Many practitioners report positive experiences, however there is still little scientific data available in Germany. An example for good documentation of successful humus formation by regenerative methods is to be found in the Ökoregion Kaindorf[322].

Sustainability potential:

- **Ecological:** Biodiversity, soil, water, climate, air, resource efficiency in production and consumption, promotion of regional, closed nutrient cycles
- **Economic:** Increase of food security, promotion of recycling economy
- **Social: -**

Risks / disadvantages: According to the German Federal Statistical Office, on about 40% of the arable land the soil is partially cultivated without ploughing, while only on one percent of the arable land ploughing is abandoned completely.[323] This trend of recent years towards no-tillage

[311] Beckhoff, J. (2018): Regenerativer Ackerbau. oekolandbau.de. https://www.oekolandbau.de/landwirtschaft/pflanze/grundlagen-pflanzenbau/regenerative-landwirtschaft/regenerativer-ackerbau/

[312] Rodale Institute (n.d.): Regenerative Organic Agriculture and Climate Change. A Down-to-Earth Solution to Global Warming. https://rodaleinstitute.org/wp-content/uploads/rodale-white-paper.pdf (20.02.2020)

[313] Grüne Brücke (2020): Willkommen! - Grüne Brücke—Regenerative Landwirtschaft. https://www.gruenebruecke.de/ (20.02.2020)

[314] New Forest Farm (n.d.). https://newforestfarm.us/ (20.02.2020)

[315] Rodale Institute (2020). https://rodaleinstitute.org/ (20.02.2020)

[316] Soil Capital—Regenerative agriculture (n.d.). http://www.soilcapital.com/ (20.02.2020)

[317] Verein Ökoregion Kaindorf (2018). https://www.oekoregion-kaindorf.at/ (20.02.2020)

[318] Hes, D., & Rose, N. (2019). Shifting from farming to tending the earth: A discussion paper.

[319] Hatfield, J. L., & Karlen, D. L. (1993): Sustainable Agriculture Systems. CRC Press.

[320] Hes, D., & Rose, N. (2019): Shifting from farming to tending the earth: A discussion paper.

[321] Beckhoff, J. (2018): Regenerativer Ackerbau. oekolandbau.de. https://www.oekolandbau.de/landwirtschaft/pflanze/grundlagen-pflanzenbau/regenerative-landwirtschaft/regenerativer-ackerbau/ (20.02.2020)

[322] Verein Ökoregion Kaindorf (2018): Ökoregion Kaindorf. https://www.oekoregion-kaindorf.at/index.php?id=522 (20.02.2020)

[323] Universität Hohenheim (2019): Konservierende Bodenbearbeitung: Fachtagung diskutiert veränderte Pflanzenschutzstrategien. Pressemitteilung. https://www.uni-hohenheim.de/pressemitteilung?tx_ttnews%5Btt_news%5D=42432&cHash=61a935297a040281960f1d472789de87 (20.02.2020)

is largely implemented by conventional farmers. In order to control weeds in their crops they often use herbicides[324], and thus fail to meet the goals of regenerative agriculture by a pesticide-free cultivation.[325] So far, there are yet few organic farmers who actually reach these goals.[326]

It is challenging and requires a great deal of experience to incorporate the nurse or cover crops[327]. Other methods of regenerative agriculture also require expertise, training and time. In addition, the methods used have to be adapted to the respective local conditions and soil, which in turn requires very good knowledge. Farmer Benedikt Bösel points out the lack of encouragement regarding multifunctional land use in Germany, which makes it difficult for farmers to build up experience with regenerative agriculture[328].

[324] Agrarheute (2016): Pfluglose Bodenbearbeitung: Pro und contra. https://www.agrarheute.com/technik/ackerbautechnik/pfluglose-bodenbearbeitung-pro-contra-513975 (20.02.2020)
[325] Ökolandbau (2018): Regenerativer Ackerbau. https://www.oekolandbau.de/landwirtschaft/pflanze/grundlagen-pflanzenbau/regenerative-landwirtschaft/regenerativer-ackerbau/ (20.02.2020)
[326] Kretschmann, K. und Behm, R. (2017): Mulch total - Ein Weg in die Zukunft. OLV.
[327] Beckhoff, J. (2018): Regenerativer Ackerbau. oekolandbau.de. https://www.oekolandbau.de/landwirtschaft/pflanze/grundlagen-pflanzenbau/regenerative-landwirtschaft/regenerativer-ackerbau/ (20.02.2020)
[328] von Ketteler, L. (2019): Regenerative Landwirtschaft in Deutschland. https://www.farm-and-food.com/regenerative-landwirtschaft-in-deutschland/ (20.02.2020)

3.19 Profile: Silvopastoral agroforestry systems

Category: Intermediate consumption, production

Description: In silvopastoral agroforestry systems, woody plants are combined with grazing land and livestock farming. The diverse application possibilities vary in intensity, area and combinations of livestock and woody species. It is possible to fuse livestock farming with the production of (energy) wood or with the production of food (fruits, nuts). The fusion of fodder production and livestock farming is particularly common. In this context, woody plants can be cultivated specifically for the production of fodder leaves.

Silvopastoral agroforestry systems are a subgroup of agroforestry systems (→ Agroforestry systems). They are listed separately because of their high potential to contribute to greater animal welfare and sustainability. This niche is particularly relevant for Germany, as the legal framework has so far prevented the spread of silvopastoral systems (see below Risks / Disadvantages).

