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Assessment of agroecological development: a case study of the Allgäu region

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Abstract

The framework of *agroecology territories* suggests that transitioning to sustainable agriculture and food systems is most efficient on a territorial scale. To understand the processes and show positive outcomes of agroecological development a measurement instrument is necessary. Therefore, this study combines the creation of an indicator-based assessment tool and its exemplary application in the Allgäu, a region in the south-west of Germany. Using the concept of agroecology territories as directive, combined with the opinion of local experts, 15 indicators were created and grouped in the following three dimensions: (1) adaptation of agricultural practices, (2) conservation of biodiversity and natural resources, and (3) development of embedded food systems. Data about the Allgäu region was mainly obtained by semi-structured interviews with stakeholders from the different dimensions, structured interviews with farmers, on-site observations and complementary literature and online research. In addition to the indicator-based analysis, a stakeholder analysis was conducted, as stakeholder initiative is an essential attribute of an agroecology territory. The results from the assessment tool shows that the indicators were a suitable approach. Moreover, the findings in the Allgäu also show that the region can be called an agroecology territory. Initiatives that connect all three dimensions, such as the *Allgäuer Alpgenuss* label, raise attention for authentic high-quality culinary services in the Alpine gastronomy. Hereby, traditional agriculture and processing techniques are maintained, which lead to conservation of the landscape, add touristic value, and a premium price for the local products. The strong regional identity of stakeholders and citizens is advantageous, too. The stakeholders in the region are uniquely connected through the overarching Allgäu brand, which transmits commonly pursued values of regionality, sustainability and quality. The wide scope for interpreting agroecology made the selection of indicators challenging, as well as coping with the unavoidable subjectivity introduced by the researcher and the involvement of stakeholders, but the later were crucial to the process. The assessment tool from this study can be applied in other regions to evaluate agroecological transition. Further, the findings about the Allgäu can serve as baseline to put findings from other regions into relation, through the comparison insight in most efficient processes and initiatives can be gained.

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Table of contents

1. Introduction	1
2. Current state of research.....	2
3. Research questions and scope of the thesis	4
3.1 The ontological research – is the assessment approach viable	4
3.2 Contentual analysis of the Allgäu as a candidate for an agroecology territory	4
4. Methods	5
4.1 Study area.....	5
4.2 Creating the set of indicators.....	6
4.3 Collection and evaluation of the data.....	11
5. Results.....	12
5.1 Adaptation of agricultural practices.....	12
5.1.1 Enhancing and supporting ecosystem services through agricultural practices.....	14
5.1.2 Diversification of farming systems	15
5.1.3 Grassland management	16
5.1.4 Agricultural education and farmer-to-farmer knowledge exchange	17
5.1.5 Rate of farm abandonment and structural changes	18
5.2 Biodiversity and natural resource conservation	19
5.2.1 Ecosystem services and biodiversity on permanent grassland	21
5.2.2 Protected areas and biodiversity conservation	22
5.2.3 Management of land with marginal productivity	24
5.2.4 Biodiversity measures by farmers.....	26
5.2.5 Protection of drinking water	26
5.3 Development of embedded food systems.....	27
5.3.1 Local food initiatives	29
5.3.2 Innovative management forms in food production and selling	31
5.3.3 Diversity and availability of local food products.....	33
5.3.4 Collective catering based on local and organic products	34
5.3.5 Consumer awareness and connection between producers and consumers	35
5.4 Stakeholder analysis	36
5.5 Is the Allgäu an agroecology territory?	40
6. Discussion.....	42
6.1 Discussion of the methodological approach	42
6.2 Discussion of the results	46
6.2.1 Adaptation of agricultural practices.....	46
6.2.2 Biodiversity and natural resource conservation	49
6.2.3 Development of embedded food systems.....	50
6.2.4 The Allgäu as agroecology territory	51

7. Conclusion and outlook	52
References.....	vi
Appendix	xiii

List of figures

Figure 1: The Allgäu region marked on the Germany map.	5
Figure 2: Development of the number of certified organic farms in the Allgäu from 2007 to 2018.	15
Figure 3: Change of farm sizes in the Allgäu.	19
Figure 4: Evaluation of the landscape changes around three municipalities in the Upper Allgäu.	25
Figure 5: The sign of the Allgäu brand.....	38
Figure 6: Compilation of stakeholders from the Allgäu active in the dimensions of an agroecology territory.	39

List of tables

Table 1: List of selected indicators in the category of “adaptation of agricultural practices” ...	7
Table 2: List of selected indicators in the category of “biodiversity and natural resources”	9
Table 3: List of selected indicators in the category of “development of embedded food systems”	10
Table 4: Results for the adaptation of agricultural practices criteria	13
Table 5: Summary of the results for the criteria 6 to 10.....	19
Table 6: Summary of the results for the criteria 10 to 15.....	28
Table 7: Results of the stakeholder analysis.....	40

List of appendices

Appendix 1: List of excluded indicators.....	xiii
Appendix 2: Questions for the structured interviews with farmers.....	xiv
Appendix 3: Schedule of all conducted interviews	xiv
Appendix 4: Condensed information from the ten interviews with farmers	xvi
Appendix 5: SWOT Analysis of the methodological approach	xix

1. Introduction

Global issues, such as: water pollution, resource degradation, and food insecurity are constantly worsening (Food and Agriculture Organization of the United Nations 2017). Solving these complex environmental and societal problems requires the design and implementation of more sustainable and agroecologically sound systems. The regional scale was seen to be the most efficient for transitioning toward sustainable agriculture and food systems as Wezel et al. (2016) explain with their concept of *agroecology territories*.

The term *agroecology*, defined as “the ecology of the food systems” (Francis et al. 2003), highlights the need for transdisciplinary research and a system approach for designing environmentally and socially sound food systems.

In this study, the challenge of evaluating sustainable development on regional scale was taken on, including ecological as well as societal aspects. For this purpose, an assessment tool comprised by agroecological indicators was designed. The measurement criteria have been created according to agroecological principles and the concept of agroecology territories. Such an assessment tool is relevant within this field because it can create a picture of a region showing if there is a transition ongoing and how far the development proceeded. Moreover, it is important for raising awareness about the need of agroecological projects and initiatives by showing their benefits and examples of their successful implementation. Additionally, the development can be accelerated by demonstrating which strategies are fruitful and effective. Consequentially it can be used to convince stakeholders and decision-makers to support the development.

Next to the ontological question of how to measure agroecological development, this work will investigate whether the Allgäu region is a candidate for an agroecology territory. Such territories are defined as “places engaging in a transition process toward sustainable agricultural and food systems” (Wezel et al. 2016, p. 135) – so the transition is not completed, but ongoing. Wezel et al. (2016) stress the inclusion of the following three domains to initiate such a development: (1) Conservation of biodiversity and natural resources, (2) adaptation of agricultural practices, (3) development of embedded food systems. Additional to the three domains, stakeholder initiative is the key aspect for successful transition. The stakeholders are the implementing force and only by forming a community of actors the change of the system can be facilitated.

The Allgäu region, in the south-west of Germany, was chosen to conduct exemplifying measurements. This region was selected as study subject because of the broad range of innovative projects that are brought forth (Weizenegger and Wezel 2016), the traditionally high importance of agriculture and forestry in the area, the biodiversity rich landscape, and a strong regional identity of the inhabitants. These are the aspects making this region predestinated for agroecological research.

By investigating the Allgäu's transition to sustainable agriculture and food systems, I will test which indicators are feasible to evaluate, and which conclusions can be drawn from the collection of this specific set of indicators. One of the goals is to find a balance between meaningful indicators and necessary simplification for approximating a whole system in its real-life complexity (Bell and Morse 2008).

The outcome of this thesis might be used as comparative baseline for measurements in other regions or for future assessments in the Allgäu. Further, it shows outstanding examples for other regions how to use agroecological approaches. In addition, it provides insight into the difficulties of measuring holistic and value-based concepts like agroecology or sustainability. Overall it should serve as stepping stone for the creation of the next agroecology assessment tool.

First, the two different research questions posed in this study are explained. One deals with the methodological approach of measuring the agroecological development, the second one investigates the development in the Allgäu. After looking into the current state of research, the study area is depicted. Then the creation of the indicator-based assessment tool will be presented, followed by a description of the methods for data collection. The subsequent chapter presents the results concerning the development in the Allgäu for each of the indicators and the stakeholder analysis. This chapter ends with the estimation whether the Allgäu is in the transition toward an agroecology territory or not. The discussion deals again separately with the methodological approach and the application of the assessment tool. Finally, the outlook points out the opportunities emerging e.g. from using the assessment tool in other regions.

2. Current state of research

How to measure agroecological development and the sustainability of agriculture and food systems is a methodological issue. Using indicators is only one approach out of many to evaluate the “agroecological soundness” of a system (Bell and Morse 2008).

Agroecological indicators are generally less common than sustainability indicators. Studies with sustainability indicators can be found for various scales and topics, such as cities (Michalos 2014), companies (Sandin et al. 2011), or resources like ground water (Anbazhagan and Jothibasu 2016). Agroecological indicators are apparently most commonly used for analysing certain farming systems (Bockstaller et al. 1997; Cruz et al., 2018) or within sustainability analyses as part of the parameters as in a sustainability assessment of cropping systems by Castoldi and Bechini (2010) or Migliorini et al. (2018) where agroecological indicators are combined with (soico)economic ones. The focus of this study is on regional agroecological development, because decisions and policies are often implemented on a higher level conform with administrative units. Studying agroecology only on farm scale can

lead to a disconnection between research and practice (Dalgaard et al. 2003). Therefore, the goal here is to have generalizable results, which can support improvement or acceleration of the regional agroecological development, if they are presented to main agriculture, nature conservation and food system stakeholders and the correspondent authorities.

Often sustainability is set as a development goal, for example by companies, who want a more sustainable production or municipalities who want to become a sustainable city (Bell and Morse 2008). Using indicators to assess if a certain goal or situation was achieved can be a relevant approach. Another option is to use the indicators to find out whether a situation is developing in a desirable direction, as in this study. However, multicriteria analyses pose several challenges, e.g. how to compare results from different indicators, especially if they are varying between quantitative and qualitative, or how to determine the importance or the “weight” of the individual indicators (Bell and Morse 2008). Therefore, a method, as applied in this study, should rather be regarded as a tool for creating awareness among stakeholders and as comparative system for future measurements than for an assessment in absolute terms.

Sustainability is a value-based concept, its meaning varies according to different contexts, and with the subjective view of each individual using the term. Additionally, the multiple and often conflicting ecological, social and economic goals within sustainability make the evaluation of the progress of sustainable development very challenging. This requires a systems approach, which means to acknowledge a system as a complex whole with a special focus on the interrelatedness and connectivity between its sub-systems. Furthermore it needs the acceptance that a situation is characterized by multidirectional feedback and not by linear causal links (Bawden 1991). Hence, when measuring the development toward sustainable agriculture and food systems, one must be aware of the complexity of the situation and investigate the connections between the determining factors. Only by acknowledging the interconnectedness an understanding can be achieved whether the development is going in the desired direction or not. There is no linear transition e.g. due to competing objectives, so the overall picture has to be taken into account instead of weighing single factors against one another.

Another question Bell and Morse (2008) are raising, is whether a reductionist approach, such as indicators as assessment tool can be used within the complex field of sustainability. Of course, in science researchers are forced to simplify their research objects because of their real-life complexity which limits the possibility to draw conclusions. This means that simplifying hypotheses are needed as basis for tests and measurements. If it turns out that a hypothesis does not fit reality, one needs to restart the measuring process in order to slowly approximate the actual situation (Bell and Morse 2008). This thesis is the first measurement whether a region is an agroecology territory or not. So, it can create a baseline for future assessments of the agroecological development in the Allgäu, but also in other regions.

3. Research questions and scope of the thesis

The goal of this study is to analyse the suitability of various indicators to assess agroecological development, and to explore whether the Allgäu, as an example region, is in a transition toward an agroecology territory. This approach should lead to an easily applicable assessment tool.

3.1 The ontological research – is the assessment approach viable

The first research question is: How suitable is a set of indicators as a tool to assess the transition towards sustainable agriculture and food systems on a regional scale? The indicators are selected from the three categories highlighted by the agroecology territory concept: “adaptation of agricultural practices”, “conservation of biodiversity and natural resources” and “development of embedded food systems”.

After establishing a set of indicators for each category, the following research questions have been tested. The findings are based on an exemplary data acquisition in the Allgäu:

- Which indicators are supported by existing data?
- What types of results are generated through these indicators?
- Is a set of indicators a suitable strategy to analyse the agroecological development on regional level?
- How can the results be further used?

3.2 Contentual analysis of the Allgäu as a candidate for an agroecology territory

Secondly, the study aims to assess whether the Allgäu is an agroecology territory or not. To complete this, the agroecological development of the region will be tested by implementing the above-mentioned indicator-based assessment tool.

According to the theoretical framework of agroecology territories, there should be a transition ongoing in all three dimensions of an agroecology territory (Wezel et al. 2016). Whether there is a development or not will be investigated with different indicators. The major research questions for the three dimensions are the following:

- (1) Are farmers adapting their practices to create a more sustainable agricultural system?
If yes, what types of adapted practices are implemented? Are the farmers supported through regional structures to conduct necessary changes?
- (2) How is the state of biodiversity and natural resources in the Allgäu? Are there measures to protect both? If yes, what types of protection measures are implemented in the region and by whom?

- (3) Is the development of an embedded food system ongoing in the Allgäu? Are there initiatives around local and organic food present in the Allgäu? If yes, what kind of initiatives are these?

Additionally, it is presumed that a strong stakeholder engagement enables sustainable and agroecological development. Therefore, it will be investigated through a stakeholder analysis if an engagement is visible in the Allgäu. For this analysis, the following research questions were formulated:

- a) What kind of stakeholder initiative linked to agroecological development is present in the Allgäu?
- b) Who are the key stakeholders in each of the three dimensions?
- c) Are there common themes and goals visible within the group of stakeholders?

4. Methods

4.1 Study area

The German Allgäu region was selected for this thesis because of the traditionally high importance of agriculture in the area, the biodiversity rich landscape and the outstanding number of projects forming a starting point towards sustainable and agroecological development.

The region is in the very South of Germany and shares one border with the neighbouring country Austria. The position of the region within Germany and the location of the districts is shown in Figure 1. The boundaries for this work include the following four districts within the Federal State of Bavaria: Lower Allgäu (*Unterallgäu*), Upper Allgäu (*Oberallgäu*), East Allgäu (*Ostallgäu*) and Lindau (formerly *Westallgäu*), including the three urban municipalities Kempten, Kaufbeuren and Memmingen. This excludes areas, which would be part of the Allgäu, if a landscape approach would be applied; one of these

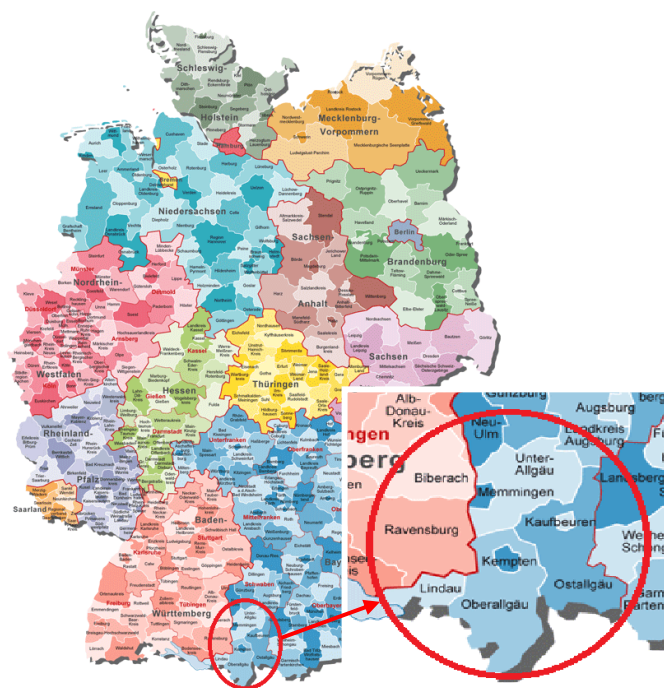


Figure 1: The Allgäu region marked on the Germany map.

Zoom on the four districts and three urban municipalities in the Bavarian Allgäu (blue part). (Source: intermap.de)

lies in the Federal State of Baden-Württemberg, another in the Republic of Austria; however, for the sake of precise statistical data the research will be constraint to the first mentioned

administrative demarcations (Institut für Länderkunde Leipzig 1997). For the Allgäu region exists more than one demarcation, so to work with it as a territory it must be clarified within which boundaries the research takes place.

As mentioned above, agriculture is of high importance in the Allgäu region. It covers in average 58 % of the whole area. Permanent pastures take up a major part of the agricultural area; it ranges from more than half of the agricultural area in the Lower Allgäu, up to almost the entire agricultural area in the district of the Upper Allgäu (Bayerisches Staatsministerium für Ernährung, Landwirtschaft und Forsten 2016). The permanent pastures are mainly used for livestock grazing, especially dairy production is prevalent. Only in the northern part of the Allgäu, where the smallest percentage of permanent grassland is found with only 66 percent of the agricultural area, cropping systems play a bigger role. The largest part of the arable land there, is devoted to silage maize, followed by wheat and winter barley (Bayerisches Landesamt für Statistik 2018).

The number of organic farms in the region are over the German average of 7 %. In the Lower Allgäu 8,5 %, in the East Allgäu 16,9 %, in Lindau 19,6 % and in the Upper Allgäu 20,5 % of the farmers are managing their farms organically (Amt für Ernährung, Landwirtschaft und Forsten Kaufbeuren 2017).

Additionally, the Allgäu is one of the hotspots for biodiversity in Germany due to its location, including Alpine foothills and Alpine lands. These areas are especially known for the high amount of species that are found there and various endemic species living in the rare habitats of the Alps (Bundesamt für Naturschutz 2015)

The region was not only selected due to the importance of the agricultural sector and its high value for nature conservation, as well because it was suspect to a previous study on rural sustainable development (Wezel and Weizenegger 2016). In that study, the authors concluded that there is an overall positive development towards sustainability ongoing also due to various initiatives promoting local and organic food production and consumption. These results will be the basis for the investigations in this study.

4.2 Creating the set of indicators

Indicators are common measuring instruments in scientific research. To evaluate complex systems, such as the environment, simplifying indicators are a useful tool. With indicators we construct an understandable picture of the system that we want to assess. The set of indicators usually has the endeavour to compile all factors that are relevant to the investigation of a system (Turnhout et al. 2007). The agroecology indicators in this thesis, were established with the intention to include ecologic as well as socio-economic aspects. Furthermore, the indicators are tailored to the concept of agroecology territories by Wezel et al. (2016). Hence,

the indicators are defined by this concept but should also lead to a deeper understanding of how to put it into practice.

As mentioned above, indicators are simplifying reality, especially when we attempt to measure complex concepts like agroecology or sustainability. Still, it is important to have a methodology for measuring agroecological development to be able to show positive outcomes of new practices and policies. Without accounting the outcome of a changed path, it won't be possible to generate understanding and acceptance for its necessity (Brugmann 1997).

The indicators that are used in this study are based on the description of an agroecology territory by Wezel et al. (2016). This is the theoretical construct that will be compared with the reality in the Allgäu region. Bell and Morse (2008) mention the possibility of comparing the gathered data with data of a reference system; such a system could be a similar region, which is at a different development stage, or it could be the same area, but data from former times. However, this was not applicable in the case of this study. Therefore, the theoretical framework – the agroecology territory – is also the reference system. The compiled dataset should lead to an estimation of the transition towards sustainable agriculture and food systems.

After establishing a preliminary set of indicators for the three mentioned dimensions, one expert interview per group of indicators was conducted. The experts gave their professional opinion on the measurability of the indicators, whether there would be data accessible or not, and appraise the wholeness of the list. The experts also contributed local knowledge and could add indicators, which are particularly important for the Allgäu, or eliminate some, which are not applicable to it. An example for a locally important category is the grassland management, as described above, it makes up for 58 to 99 percent of the agricultural area. This is also the reason why the biodiversity indicator concerning the diversity of breeds and varieties was excluded. It could be relevant in other regions, but is not very suitable for the Allgäu, because of the extremely high percentage of grassland. The list of excluded indicators can be found in Appendix 1. The main reason for the exclusion of indicators is that the data collection wouldn't be feasible in the frame of this thesis.

Table 1 shows the list of indicators, which were selected to be applied and tested in the Allgäu region. The indicators are divided in three categories, according to the dimensions of the agroecology territory concept. To have a balance between the categories only 5 elements were selected for each of them.

Table 1: List of selected indicators in the category of "adaptation of agricultural practices"

Criteria	#	Indicators
1. Enhancing and supporting ecosystem	1a	Percentage of farmers receiving payments for agri-environmental measures

services with agricultural practices	1b	Percentage of certified organic farms and agricultural area
2. Diversification of farming systems	2a	Length of crop rotation: diversified with a more than 3 different crops
	2b	Integration of cover crops and legumes in the crop rotation
3. Grassland management	3a	Proportion of farmers with extensive and biodiversity enhancing grassland management: <ul style="list-style-type: none"> • Under 4 cuts/year = extensive • 4 and more cuts/year = intensive
	3b	Share of farmers including grazing in their grassland management
4. Agricultural education, farmer-to-farmer knowledge exchange and extension service	4a	Sufficient or insufficient offers and types of offers for agricultural education
	4b	Estimation of interviewees, if the amount and diversity of information offers is insufficient, enough or good. (Offers can include excursions, field days and knowledge exchange for farmers etc.)
5. Rate of farm abandonment	5a	Percentage of farmers stopping their agricultural activities per year (development over time) <ul style="list-style-type: none"> • Positive: The change is slower or the same as current structural change in Germany • Negative: The change is faster than in the rest of the country
	5b	Average farm size (hectares and livestock number) compared to national average
	5c	Growth threshold: under which farm size the number of farms decreases, and over which size the number rises

The first set of indicators, listed in Table 1, is compiled to estimate the development from current agricultural practices, which are judged as unsustainable due to worsening environmental conditions, to more sustainable and adapted practices. What type of practices are beneficial for the adaptation to environmental changes depends strongly on local conditions, but agroecological principles, such as creating biodiversity and working in alignment with natural processes of an (agro)ecosystem (Brym and Reeve 2016; Gliessman 1990), can be the general guideline for a transition. This is addressed by the first three indicators as well as the indicators 6 and 8 in the category of conservation of biodiversity and natural resources.

The indicators 4 and 5 are investigating the outside circumstances. It is assessed whether the farmers are supported with adapting their agricultural practices through provided information meetings, advising services and knowledge exchange possibilities. The last one concerns generally, whether the conditions for farming are very challenging, which would lead to a high abandonment rate, or not and whether certain farm sizes are supported more than others.

Table 2: List of selected indicators in the category of “biodiversity and natural resources”

Criteria	#	Indicators
6. Ecosystem services and biodiversity on permanent grassland	6a	Development of grassland area: <ul style="list-style-type: none"> • Positive: Stable or increasing • Negative: Decreasing
	6b	Number of farmers with the governmental <i>species rich grassland program</i> ¹
	6c	Incentives for biodiversity protection measures on grassland for farmers
7. Protected areas and biodiversity conservation	7a	Protected areas in the Allgäu: <ul style="list-style-type: none"> • Positive: wide range of protected zone Negative: only loose protection types • Positive: General increase and increase of important protection types Negative: General decrease and decrease of certain protection types
	7b	Important habitats outside of protected zones: <ul style="list-style-type: none"> • Positive: management measures in these areas are carried out, if necessary • Negative: decrease of the habitats due to a lack of management
8. Management of land with marginal productivity	8a	Estimation by actors in the nature conservation sector, if areas without monetary profitability are managed in favour of biodiversity
	8b	Initiatives to conserve land with marginal productivity
9. Biodiversity measures by farmers	9a	Number of farmers who conduct biodiversity measures
	9b	Types of measures the farmers conduct
10. Protection of drinking water	10a	Low to high drinking water quality in the region
	10b	Impact of agriculture on drinking water: <ul style="list-style-type: none"> • Positive: agriculture is no threat to drinking water quality • Negative: agriculture is a threat to the drinking water quality
	10c	Measures undertaken for drinking water conservation

The second set of indicators – shown in Table 2 – concerns the protection of biodiversity and natural resources, which are the foundation of life and constitute the basis for ecosystem services (Wezel et al. 2016). The indicators for this domain were selected to measure biodiversity protection on farmed areas (indicators 6, 8 and 9) and areas with management restrictions or no interference (7). The last indicator (10) in this section regards the

¹ The species rich grassland program is result-oriented, which means not the certain practices are rewarded, in this case certain indicator species must be found to obtain the compensational payment. In this program, the farmer has more management freedom, but he has also the full responsibility for maintaining the habitat for the indicator species (Bayerische Landesanstalt für Landwirtschaft, 2017)

conservation of another essential resource: water. The result for this indicator stands exemplary for the handling of crucial resources in the region.

Table 3: List of selected indicators in the category of “development of embedded food systems”

Criteria	#	Indicators
11. Local food initiatives	11a	Estimation whether there are few or many initiatives around local food
	11b	What types of initiatives do exist?
	11c	Level of awareness about the initiatives within the local society and accessibility of these initiatives for the citizens
12. Innovative management forms in food production and selling	12a	Are innovative projects around food production and consumption existing?
	12b	What types of projects are these?
13. Diversity and availability of local food products	13a	Narrow to broad range of local foods – insufficient or sufficient diversity to satisfy the needs of the consumers
	13b	Low to high availability of local food
14. Collective catering based on local and organic products	14a	Percentage of regional food in out of home kitchens
	14b	Initiatives to support this development
15. Consumer awareness and connection between producers and consumers	15a	Estimation of stakeholders, if local consumers have a low or high awareness level of the importance of local and organic food
	15b	Few to many connection points for consumers and producer – types of contact points

Table 3 shows the last section, which is researching whether there is a development of an embedded food system in the Allgäu ongoing or not. Embedded food system means a food system with regional products, in which the consumers know where their food comes from. It strengthens the link between inhabitants and their “territory” and changes social and economic relations. Such changes can as consequence help to solve ecological and social issues (Wezel et al. 2016), for example when people buy locally they see the outcome of their purchase decision, whereas in a global food system the lack of connection between producers and consumers leaves the consumer unaware of their influence.

The first two indicators provide insight, if initiatives exist to change the current conventional way of food supply. Indicator 13 asks the question, if the consumers have the chance to fulfil their needs with local products and if it is a real accessible and convenient alternative to the

conventional grocery shopping. The results are only discussing the diversity of available products and not the amount per person. Number 14 is relevant because the use of local food in out-of-home-kitchens can be a big step towards an embedded food system. The unity of the canteens in the region would increase the demand for local food strongly and enhance the infrastructure and short supply chains. The last indicator queries if the consumers already do have a certain level of awareness concerning local food supply and if the possibility for consumers and producers to reconnect is already given.

4.3 Collection and evaluation of the data

To analyse the present situation, different types of interviews were held, project sites were visited to get a personal insight and the opportunity for short informal conversations with project leaders or participants. Online research was conducted to get complementary information in addition to the interviews.

Most of the interviews were conducted as semi-structured interviews. This methodology was identified as being the most appropriate to extract most relevant information from the interviews with stakeholders from agriculture, nature conservation and the food system. The method is particularly suitable for small-scale case studies and provides good flexibility to adapt to new information appearing during the process of the interview (Drever 1995). Semi-structured interviews are a qualitative method which uses predetermined questions but leaves freedom for spontaneous changes by the interviewer, hence the method is very efficient when it comes to explore someone's view on a specific topic (Qu and Dumay 2011).

Due to the time frame of this study, it was not possible to do empirical research by gathering data from a significant number of farmers, consumers or nature conservation activists. In order to get still a valuable insight, the interviewees were selected by the attribute of being a contact person for them. So, the chosen interviewees all had special knowledge based on their daily work. The directors of the agricultural administration for example do consulting for farmers, teach at the agricultural vocational school and have access to agricultural data, which is gathered through the subsidy applications. Another example are the landscape management associations, which work together with farmers, representatives from the municipalities and the nature conservation administration. Hence, the interviews were held in regard to their personal knowledge concerning their daily work, but also as representatives for stakeholder groups with whom they are in frequent exchange or cooperation.

The interviews with the farmers were approached a bit differently because the aim was to collect comparable information about each farming system. Therefore, the interviews were conducted as structured interviews with preset questions. The list of questions can be found in Appendix 2. In some cases, the questions could deviate, if a farmer has a special practice or a special production branch on the farm, but after a short excursus the conversation is led back to the original questions. The interviews with the farmers were held via telephone.

Agriculture is the core element of the study, because all three dimensions of the agroecology territory converge around agriculture. Therefore, 10 interviews with agricultural practitioners were conducted with the purpose of getting an insight into individual farm systems and to get exemplary data for the indicators. The information gathered during this part served additionally as countercheck of data from the expert and stakeholder interviews to assess if the information was interpreted right and conform to the daily work of a practitioner.

A calendar with all interviews conducted during this study is findable in Appendix 3. It shows the occupation of the interviewees and in which of the three dimensions of an agroecology territory the interviewee is mainly active.

The data processing mainly relies on evaluating what types of phenomena, contributing to an agroecology territory, are present in the region. Another part of the evaluation is the comprehension of the impact of the different phenomena on the three dimension and their connections between each other. Hence, the assessment judges the presence or the absence of attributes of an agroecology territory, rather than measuring the extent to which the Allgäu already transitioned to sustainable agriculture and food systems.

Based on the sum of information, from all interviews, observations, and online research conducted for the indicators, a stakeholder analysis was implemented. It serves to evaluate the stakeholder initiative in the Allgäu region as part of a possible agroecology territory. Therefore, the data was analysed to determine key stakeholders and in which of the three dimensions each key stakeholder is active. Additionally, recurring themes mentioned by the interviewed stakeholders were identified to investigate if there is a connectedness and common action in the region. These themes also give an insight, which direction of development is desired by local stakeholders.

5. Results

In the following the results for the 15 criteria are presented, in each section is a number in parentheses to show which specific indicator the following information concerns.

5.1 Adaptation of agricultural practices

The adaptation of agricultural practices means a transition from conventional agriculture to agricultural systems, which can cope with current environmental and societal challenges, such as land degradation, exploitation of natural resources, biodiversity loss, poverty and food insecurity, and help to mitigate them. Such alternative practices can be agroecological practices, which are “[...] aiming to produce significant amounts of food, which valorise in the best way ecological processes and ecosystem services in integrating them as fundamental elements in the development of the practices [...]” instead of fully relying on mineral fertilizers and synthetic pesticides (Wezel et al. 2014, p. 10). These practices can include integration of

cover crops in the crop rotation and intercropping, special crop rotations or reduced tillage, just to mention a few examples.

The data from the farmer interviews can be found in a summarizing version in Appendix 4.

Table 4 gives an overview of the results concerning the indicators in the dimension of “adaptation of agricultural practices”. The green colour in the indicator field means the result was positive, whereas the orange colour was given for results judged as insufficient. The colour system is applied to the tables in all three dimensions (tables 4, 5 and 6).

Table 4: Results for the adaptation of agricultural practices criteria

Criteria	#	Present situation in the dimension of “adaptation of agricultural practices”
1. Enhancing and supporting ecosystem services with agricultural practices	1a	60 % of farmers are taking part in the cultural landscape program by conducting e.g. extensive grassland management practices
	1b	17 % of farmers are certified organic
2. Diversification of farming systems	2a	50 % of farmers with cropland have a diversified cropping system (data from the East Allgäu) From farmer interviews: Farmers have 3 to 7 crops per year on their land
	2b	<ul style="list-style-type: none"> • One fifth have intercrops, legumes and cover crops for soil protection in their crop rotation (data from the East Allgäu) • For more diversification in the biomass plant production a LEADER project was formed to promote <i>S. perfoliatum</i> as alternative to maize growing
3. Grassland management	3a	The average grassland management is on the lower end of intense: <ul style="list-style-type: none"> • Average of 4 grass cuts per year (ranging between 3 and 6) • Manure application after each cut is common From farmer interviews: Biodiversity or water protection measures are conducted only on small patches of the total grassland of one farm
	3b	<ul style="list-style-type: none"> • Grazing of the livestock during summer months is practiced in the mountainous areas • In the lower lands free range stables prevail
4. Farmer-to-farmer knowledge exchange and extension service	4a	<ul style="list-style-type: none"> • Various schooling opportunities for new farmers are accessible • The curriculum takes environmental challenges into account and shows income diversification possibilities (e.g. tourism, direct marketing...)
	4b	Offers estimated to be between enough and good: <ul style="list-style-type: none"> • Various seminars with topics such as extensive animal husbandry, diversification possibilities, agrobiodiversity, soil protection practices or animal welfare are offered in the region • Highest participation by farmers reach information events dealing with topics such as the new fertilisation regulation or other legal changes

		<ul style="list-style-type: none"> Farmer-to-farmer knowledge exchange events are mainly offered by local groups like farmers' associations The organic model region brings together organic farmers in working groups concerning specific topics (e.g. marketing possibilities for organic beef meet)
5. Rate of farm abandonment	5a	Rate of farm abandonment between 1.2 and 2.2 % per year
	5b	<ul style="list-style-type: none"> Average farm size between 20 and 29ha (national average ~60ha) 80 % of dairy farmers have < 50 cows, 14 % has > 50 cows, 1 % has > 100 cows
	5c	Growth threshold of farms is 50 ha (farms < 50 ha are decreasing, farms > 50 ha are increasing)

5.1.1 Enhancing and supporting ecosystem services through agricultural practices

(1a) Around 60 percent of the farmers in the Allgäu receive payments from the Bavarian cultural landscape program (Dosch, personal communication 2018; Hoffmann, personal communication 2018). The program is established to compensate agriculturalists for services contributing to the common weal. Such services can be climate, soil or water protection measures or maintenance of biodiversity and the cultural landscape. The farmers can either apply separate measures to obtain the compensation payments, for example mulch sowing to avoid erosion or reduced livestock density for a decrease of methane emissions. The other possibility is to manage the whole farm certified organic, because the measures prescribed by the certification regulation are accepted by the cultural landscape program as contributing to common interest services (Bayerisches Staatsministerium für Ernährung, Landwirtschaft und Forsten 2017).

In the Upper Allgäu the number of farmers who receive these payments is higher (85 %) than in the East Allgäu (41 %) (Dosch, personal communication 2018; Hoffmann, personal communication 2018). In both cases the percentage is mainly composed by farmers who decided to manage their grassland extensively and farmers who work certified organic (Staatsministerium für Ernährung, Landwirtschaft und Forsten 2018). The extensive grassland management means a moderate stock density of grazing animals, a reduced mowing intensity and an interdiction of utilization of mineral fertilisers leading e.g. to less emissions of greenhouse gasses and higher biodiversity. The organic farmers committed for example to stop mineral fertilizer and synthetic pesticide application, and moderate livestock densities, also to reduce emissions and long-term problems because of pesticide residues (Bayerisches Staatsministerium für Ernährung, Landwirtschaft und Forsten 2017).

(1b) Around 17 percent of the farmers in the Allgäu are organically certified. The number ranges from 9 percent in the Lower Allgäu to 21 percent in the Upper Allgäu and Lindau. Since

2007 around 850 farms decided to become organically certified.