Aim and innovation: Silvopastoral systems have multiple environmental advantages over open pasture systems. These include a higher biodiversity, the reduction of soil erosion and the buffering of climate extremes. Results of studies suggest that silvopastoral systems have a higher potential to reduce greenhouse gases from agricultural land and can store greater amounts of carbon than open pasture systems, traditional plantations and arable farming systems[329]. Studies also show higher productivity in the production sectors (animal feed, meat, egg and milk production)[330]. In addition, the fusion of woodland and pasture land can have a positive impact on animal welfare. Shrubs and trees offer comfort due to the shade and also resemble the natural habitat of the most common farm animal species.

Actors: Wine producers, horticulture, fruit growing farms, forestry institutions, livestock farms, gourmet meat producers (Iberian ham)

Age of the niche: Even though the term 'Silvopasture' is relatively new, it describes one of the oldest forms of land use. For thousands of years, animals have been driven into the forest for fattening and leaves have been used as their feed. Terms for such traditional forms of land use are forest pasture, the German “Hutewälder” and pollarding.

State of development and current dynamics: As a type of silvopastoral system, forest pastures form a significant proportion of the estimated 33% of the total area of pasture land on earth[331]. Such systems are especially to be found in the countries of the Global South. In Europe and especially Germany, however, this form of land use has become rare. In 2009, a study concluded that the economic potential and the possibilities of dual use of forest areas in Germany are hardly known[332]. According to the study, there is still a lot of potential in this regard in Germany. However, the legislation in Germany limits the spread of silvopastoral systems. These forestry law framework conditions came in response to an overuse of forests by livestock farming. Modern examples have been rare and frequently fallen out of the classification of use. As a result, illustrative examples of the economic potential are currently lacking.

[329] Peichl, M. et al. (2006): Carbon Sequestration Potentials in Temperate Tree-Based Intercropping Systems, Southern Ontario, Canada. Agroforestry Systems, 66(3), 243–257. p. 243 https://doi.org/10.1007/s10457-005-0361-8

[330] Jose, S., & Dollinger, J. (2019): Silvopasture: A sustainable livestock production system. Agroforestry Systems, 93(1), 1–9. p. 1 https://doi.org/10.1007/s10457-019-00366-8

[331] Gallego-Giraldo, L., et al. (2011): Salicylic acid mediates the reduced growth of lignin down-regulated plants. Proceedings of the National Academy of Sciences, 108(51), 20814–20819. p. 115. https://doi.org/10.1073/pnas.1117873108

[332] Chalmin, A. et al. (2009): Neue Optionen für eine nachhaltige Landnutzung. Schlussbericht des Projektes Agroforst. p. 140.

Examples: Dehesa Farms - Spain, Weidegänse und Trüffel - Switzerland[333]; Nith Valley Eggs - United Kingdom[334]; Sainsbury's cooperation with silvopastoral chicken farming - United Kingdom[335]

Sustainability potential:

- **Ecological:** Biodiversity, soil, water, climate, air, resource efficiency in production and consumption
- **Economic:** Increase of food security, promotion of recycling economy (indirect)
- **Social:** Animal welfare

Risks / disadvantages: In addition to the above mentioned disadvantages of the silvoarable agroforestry systems, silvopastoral systems can, under high grazing pressure, cause increased damage to the woods through heavy treading and feeding[336], which makes the systems particularly cost and time intensive. Additional protective measures must be taken.

In Germany, the distribution of silvopastoral forest pastures is more difficult because of the legislation in place. Both the national legislation on forestry ('Bundeswaldgesetz') and the state legislation on forestry ('Landeswaldgesetz') define the legal framework[337]. According to the national legislation on forestry, areas with tree population, which at the same time serve the cultivation of agricultural products (hence agroforestry use and thus silvopastoral forest pastures), can no longer be considered forests. This would signify a change of land use and thus a transformation of the forest.[338] The state legislation on forestry lists a number of principles that must be fulfilled in order to be able to implement modern silvopastoral forest pasture. Apart from the forest owner's consent, these include forest conservation, the safeguarding of forest functions through prudent, extensive pasture management, minimum relative stock of trees, prudent management in line with a certain set of rules and the right of access.[339] A simplified legislation could exploit the potential of forest pastures and increase the lack of practical knowledge in Germany.

[333] Baumann-Oerhallau (2017): Baumann Oberhallau – Weidegänse, Trüffel und weitere gesunde Nahrungsmittel. https://www.baumann-oberhallau.ch/ (20.02.2020)
[334] Free Range Eggs (n.d.): Nith Valley Eggs. http://www.nithvalleyeggs.co.uk/ (20.02.2020)
[335] Sainsbury's. (n.d.): Woodland hens roam free – for cracking eggs – Sainsbury's. https://www.about.sainsburys.co.uk/making-a-difference/our-values/our-stories/2017/woodland-hens-roam-free-for-cracking-eggs (20.02.2020)
[336] Chalmin, A. et al. (2009): Neue Optionen für eine nachhaltige Landnutzung. Schlussbericht des Projektes Agroforst. p. 122.
[337] Landesbetrieb ForstBW. (2017): MERKBLATT Waldweide. p. 16. https://www.forstbw.de/fileadmin/forstbw_infothek/forstbw_praxis/ForstBW_Merkblatt_Waldweide_WEB.pdf (20.02.2020)
[338] ibid.
[339] ibid.