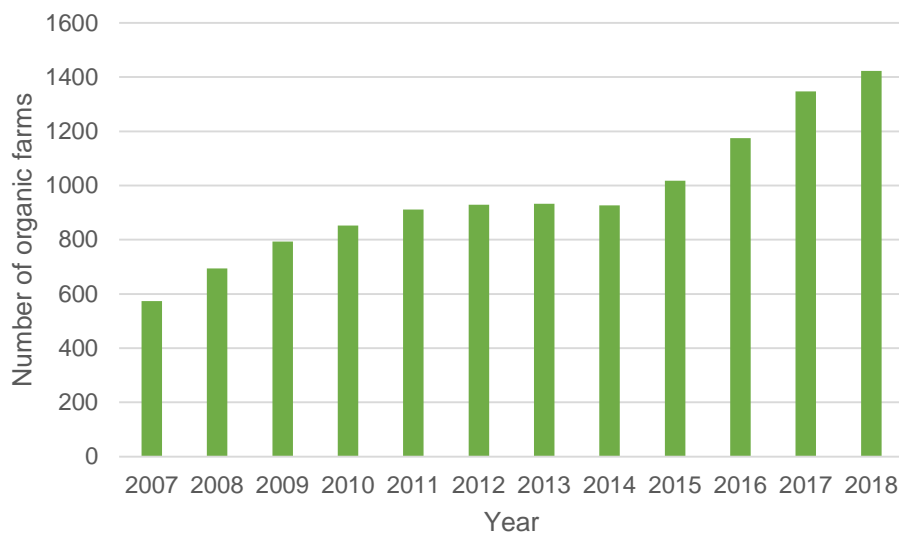


Figure 2: Development of the number of certified organic farms in the Allgäu from 2007 to 2018.

The numbers are based on the statistics produced through the applications for CAP subsidies (Amt für Ernährung, Landwirtschaft und Forsten Kaufbeuren 2017).

Except for the year 2014, there is a continuous increase in the number of organic farms as shown in Figure 2.

5.1.2 Diversification of farming systems

In the East Allgäu, cropland makes up 13 % of the agriculturally used land. (2a) More than half of the farmers, who have cropland there, have diversified their cropping system. In the Lower Allgäu the percentage for cropland is even 34, but within the time frame of this study the data collection in this district was not possible. According to the local agricultural administration, 142 farms have a crop rotation with three or more crops. This number sounds rather small, but in the East Allgäu only 220 - 250 farms are obliged to follow greening regulations to activate the area payments according to the EU Common Agricultural Policy (CAP) (Dosch, personal communication 2018). Included in this number are also farmers with arable land between 10 and 30 hectares, who must have only two different cultures per year on their total cropping area to fulfil the regulation. Free of greening regulations are organic farms as well as farms with arable land under 10 hectares.

(2a) According to the farmer interviews, in the Lower Allgäu the diversity of crops per farm and year range from three crops to seven crops. The farmer with only three crops cultivates maize, wheat and barley. He uses the yield from the harvest to feed his dairy cows. The farmer with the most diversified cropping grows maize, triticale, a triticale-rye-association, sugar beet, red clover, fodder grass and *Silphium perfoliatum*. Almost all his harvest goes to a biogas plant,

which he owns together with neighbour farmers. A very small part of the products is fed to the 15 cattle he holds for meat production.

(2b) Intercrops and cover crops, as well as legumes for soil protection are integrated in the crop rotation of around a fifth of the farmers from the East Allgäu (Dosch, personal communication 2018). All interviewed farmers with arable land had at least one intercrop, e.g. *Trifolium alexandrinum* or *pratense*, a winter cereal or green rye after maize. Only one did not have a legume in the crop rotation, the others had different types of clover. The farmer who produces mainly for the biogas plant, has the most diversified crop rotation. He includes not only intercrops and legumes, he also has crop associations and a cup-plant (*S. perfoliatum*) as biomass plant, which is a perennial plant that can be harvested after the establishment year for around 15 years. *S. perfoliatum* is especially promoted in the Allgäu, by a LEADER+ project² from *renergie Allgäu e.V.* and the LEADER local action group Lower Allgäu. The project creates awareness and knowledge about alternative biomass plants besides maize to prevent that the maize growing for biomass production takes over the landscape. There is already a bad image of renewable energy arising, because of the impacts of maize cultivation, such as erosion, soil degradation and the disfigurement of the landscape. The project includes eight demonstration sites to collect data about cultivation of *S. perfoliatum* and a new job position was established solely for consulting farmers concerning all matters of its cultivation (Unterallgäu Aktiv GmbH 2018).

5.1.3 Grassland management

(3) The average mowing frequency all over the Allgäu is four times per year. It ranges from one to six cuts per year depending on the intensity of the farming practice and the altitude on which the farm is situated. In the lower lands, extensive grassland management means up to three cuts per year, in higher altitudes a management with one cut would be extensive (Dosch, personal communication 2018; Hoffmann, personal communication 2018).

The interviewed farmers from the Upper Allgäu, who had their land on altitudes between 720 and 900 meters above sea level, stated a mowing frequency of four to five times a year. The answers did not differ between organic and conventional farm management. All of them apply liquid manure after each cut if sufficient manure is available.

The answers by farmers from the lower lands varied between three to six cuts, the average overall is a mowing frequency of five times. The two organic farmers were the ones who

² LEADER is an initiative by the European Union to support regional development. The acronym is French and stands for *Links between actions for the development of the rural economy*. The goal of the program is to revitalise the rural areas. Local actors get the possibility to plan and implement actions and to get financial support from state and EU subsidies (Paneva 2014).

indicated the lower frequencies. Fertilisation after each cut is commonly practiced in this area too, either with liquid manure or digestate from the biogas plant.

Two farmers reported that they had fields in the catchment area of a lake, where they mow only two times. With the reduced number of cuts, they also apply fertiliser only twice a year to protect the water body. Both farmers practiced this on an area bigger than prescribed in the regulatory framework.

(3b) Only one of the interviewed dairy farmers in the Lower Allgäu has his cows grazing outside between May and October. The others have them in free moving stables the whole year and are fed with silage and hay from the grassland and get additional concentrate fodder like maize or soy and rapeseed cake.

In the Upper Allgäu, all farmers reported that the animals are grazing outside from mid-April until October. Two explained that their cows can be on the pasture only half of the day, because they need to collect the manure in the stable. The manure must be collected in the stable because the farmers dilute it with rain water to spread it evenly over the area and to have the right amount for the whole year. The fodder outside the grazing period is the same as in the Lower Allgäu.

5.1.4 Agricultural education and farmer-to-farmer knowledge exchange

(4a) According to the interviewees, the local agricultural administration strives to provide various training opportunities for agriculture related occupations to counteract trends like rural depopulation and structural change in the agrarian sector (Dosch, personal communication 2018; Hoffmann, personal communication 2018). There are classic agriculture schools with practical apprenticeships to learn the basics of how to manage a farm and the possibility to continue studying by completing the agriculture mastery school. In both schools the focus is to educate farmers, who understand ecological concepts and value regionality. Further, emphasis is put on the personal development of each student for competences such as communicating issues of the agricultural sector and being an active part in communal politics (Dosch, personal communication 2018; Hoffmann, personal communication 2018). Another possibility is the “BiLa” program, which is an educational program for part-time farmers. The program can be completed in parallel to another job by participating in regular evening courses. Both educational forms endeavour to help new farmers to lead their business in an economically viable way and to slow down the structural change and the rural depopulation by enabling people to make a living from their land.

(4a) Linked to the agricultural education is the school for home economics, where it is taught how to lead a household or a family in a sustainable way. This program is mainly chosen by women and it supports their creative entrepreneurial ideas, which can lead to diversified

businesses in the farming sector (Hoffmann, personal communication 2018). In the Allgäu, many farms use tourism as their second pillar for income. The concept of “farm holidays” is very popular in the region and is only one example for the creation of additional income (Allgäuer Urlaub auf dem Bauernhof 2018). This can be particularly relevant for small farms, who cannot generate enough income with solely agricultural activities.

(4b) Besides these school opportunities, there is a broad offer of presentations and excursions dealing with current topics. For example, in 2018 the changed fertiliser ordinance is a big topic. Hence, the agricultural administration organizes information evenings to explain the impact of the new regulation. This event in the Upper Allgäu reached around a third of the farmers from this administrative district (Hoffmann, personal communication 2018). For other events no data about the participation is available, but this example shows that events like this are needed and well attended.

(4b) Other workshops and presentations by the agricultural administration deal with topics like extensive animal husbandry, diversification possibilities, agrobiodiversity, soil protection practices or animal welfare. Thereby they try to inform farmers about socially and environmentally relevant topics and to give them input how to ameliorate their livelihoods for example through diversification (Dosch, personal communication 2018).

(4b) Farmer-to-farmer knowledge exchange events are mainly organised by local groups of the Bavarian farmers’ association, or organic farmers’ associations, such as *Bioland*. These organisation types consist of active farmers. Their gatherings often include farm visits to discuss certain topics, such as plant protection or cultivation methods, directly on-site.

(4b) Rather special in the Allgäu is that the Upper Allgäu was selected to become one out of six *organic model regions* in Bavaria. This means that there is a project manager employed by the agricultural administration, who should support production, processing and marketing structures for organic farms. Meetings and workshops are organised in the frame of this project, for example there was an information meeting for farmers about rearing of calves for organic meat production and the current marketing possibilities for the organic beef meat. The interest was relatively high, 80 organic farmers from the district participated. More general events for farmers and the public are screenings of documentaries, which deal with topics within the field of agriculture, for example *code of survival*, with discussions afterwards. *Open farm days* where the farmers give guided tours and allow consumers to see the fields, stables and processing facilities are arranged (Diem, personal communication 2018).

5.1.5 Rate of farm abandonment and structural changes

(5a) Data from the Allgäu show a loss of farms at a rate between 2 and 4 percent yearly between 1999 and 2010. There is no data yet available for the current decade, but an estimation of the agricultural administration is a rate of only 1.2 percent per year for the Upper

Allgäu, which is only half of the German average (Hoffmann, personal communication 2018). For the East Allgäu the estimation was 2.2 percent (Dosch, personal communication 2018). (5b) In the region, the number of farms is decreasing, but the average area per farmer is growing. The average size is only half or a third of the national average: 29 ha in Upper, Lower and East Allgäu, in Lindau only 20 ha (Bayerisches Staatsministerium für Ernährung, Landwirtschaft und Forsten 2016). (5c) The growth threshold – under which the number of farms decreases and over which the number rises – is at the level of farms with over 50 hectares according to data from municipal statistics 2017 (Bayerisches Landesamt für Statistik 2018a, 2018b, 2018c, 2018d, 2018e, 2017, 2016). This threshold is shown in the Figure 3.

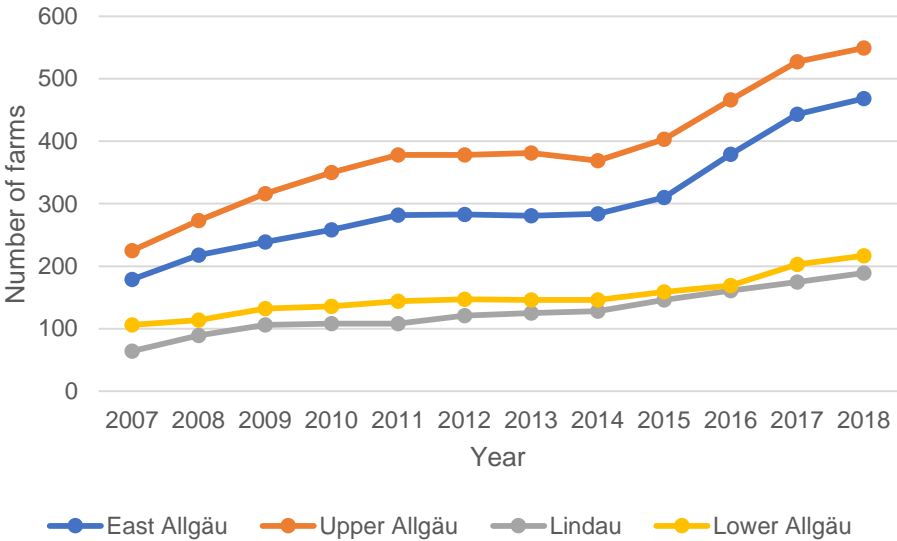


Figure 3: Change of farm sizes in the Allgäu. It shows a decreasing trend for farms with a size under 50 hectares and an increase o with over 50 ha (Bayerisches Landesamt für Statistik 2018a, 2018b, 2018c, 2018d, 2018e, 2017, 2016).

(5b) Dairy production is the prevalent production sector in the Allgäu. Over 80 percent of the dairy farms there have less than 50 cows, 14 percent have 51 or more and only one percent has over 100 cows (Hoffmann, personal communication 2018). The German average is 63 dairy cows per farm and 16 percent of the farms have over 100 cows (Deutscher Bauernverband 2018).

5.2 Biodiversity and natural resource conservation

Table 5 summarizes the results for the five criteria of the dimension “biodiversity and natural resource conservation”.

Table 5: Summary of the results for the criteria 6 to 10

Criteria	#	Present situation in the dimension of “biodiversity and natural resource management”
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6. Ecosystem services and biodiversity on permanent grassland	6a	<ul style="list-style-type: none"> • Between 1999 and 2010 around 10 % of the grassland area was turned in another land use type • Currently the area is stable or increasing • There is still pressure on grassland
	6b	33 farmers from the Upper and East Allgäu participate in the result-oriented subsidy program for species rich grassland
	6c	<ul style="list-style-type: none"> • In the Upper Allgäu 30 % of farmers are in the program for extensive grassland on forest borders • In the East Allgäu contractual nature conservation measures play an important role • Extensive grassland management is practiced especially in higher altitudes • Special marketing and price for milk from grass/hay fed cows to ensure management of mountainous pastures • Creation of autochthone seed mixtures for more biodiversity in low land grasslands • In organic management farmers mow later • Some farmers leave stripes uncut as insect habitat
7. Protected areas and biodiversity conservation	7a	<ul style="list-style-type: none"> • A stable amount of land is under different protection status • Nature reserves and nature parks cover each around 8 % of the region, protected landscape areas 14 % and Natura 2000 habitats around 13 %
	7b	<ul style="list-style-type: none"> • Over the last decades some fens and marshes were renatured as flood reservoirs • Some of the litter meadows were taken back under management for hay production in organic animal husbandry or are maintained by the landscape management association • There are various nature conservation projects for specific biotopes or (strongly) endangered species • Local alliances were formed for nature conservation, such as the marsh alliance Allgäu or cultural landscape Günzthal
8. Management of land with marginal productivity	8a	<ul style="list-style-type: none"> • Nature conservationists see it as “conflict free zone”, which can be maintained if resources (labour, money...) are available either by the land management associations or the land owners • Still less productive areas are taken out of cultivation and thereby lose their value for many species quite quickly
	8b	<ul style="list-style-type: none"> • Positive example: Farmers in Bad Hindelang founded a Nature and Culture association to follow self-imposed rules to conserve the landscape • To keep less productive mountainous pastures in management, initiatives, such as LandZunge and Allgäuer Alpgenuss, are aiming for a higher price for products from areas with more difficult working conditions
9. Biodiversity measures by farmers	9a	From farmer interviews: 8 out of 10 farmers reported to practice measures to enhance biodiversity
	9b	Same measures as describe in criteria #2 and #6, additionally: <ul style="list-style-type: none"> • Maintenance of hedges as habitat • Inclusion of perennials in the crop rotation
10. Protection of drinking water	10a	Widely no need for preparation of drinking water before it is distribution
	10b	No problems with Nitrate in the groundwater in the Allgäu

10c	<ul style="list-style-type: none"> • The water suppliers own parts of the land in water protection zones • Collaboration between agricultural schools and water suppliers to create awareness for water protection under the future land managers
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5.2.1 Ecosystem services and biodiversity on permanent grassland

The prevalent land use type in the Allgäu is permanent grassland. Permanent grassland can support and deliver many ecosystem services and can contribute to maintaining biodiversity. (6a) During the period from 1999 to 2010, 9.6 percent of the grassland was turned into another land use type. Partly it was taken out of agricultural use and was left to natural succession or turned into crop land. Recently, the grassland area became stable again or increases slightly due to policy changes (Wilke 2017). Especially in the Lower Allgäu the maize cultivation for biomass and biogas production gained importance (Bayerisches Landesamt für Statistik 2018a, 2018b, 2018c, 2018d, 2018e, 2017, 2016).

The value of grassland for biodiversity conservation varies with its management. (6b) In the Upper Allgäu 21 farmers (out of ~3400) are participating in the result-oriented subsidy program for species rich grassland and 30 percent of the farmers have parts of their grassland in the program for extensive grassland at forest borders. In the East Allgäu 12 farmers (out of ~2500) participate in the species rich grassland program, but the interviewees underpinned the fact that contractual nature conservation measures play a far bigger role for the grassland in the Allgäu (Dosch, personal communication 2018; Hoffmann, personal communication 2018). Contractual nature conservation measures are for example extensive grazing of alpine pastures with cows or mowing of grassland with special value for nature conservation before mid-June followed by a cultivation break until mid-September (Bayerisches Staatsministerium für Ernährung, Landwirtschaft und Forsten 2011).

The informants from the landscape management associations Upper Allgäu highlighted the importance of grassland in higher altitudes, because in the mountainous areas grasslands must be managed more extensively due to the harder working conditions. First, mowing is more difficult on steep areas. Secondly, the growth conditions are poorer so the period between the cuts is longer, because the grass needs more time for the same amount of biomass production than under better conditions. Additionally, the whole vegetation period is shorter leading to less cuts overall. It is very important that these areas stay in agricultural management because they would turn into brush or woodlands without regular mowing and lose their high relevance for biodiversity, as well as their attraction for tourism. (6c) The farmers in the Allgäu are supported by European subsidies, but also by regional marketing efforts, which promote milk from cows fed with grass and hay from mountainous grasslands or by graze on them (Pscherer and Schaefer, personal communication 2018).

Other important habitats are litter meadows, which are often under the maintenance of the landscape management association. (6c) The interviewee from the East Allgäu said that 40 farmers are in narrow collaboration with the association either because they have contracts for some of their areas or they are conducting mechanical work for the association on conservation areas (Saitner, personal communication 2018).

(6c) In the Lower Allgäu where the soils are more fertile, grasslands are managed very intensively, so the approach to bring biodiversity into these areas is different. Efforts are made to create seed mixtures for grasslands to enrich the biodiversity there if farmers agree to lower the intensity to medium. The goal is to conserve genetic resources from the region and create habitats for species who need an intermediate habitat type (Franke, personal communication 2018). According to Franke (personal communication 2018) nature conservation focuses often on extreme sites, such as nitrogen-poor swards, leaving out species which need an intermediate between intensively and extensively managed agricultural land. Another effort is made by the municipalities, they try to buy agricultural land to manage for nature conservation there, because they see it as public task. They can manage the area differently since they do not need to achieve revenue from this land.

(6c) To maintain biodiversity the organic farmers have to mow later so the different plant species have more time to produce seeds. Others mentioned that they leave stripes uncut as habitat for insects. And farmers with bedding meadows saw these areas as contribution to biodiversity because they are managed extensively with only two cuts.

5.2.2 Protected areas and biodiversity conservation

The Allgäu has many special biotopes which became endangered over time due to intensification of land use or land use changes. Many of these biotopes are rare nowadays and serve therefore as habitats for a range of protected species.

(7a & 7b) Fens, marshes and litter meadows were drained for more intense agriculture, but over the last decades their importance as flood control reservoirs came back into consideration. Furthermore, with increasing organic animal husbandry the use of litter meadows becomes important again. Both factors are leading to a renaturation of these ecosystems, which are hosting endangered species such as the flowers *Primula farinose* and *Trollius europaeus*, the strongly endangered snake *Vipera berus* and diverse insect species, such as the dragonfly *Aechna subarctica* (BUND Naturschutz Kreisgruppe Kempten 2018a; BUND Naturschutz Kreisgruppe Lindau 2018). An example for a renatured marsh is the 85ha big *Werdensteiner Moos* in the Upper Allgäu. It was drained during the 19th century and afforested. In 1985 a collaboration between the nature conservation authorities, the Bavarian state forest enterprise and the nature conservation NGO started the restoration of the marsh by closing the drainage channels. Thereby, over the last 30 years the natural conditions were

recreated. The area became a Natura 2000 habitat and is used for nature education and recreation (Bayerische Staatsforsten AöR 2018; BUND Naturschutz Kreisgruppe Kempten 2018b).

(7b) Another important habitat is the nutrient poor grassland and mountain grassland. Both habitat types are strongly declining because these sites with marginal productivity drop in many cases out of the land use during the agricultural intensification process. These ecosystems are essential for endangered plant species, such as *Arnica montana*, *Nardus stricta* and *Gentiana purpurea* and a wide range of endangered insect species (BUND Naturschutz Kreisgruppe Kempten 2018a). The maintenance and the issues of conserving these habitats will be described in the section 5.2.3 Management of land with marginal productivity.

(7a & 7b) Rare amphibians and mussels are inhabiting the Allgäu as well. In the East Allgäu is a project ongoing to protect *Coenagrion mercuriale* (a dragonfly) and the yellow-bellied toad *Bombina variegata* (BUND Naturschutz Kreisgruppe Ostallgäu-Kaufbeuren 2018). The project is carried by the land management association East Allgäu. The measures are creation of ponds and leaving forest dirt roads unsurfaced, so water can accumulate in puddles, both to offer the toads spawning opportunities (Bayerische Akademie für Naturschutz und Landschaftspflege 2018). Germany is a focal point of the occurrence of the yellow-bellied toad (*B. variegata*) and thereby has a special responsibility for its protection (Bundesamt für Naturschutz 2016). In the Lower Allgäu the thick shelled river mussel is occurring in some of the streams (BUND Naturschutz Kreisgruppe Memmingen-Unterallgäu 2018).

(7a & 7b) Bound to a certain altitude of 1400 – 2470 meters is for example the flower *Gentiana Bavaria*. *Leontopodium nivale* or *alpinum* – the so-called Edelweiss – is growing even in higher altitudes. Both plants have symbolic value for Bavaria and are yet endangered or even strongly endangered. The western capercaillie (*Tetrao urogallus*) is threatened by distinction and is strongly relying on mixed mountain forests in an altitude between 700 - 1500 meters. The three species are still occurring in the Allgäu and are strongly protected. Important for the protection is a strong visitor guidance and awareness raising about the threatened species (BUND Naturschutz Kreisgruppe Kempten 2018a).

The above-mentioned endangered species, which still find habitats in the Allgäu, are only a few examples to give an insight in the wide range of habitat types that are conserved in the region. The German nature conservation office remarks that the mountainous regions in Germany, one of them is the Allgäu, are biodiversity hotspots with a particularly high proportion of natural or semi-natural habitats (Bundesamt für Naturschutz 2016).

(7a) The abundant protection statuses in the Allgäu are the common ones, such as *nature reserves* (Naturschutzgebiet), *protected landscape areas* (Landschaftsschutzgebiet), Natura 2000 habitats, geo- and nature parks as well as natural and landscape monuments. Nature reserves and nature parks cover each around 8 % of the region, protected landscape areas

14 % and Natura 2000 habitats around 13 % (Hanning 2017a, 2017b; Regierung von Schwaben 2018). The size of the area is rather stable. Especially the nature reserves are neither increasing nor decreasing, because the regulation is very strict. The other statuses can be changed more easily, and the management regulations are not very prohibitive or imposing (Franke, personal communication 2018; Pscherer and Schaefer, personal communication 2018; Saitner, personal communication 2018).

The interviewees working in nature conservation and landscape maintenance all agreed that usually the stricter the regulation of an area protection status, the better for species conservation. One of the informants from the association for landscape management saw the prohibitive statuses less favourable since some land management practices are often crucial to keep a habitat suitable for certain species. In his opinion EU-wide regulations, such as the approach of Natura 2000, are more successful. On these areas the nature conservation administration is responsible to keep the habitats intact or even enhance their conditions. This makes it easy for associations to get a contract for these areas and funding to do the restoration work, which often does not generate income like other agricultural practices.

(7b) Mentioned as particularly important were local alliances for nature conservation, such as the foundation *cultural landscape Günztal* or the *marsh alliance Allgäu*. The foundation was started 1994 by two citizens and is now a collaboration between public administration offices, municipalities, farmers, schools, sponsors and other associations. The goal is to protect the biotope network in the catchment area of the stream *Günz*, which is connecting the Allgäu with the Danube River. The marsh alliance is a cooperation between the three municipalities Upper Allgäu, East Allgäu and Lindau and the cities Kaufbeuren and Kempten. Like the foundation, they partnered with public nature conservation authorities, agricultural administrations, land owners and many more.

5.2.3 Management of land with marginal productivity

(8a) Areas with marginal productivity are very important for nature conservation in the Allgäu. These can be mountainous grassland, litter meadows or marshes. The crucial point on these areas is to find a possibility to continue the land use practices, which turned them over decades into the biotopes and habitats they are today. More must be done to protect these areas according to the opinion of a nature conservationist (Güthler, personal communication 2018).

(8a) The landscape management association in the Upper Allgäu sees the land with marginal productivity as quite conflict free zone. The association can offer farmers to restore the habitats with public funding, after successful restoration the farmers can continue with the extensive management and obtain the subsidies for it (Pscherer and Schaefer, personal communication 2018).

(8a) In the East Allgäu the interviewee from the landscape management association was more concerned. The less productive areas fall out of cultivation and quickly lose their value for species dependant on these habitats for example through natural succession. If the cultivation is not profitable for the farmers anymore and the monetary incentives are not sufficient to continue the maintenance, the landscape management association would have to step in, but their capacity is restricted (Saitner, personal communication 2018).

The informant from the Lower Allgäu explained that the focus there is put on wetlands and marshes and less on sites with marginal productivity (Franke, personal communication 2018).

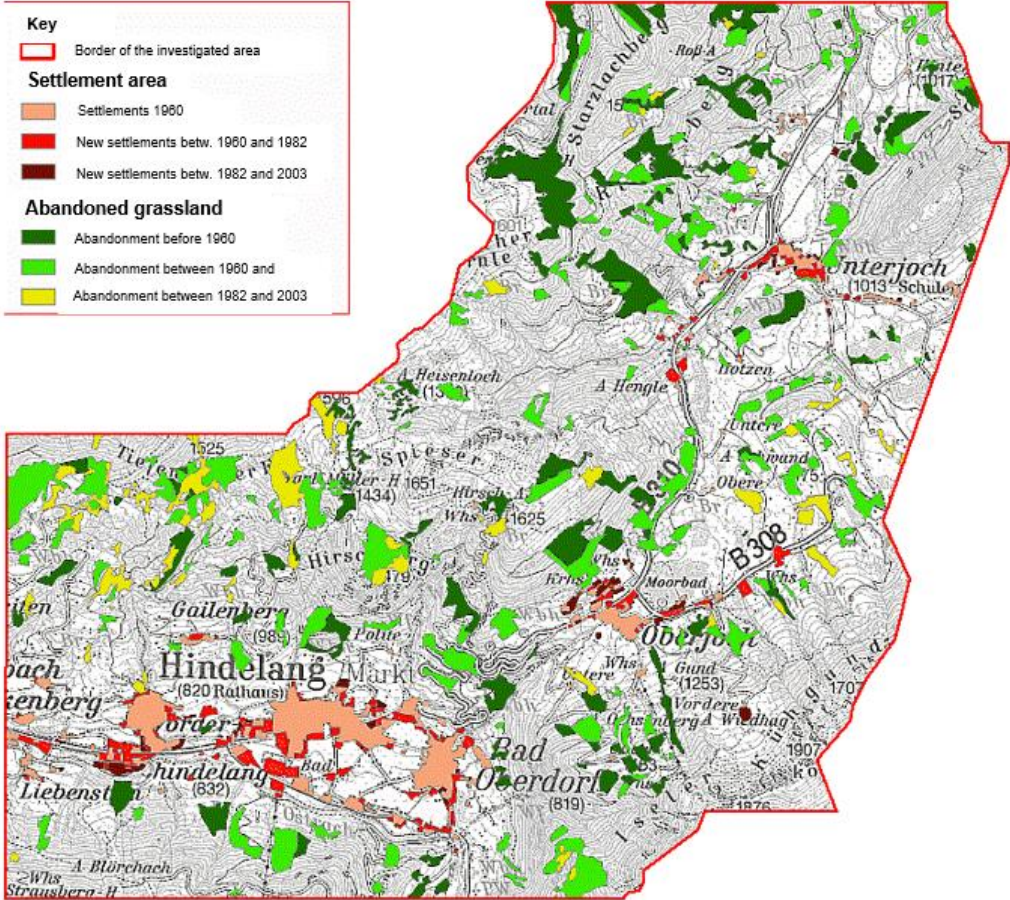


Figure 4: Evaluation of the landscape changes around three municipalities in the Upper Allgäu. Focusing on abandoned grassland and new settlements between 1960 and 2003. The results are that 1960 the abandoned grassland area was 10 percent of the whole grassland, in 1982 additional 11 percent were under succession and 2003 4 percent more were abandoned. The increase of settlements slowed down strongly too from 52 percent to a growth of only 10 percent (CIPRA n.d.).

(8b) Landscape changes are ongoing in the whole Alps region. Around 2005 a project was started in the Upper Allgäu to make the public aware of these changes by comparing pictures from the early 2000s with pictures from the beginning of the 20th century. Additionally, maps were created to point out the abandoned former extensively managed grasslands and the increased settlement areas. As second step they demonstrated the possibilities to slow the

development down. Figure 4 above shows one of the evaluations of the landscape development in the Upper Allgäu (CIPRA n.d.).

(8b) Bad Hindelang was mentioned as a great example for counteracting this rapid change. In 1992, the 86 farmers formed the Hindelang – Nature and Culture association. By joining this association, the farmers committed to quite strict rules for managing their agriculture. They agreed to have only one livestock unit per hectare, that they would produce 90 percent of the fodder within the municipal area and stop to use mineral nitrogen fertiliser. With these extensive management practices, they want to protect the extremely species rich mountainous pastures. Moreover, the consecutive goal of the association was to enhance the tourism and keep the landscape attractive for visitors (CIPRA n.d.).

(8b) A similar connection is made with projects like *LandZunge*, *VitalZunge* and *Allgäuer Alpenjuss*. With these programmes and projects stakeholders from agriculture, gastronomy nature conservation, want to protect the nature together by achieving a premium price for regional quality products that are produced in an environmentally benign way. These initiatives will be described more detailed later in the section about the embedded food system.

5.2.4 Biodiversity measures by farmers

(9a & 9b) The most common measure for biodiversity is to do the first grass cut later in the year, which is also obligatory for organic farmers. One practitioner explained that they would leave additionally some stripes, not to take everything away at once. Three farmers reported that they have some patches where they mow only two times a year. On these patches, they only produce hay, and the fertilisation is kept at the minimum. Another farmer mentioned to have hedges that he maintains.

(9a & 9b) Two of the crop farmers use flowering patches on field margins to support biodiversity. Others create long crop rotations also including perennial crops to control diseases and reduce soil degradation by integrating crops with different demands.

(9a & 9b) Two of the interviewed farmers (1 organic, 1 conventional) said they would not carry out any measures to increase biodiversity on their farm ground.

5.2.5 Protection of drinking water

(10a) In the Allgäu the water supply happens with local sources, either through deep wells or mountain springs. The interviewed water suppliers and online sources (Drexl, personal communication 2018; Heiß, personal communication 2018; Fernwasserversorgung Oberes Allgäu, 2018; Zweckverband zur Wasserversorgung der Woringen Gruppe, 2018) show that there is no need for preparation before the water is distributed to the consumers because the water has already very high quality. In some cases, manganese and iron contents are reduced through a biological process or oxygen is added (Heiß, personal communication 2018).

(10c) The suppliers who pump the water from deep wells are not so quickly affected by land use changes (Drexl, personal communication 2018). Whereas wells, which are closer to the surface, are very sensitive to the land use practices conducted over the water storage or close by. In both cases, the groundwater is protected by three protection zones. The interviewee explained that the water supplying association owns the land in zone 1 (immediate area around the well) and most of the land in zone 2 (land under which the water flows during the last fifty days before it reaches the pumping station). They either bought the land or arranged voluntary parcel changes with the farmers. It is important to reduce the land management practices to a minimum in these areas, to reduce the nitrogen leaching into the groundwater. For farmers who do not want to sell or change their land, a compensation payment is possible. The land owned by the water supplier from the East Allgäu is only grassland, so the only management is to mow two times a year (Drexl, personal communication 2018; Heiß, personal communication 2018).

The most problematic areas are the ones, which are not in the protected zone but immediately bordering. The agricultural practices there can influence the water quality too, but there are no official standards. (10c) To reach the farmers the water suppliers organise events to show their technical centre and inform the participants about the topic. Moreover, they invite the students from the agricultural school to the waterworks to explain the importance of the protection zones and to start a good communication with the new generation of farmers. This way the young farmers will be more open to land parcel exchange or compensation payments (Heiß, personal communication 2018).

(10c) Another initiative are the round tables organised by the agricultural administration, where stakeholders come together to discuss strategies to keep the good water quality in the Allgäu. These meetings include stakeholders, such as farmers, the farmers' association (*Bauernverband*) as well as the dairy farmers' association, foresters, water suppliers, the local water consultant and communal politicians (Heiß, personal communication 2018).

(10b) Nitrate from agricultural fertilisers is not the only endangerment of the drinking water, but this problem is relatively influenceable compared to other issues from the water suppliers' perspective. Other issues can be construction of roads or sewage from industry, which must be regulated by the water administration, in a way that they do not affect the protected zones. The interviewed water suppliers did not report problems with Nitrate in the ground water because of good protection measures additionally to advantageous geological structures (Drexl, personal communication 2018; Heiß, personal communication 2018).

5.3 Development of embedded food systems

Table 6 sums up the outcomes of the investigations concerning the development of an embedded food system in the Allgäu.