3.20 Profile: Social farming

Category: Production, processing

Description: Social farming describes concepts of multifunctional farms or market gardens. People with physical, mental or psychological impairments are integrated in all activities. Likewise, people from socially disadvantaged backgrounds, juvenile offenders, young people with learning difficulties, recovering addicts, autistic people, homeless people, the long-term unemployed and active senior citizens are integrated in the work on the farm. The social farming concept also includes educational initiatives such as school and kindergarten farms.[340] Recently, initiatives for the integration of (unaccompanied) refugee minors into farms have also been established.[341]

Aim and innovation: In addition to their ecological effects, these multifunctional farms contribute to the development of rural areas and regional networks[342] by becoming a place of learning, gaining experience, therapy, work and residence as well as a place of social encounter and culture instead of simply being a production site for food and renewable raw materials.[343] Instead of choosing a classical form of therapy, the 'therapeutic' process herein translates into people being 'purposefully' employed for the work that actually arises. Depending on one's own strengths, this can include gardening or working with farm animals. This way new prospects open up for the farmers: they can offer alternative services, diversify the spectrum of their activities, develop new sources of income and they can expand the role of agriculture in society.

Actors: Producers, processors, people with physical, mental or psychological impairments, people from socially disadvantaged backgrounds, juvenile offenders, young people with learning difficulties, recovering addicts, autistic people, homeless people, the long-term unemployed and active senior citizens, migrants, support centers.

Age of the niche: As early as in the 14th century, people with mental health impairments were cared for in monasteries. Care facilities as well as farmers who took care of people with mental and physical impairments already existed in the 19th century.[344] The modern form of social farming emerged about 25 years ago[345].

State of development and current dynamics: In many European countries, social farming began as a niche between the agricultural, health and social sectors. After this initial phase, various actors got in touch with each other and built up networks that led to system changes. The most important changes were induced by government support and the establishment of financial structures for social farming. New system actors, such as support centers, were founded.

In Germany, social farming is not new. However, most often it is individual farmers who strive for social impact through social farming. In this country, as in most countries, social farming

[340] Soziale Landwirtschaft (2015): Soziale Landwirtschaft auf Biobetrieben. https://www.oekolandbau.de/landwirtschaft/betrieb/oekonomie/diversifizierung/soziale-landwirtschaft/ (20.02.2020)

[341] Alma (n.d.): Unbegleitete Minderjährige Flüchtlinge in der Sozialen Landwirtschaft: Netzwerk alma. http://www.netzwerk-alma.de/projekte-fluechtlinge.shtml (20.02.2020)

[342] Soziale Landwirtschaft (2015): Soziale Landwirtschaft auf Biobetrieben. https://www.oekolandbau.de/landwirtschaft/betrieb/oekonomie/diversifizierung/soziale-landwirtschaft/ (20.02.2020)

[343] Forschungsinstitut für biologischen Landbau (2008): SoFar - Soziale Landwirtschaft in Deutschland. http://www.sofar-d.de/?sofar_dt (20.02.2020)

[344] Buist, Y. (2016): Connect, Prioritize and Promote. A comparative research into the development of care farming in different countries from the transition perspective. p. 30.

[345] ibid.

remains not part of a major social movement[346]. Currently in many German states, there is still a lack of funding for care programs that could in turn provide financial incentives for these social farms.

There is a tendency for social farming to increasingly catch the attention of policy makers, not least because of the importance of natural space and agricultural areas for the social, physical and psychological well-being of people (at various levels). Representatives of health care institutions advocate alternative forms of therapy that are embedded in social contexts.

Examples: Juchowo Farm in Poland[347], European Academy for the Culture of Landscape (PETRARCA), Flanders, UK, Norway, Dannwisch (near Hamburg), Network-alma, Naatsaku Noortetalu - Estonia[348], La Fattoria Solidale del Circeo - Italy[349], Loidholdhof - Austria[350], Glittre gård - Norway[351]

Sustainability potential:

- **Ecological:** -
- **Economic:** Poverty reduction, increase of food security
- **Social:** Health: Access to healthy food (indirect), participation, social justice

Risks / disadvantages: There is a risk of abuse. Especially when working with socially, physically or mentally impaired people, it must be ensured that they are not abused as low-cost workers. Depending on the individual case, specialist skills are necessary to ensure appropriate care. If, in addition the farm performs tasks (e.g. health and social care) which are assumed to be the responsibility of the state, as is the case in Norway, then different ministries, such as those of agriculture, education and research, health and social affairs should work together. In Norway, an inter-ministerial committee has been set up for this purpose, bringing together representatives of various ministries[352].

According to an analysis from 2010, one of the difficulties in establishing social farming in Europe is the poor communication between politicians, representatives of the health sector and the agricultural industry[353]. For example, the recognition of farms as part of the health care system could provide permanent financing for those farms that perform such public tasks. Solutions from other European countries can serve as a model in this regard.

[346] In Germany, the possibility of integrating people with physical, mental or spiritual impairments into farms is limited, among other things, by the legally regulated central workshops for people with impairments.
[347] Juchowo / Fundacja im. St. Karłowskiego (n.d.). https://www.juchowo.org/strona-glowna.html
[348] Naatsaku (n.d.). http://www.naatsaku.com/ (20.02.2020)
[349] Fattoria Solidale del Circeo (2019): Home. http://www.fattoriasolidaledelcirceo.com/ (20.02.2020)
[350] Loidholdhof Integrative Hofgemeinschaft (n.d.). https://www.loidholdhof.at/ (20.02.2020)
[351] Glittre Gård (n.d.): Glittre Gård – – det handler om folk og dyr. https://glittre.no/ (20.02.2020)
[352] Haugan, L. et al. (2006): Green care in Norway—Farms as a resource for the educational, health and social sector. https://doi.org/10.1007/1-4020-4541-7_9 p. 112.
[353] Andres, D. (2010): Soziale Landwirtschaft im Kontext Sozialer Arbeit: Alternative Betreuung und Beschäftigung für Menschen mit psychischer Beeinträchtigung. Akademische Verlagsgemeinschaft München. p. 20.