Table 6: Summary of the results for the criteria 10 to 15

Criteria	#	Present situation in the dimension of “development of an embedded food system”
11. Local food initiatives	11a	Comparatively many initiatives around local food due to diversification opportunities and the strong regional identity of Allgäu residents
	11b	The local supermarket Feneberg established the “VonHier brand” for local organic products <ul style="list-style-type: none"> • The association Pro Nah in the Lower Allgäu promotes short supply chains for food by showing the connection to higher life quality through it • There are many other small initiatives around local food, such as a village shop based on citizen participation in Krugzell
	11c	<ul style="list-style-type: none"> • In the Bio-Ring Allgäu creates yearly a free booklet where all initiatives around local organic food are listed • Labels like LandZunge, VitalZunge and Allgäuer Alpenuss are gauging awareness for regional products • Easily accessible because of the diversity, very convenient is also the brand for local food in the supermarket
12. Innovative management forms in food production and selling	12a	There are innovative projects around food production and consumption in the region
	12b	<ul style="list-style-type: none"> • A bakers’ guild for craft bakeries was formed in the Allgäu to promote the regional sustainable baking tradition • The Ökoase whole food shop created an association called Regional Value Allgäu to gather money for supporting organic agriculture • The oil mill in Kempten builds a network with farmers who are willing to grow oil seeds to produce fully regional oils • The RegioSchmecker award is given to producers of high quality regional foods to raise awareness for local producers And many more...
13. Diversity and availability of local food products	13a	<ul style="list-style-type: none"> • Regional products from the Allgäu are not particularly diverse, but they cover some of the most consumed foods in the region • Under the VonHier brand more than 400 different regional products are sold
	13b	<ul style="list-style-type: none"> • There are at the minimum 6 food box schemes in the region, one delivers in a radius of 50 km • Farmers’ markets are in around 30 cities in the Allgäu • Increase of “Regiomaten”, which are vending machines for local products making local food accessible around the clock
14. Collective catering based on local and organic products	14a	<ul style="list-style-type: none"> • So far, no numbers are available
	14b	<ul style="list-style-type: none"> • Organic model region started in 2016 to bring stakeholders from agriculture and out-of-home-catering together • Seminars and workshops concerning the topic are happening • Big caterers in the region are willing to participate • A school wants to become an example school and serve up to 30 % local food • The Allgäu brand gives incentives for local gastronomy to use regional products • VitalZunge labels company and hospital canteens, which include a certain amount of local food in their offers

15. Consumer awareness and connection between producers and consumers	15a	The demand for regional food is an increasing trend in the Allgäu – and so is the awareness slowly, but steadily raising
	15b	<ul style="list-style-type: none"> • Farm days for consumers are organized • Local farmers who deliver to Feneberg are presented on the website and in the VonHier-magazine • Social media is used as platform to show production processes, e.g. by the alpine dairy in Gunzesried • Other offers are guided tours through processing facilities of cheese makers or distilleries • 2015 the first CSA was found, until 2018 five more followed, this way of agriculture includes the consumers directly in the farming system • The established weekly markets and on-farm shops are sites for direct consumer and producer interaction • The festive week 2018 in the Allgäu has an exhibition dedicated to the topic “farmers and consumers hand in hand”

5.3.1 Local food initiatives

(11a) According to the interviewed stakeholders, the development of a regional food system in the Allgäu is a steady, but slow process (Diem, personal communication 2018; Sita, personal communication 2018). It was further estimated by interviewees that there are comparatively many initiatives around local food. Reasons therefore are the good diversification possibilities for farmers and food processors among others due to the tourism sector, the strong regional identity of the consumers and the types of foods produced in the Allgäu, which are used on daily basis in the kitchen, for example milk and dairy products, meat, flour, potatoes and apples (Gabler, personal communication 2018; Hoffmann, personal communication 2018; Sita, personal communication 2018).

(11b & 11c) The biggest initiative around local food came from the local supermarket chain *Feneberg*. It is a family enterprise with around 80 shops, whereof the majority is in the Allgäu. Hannes Feneberg, one of the directors of the company, launched 1998 the *VonHier* brand. Under this brand they decided to sell organic products, which are produced within a radius of 100 km. The marketing of the brand puts the emphasis on the regionality of the products and less on the organic certification. VonHier is helping the supermarket to compete with bigger supermarket chains because it gives the shop a unique feature and at the same time it supports the local farmers. The supermarket enters into contracts with producers to give them a security of demand and price (Feneberg Lebensmittel GmbH 2018a). One of the farmers who deliver to Feneberg explains in a video that he only invested in a goat herd, milking and cheese making facilities, because he had a sales agreement with the local supermarket (Ökomodellregion Oberallgäu Kempten 2015).

(11b & 11c) In the Lower Allgäu the association *Pro Nah* promotes short supply chains, including local food supply. Their aim is to communicate the connection between local supply

and a higher life quality, for example by raising awareness about the importance of good agricultural practices to keep the landscape as recreational area for the population and tourists. Therefore, they create activities where the citizens can participate, e.g. voting for the favourite local business. During this activity all nominated businesses were introduced in a newspaper article and could win the attention of local customers (Allgäu GmbH 2018; ProNah Unterallgäu 2018).

(11b & 11c) In 1987 the *Bio-Ring Allgäu e.V.* was founded to show the relevance of organic agriculture in the Allgäu. Within this association producers and consumers from the region work together to promote local organic food, to do lobby work for organic farmers and create a network for producers, sellers and consumers. One important part of their work is the compilation of the regional and organic shopping possibilities. They create yearly a free booklet where all organic direct sellers, organic farmers' markets, organic bakers and butchers and many more are listed. This tool makes it very easy for the consumer to find the products they are looking in organic quality and directly from the region (Räder 2018).

(11b & 11c) Another impulse to gauge awareness for regional products and to support the producers are local brands like LandZunge, VitalZunge and Allgäuer Alp Genuss, which were mentioned briefly in the previous chapter because of their landscape protection support.

The founding idea of LandZunge was to offer guests of the region high quality food from local producers. They want to gather gastronomic enterprises under the label, to generate higher demand of the local foods to strengthen the regional economy. As example, in 2018 70 restaurants are labelled as LandZunge restaurants, which have sales agreements with label partners. Under the label partners are big firms that can satisfy the broad demands of the restaurants, as well as small producers with niche products. To support the small producers, the gastronomic enterprises decided to offer their guests specialties with these niche products. Hence, the idea is to create a regional circulate economy (LandZunge 2018a).

VitalZunge is the sister project of LandZunge. It follows the same principles as LandZunge, but it is targeted at out-of-home-kitchens. So far there are seven canteens joined under the label, under these canteens are a hospital, an elderly home and a caterer for enterprises. In this project the focus is even more on the quality and the healthiness of local products because the food is, amongst others, for recovering hospital patients, spa guests or senior citizens. The founders of VitalZunge have the goal to bring 20 participants together under the label (LandZunge 2018b).

The Allgäuer Alp Genuss aims to contribute with their label to authentic high-quality culinary services in the Alpine gastronomy. They give incentives to use locally produced traditional foods. Thereby they enforce the agriculture in the region and the traditional food processing crafts. Over 100 producers are following the criteria of the Allgäuer Alp Genuss and deliver to the Alpine restaurants – the so called *Alpen* (Schwarz, presentation 2018).

(11b & 11c) Important for an embedded food system are also small stepping points like village stores. In many villages the shops are closing due to the strong competition of supermarket chains or due to a lack of successors. In Krugzell, a village in the Upper Allgäu, the citizens stopped their last village store from closing by designing a concept with citizen participation. In the shop local products are prioritized. The project was supported by the LEADER+ program. It enhances life quality in the village, creates jobs and closes supply gaps (Regionalentwicklung Oberallgäu 2004).

5.3.2 Innovative management forms in food production and selling

This criterium was selected to show special initiatives from the region to create an understanding how the development of an embedded food system is brought forward by individual projects. This makes the indicators in this section solely descriptive. (12a) In the following, eight innovative projects around local food production and selling from the Allgäu are presented. It is not a full census; the aim is to highlight a few projects with different goals. (12b) The number of craft bakeries is strongly decreasing in the region. On the one hand, the competition against industrial bakeries, who can produce for a lower price, is a big issue. On the other hand, finding people who want to learn the baking craft is evenly problematic. To stop the decline of craft bakeries, the bakers who are left in the Allgäu found an association to find strategies to stay economically viable and to create a better image of the metier. To differentiate their products from industrial baked goods, they decided to follow four quality criteria: First criterium is the regionality, so the bakers agreed to use as many ingredients from local producers as possible. Second is sustainability, taking every baker to have the future of their business and the needs of the future generation in mind. Followed by tradition, meaning that the bakers should produce according to traditional manners for example with natural sour dough. And the last point is the fairness, here they put it on themselves to have good handling of their employees, fair contracts with partners and deliverers and especially for the apprentices. They decided to pay them a salary higher than the common tariff, as one step towards a better image of the metier (Allgäuer Bäcker 2018; Baustetter, presentation 2018). (12b) The *Ökoase* was first an organic shop in the city center of Immenstadt, but due to the high demand of customers, the founder of *Ökoase* decided to turn it into an organic whole sale at the city periphery. The goal is to give as many local organic farmers the possibility to use the shop as marketing platform. To distribute the regionally produced foods better in the region, they try to partner with hotels, restaurants and canteens. Additionally, they created a non-profit organisation called *Regionalwert Allgäu e.V.* (translated: regional value Allgäu). Every customer becomes automatically a member in the association and with every purchase at the shop a small percentage of the payment goes to the organisation. The gathered money is used to support and increase organic agriculture in the region. The shop includes also a bistro,

where lunch and coffee are served. This space can be used by the locals for socialising, discussions and events concerning the topics, such as sustainable consumption and organic agriculture (Hüttenrauch 2018).

(12b) Another initiative was started by a pharmacy in Kempten. The *train station pharmacy* has a long tradition and the owner started early to produce own brand pharmaceuticals under sustainable production aspects. In 2001, under the roof of the pharmacy, an organic food store opened (Wolz 2018a). Many products are from local farmers, bakers and butchers. But the assortment includes organic products from other countries, too. The owner pays attention to fair production and animal welfare, regardless where the products are coming from. In 2016 the operators of the food store obtained the permission for in-house food processing. Since then, a bakery was included into the facilities as well as an ice-cream maker, a kitchen for warm lunch and facilities make preserved foods for the shop. The Naturpur shop also conducted projects like healthy food and movement for schools and gives cooking lessons for interested people or offers gourmet evenings. Furthermore, the owners try to reduce the package waste and offer not packed goods (Wolz 2018b).

(12b) The way in which the *Diepolz* cheese is made, is quite traditional. The alpine dairy is situated above 1000 meters altitude and the cooperating farmers, who deliver their milk, still practice transhumance. So, in summer the cows are on the mountainous pastures and in winter they feed on hay from extensively managed grassland. In the alpine dairy, everyday milk is processed into cheese, yogurt and butter. The marketing is less traditional, because besides their shop, which is directly next to a mountain farm museum, and the cheese, which is sold in the nature experience centre in Bühl, they also have a truck driving to the various weekly markets and additionally they established an online shop to reach more customers and give customers who live further away the chance to order handcrafted mountain cheese from the Allgäu (Bergkäserei Diepolz 2018).

(12b) Another very special initiative is the oil mill in Kempten, where Xaver Dopfer, a farmer had the idea to produce regional edible oils. His fields are on 800 m altitude, so he cannot grow the oil seeds himself. Therefore, he tried to find farmers who want to become partners and include oilseeds in their crop rotation. He produces hemp, linseed, canola and sun flower oil, just to mention a few. The owner uses only certified organic seeds and instead of producing waste, he uses the oil cakes – the left over from milling the seeds – to produce flour from it. The enterprise has ten employees and Xaver Dopfer is looking for more farmers who can produce oil seeds locally, because the demand for his products is still growing (Bayerischer Rundfunk 2015; Dopfer 2018).

(12b) *RegioSchmecker* is an award for regional foods, which was given to products that stand out due to their special taste and their high quality. It was a two-year project with the objective to create more awareness of the regional products and serve as platform for producers to

promote their goods. In the selection of the awarded goods, the way of production also was decisive. Only producers who use traditional crafting skills or sustainably grown regional ingredients could get the RegioSchmecker label for one of their goods (Jarosch 2015).

(12b) The project *Allgäuer Krämlle Ecke* established a corner with regional food in 80 tourist establishment. The idea for the project came because of the increasing demand for local products by visitors and a lack of marketing possibilities for small producers (Regionalentwicklung Oberallgäu 2011).

(12b) Another innovative idea came from an alpine dairy association in the Gunzesried valley. The alpine dairy exists already over 100 years and the farmers in the valley still deliver their milk to this dairy. The number of farmers decreased over time to 15 farmers with 16 cows in average. So, the milk is still produced in an extensive way. The processing facilities are endowed with state-of-the-art technology. For example, the farmers can deliver whenever it is convenient for them, because of an automatic milk receptor on the outside of the processing facilities. Every year 1.2 million litres of milk are processed in the dairy in Gunzesried. During the process of turning milk into the various dairy products, whey remains as a side product. The amount of whey is too high to use as feed and too little to dry it as protein powder. So, the members of the association had the idea to build a biogas plant especially for the accumulating quantity of whey. It was built in 2015, since then the process energy in the dairy comes from burning the methane gas. Additionally, the quantity is sufficient to heat the shop and two apartments. This method can save heating oil and mitigates the waste problem (Haslach, presentation 2018; Regionalentwicklung Oberallgäu 2014).

5.3.3 Diversity and availability of local food products

(13a) The informant – working in the local food system – explained that the diversity of products from the region is not particularly high. Anyway, in his opinion the regional products have the advantage that they are the foods which are used in the everyday kitchen, thereby they are some of the most frequently consumed goods. Such goods are for example flour, eggs, apples, potatoes, milk and other dairy products. The interviewee from *Bio Mercato* Kempten demonstrated that his shop has around 8000 products and only 500 are regional. But in his shop every product is certified organic, so for him the focus in his shop is organic quality and regionality only is the second priority (Sita, personal communication 2018).

(13a) The local supermarket chain Feneberg states on their website that they have over 400 regional products from 600 producers, which are all under the VonHier brand. These products include bread, cheese, dairy, meat, fruit and vegetables, eggs, cereals and pasta, cooking oils, and canned foods (Feneberg Lebensmittel GmbH 2018a).

(13a) Other examples for shops with regional food are *BioWelten Ökoase* in Immenstadt and *PurNatur* in Kempten. Both shops have exclusively certified organic products but try to offer as

many regional articles as possible. (13b) PurNatur has additionally a delivery system for fruit and vegetable boxes. In the whole region are at the minimum five other food box deliverers available. PurNatur only delivers in a radius of 12 km, whereas other farmers deliver in a radius of 50 km. The deliverers are present in all administrative units of the Allgäu, so the food boxes are available for a wide range of the population (Bio-Ring Allgäu 2017; Hüttenrauch 2018; Wolz 2018b).

(13b) In the Allgäu region are farmers' markets in around 30 different cities. Most of them are weekly markets, three happen twice a week, one takes place only every second week, another one only monthly. The majority is open during the morning and only five are during the afternoon. And commonly the markets are held in the second half of the week, only one is on a Monday and three on a Tuesday (Bio-Ring Allgäu 2017).

(13b) A new trend is the so called *Regiomat*, which is a vending machine for regional foods, such as milk, meat, eggs and jam. These automatic vendors are put up on farms or in city centres and they should make it more convenient to buy food from local producers. The customers have the advantage that the food is accessible around the clock and the farmers don't have to spend time for selling their products or don't have to pay a salesperson (Dosch, personal communication 2018).

(13a) Christian Gabler from the Allgäu brand pointed out the extreme overproduction of milk and dairy if the products would only be consumed within the Allgäu. Obviously, the goal is not to become a food sovereign region and the range of products would not be sufficient for it, but the goods which are produced are strongly demanded by the population. Additionally, the products are usually marked as regional – for example with the VonHier label – and easily accessible in the supermarket or organic shops (Gabler, personal communication 2018)

5.3.4 Collective catering based on local and organic products

(14a) To the point of the data collection were no numbers available about the proportion of regional and organic food in collective catering. (14b) Nonetheless, the development is currently starting according to Sarah Diem, the project manager for the organic model region Upper Allgäu. In 2016 Diem started within the frame of the model region project to raise awareness under the consumers and producers about the importance of organic and local food. A working group was found, to bring together the actors from collective catering and the local food producers. In the working groups the stakeholders could discuss the needs of the collaborating groups. For example, the canteens need a stable amount of food with a constant quality and price, whereas the farmers are not able to predict their harvest but have less risk if they have secure demands before harvest (Diem, personal communication 2018).

(14b) Furthermore, the model region managers organise seminars and workshops, such as a coaching for canteens how the cooking must be changed to include more regional and organic

food. One of the biggest caterers, *Menü.Service.Allgäu*, who delivers to hospitals, elderly homes and schools is interested in the program and wants to increase the proportion of the local and organic products in their meals. Another coaching brought together chefs, restaurant owners, caterers, producers with direct marketing, food processors and multipliers, and they addressed the topic how the organic certification of a gastronomic business pays off for the entrepreneur. The workshop was held at the hotel *Ifenblick* in Balderschwang, Upper Allgäu, which serves 100 percent organic food (Diem, personal communication 2018).

(14b) The Allgäu brand wants to set incentives as well to increase the amount of local food in the canteens and gastronomy. Therefore, one of the criteria to become a brand partner is the utilization of locally produced groceries. Either in the canteen for employees or at the breakfast buffet of hotels (Gabler, personal communication 2018).

(14b) Another approach to the topic was the workshop “organic for everyone”, in this seminar it was dealt with the question how schools and child care institutes can integrate organic food in their kitchens, even with a small budget. One school in the area, the *Hildegardis Gymnasium Kempten*, is willing to become a “climate school”, with the goal of CO₂ neutrality. Serving 20 – 30 percent local, organic food is one of the steps in their action plan (Diem, personal communication 2018).

(14b) As mentioned above, initiatives which started independently from the organic model region are for example *LandZunge* and *VitalZunge*. Both promote an increase of regional food, *LandZunge* puts the focus on gastronomy and *VitalZunge* sets the goal for canteen kitchens.

5.3.5 Consumer awareness and connection between producers and consumers

(15b) Many of the above-mentioned initiatives are aiming to bring consumers and producers closer together. For example, Feneberg has a section on their website where producers can introduce themselves and their products. On some of the farms *VonHier*-farm days are organized to invite interested consumers to see and understand where their food comes from. Moreover, there is a free *VonHier*-magazine with information about foods, recipes and outdoor activities in the Allgäu (Feneberg Lebensmittel GmbH 2018b).

(15a) The described labels have the effect that the citizens and tourists understand the value of local producers. By getting more information about how the food is made and by whom, the consumers get more involved and connected to their food (Gabler, personal communication 2018).

(15b) The *PurNatur* organic food store made one-minute information videos showing the different parts of their business, such as the bakery or the bistro (Wolz 2018b). Similarly, the alpine dairy in Gunzesried made a small movie about the cheese production. The videos are

shared via social media and give the consumers a special insight into the firms (Haslach, presentation 2018).

(15b) Another concept to involve the consumer are guided tours through the manufacture. In the Allgäu are for example various demonstration dairies or show distilleries. Usually, the visitors are led through the production facilities and get explanations for the production process followed by a tasting of the in-house products (Mir Allgäuer Urlaub auf dem Bauernhof 2018; Walder Käskuche 2018).