3.21 Profile: Solidarity table

Category: Consumption, waste and recycling

Description: Food waste of the retail sector is saved by a community and either redistributed to people with limited financial resources, or processed into a dinner that is shared among the community. Such a 'solidarity table' gives people with a migrant background, low income and those without a fixed place of residence, work or social welfare the opportunity to access food and a community. In addition, educational workshops on food cultivation, composting and beekeeping are offered by a few initiatives in their urban gardens.[354]

Aim and innovation: Through recovery, processing and redistribution, unwanted food waste and poverty in cities are being counteracted. Through the distribution and joint consumption of food, the food security of people in economic distress is strengthened. By providing free meals to people without verification of their income, origin or other documents, or with a 'pay as you feel' approach, this concept also counteracts social isolation among people with few financial resources. People (who may themselves live in precarious conditions) are engaged as volunteers to help with the preparation of the food packages, the collection of the food waste and the communal cooking (partly in mobile field kitchens).[355] This integration strategy should promote horizontal solidarity, emancipation from one's own situation and active citizen participation.

Actors: Migrants, volunteers, food retailers, suppliers

Age of the niche: There are similar concepts like the German 'Tafel', which has been active since 1993. However, due to increasing food waste, which has now reached 11 million tons of food waste per year in Germany[356], the number of initiatives that aim to save food has increased (→ Food sharing[357]). In addition to the Climate Crisis, the Global Financial Crisis from 2007 onwards has greatly exacerbated the situation of low-income households in the European Union and of many people in the Global South. The migration crisis led to bottlenecks in the food supply to socially and economically isolated people, especially in European cities. As a result, many of these initiatives have been established in the last 5-10 years.

State of development and current dynamics: These initiatives are spreading above all in urban regions, where this multiple crisis is to be noticed first. They are particularly relevant where public systems fail to provide sufficient access to food for isolated people. If the initiatives were to continue to grow, food waste could also be curbed. For example, in Thessaloniki, where Pervolarides has set up such an initiative, an estimated 10 tons of unwanted food was recycled in 2018.[358]

[354] Agroecopolis (2018): Cooking together for all. https://www.agroecopolis.org/cooking-together-for-all/ (20.02.2020)
[355] Vluchtelingenwerk Vlaanderen (2017): Cuisine du monde pour tout le monde. https://www.gastvrijegemeente.be/initiatieven/cuisine-du-monde-pour-tout-le-monde (20.02.2020)
[356] Bundeszentrum für Ernährung (n.d.): Lebensmittelverschwendung. https://www.bzfe.de/inhalt/lebensmittelverschwendung-1868.html (20.02.2020)
[357] Haack, M., Engelhardt, H., Gascoigne, C., Schrode, A., Fienitz, M. & Meyer-Ohlendorf, L. (2020): Sozial-ökologische Transformation des Ernährungssystems: Nischen des Ernährungssystems. German Environment Agency, Dessau-Roßlau.
[358] Pervolarides (2018): Pervolarides Activties Dokument. Pervolarides of Thessaloniki.

Examples: Collectactif - Belgium[359], Collectmet (and Palletactif, veloactif, Cuisine du monde pour tous le monde) - Belgium[360], Pervolarides - Greece[361], Agroecopolis - Greece[362], Ethos - Greece, The Real Junk Food Project Brighton - United Kingdom[363], Tunceli, Ovacik – Turkey

Sustainability potential:

- **Ecological:** Resource efficiency in production and consumption, promotion of regional, closed nutrient cycles
- **Economic:** Poverty reduction, increase of food security, promotion of the recycling economy, creation of transparency along the value chain
- **Social:** Health: Access to healthy food, participation, social justice, awareness / education for sustainable nutrition

Risks / disadvantages: The niche offers a solution for the reduction of food losses through their continued use, but it does not address its causes, namely the prevention of food waste in the first place. By ensuring the demand of the wasted food products, this niche is accompanied by the risk that food will continue to be excessively produced and disposed of.

The niche combines several potentials for sustainability. In addition to the ecological and economic goals, in social aspects it especially supports the reduction of suffering and symptoms experienced by the beneficiaries. However, the niche does not directly tackle the source of the prevailing problem situations experienced by migrants as well as low-income and socially isolated people. These social issues must be improved through legislation, as well as through increased provision of social institutions and subsidies by the State. There is a risk that this civic engagement will be taken for granted, and thereby the pressure for necessary changes to the pivotal factors mentioned above could diminish.

[359] Le collectactif (n.d.). https://www.collectactif.com/ (20.02.2020)
[360] COLLECTMET (n.d.). https://www.facebook.com/collectmet/ (20.02.2020)
[361] Περβολάρηδες Θεσσαλονίκης-Pervolarides of Thessaloniki (n.d.). https://www.facebook.com/pages/category/Community/Περβολάρηδες-Θεσσαλονίκης-Pervolarides-of-Thessaloniki-1519674164926145/ (20.02.2020)
[362] Agroecopolis (n.d.). https://www.agroecopolis.org/ (20.02.2020)
[363] The Real Junk Food Project Brighton (n.d.). http://www.realjunkfoodbrighton.co.uk/ (20.02.2020)

3.22 Profile: Sustainable water cycles

Category: Intermediate consumption, production

Description: Sustainable water cycles include approaches that sustainably strengthen the water balance, and which can be integrated into food systems. These include water filtering, water treatment, seawater desalination, water harvesting, water retention systems and design concepts such as Keyline design. Elements from holistic concepts such as permaculture and regenerative agriculture are taken into account.

Aim and innovation: The approaches aim to strengthen the resilience of natural water cycles and food systems to droughts. In light of the global water shortage, this should provide for more water available for the production of food.

In many countries, there is a lot of research being conducted on how to improve the supply of fresh water through measures such as desalination and water recycling. One approach that combines many ideas into one system is the so-called Seawater Greenhouse. It is a greenhouse system in which crops are irrigated with seawater that is sustainably desalinated through solar energy[364]. The concept can be used in hot and dry regions with access to salt water or polluted groundwater[365]. As a positive side effect of the innovation, the evaporation of salt water causes a cooling and moisturizing effect of water vapor on the microclimate and thus on the plants[366]. The concept leads to significantly reduced irrigation requirements and thus lower operating costs compared to conventional greenhouse systems[367].

Scientists are also working on techniques on how to harvest water from the atmosphere to make it available for further use. Condensers, Fog Catchers and Humidity-Harvesting are examples of sustainable approaches that rely on affordable, simple equipment and materials[368]. Fog-catching is a simple method to create a sustainable source of fresh water for reforestation, horticulture and as drinking water for humans and animals[369]. The method has received increasing attention over the past decades and has continually been developed further[370]. In arid and semi-arid regions, where fresh water is scarce but fog occurs regularly, it is possible to install a passive network system for the collection of fog water[371]. The foggy air is forced by the wind through the fabric of the net, where tiny droplets are collected and together form larger drops. These flow into a collection tank. The fog collection rate varies greatly from location to location, but rates of 3 to 10 liters/per m^2 of net are typical[372].

The Keyline design is a holistic design system for improving the water balance in landscapes and agricultural systems. It is based on the topographic properties and natural behavior of water[373], and is often combined with permaculture[374]. The basic idea of Keyline design is to use the water flow in agricultural landscapes in a targeted manner and to distribute it evenly. This is achieved

[364] Davies, P. und Paton, C. (2004): The Seawater Greenhouse and the Watermaker Condenser
[365] Al-Ismaili, A., & Bait Suwailam, T. (2018): Simulation Models of the Seawater Greenhouse. International Journal of Engineering & Technology, 7, p. 90. https://doi.org/10.14419/ijet.v7i3.4.16190
[366] Seawater Greenhouse (n.d.): Technology https://seawatergreenhouse.com/technology (20.02.2020)
[367] Seawater Greenhouse (n.d.): Technology https://seawatergreenhouse.com/technology (20.02.2020)
[368] Ferwati, M. S. (2019): Water harvesting cube. SN Applied Sciences, 1(7),779. https://doi.org/10.1007/s42452-019-0730-y
[369] Batisha, A. F. (2015): Feasibility and sustainability of fog harvesting. Sustainability of Water Quality and Ecology, 6, p. 1–10. https://doi.org/10.1016/j.swaqe.2015.01.002
[370] ibid.
[371] ibid.
[372] Klemm, O. et al. (2012): Fog as a Fresh-Water Resource: Overview and Perspectives. Ambio, 41(3), pp. 221–234. https://doi.org/10.1007/s13280-012-0247-8
[373] Kullik, N. (2016): Entwicklungsszenario der landwirtschaftlichen Flächennutzung durch ein Keyline Kultivierungsmuster: Die Gemeinschaft Schloss Tempelhof in Deutschland.
[374] ibid.

by systematic planning and subsoiling in a cultivation pattern that corresponds to the topography of the cultivated areas[375]. Terraces, ponds, rows of trees and special soil cultivation tools such as the Keyline plough are integrated into the concept in order to infiltrate water efficiently into the soil and keep it there as long as possible[376].

Water retention systems have been developed for the regeneration of water cycles. They retain water for as long as possible where it rains down on the land. Water retention systems can vary in size, from ponds to small lakes, which are not sealed with concrete or foil, but are only lined with natural materials so that the water can slowly infiltrate into the earth. The water bodies can be linked together to form entire water retention landscapes[377]. A well-known example of retention landscapes was inspired by the permaculture pioneer Sepp Holzer and is located in the Portuguese community of Tamera, where its implementation proved a remarkable influence on food sovereignty and water self-sufficiency.

Actors: Farmers, companies, associations

Age of the niche: Methods for harvesting rainwater, floodwater and groundwater have been practiced for thousands of years, ranging from the most rudimentary techniques to complex systems such as the Roman aqueducts[378]. As early as 7000 B.C.[379], rainwater harvesting was practised in many cultures in arid and semi-arid climate zones such as the Middle East, North Africa and West Asia[380]. Each of the emerging cultures invented its individual concept for collecting, diverting and using water for land use systems[381]. Modern fog catchers were first introduced in the middle of the 20th century. [382] At about the same time, Keyline design systems were developed by P.A. Yeoman in response to the increasing expansion of deserts and erosion[383]. Seawater Greenhouse systems were first designed in 1994 on Tenerife with the participation of several European research centers[384].

State of development and current dynamics: Initiatives and the development of technologies for sustainable water cycles are increasing rapidly in parallel with the scarcity of water. The non-profit organization 'Warka Water' has set itself the goal of building fog-catchers in dry regions[385]. Further Seawater Greenhouse systems have been established in arid regions such as the United Arab Emirates, Oman and Israel and are continuously being further developed[386].