(15b) 2015 was the first community supported agriculture (CSAs) founded in the Allgäu. Since then 5 others followed this path. CSAs are a strong way to connect consumers to their producers. First, because it is the community that carries the agricultural business and the consumers get their food regularly from the same farmer. Secondly, the members of the CSA are usually asked to work at least once a month in the farm (Hatt 2015).

(15b) More passive than the connection in CSAs are the bounds between consumers and producers on weekly markets or in on-farm shops, but it also creates an exchange opportunity between the two parties. One of the informants from the agricultural administration mentioned that there are over 80 on farm sales in the Allgäu, which is in his opinion already a very good number (Dosch, personal communication 2018).

(15b) Another interviewee highlighted that the festive week in the Allgäu, with yearly 140,000 visitors, has in 2018 an exhibition with the motto “farmers and consumers hand in hand”. According to him, events like this can lead to more recognition and appreciation for regional food (Hoffmann, personal communication 2018).

(15b) Initiatives such as the *Bioring Allgäu* where consumers and producers work together to promote organic agriculture, help to reconnect the two parties. They are establishing a network between farmers, processors, sellers and buyers. Enhance the regional marketing for example by publishing each year an organic shopping guide and helping to organise farm experience days (Räder 2018).

(15a) One of the stakeholders in the regional food systems said that the demand for regional food is an increasing trend in the Allgäu – already for several years now. In his opinion the supermarket director who established the VonHier label in 1998, was one of the pioneers who understood this trend. He explained further that it seems like the consumers are more drawn to local products than to organic products. This is also his explanation why Feneberg puts the regionality in the foreground, even though all VonHier products are organic as well (Sita, personal communication 2018).

5.4 Stakeholder analysis

During the interviews with people from the three dimensions of an agroecology territory, it became obvious that the mentioned stakeholders are often overlapping. Beginning with the agricultural sector, both interviewees from the agricultural administration named mainly the

same key stakeholders. Under these were for example the farmers on the first place, followed by processing firms and associations such as dairies and butcheries, supporting structures like farmers' associations, machine sharing organisations, breeding associations, companies for agricultural technology, retailers, tourism associations especially for farm holidays. Hoffmann (personal communication 2018) opines that the network of the actors connected to the agricultural sector is very strong, which leads in his opinion to an awareness of a "good" – meaning environmentally benign – agriculture under the citizens and as consequence to an increased demand of regional products. Dosch (personal communication 2018) sees the region as almost self-sufficient, not regarding food supply, but concerning agricultural technology, animal fodder, processing facilities etc., which results in a strong regional value chain that lets profit the local actors most.

In 1995, the first Allgäu conference was held with stakeholders from politics, economy and science. At that time, the goal was to work together within the region to transform the Allgäu into an attractive business location – therefore the *Allgäu Initiative* was found. According to the Germany wide regional ranking, the districts in the Allgäu continuously improved their economic situation, especially the Lower Allgäu came from place 47 in 2011 to place number four in 2017 in the national ranking. This ranking compares the German administrative districts through evaluating economic and societal factors, such as gross domestic income or employment rate. Using this ranking as an indication it seems like the stakeholder collaboration which started at the first Allgäu conference was successful (B4B Wirtschaftsleben Schwaben 2010).

The stakeholders cooperating in the Allgäu Initiative started then, in 1998, the *Energy and Environment Centre Allgäu*. This institution has the purpose to facilitate the energy transition from fossil to renewable energies. The centre brings again actors from different sectors together, again from economy and municipalities additional to energy efficiency consultants, architects or construction firms. The main task of this non-profit organisation is to provide consulting for new construction undertakings or look for subsidies for climate protection projects (Energie- und Umweltzentrum Allgäu 2018).

Furthermore, the Allgäu initiative is involved in the development of the university in Kempten and has supported the founding of enterprises in the region (B4B Wirtschaftsleben Schwaben 2010).

In 2004 the *Allgäu Marketing GmbH* started, here the focus was fully on tourism and the transformation of the Allgäu into a holiday region. Interestingly in 2011, the Allgäu Initiative and the Allgäu Marketing GmbH were merged into the *Allgäu GmbH*. Under the leaders of the new formed company are still tourism associations and the regional chamber of industry and

commerce, but also the local action groups of the EU LEADER program have strong influence. After merging the two organisations, the major focus was pointed towards bringing forth the Allgäu brand (Figure 5 shows the sign of the brand) and convert it from a brand of origin into a quality brand (Allgäu GmbH 2012). Already in 2012, the Allgäu brand received the internationally renowned *Superbrand* award, as only regional brand, based on aspects, such as brand acceptance, customer loyalty and longevity (Allgäuer Zeitung 2012). The brand manages to connect stakeholders from tourism, service providers, agriculturalists, industry, administration, communal



Figure 5: The sign of the Allgäu brand
(source: Regional-entwicklung Oberallgäu)

politics, but also the Allgäu citizens as shown in a study from 2015. The study was conducted by the university Kempten, to research the degree of brand awareness of the Allgäu brand within the region. The results show that the big majority of the society in the Allgäu knows the brand. Additionally, 90 % of the interviewed citizens said that they are proud to be an Allgäu-inhabitant – not only the original population, also most of the new residents reported to be proud to live in the Allgäu. This outcome affirms that the regional identity of the residents is particularly strong (Bauer and Niemeijer 2015; Landkreis Unterallgäu 2016a).

The brand might not involve all stakeholders in the same way and there is still a focus on tourism, but it transmits values, such as regionality, sustainability and quality, over the whole region (Allgäuer Zeitung 2012).

Next to the region over-arching Allgäu brand, the administrative districts also created their own separate images which they use to present their districts to the outside. The Upper Allgäu presents itself as place for outdoor and nature recreation activities, having the mountains as highlight (Oberallgäu Tourismus Service 2018). The East Allgäu was given the image of one big castle garden because of the high number of famous palaces and castles within the district (Landkreis Ostallgäu 2018). The Lower Allgäu invented itself as spa and recreational area with focus on health (Landkreis Unterallgäu 2016b). These positive images of the districts can function as a common vision that the stakeholders can pursue together.

In the biodiversity and natural resource dimension, farmers were often named as key stakeholders, too. On the one hand, because they manage the biggest part of the “natural” area. On the other hand, some of the farmers serve as frontrunners trying new ways of land management, for example farmers who start CSAs, and can thereby inspire others to follow and create awareness of the issues. Also seen as important actors were various nature conservation NGOs, the nature conservation administration, the agriculture and forestry administration, municipalities as well as the landscape management association. Moreover, the tourism sector was mentioned as well, even though the ulterior motive might not be the same, they play a big role in landscape protection.

Talking about embedded food systems the farmers were again mentioned first, because they are the ones delivering the local foods. Secondly, processors and retailers were named, who make the food accessible. Listed were also the multiplier initiatives that raise attention for the importance of high food quality and regionality, as labels like AlpGenuss or LandZunge do. And of course, the consumers are crucial actors in this dimension, with their buying decisions they can determine whether a local food system can evolve or not. The advantage in the Allgäu is the strong local identity, as mentioned above, and tourists who come to the Allgäu to experience traditional products and local food.

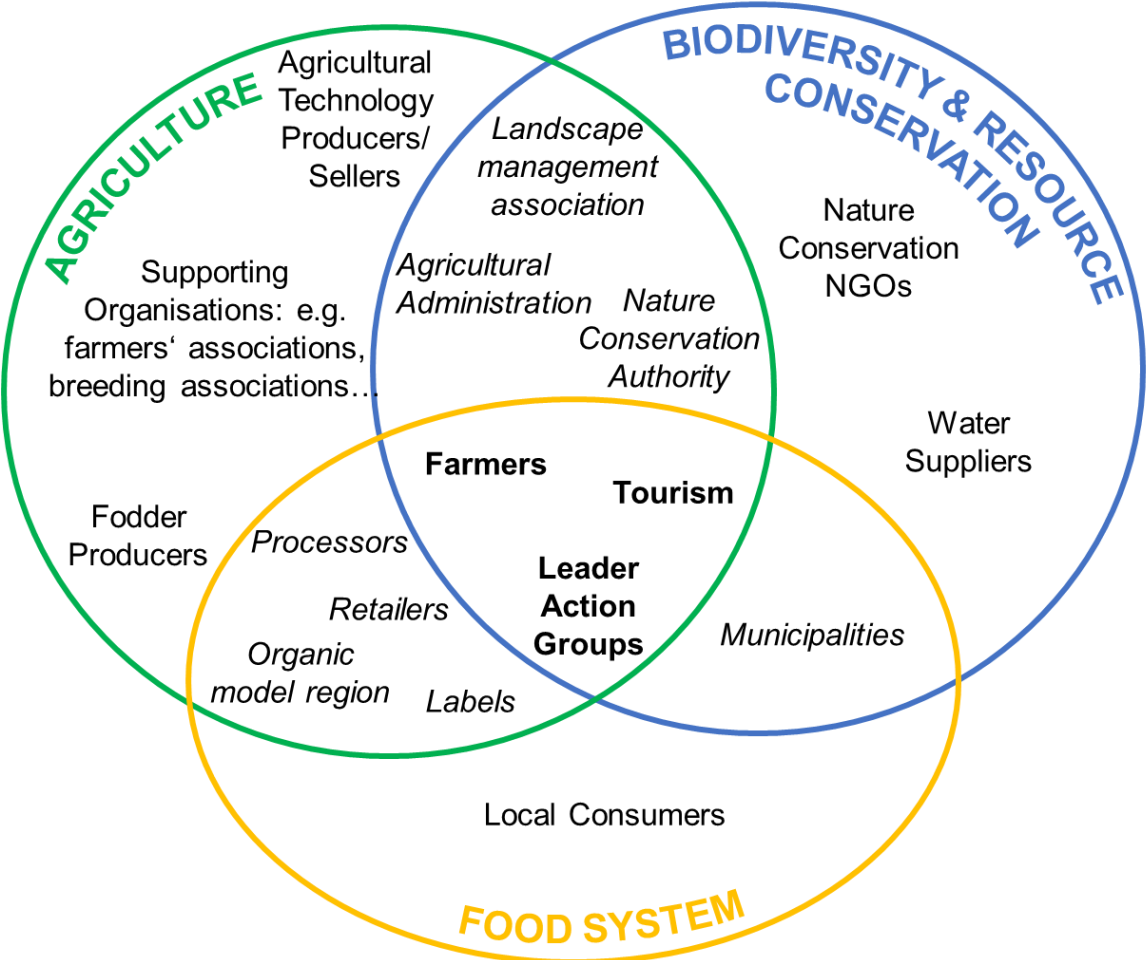


Figure 6: Compilation of stakeholders from the Allgäu active in the dimensions of an agroecology territory.

Figure 6 shows a compilation of the actors in the three dimensions of an agroecology territory, which were named as key stakeholders during the interviews. It becomes obvious that most of the stakeholders are active in more than one dimension. The stakeholders who are in the overlapping zones form a linkage between the dimensions. For example, the landscape management association has nature conservation goals and achieves them by working together with farmers and land owners. Therefore, having many multifunctional or

transdisciplinary stakeholders in a region can lead to more collaboration and a faster development if a common goal is set.

Interestingly, the themes regionality, sustainability and quality, which the Allgäu brand wants to promote in the region, were recurring in the interviews with stakeholders from all three categories. Furthermore, projects supported by the LEADER local action groups were used as good examples for change in most of the interviews. The topic of tourism constantly reappeared as well. It was described as an impacting factor in all three categories. It was mainly considered as a positive aspect, and it seemingly leads to a common goal between the stakeholders: creating a whole “Allgäu-experience”. Visitors should come to the Allgäu to enjoy the conserved nature, in which the farmers and their animals are appreciated as part of it, to eat healthy, local and high-quality foods. This idea sounds romanticised; however, it needs the effort and collaboration of stakeholders from agriculture, nature conservation and the food system. Additionally, it is not only desirable for tourists, it also increases the life-quality of the population.

In .

Table 7 the results from the stakeholder analysis are summed up.

Table 7: Results of the stakeholder analysis

Results from the stakeholder analysis:
<ul style="list-style-type: none">• There were many overlaps when asking about the key stakeholders in the three dimensions of an agroecology territory• Farmers, tourism and the LEADER local action groups were mentioned to be key stakeholders in all three dimensions• The values regionality, sustainability and quality were recurring themes in the interviews conducted during this study• Creating a whole “Allgäu-experience” was seemingly a common goal between the stakeholders• The Allgäu GmbH brings together stakeholders from tourism, service providers, agriculturalists, industry, administration and politics• The goal of the Allgäu GmbH is to bring forth the Allgäu brand• It transmits values, such as regionality, sustainability and quality, throughout the region• Additionally, the districts created their own images of themselves e.g. the East Allgäu describes itself as one big palace park or the Lower Allgäu calls itself Kneipp-land and presents itself as spa and recreational area• Through these brandings a common vision is created which the stakeholder can pursue together

5.5 Is the Allgäu an agroecology territory?

After collecting data for the 15 agroecological indicators and conducting a stakeholder analysis, an insightful picture of the present development in the Allgäu could be created. Drawing a conclusion from this picture, the answer is: the Allgäu is in a transition towards sustainable agricultural and food systems. In all three investigated dimensions positive developments and outstanding examples are existing. Additionally, there is a connection and

common values visible between stakeholders who can bring the agroecological development further.

The structural change in agriculture in the Allgäu is comparatively slow. Small farms aren't vanishing as fast as in other regions and the livestock units per farm stay on a moderate level. This results from income diversification opportunities, such as touristic offers or direct marketing. Additionally, there is coherent marketing of high quality regional products in the Allgäu, through the Allgäu brand or labels pointing out the traditional and environmentally benign production of regional products. Economic incentives for extensive land management practices are used by the farmers as well. Still, in parts of the Allgäu, where the soil is more fertile, the structural change is quicker, and the intensification is ongoing. For example, in the Lower Allgäu, the biogas production increases and with it the maize cultivation rises. First measures are taken to support the farmers to find alternatives, such as *S. perfoliatum*, but the project must be spread further to effectively counteract the negative impact of maize monocultures on the environment and the landscape.

The Allgäu has naturally very valuable biodiversity hotspots and the classic nature conservation institutions, such as the nature conservation authorities, landscape management associations and NGOs, are supporting and protecting them to their possibilities. Also, the size of areas under protection are remaining stable. Rather special for the Allgäu are local collaborations targeting to protect specific biotope types, such as the marsh alliance. Another example is the collaboration of farmers in Bad Hindelang who decided to follow self-imposed rules to conserve the landscape together. For less productive lands like mountainous grassland the influence of the touristic sector is very helpful. Labels like LandZunge and Allgäuer Alpgenuss can lead to higher income for farmers who keep working in the traditional way. In areas where the agricultural conditions are better, the intensification is harder to stop. In these areas compromises are searched to create intermediate habitats between intensive and extensive agriculture or farmers leave stepping stones for species to move from one habitat to another.

Local food is on the one hand available as staple food, consumed by locals on daily basis. It is conveniently accessible in the supermarket, at farmers' markets, through box schemes or organic food stores. On the other hand, the regional food is almost handled as a touristic attraction. Its high quality is pointed out by the Allgäu brand and other labels. In the Allgäu the food consumers can get directly in touch with the producers and processors e.g. at open farm days, farm holidays or demonstration cheese making facilities. Generally, the local food system is on a good way. There is a strong regional identity of the citizens in the Allgäu who want to support local producers, complemented by the touristic sector which works in collaboration with farmers because they are the ones maintaining the landscape as tourist attraction.

The stakeholders appear to aim for a similar development in the Allgäu and work towards regionality, sustainability and quality. These terms still have a wide scope for interpretation and a conflict of objectives can occur between or within one of the goals. Such a conflict could be e.g. whether a conventional but regional product is more sustainable than an imported certified organic product. Different stakeholders might have different perceptions of the right way to achieve this development, in any case it creates a good basis for negotiation to have common goals.

These results let conclude that the Allgäu is an agroecology territory, because there is an ongoing development toward more sustainable agriculture and food systems. Anyhow, there is still the possibility and the need for further development in all three categories. The initiatives built a strong basis for a fast transition, but many of them have the potential and should be expanded over the whole region.

6. Discussion

6.1 Discussion of the methodological approach

The assessment tool in this study did not enable easily comparable quantitative results. This might have been more appealing to some of the readers because it would lead to a clearer result. However, as Bell and Morse (2008) describe in their book, such an approach could lead to a flat reductionistic picture of the ongoing development of a system, or in this case, the Allgäu region. Furthermore, I did not want to assume that agroecological development can be measured with empiric methods, because it would mean that the happenings in a region are “[...] fixed, knowable, measurable and, therefore, predictable” (Bell 1996). The approach of this work is aiming for holism, as contrary to analysing individual units of a system. Looking at the whole does not mean that it attempts to measure every part of the complex system, it rather means to look at it with a focus on interactions and processes happening (Bell and Morse 2008). I realized this in my work by focusing on a few projects and giving insights into the way they influence the region and impact different stakeholders. For example, in the section about local food initiatives, I decided to give detailed information about seven outstanding examples, instead of counting the number of projects and evaluating whether it is a high or a low number. This should give readers the possibility to understand the layout of the initiatives and make it easier to estimate the effect of a project in the region, also regarding implementing similar projects in another region.

When talking about interaction, one must be aware of the interaction between the observer and the system as well. Especially the subjective point of view during the creation of the set of indicators must be pointed out. Subjectivity cannot be avoided, particularly with topics like sustainability or agroecology, where everyone – the researcher as well as the stakeholders – have different interpretations. During the creation of the assessment tool in this study,

stakeholders were involved, too. According to Bell and Morse (2008) the subjectivity should be accepted because outcomes of a study will more likely be used as the basis for further planning when they reflect the interests of local stakeholders. So, the subjectivity of the findings in this study was tolerated, for the benefit of including interests and perspectives of local stakeholders in the measurement. The results might be influenced by this, e.g. when interviewees were talking about their own initiatives, they might overestimate the impact of the specific phenomenon on the transition process due to their direct involvement, whereas other initiatives might be left out or their effect might stay underrated because nobody directly involved was interviewed.

In the case of this study, the agroecological indicators were created by using the theoretical framework of “agroecology territories” by Wezel et al. (2016) as directive. Only as second step, the preliminary list of indicators was adjusted to the Allgäu region by discussing them with local experts. Another approach proposed by Reed et al. (2006) is to investigate first the context, meaning the key stakeholders and the specific system that is relevant for the measurement. In my opinion both approaches have advantages and disadvantages. I chose the first approach because the aim of this study was to establish a set of indicators that could be used for other regions as well. However, there are two categories, both concerning grassland, which might not be of interest in another region, but they had to be included to make the assessment most relevant for the Allgäu region. Therefore, the compromise between locally specific and globally applicable was to establish indicators that can be used in other contexts after being slightly adjusted to regional particularities.

Another compromise was established to determine the number of indicators. This time, the purpose was to balance the efficiency of the data collection, and the coverage of all relevant parts of an agroecology territory. This dilemma is also described by Tanguay et al. (2010), who concludes that it is unavoidable that the indicator selection is subjective at some points of the process. To reduce the subjectivity, I included in the first draft of the indicator list all attributes which an agroecology territory should have. Later in the process, another external factor influenced the list: the availability of data, which Tanguay et al. (2010) name as one of most challenging aspects of measuring sustainable development, which is also applicable for agroecological development. Due to the scope of this study, some indicators had to be excluded. For example, no data could be generated about consumers’ decisions to buy local food, or the proportion of semi-natural elements in the landscape. In a study with a larger scope, data for this topic could be collected through consumer surveys and aerial photo analysis. After eliminating the indicators without data source and talking to local experts, five criteria with two to three indicators each were selected per dimension of an agroecology territory. The intention was to mitigate thereby an overemphasis of one section.

Often, methodology types from social science, as I used for the data collection, get criticised as biased by the world-view, assumptions, and values of the researchers. Diefenbach (2009) remarks that the same biases, criticised in qualitative research, influence quantitative research, but formulas and diagrams are in most cases perceived as more objective. Research is always to some extent subjective. To cope with this, it is crucial, according to Diefenbach (2009), that the researcher clearly states his or her own assumptions and interests about the research topic. To accomplish that, the definition of an agroecology territory is stated right in the beginning of this study, to highlight the basic assumptions. Furthermore, as an agroecologist, I am not an objective observer of the situation in the Allgäu. By establishing the indicators before looking into the situation in the region, I could maintain a certain neutrality, but of course, I focused more on the positive examples, rather than the negative ones. Declared as one of the possible research outcomes was that the investigated development in the Allgäu could serve as example for other regions. With this statement, I made my positive bias towards agroecological development explicitly from the beginning. Alongside with his issue, Diefenbach (2009) points out the problems of data collection through interviewing, because the researcher decides which stakeholders get a voice to explain their interests, values and perceptions, whereas other are fully excluded. In this study, I relied on experts to provide information about stakeholders who are active in the field of agroecological development and a self-conducted stakeholder analysis. Through the focus on stakeholders who are active in the development, the process was already selective. This kind of selection was intentionally, because the study investigates the ongoing development and not a lack of development. If a subsequent research should lead to accelerate the agroecological development in the region and put new initiatives into action, it would be essential to include stakeholders who are decisively not involved in the process. For the explorative and descriptive study, which I conducted so far, it was of little interest to understand the motivation of non-participating or counteracting parties.

Collecting data by conducting interviews is a controversial topic. Alvesson (2003) cautions researchers to be aware that the interviewee might follow societal norms when answering the questions, instead of giving a personal answer. He also concedes that an interview without influence by the interviewer is impossible. Therefore, the data from interviews in this study should be seen as information coming from a certain social setting. In the Appendix (p. xiv), I included a calendar that describes the occupation of the interviewee and the medium of interview (personal meeting or telephone). That way, the readers can get an idea of the social setting of the data collection. Additionally, before interviewing a farmer, I gave a very brief description of the research project, and only the last question was directly about agroecology. This way they had little room for speculation, which expectations towards their answers I could have. Finally, it is important to be aware that the gathered data cannot be completely neutral,

but the outcome is still highly relevant information about the ongoing agroecological development in the Allgäu.

During my research I did not come across other case studies assessing the agroecological development on the territorial scale. Rather frequent, indicator-based studies are conducted on farm scale. For example, in Bockstaller et al.'s (1997) article the indicators serve as decision aid for farmers, who want to transition to integrated arable farming systems. The indicators were established to measure which practices the farmers must adapt to fulfil the principles of this management form. One indicator was e.g. the development of soil organic matter. The satisfactory level of soil organic matter content was determined according to local conditions. Consequently, after measuring the indicator on field scale, the farmers know whether they are below or above the satisfactory level, and whether they have to increase the soil organic matter content or keep it stable.

Castoldi and Bechini (2010) were using data from interviews as well, striving to measure the sustainability of cropping systems through applying a combination of economic and agroecological indicators. They included criteria, such as "ground water protection" and "correct soil management" (considering nutrient household and crop rotation...), which are similar to the criteria in this study. Like Bockstaller et al., their focus was to create a decision aid e.g. for policy makers. Therefore, they decided to use only quantitatively measurable indicators and to create an index, ranking the results in *minimum*-, *optimum*- and *maximum-sustainability*.

These two examples from literature have the advantage that their outcomes are easier to grasp than the results in this study, and the indicators can be compared to each other. This is particularly important for the target groups they aim to reach. However, aggregating indicators to one index number or using thresholds to indicate whether a system is agroecological or not, can lead to an underestimation of the complexity and to disregarding trade-offs among the evaluated components. In the case of my study, it was foremost relevant to specify attributes of an agroecology territory and find suitable indicators to evaluate them, but for further applications of the agroecology territory assessment, it should be considered to establish thresholds.

The data was accumulated and processed as an image of the situation in the Allgäu, so the development state of the single indicators is not yet evaluated. This might become necessary for example to show decision makers for which indicators or dimensions of an agroecology territory more resources should be used. Bell and Morse (2008) recommend for such a case the identification of *the band of equilibrium*. In this method, every indicator is seen as a continuum. Along this continuum three levels have to be set: (1) the level below expectations, (2) the state of equilibrium meaning the level in which expectations are fulfilled and (3) the level beyond expectations. This is a long process and should be conducted with a group of

stakeholders to include a broad range of opinions and to ensure that the project target – the level of expectation – corresponds to the ideas of the main actors.

Appendix 5 is a SWOT analysis of the methodological approach. It gives an overview of the above discussed advantages and disadvantages of the indicator-based assessment tool.

6.2 Discussion of the results

Aside from the possibility of using the results for facilitating further changes in the Allgäu region, their importance stems from the agroecological approach used for the assessment, which unites findings within natural and social sciences. For example the evaluation of indicators within the criteria “enhancing and supporting ecosystem services” or “diversification of farming systems” mostly concern ecological principles, whereas “agricultural education and farmer-to-farmer knowledge exchange” or “consumer awareness and connection between producers and consumers” target societal aspects. As Francis et al. (2003) explain, this type of transdisciplinary research which widens the view to the whole food system, instead of e.g. focusing only on production aspects, is crucial to design future sustainable systems. Further, the results in this study serve as example of local alternatives within the context of the trends in the current global food system.

The results about the region are mainly analytical, a possibility to put the results into practice is provided by Duru et al. (2015). They create a methodology for transition management, the perspective is as well widened to the whole food system. Based on their meta-analysis they designed a five-step methodology for transitioning towards bio-diversity agriculture. The transition should be facilitated on the territory scale as well and they name similar three dimensions as important for the transition as in the agroecology territory framework: the farming system, supply chains and biodiversity and resource management. Duru et al. (2015) strongly recommend a participatory approach and to draw on methods from social sciences. The five steps include analysing the current system/problem, creating scenarios of the biodiversity-based agriculture on territory level and a shared vision, designing a pathway of transition and facilitate stakeholders to guide the transition by establishing adaptation strategies. There are many perceptions in their transition methodology similar to the ideas building the basis for my study. Thereby the indicators, which I created could serve as assessment tool for the first step of the transition management.

In the following paragraphs some of the indicators and the collected data for them will be discussed. Not all the indicators will be revisited, because many of the issues are recurring.

6.2.1 Adaptation of agricultural practices

The results for the first assessment category, “enhancing and supporting ecosystem services through agricultural practices”, are solely based on data from the Bavarian cultural landscape

program. The considered measures from this program were extensive grassland management without mineral fertiliser and certified organic agriculture. The first one was chosen because of the predominance of grassland in the Allgäu. It might provoke some scepticism because agricultural subsidies are not always perceived as positive. Still, according to an ecological assessment by Haas et al. (2001) grassland management in certified organic farming systems show the best performance in categories, such as resource utilisation, soil, climate and biodiversity protection. Also, management without mineral fertiliser shows a similar performance as organic management in some of the categories, whereas the intensive management has the worst environmental impact. Agroecology and organic agriculture are not congruent, it is still handled as an important criterion with reference to the review of similarities and differences of agroecology and organic agriculture by Migliorini and Wezel (2017). They conclude that the two management approaches have very similar principles and practices. They describe both as holistic approaches, which promote sustainable use of resources and biodiversity conservation, while working towards a sustainable agriculture and food system. This is corresponding with the goals of an agroecology territory and makes the percentage of organic agriculture in the Allgäu a valid indicator.

The indicator about the diversification of cropping systems is in the Allgäu only limitedly informative, because of the high proportion of grassland. Farms with a focus on crop production are solely in the Lower and East Allgäu. The diversification of these farms can be measured with the applied indicator, but it does not have such a high informative value because the predominant system is grassland, which cannot be diversified in the same way (Dosch, personal communication 2018; Hoffmann, personal communication 2018).

A crop rotation with maize, barley, wheat and an intercrop is very common for dairy farmers in the lower lands. The more diversified crop rotations appeared to be ones with specialisation on biomass production for biogas. Hence, in terms of diversification the biomass production can be advantageous, especially if alternatives to maize, such as *S. perfoliatum*, are used. However, crop production for biomass is discussed controversially in the field of agroecology. It takes away space for food production, which could lead to higher prices for food crops and finally result in a conversion of e.g. forestland to crop land to compensate the reduced food production (Boulamanti et al. 2013). Also, the greenhouse gas emissions are often underestimated, particularly when the main feed-in substance is maize (Boulamanti et al. 2013). However, according to Valentine et al. (2012) biogas production is an important step in becoming independent from fossil fuels, which should be part of the transition towards more sustainable agricultural systems as well.

Even harder to assess was whether there is farmer-to-farmer knowledge exchange in the region or not, and if yes to what extent. There are no numbers available for participation at information events or other happenings and it could only be evaluated by a survey with farmers

if there are enough meeting opportunities and which kinds of events are most useful in their opinion. The indicator was still included due to the high relevance of farmer networks as Altieri et al. (2015) point out. According to Altieri et al. (2015), networks, such as *Campesino a Campesino*, are crucial to scale up agroecology. They state that knowledge sharing between farmers will facilitate the adaptation of agroecological practices for climate change resilient agroecosystems. Consequently, this indicator should be kept in the assessment and should be further investigated in future studies on agroecology territories or agroecological development.

Easier to rank is the rate of farm abandonment. Numbers of farms are continuously decreasing in Germany, and so is the number of farms in the Allgäu. Over the last decades the rate of farm abandonment in Germany was at around 3 % per year. In recent years the rate slowed down to 2.4 % a year, if farms with less than 5 ha are included (Deutscher Bauernverband 2018). For the Allgäu the abandonment rate is between 1.2 and 2.2 % depending on the district. Also, the average farm size of 29 ha is much lower than the national average, which increased from 52 ha in 2007 to 60.5 ha in 2016. The growth threshold over which the number of farms increases in whole Germany is at 100 ha (Deutscher Bauernverband 2018), whereas in the Allgäu it remained at 50 ha (Bayerisches Landesamt für Statistik 2018a, 2018b, 2018c, 2018d, 2018e, 2017, 2016). The structural change in the Allgäu is slower than in the rest of Germany, which might be a sign for less intensification in the Allgäu. This could stem from diversification possibilities for farmers in the region e.g. the tourism sector offers various possibilities for the farmers, also added value to primary products could play a role. For example, milk which is processed by local dairies can be sold independently from the global milk price, this provides an advantage in times of low milk prices (Wezel and Weizenegger 2016). According to Hoffmann, director of the agricultural administration Upper Allgäu and teacher at an agricultural school, the agricultural education targets the diversification possibilities in the agricultural sector, too. Thereby, they want to maintain economic viability of farming activities at any scale and keep young dedicated people in the region to prevent rural depopulation. Rural depopulation is one of the trends which came along with a decreasing number of people working in the primary sector and can have bad effects on the socio-economic situation of a region (Fielding 1989). For this indicator simply stating a percentage and putting it into relation to developments in other regions would be sufficient. Nevertheless, I decided to add qualitative information from the stakeholder interviews because the attention of this assessment is put on possibilities to cope with issues, such as farm abandonment, and to point out examples which are facilitating the transition.

6.2.2 Biodiversity and natural resource conservation

The Allgäu has a high percentage of protected areas. Remarkable is that 8 % of the region is protected as nature reserve, whereas only 2.3 % of Bavaria and only 4 % of Germany has this protection status (Bundesamt für Naturschutz 2015; Hanning 2016). Protection areas are generally seen as positive by nature conservationists in the Allgäu. The legal directive sets rules for the maintenance and can lead to funding for landscape maintenance practices or prohibits any interventions. Thereby the areas can be kept in good condition and serve either as core zones with a positive spill over effect or as stepping stones between habitats. Not all protection statuses have the same impact. According to local nature conservationists, the framework of landscape protection areas as well as the landscape and nature monuments are judged as too loose and unspecific to really achieve species conservation. From the experts view they mainly serve to keep an attractive landscape for tourists (Güthler, personal communication 2018). However, landscape protection can reconcile many factors, as it is described in the *cultural landscape change* project: an intact landscape is a habitat for manifold animal and plant species, it is home for the local people and economic basis for a touristic region at the same time (CIPRA n.d.). Mentioned as negative aspect was also that only the rather protection areas with rather loose regulations, such as landscape protection areas, are increasing. The suggested reason for this was that they are quite easy to change or to revoke the status again.

Not only the areas with a protection status are important for nature conservation. Farmers manage the majority of the land in the Allgäu, thereby they play a key role in nature and resource conservation. Grassland as prevalent land cover is very beneficial from this point of view. It is highly valuable for soil and water protection, because the permanent vegetation prevents erosion and leads to a high humus content. Thereby, permanent grassland acts as carbon sink. Because of the good soil structure water infiltrates easily and it helps to refill the groundwater storage (Wilke 2017). So, permanent grassland systems often have agroecological advantages compared to cropland, of course depending on the intensity of both management systems. The performance of the agriculture in the Allgäu might be rated as more environmentally friendly than agriculture in other regions, already due to the composition of its landscape. So, to evaluate if there is a progress towards becoming an agroecology territory, the attention was put on aspects, such as incentives for farmers to extensify their grassland management, e.g. the agri-environment measures by the cultural landscape program or the premium prize for grass/hay fed cows, the individual management practices of farmers, and the development of the size of the grassland area. Concluding from the results, I would say that the initiatives are fruitful and taken on by a considerable number of farmers, but in the future the incentives should also be tailored to farmers in areas with more intensive agriculture. In these areas the pressure on grassland is particularly high, because of the strong demand

of fodder crops and increasing need of biomass crops for biogas. Due to these pressures the EU changed the regulations for conversion of grassland, since then a permit is necessary, and it is prohibited to till grassland with high value for nature conservation (Wilke 2017). Since then the grassland in Germany is slightly increasing again, but the conversion pressures are similarly high (Wilke 2017).

Other very important areas for nature conservation – mainly without protection status – are the marginal productivity sites. The sites often have quite extreme conditions and host many endangered species. For this reason, the management of these areas was included as assessment parameter. The issue with these areas is that there is not much data about the management available. In another time frame this should be further investigated e.g. through more elaborate farmer interviews.

The indicators in the category “protected areas and biodiversity conservation” are a good example to show that quantitatively assessable indicators are relevant and easy to compare. However, the size of the protected area on its own is not very meaningful, because of the differences between the protection status and the highly relevant nature conservation efforts outside of protected zones. Therefore, the qualitative aspects should not be disregarded, and it should be aimed for the most meaningful results by combining quantitative and qualitative indicators.

6.2.3 Development of embedded food systems

Going into the food system data availability was very limited. For example, for the category “collective catering based on local and organic products” were no numbers available for the Allgäu. The manager of the organic model region reported that it is part of her tasks to facilitate a development in this field (Diem, personal communication, 2018). Organic food in out-of-home-kitchens is also a Germany-wide trend according to Grundnig, leader of gastronomy advising at Bioland (Kreisbote 2017). So far, the focus is on organic supply which partly conflicts with the idea of local food in canteens. The logistic issues are apparently the main factor why the supply happens through big organic retailers. The organic model region in the Upper Allgäu is searching for a compromise where regional organic producers collaborate and deliver the products which they have in sufficient quantity, e.g. dairy and meat products, and a big retailer supplies the rest (Kreisbote 2017). Still, it is questionable whether organic food with a long transport way or regional conventional food should be prioritised. In a region transitioning toward sustainable agriculture and food systems both should be promoted. Therefore, producers of regional food would need advocates pushing their interests in the same way as the organic model region and the organic farming associations are currently for organic food.