[375] ibid.
[376] Ridgedale Farm AB. (2019). Keyline Design—Ridgedale PERMACULTURE. http://www.ridgedalepermaculture.com/keyline-design.html (20.02.2020)
[377] Tamera (2018): Global Ecology Institute – decentralized ecological solutions. https://www.tamera.org/global-ecology-institute (20.02.2020); Living Gaia e.V. (2019): Naturheilung durch Retentionslandschaften—Living Gaia—Ein holistisches Heilungsbiotop in Alto Paraíso, Brasilien. https://www.living-gaia.org/wasser-retentionslandschaft.html (20.02.2020)
[378] Yazar, A., & Ali, A. (2016): Water Harvesting in Dry Environments. https://doi.org/10.1007/978-3-319-47928-6_3
[379] ibid.
[380] ibid.
[381] Oweis, T. et al. (2001): Water harvesting: Indigenous knowledge for the future of the drier environments.
[382] González, J. I. B. (2006): La captación del agua de la niebla en la isla de Tenerife. Servicio de Publicaciones de la Caja General de Ahorros de Canarias. Las Palmas de Gran Canaria. p.220. Investigaciones Geográficas (41), pp.176-178. Spanien.
[383] Ridgedale Farm AB. (2019). Keyline Design—Ridgedale PERMACULTURE. http://www.ridgedalepermaculture.com/keyline-design.html (20.02.2020)
[384] Gioda, E. et al. (1993): Fog collectors in tropical areas. In: Becker, A., Sevruk, B. & Lapin, M.: Proceedings of the Symposium on Precipitation and Evaporation, Vol. 3 Bratislava, Slovakia, 20 - 24 September 1993, pp.273–278.
[385] Warka Water Inc. (2018): Warka Water – Every Drop Counts. http://www.warkawater.org/ (20.02.2020)
[386] Gioda, E. et al. (1993): Fog collectors in tropical areas. In: Becker, A., Sevruk, B. & Lapin, M.: Proceedings of the Symposium on Precipitation and Evaporation, Vol. 3 Bratislava, Slovakia, 20 - 24 September 1993, pp.273–278.

Examples: Epicuro[387], Seawater Greenhouse[388], Warka Water[389]

Sustainability potential:

- **Ecological:** Biodiversity (indirect), soil, water, climate (indirect), air (indirect), resource efficiency in production and consumption, promotion of regional, closed nutrient cycles
- **Economic:** Increase of food security, promotion of recycling economy
- **Social:** Health: Access to healthy food (indirect)

Risks / disadvantages: The approach of the Seawater Greenhouse is highly technological. Apart from the target group of larger producers in windy coastal areas, the approach is less suitable for the production inland, since high pumping costs for sea water transport to the Seawater Greenhouse increase in parallel with the distance to the coast. On the other hand, Seawater Greenhouses do not demonstrate a feasible solution for small-scale production, since the condenser requires high initial investment[390]. For it to be useful to them, it would require governmental support, or product development of cost-effective alternatives[391].

For the successful application of Fog Catchers and Humidity-Harvesting a high humidity in the regions is necessary. In contrast to the Seawater Greenhouse, the initial costs, prerequisites and the use are much lower and simpler. A small disadvantage of the Keyline design is the less efficient soil cultivation with tractors or larger machines due to the trenches and embankments.

[387] Epicuro Solar Desalinator—Epicuro Innovations Hub (2020). https://www.epicuro.co.uk/innovations-hub/?page_id=966 (20.02.2020)
[388] Seawater Greenhouse (n.d.): Seawater Greenhouse. https://seawatergreenhouse.com (20.02.2020)
[389] Warka Water Inc. (2018): Warka Water – Every Drop Counts. http://www.warkawater.org/ (20.02.2020)
[390] Davies, P. und Paton, C. (2004): The Seawater Greenhouse and the Watermaker Condenser. p. 6.
[391] S. N. Kang'au et al. (2011): Farm water use efficiency assessment for smallholder pumped irrigation systems in the arid and semi-arid areas of Kenya. Agricultural Engineering International: CIGR Journal. Vol. 13, No. 4, 2011. Manuscript No. 1672.

4 Concluding findings of the niche analysis

According to transformation theories, niche innovations spurred on by civil society have the potential to bring about the transformation towards a more sustainable food system. Thanks to a variety of niches, which can be understood as a network of actors who initiate similar initiatives, the existing systems can be positively influenced and the unsustainable practices replaced. Current societal trends, such as climate change, globalization or the demographic change, can boost the penetration of niches into the mainstream. The plurality of the niches examined in this project is crucial to bring about a change in the entire complex food system through an equally broad approach of complementary niches.

The niches were identified in cooperation with *Nyéléni Food Sovereignty Movement in Europe and Central Asia* as well as *Friends of the Earth Europe* and other European networks. A public call for niche descriptions was disseminated throughout the partner networks and further niche initiatives were collected by means of desktop research. From the large number of research results, 22 niches were selected based on the 19 ecological, economic and social selection criteria for closer examination. Niches were selected that address different process stages along the value chain of the food system, that have high and integrated potentials for sustainability with regard to ecological, economic and social goals, that already show initial practical experience and successes in the implementation, that are little or not known in Germany and have not been examined in detail in the TransfErn research project. They were then analyzed in detail and presented in the form of profiles.

The niches represented here speak of a high degree of diversity, be it in terms of their approach, their goals, their degree of innovation, the process stages and sustainability goals they address, as well as their probability of transforming the food system. What they have in common is a high sustainability potential, as long as they are applied as recommended in the fact sheets, they are supported by civil society and the state, and some risks are minimized by appropriate framework conditions.

In order to be able to transform the food system in all its complexity and multi-layeredness, **holistic, far-reaching niche approaches** are particularly advantageous, which address many process stages and sustainability goals and involve a plurality of actors. This is the case with →bio-districts/eco-regions and agroecology schools. Due to their holistic nature, they have a direct and indirect influence on almost all objectives of the three sustainability dimensions. They challenge the existing rigid structures of the current food system and industrialized agricultural system, and offer alternative solutions that strongly rely on the sovereignty of the local community and create new local structures. This structural approach might encounter more resistance when expanding into the mainstream. Out of all niches studied, their sustainability potential is the most comprehensive, and risks and disadvantages are by far the lowest.

In **ecological terms**, particularly the niches → (silvopastoral) agroforestry systems, flowering meadows, bio-intensive agriculture, biocyclic vegan farming, Humanure, regenerative agriculture and sustainable water cycles are effective. →Agroforestry systems could be promoted by having them recognized by German legislation as an independent form of land use, thus making agricultural support in line with the EU regulation possible. Also →silvopastoral agroforestry systems experience great difficulties to spread in Germany due to the national legislation on forestry ('Bundeswaldgesetz') and the state legislation on forestry ('Landeswaldgesetz'). Multifunctional land use would also benefit →regenerative agriculture. →Biocyclic vegan farming could be promoted by a differentiation of biocyclic humus soil with regard to the nitrogen upper limit in the German fertilizer ordinance ('Düngeverordnung').

Simplified legislation at these points could remedy the lack of experimentation in Germany and thus enable the development of practical examples and knowledge for the development of these niches. →Sustainable water cycles will continue to attract more attention, especially in view of the increasing threat of water shortages. The innovations presented, such as Keyline design, water retention systems, fog catchers and humidity-harvesting hold considerable potential. Only the Seawater Greenhouses are significantly more exclusive in terms of both location and acquisition costs and should be promoted by the government for a sustainable, widely accessible use. For the ecologically highly valuable distribution of Humanure composting toilets or container systems, its social acceptance, the legal requirements and knowledge gaps regarding the design and handling of the toilets would have to be improved. The **social goals** of inclusion, participation, social justice and access to healthy food are met not only by →bio-districts/eco-regions and agroecology schools, but especially by the niches of →social farming, solidarity table and participatory evaluation and certification systems. The niches →agroecology schools, bio-districts/eco-regions, market gardening, open source seed banks and protection of seeds, participatory evaluation and certification systems and solidarity table also strongly include the **economic component** in their approach.

The niches →open source seed banks and protection of seeds, open source manuals for farming tools and agroecology schools follow the principle of **free access for all people to traditional seeds** and to **technological and agricultural knowledge**. They create new structures for sharing knowledge, which is becoming increasingly exclusive in the current food system due to widely-used patenting practices. Similar to the global goal of food security, the question is no longer one of simply increasing food production (since the quantity is theoretically sufficient in global terms), but of 'access' to healthy food for large parts of the population suffering from malnutrition. The increasing inequality in access to healthy food has many causes, one of which is the monopolization of knowledge, which can be avoided by increasing 'access' through open source structures. This reduces dependence on large agricultural and technology corporations, avoids soil degradation and biodiversity loss and promotes context-adequate, climate-friendly, small-scale agriculture. Also →participatory evaluation and certification systems counteract the exclusive access to certification. In addition, they support the active involvement of consumers in the composition of their food, which promotes awareness and education with regard to healthy nutrition and a sustainable agricultural system and lifestyle.

Some of the niches **replace products, resources or processes** that are harmful to the environment in their current use (→ alternative packaging materials, alternative protein feed, insect food products, mobile slaughterhouses, re-/upcycling of food waste). Thereby they can have a strong, positive impact on several sustainability goals at the same time, thus providing a diverse and broad range of environmental benefits (→ alternative packaging materials, alternative protein feeds), or they can focus on a specific sustainability issue, such as animal suffering (→ mobile slaughterhouses). Despite the clearly positive effects on the respective goals, it must be taken into account that such a substitute is limited in influencing a transformation of the food system. A substitution merely causes a selective change in the system without touching the structural network. Thus, current environmentally harmful structures, lifestyles, behavioral and thought patterns that are dependent on the product or process to be substituted do not get affected or exnovated. New, different structures, lifestyles, patterns of behavior and thinking necessary for a comprehensive transformation also do not get established. Such substitution niches are thus comparatively easier and quicker to introduce and spread in the system, but they only have a selective effect on the symptoms rather than on the real causes of the current sustainability deficits. For example, →alternative packaging materials, re-/upcycling of food waste and the solidarity table help to replace climate-damaging plastic packaging based on fossil fuels or bio-based and biodegradable plastics with sustainable, renewable raw materials and reduce the disposal of food. However, packaging and food waste should first and foremost be avoided from the beginning. The situation is similar with →alternative protein feeds and →insect food products. Instead of focusing on the more environmentally friendly replacement of feed material for intensive animal breeding and excessive meat consumption, here too the main solution that is needed is a rethinking on the consumer side with regard to what is on average an excessive and unhealthy level of meat consumption. If the behavioral pattern of meat consumption changes, this way intensive livestock breeding with high land requirements, greenhouse gases, protein feed requirements and animal suffering can also be reduced. The →mobile slaughterhouses niche is aimed at reducing animal suffering caused by long transport routes to slaughterhouses. However, although suffering is reduced here, the overriding problem of climate-damaging industrial animal husbandry and the ethically critical slaughter of animals still needs to be fundamentally transformed. The mobile slaughterhouses will probably primarily function as an important market niche for smaller organic farms, for whom slaughtering with the least possible suffering of the animals is important. The risk of improving only the symptoms of the sustainability deficits is that people will soon rely on this support and the pressure to tackle the actual causes will decrease. Despite this criticism, these niches are extremely important, because as long as resistance does not cause the right adjustments to be made, these niches can quickly and significantly reduce the burden on the ecosystem and, in some cases, animal suffering. The EU approval for the recycling of former food, organic residues and catering waste as feed for insects would be beneficial for the niches →alternative protein feeds and →insect food products.

For some niches, the possible **long-term negative effects** are not yet fully foreseeable, as some of them pursue very **novel** (→Effective Microorganisms) or **highly industrialized approaches** (→Digital Farming, effective microorganisms in the industrial sector, alternative protein feed, sustainable water cycles - Seawater Greenhouse). Technological innovations, such as →Digital Farming, are often regarded with a lot of hope, expecting from them the decisive solution to the sustainability deficits. However, their use is primarily aimed at the efficiency of large industrial farms, and in contrast they carry a very high risk of negatively affecting many other sustainability areas, such as the profitability of small farms and biodiversity. They can have a positive impact, if the application and dissemination in Germany is accompanied by governmental support (e.g. support of cost-effective alternatives, protection of biodiversity and small farms, adaptation of legal framework conditions), taking into account open source alternatives and corresponding regulations. However, if they are left to the free market, there is a risk that they will exacerbate the inequality gap and the highly industrialized, climate-damaging, socio-ecologically dysfunctional system.

Throughout Europe, **associations** are already forming **within some niches**, such as URGENCI, which brings together the Community Supported Agriculture initiatives[392]. They already provide half a million members throughout Europe with food[393]. There is great development potential for the other niches. In addition, there is a lot of potential for cooperation **across niches**. Various niche constellations for exploiting the potential synergies are conceivable. Particularly suitable for niche cooperations are the niches →agroecology schools, agroforestry systems, bio-districts/eco-regions, market gardening, biocyclic vegan farming, flowering meadows, participatory evaluation and certification systems, regenerative agriculture and social farming.

[392] Haack, M., Engelhardt, H., Gascoigne, C., Schrode, A., Fienitz, M. & Meyer-Ohlendorf, L. (2020): Sozial-ökologische Transformation des Ernährungssystems: Nischen des Ernährungssystems. German Environment Agency, Dessau-Roßlau.
[393] Heinrich-Böll-Stiftung et al. (2017): Konzernatlas - Daten und Fakten über die Agrar- und Lebensmittelindustrie. 2017. Berlin. https://www.boell.de/de/konzernatlas (20.02.2020)

These niches can be also very well linked to niches from the TransfErn project, such as →Community Supported Agriculture, Regionalwert AG, Food Coops and vegan nutrition.

Here, cooperations could be established, joint funding could be obtained and joint advocacy work could be carried out, joint infrastructure channels (such as media, sales channels, rooms, etc.) could be used and producer and consumer sides could be linked, cultivation techniques could be exchanged and more process stages could be integrated, etc. In particular, the above-mentioned strongly ecologically oriented niches → (silvopastoral) agroforestry systems, market gardening, biocyclic vegan farming, Humanure, regenerative agriculture and sustainable water cycles can be very well combined with participatory evaluation and certification systems in order to create sales and marketing opportunities of the valuable agricultural products. They could also be well linked to →agroecology schools, since the knowledge of crop rotation, compost management, fertilization and soil cultivation techniques is crucial for a successful application of the →regenerative agriculture, market gardening, biocyclic vegan farming, agroforestry systems and effective microorganisms. Due to the lack of practical examples in Germany, such an exchange of experience between producers as with the principle of agroecology schools would be highly recommendable.

5 Outlook

In this report 22 niches from Europe are presented, which are not yet or only to a small extent practiced in Germany. The results of this study can be used by civil society, politics and science as a basis of information in order to initiate or promote such initiatives in diverse ways within the framework of their work. In this sense, all niches can demonstrate first positive applications in several European countries and each has a specific sustainability potential.

In addition to the promotion of these niches by associations and federations in Germany, the transnational networking of the associations and federations with the European niche actors mentioned here could also be beneficial for the development of these niches and their contribution to the change in the food system. This would allow the niches to grow in reach and to optimize the niche itself through interactive exchange. Last but not least, individual initiatives can better adapt to national conditions and local contexts thanks to being able to access a great wealth of experience.

In addition, the results of this project can also inform decision-makers in politics, the public sector, the private economy and civil society about which niches are currently on the move throughout Europe, with which they would like to cooperate for their goals and purposes, and which niches are worthy of support, taking into account the specific risks.

It can be assumed that a broad approach such as the one taken from the niches →bio-districts/eco-regions and →agroecology schools has a high potential to positively impact the transformation of the complex food system. Thus, they are more likely to contribute to a change of the food system than niches that only address a few aspects, such as the niche of →mobile slaughterhouses. Open source concepts such as →open source manuals for farming tools, →open source seed banks and protection of seeds as well as the →agroecology schools represent a promising development to prevent the loss of traditional knowledge and seeds due to patenting and monopolization. In addition, many of the niches offer more sustainable alternatives to the current unsustainable use of certain products, resources and processes, such as →alternative packaging materials, alternative protein feed, insect food products, mobile slaughterhouses and re-/upcycling of food waste.

The knowledge gained could be supplemented by further investigations. Further in-depth analyses and evaluations of the niches could, for example, start with stakeholder analyses, quantifications of the sustainability potential and risks, as well as the assessment of the transformation potential.

Overall, the niches presented here in profiles confirm the assumption that many niche innovations are being vigorously promoted by civil society actors in Europe, which can lead to a more sustainable food system. These niches are not yet or barely active in Germany, and could be initiated and promoted by an exchange of ideas from associations and federations. In order to make the information freely available and thus enable networking, the fact sheets will be made immediately available in parallel on the online platform FoodSystemChange[394]. Thus, associations in Germany as well as niche actors across Europe can benefit from the wealth of ideas and exchange experiences with each other. The exploitation of synergy potentials is central to a sustainable change in the food system.

In order to transform the current food system into an environmentally friendly, sustainable system, it requires further in-depth examination and the evaluation of existing niches and,

[394] www.foodsystemchange.org

derived from this, the promotion of promising models, which should lead to the advancement of the niches into the mainstream.

6 List of references

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