The investigation of the regional food system was most time-consuming because in this dimension it was more challenging to identify key stakeholders and data was not available in an easily accessible form as for some indicators in the other dimensions. However, the results already give an overview showing that the farmers have many local processing and selling opportunities for their products. It is advantageous that the region is a popular tourist destination, but also the strong regional identity of the locals makes the development of an embedded food system easier. Rosset and Martínez-Torres (2012) describe the agroecological development as a chance to regain autonomy of food producers, processors and consumers. Such a development is happening in the Allgäu, for example farmers in the Gunzesried valley are still only delivering their milk to the traditional dairy in the valley. This gives them the autonomy to decide how and what they want to produce, what quantities they want to produce and how they are going to sell it. Even the price stays quite independent from the global market. Another example are the farmers in Bad Hindelang, who even decided to set themselves regulations to preserve their resources in the best possible way. The network of farmers producing for the oil mill in Kempten has a similar effect. Van der Ploeg (2008, cited in Rosset and Martínez-Torres 2012) describes this type of regaining (or maintaining) autonomy from input and food markets the process of re-peasantization³. To him the re-peasantization is a chance for sustainable growth of agriculture by adapting agroecological practices and transitioning towards food sovereignty.

The list of examples could have been easily prolonged, but to keep the information within the scope of this study I decided to show mainly examples which are specific for the Allgäu region. There are many more organisations and initiatives supporting the agroecological development. Some of them are well established in Bavaria or Germany. It does not mean that they contribute less to the development, but the research intention was to find out, if there are special processes and initiatives especially in the Allgäu.

6.2.4 The Allgäu as agroecology territory

Even though there is not yet a comparison with another region possible, one can conclude that the Allgäu is an agroecology territory. This is a qualitative statement based on the assessment of the indicators. The evaluation shows that 80 % of the indicators are positive for the Allgäu

³ Definition of peasant condition according to van der Ploeg (2008, cited in Rosset and Martínez-Torres 2012): “[...] It aims at and materializes as the creation and development of a self-controlled and self-managed resource base, which in turn allows for those forms of co-production of man and living nature that interact with the market, allow for survival and for further prospects and feed back into and strengthen the resource base, improve the process of co-production, enlarge autonomy and, thus reduce dependency... Finally, patterns of cooperation are present which regulate and strengthen these interrelations.”

and the stakeholder analysis showed as well a positive result. However, a judgement about how far the transition has progressed is not possible.

This result is also coinciding with the judgement by Wezel and Weizenegger (2016), who concluded that there is sufficient evidence for an ongoing sustainable development in the Allgäu. Furthermore, a Germany wide study on the resilience of districts and cities rated the Upper Allgäu as very resilient, Lindau and the East Allgäu as resilient and the Lower Allgäu as rather resilient (Behrendt et al. 2010). Grounded in this context, the results from the Allgäu can constitute the baseline for future studies on agroecology territories and agroecological transition. The Allgäu reached quite high scores, which might have to be reconsidered when seen in relation to results from other region. A comparing study could also enable a better judgement which initiatives are most effective and lead to a better understanding which stakeholder constitution facilitates change most successfully, so a comparison could facilitate a multi-layered assessment including factors besides the presence of initiatives, such as their effectiveness or their range within the region.

When the assessment gets applied again, a region with more than half of the indicators per dimension judged as positive could be called agroecology territory. Important is that the transition needs to be ongoing in all three dimensions at the same time and the stakeholder analysis should reveal positive outcomes too, e.g. first collaborations between stakeholders from the different dimensions, common values or even already common goals to work towards.

7. Conclusion and outlook

This study had foremost a theoretical and analytical purpose by establishing a methodology and do preliminary investigations in the Allgäu. As per definition, agroecology territories are “places engaging in a transition process toward sustainable agriculture and food systems” (Wezel et al. 2016) – this process is existing in the Allgäu to an extent that the region can be called an agroecology territory. The agroecological approach in this study makes the results relevant as example for creating sustainable and resilient future systems by including the whole system and taking social as well as ecological aspects into account. Furthermore, it approves indicators as a suitable tool to measure, if a region is an agroecology territory.

Concerning the investigations in the Allgäu, the data collection was in many cases only exemplary, because of the double focus of this study. For example, it could provide a far deeper insight in the agricultural and food system to do farmer and consumer surveys with a statistically significant number of participants. However, by focusing on outstanding examples, experts’ opinions and observations of overarching processes, the transition which is ongoing in the Allgäu became visible, too. More than half of the farmers take part in the cultural landscape program, a high number of farms are certified organic and there are many diversification opportunities for farmers, also promoted by agricultural education institutions. There are nature conservation activities from individual measures, such as flower strips or

reduced mowing frequency, to collective undertakings as the marsh alliance Allgäu. Collaborations between nature conservation, sustainable agriculture and tourism are very valuable, too, e.g. the labels LandZunge and Allgäuer Alpgenuss. Farmers, tourism and the LEADER local action groups were mentioned recurrently as important stakeholders in the context of agroecological transition. Additionally, the strong regional identity of the residents in the Allgäu is a supporting force for local food initiatives, such as the VonHier brand, and the Allgäu brand can build on this foundation as well. This brand also transmits the ideas of regionality, sustainability and quality throughout the region leading to a common goal of creating a whole “Allgäu-experience”. These examples from the Allgäu are evolving into a regional network of innovators and followers, as De Nooy van Tol (2016) describes in her book about transitioning to agroecology. Such a network accelerates the agroecological transition because it considers the agroecosystem of a whole region, linking farming and non-farming activities together for a simultaneous sustainable development in various sectors (Wezel et al. 2016).

Continuing from the results in this study, one of the arising questions is: how the Allgäu could transition further – relative to the current state of the development – towards an agroecology territory? Furthermore, applying the set of indicators in other regions would be an important step to put its viability to test. Later, when results from other territories are obtained, a comparative study should be conducted to understand which practices and initiatives are most effective. It would further enable to judge the state of transition of the territories by setting them in relation. This could give impulses and motivation for the examined as well as other regions, to invest more in a transition toward more sustainable agriculture and food systems by applying an agroecological approach.

Along the way of testing the set of indicators, the question of scale should be kept on the agenda. On the one hand, to find out which scale is most appropriate to facilitate agroecological development. On the other hand, to investigate the “paradox of scaling out niche innovations”, discussed by Pant (2016) in the context of agroecological practices. It should be closely observed and anticipated, if the wide spread implementation and adaptation of agroecological practices leads to a loss of the core values and aspirations behind it. Working with a value-laden term like agroecology entails many challenges, particularly for scientific work, but it also makes the concept highly desirable, inclusive and efficient.

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Appendix

Appendix 1: List of excluded indicators

The table below shows the indicators, which were eliminated after the interviews with local experts and a preliminary research concerning the availability and accessibility of data. The criteria or indicators might be relevant for other regions and the data availability and accessibility might change with the scope of a study and with regional specificities.

Criteria	Indicators	Reasons for exclusion
(1) Adaptation of agricultural practices		
Autonomy in production	<ul style="list-style-type: none"> Percentage of farmers who decreased external inputs % of external fodder supply for livestock Amount of external inputs from fertilisers, pesticides etc. 	In-depth farmer interviews are needed to collect the data for this criterium
<i>Additional to:</i> Diversification of farming systems	Proportion of semi-natural elements in the agricultural landscape	An analysis of aerial pictures is necessary for data collection
(2) Conservation of biodiversity and natural resources		
Diversity of crop varieties and breeds	<ul style="list-style-type: none"> Number of interviewed farmers with rare crop species or animal breeds Incentives to integrate special crop varieties or animal breeds, such as land races 	Not so relevant in the Allgäu, because of the high percentage of permanent grassland
Urbanization	Slow to fast urbanization - Compared to other regions	Besides the size of the converted area, data has to be available about the type of land that is converted
(3) Development of embedded food systems		
Consumer awareness of agroecological production	<ul style="list-style-type: none"> Reasons why consumers buy local food Where do they buy it? What is the proportion of local/organic products in regular grocery shopping? 	Consumer survey has to be conducted for this information
Regional economic value from local food system	<ul style="list-style-type: none"> Yearly turnover of the local food production sector Quantity of local food cooked and consumed in hotels, restaurants, Alpine small-scale gastronomy... Which selling points are frequented by tourists? Which selling points are frequented by locals? 	There is currently no data available. Estimations could be drawn from surveys in gastronomy and grocery shops
Employment in local food production and marketing	Proportion of jobs in local food production and consumption compared	There is no data available.

	to the total amount of workplaces in the region	
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Appendix 2: Questions for the structured interviews with farmers

Questionnaire for the interviews with farmers:

1. Name of the farmer
2. Age of the farmer
3. Location of the farm and altitude
4. When did you start farming? How did you become a farmer?
5. Size of the farm: How much grassland, arable land and forest do you have under your management?
6. Is your farm conventional or organic? (if organic, how did you decide to convert to organic management?)
7. Is it a crop / livestock / mixed farm?
 - a. If livestock: Which animals do you have? How many?
 - b. How are you feeding the animals? What types of fodder do they get?
8. How are you managing your grassland: mowing frequency, fertilization? When are you mowing the first time? How long are animals grazing on the grassland?
9. How many different crops do you cultivate normally?
10. How many different crops do you have in your crop rotation? (Any special varieties?)
11. Do you have legumes in the crop rotation?
12. Are there intercrops or cover crops in your crop rotation? How long do you have bare soil on the fields?
13. Do you have direct marketing on the farm or do you sell via a local shop?
14. Who is the biggest buyer of your products?
15. Do you participate in any knowledge exchange offers in the region?
16. Do you apply any biodiversity conservation measures on the farm?
17. Do you receive EU and/or state subsidies or have agri-environmental programmes?
18. Are there any specificities on your farm you would like to mention?
19. Do you know what agroecological practices are? If yes, which ones do you practice on your farm?

Appendix 3: Schedule of all conducted interviews

The following tables show a list of the 24 interviews, which were conducted in the frame of this study. It shows the date of the interviews and the dimension within which each stakeholder is mainly active. Further it lists the names of the interviewees and the institutions they are working for, and whether the conversation was via telephone or in a personal meeting.

March 2018

Date (dd.mm.)	Dimension	Person and institution	Medium
22.03.	Conservation of biodiversity and natural resources	Expert interview - Andreas G�thler, centre for nature experience	personal meeting
29.03.	Development of an embedded food system	Expert interview - Christian Gabler, Allg�u GmbH (Allg�u brand)	personal meeting

April 2018

Date (dd.mm.)	Dimension	Person and institution	Medium
11.04.	Development of an embedded food system	Sarah Diem, organic model region Upper Allg�u	personal meeting
29.03.	Adaptation of agricultural practices	Expert interview - Rainer Hoffmann, agricultural administration Upper Allg�u	personal meeting

June 2018

Date (dd.mm.)	Dimension	Person and institution	Medium
05.06.	Adaptation of agricultural practices	Peter Dosch, Agricultural Administration Kaufbeuren	telephone
11.06.	Conservation of Biodiversity and Natural Resources	Stefan Pscherer, Leonie Schaefer, Landscape management association Upper Allg�u	personal meeting
12.06.	Development of an embedded food systems	Andrea Sita, Bio Mercato, Oli di Vini	telephone
13.06.	Adaptation of agricultural practices	2 farmers from the Lower Allg�u	telephone
14.06.	Conservation of biodiversity and natural resources	Jens Franke, Landscape management association Lower Allg�u	personal meeting
18.06.	Adaptation of agricultural practices	1 farmer from the Lower Allg�u & 1 farmer from the Upper Allg�u	telephone
18.06.	Conservation of biodiversity and natural resources	Annette Saitner, Landscape management association East Allg�u	telephone
20.06.	Adaptation of agricultural practices	2 farmers from the Upper Allg�u	telephone
21.06.	Adaptation of agricultural practices	1 farmer from the Lower Allg�u & 2 farmers from the Upper Allg�u	telephone

22.06.	Adaptation of agricultural practices	1 farmer from the Lower Allgäu	telephone
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July 2018

Date (dd.mm.)	Dimension	Person and institution	Medium
06.07.	Development of an embedded food system	<ul style="list-style-type: none"> Peter Haslach, Innovative Whey Utilisation; Theresia Schwarz Allgäuer Alpgenuss; Thomas Baustetter, Craft Baker Association in the Allgäu 	personal meeting at excursion
09.07.	Conservation of biodiversity and natural resources	<ul style="list-style-type: none"> Heiß Hermann Water Supplying Association Gennach Hühnerbach Gruppe - East Allgäu; Armin Drexl, Water Supplying Association Staudenwasser Lower Allgäu 	telephone

Appendix 4: Condensed information from the ten interviews with farmers

The following two tables show the condensed information collected during the farmer interviews. Five farmers from the Upper Allgäu and five farmers from the Lower Allgäu were asked the same questions during a telephone interview.

Farmers from the Upper Allgäu					
# of the interview	1.	2.	3.	4.	5.
Age of the farmer	33	40	36	57	53
Altitude of farm (m)	900	734	740	800	720
Farm size (ha)	19,5	50	35,6	70	34,5
Land tenure (ha)	11,7	36	16	27	26,5
Grasland (ha)	11,7	50	34	58	33
Arable Land	0	0	0	0	0
Forest	0	0	1,6	12	1,5
Conventional/ Organic	convention.	organic	organic	organic	organic
Livestock	Dairy cows	Dairy cows	Dairy cows	Dairy cows	Dairy cows
Amount of Livestock	25	46	40	62	40
Fodder in the stable	Silage, hay, concentrate	Silage, dry fodder	Hay, silage	Silage, corn	Silage, maize, concentrate
Grazing time	Mid-April to October	Mid-April to mid-October	Mid-April to October (half day)	May to November	May to September (half day)
Cutting frequency of grassland	5	5	5	4 to 5	4 to 5

Fertilization of grassland	liquid manure after each cut, 2 times a year fertilisation with lime	liquid manure after each cut (12-15 m ³ per ha)	liquid after each cut, if it is enough	n.a.	liquid after each cut, if it is enough
Number of different crops per year	0	0	0	0	0
Intercropping	0	0	0	0	0
Legumes in crop rotation	0	0	0	0	0
Direct marketing	0	0	0	0	0
Buyer	dairy factory	dairy factory	dairy factory	dairy factory	dairy factory
Biodiversity measures	2 ha land are next to a lake, which are mowed only 2 times per year, maintains hedges	0,3 ha are only cut 2 time per year (lake is nearby) and 3 - 4 ha where hay is made, is cut later than the rest	bedding meadows, field margins with herbs and flowers	later mowing to enhance species richness on the pastures, leave grass stripes uncut as refuge for insects	No
Subsidies	Yes	Yes	Yes	Yes	Yes
Knowledge about agroecology	Yes	Yes	No	Yes	Yes

Farmers from the Lower Allgäu					
<i># of the interview</i>	6.	7.	8.	9.	10.
Age of the farmer	47	57	56	46	54
Altitude of farm (m)	450	600	550	645	596
Farm size (ha)	65	176	82	77	43
Land tenure (ha)	32,5	120	27	9,5	26
Grasland (ha)	65	65	30	20	29
Arable Land	0	111	50	57	14
Forest	0	0	2	0	0
Conventional/ Organic	organic	convention.	convention.	convention.	organic
Livestock	Dairy cows	Dairy cows	Dairy cows	Cattle	Dairy cows
Amount of Livestock	60	180	100	15	35
Fodder in the stable	Hay, silage	Silage, hay, maize, soy, rapeseed	Silage, hay, maize, other cereals	Maize, cereals	Summer: Gras, cereals, hay; Winter: Silage, hay, maize
Grazing time	May to October	never	never	There is an outdoor free-range	never

				area adjacent to the stable	
Cutting frequency of grassland	3 to 4	5 to 6	5	5	4 to 5
Fertilization of grassland	n.a.	n.a.	n.a.	after every cut, with digestate from biogas plant	after every cut, with liquid manure
Number of different crops per year	0	4 to 5	3 - Maize, wheat, barley	7 - maize, triticale, triticale rye association, sugar beet, red clover, <i>S. perfoliatum</i>	6 - triticale, barley, oat, associations, maize, clover
Intercropping	0	<i>Trifolium alexandrinum</i> , winter greening	Winter greening after cereals	Greenrye after maize	Winter greening after cereals
Legumes in crop rotation	0	<i>Trifolium alexandrinum</i>	0	<i>Trifolium pratense</i>	<i>Trifolium</i>
Direct marketing	0	0	0	0	0
Buyer	dairy factory	dairy factory	dairy factory	biogas plant	dairy factory
Biodiversity measures	later mowing to enhance species richness	longer crop rotation, minimum of pesticides (especially insecticides)	No	flowering patches as field margins with sunflower, <i>S. perfoliatum</i> etc. for bees and other pollinators	later mowing when hay making, so the different species have more time to seed
Subsidies	Yes	Yes	Yes	Yes	Yes
Knowledge about agroecology	Yes	Yes	No	Yes	Yes

To the question if there are any specificities on the farms farmer 2 replied that they built a small biogas plant 23 years ago. Each year 23 t of maize are bought as additional input for the biogas plant. The digestate is very important for the fertilization, because of the biogas plant they stopped applying mineral fertilisers 20 years ago. Farmer 7 explained that their farm is managed by three families in a private corporation, but it will be separated in a few months after the interview. The last farmer who answered something to this question, was farmer 9

who uses almost all plant products for a biogas plant, which he shares with some neighbouring farmers.

Appendix 5: SWOT Analysis of the methodological approach

Strengths	Weaknesses
<ul style="list-style-type: none"> • The indicator-based assessment is easy to apply • The approach can be adapted to any local specificities • Focus on the interactions, processes and examples of the agroecological development to get a wholistic view of the situation • Stakeholder involvement ensures that interests and values of locals are included in the analysis • The scale evaluates developments of farming and non-farming activities together 	<ul style="list-style-type: none"> • No quantitative easily comparable results • Subjectivity influencing the creation of the assessment tool • Subjective results because of data collection through interviewing • No clear statement possible, if the region is an agroecology territory
Opportunities	Threats
<ul style="list-style-type: none"> • Examples can be adapted in other regions • The study can contribute to finding a common understanding of agroecological transition • Measurement of agroecological transition can show its positive impact and its importance • Knowledge generated with this assessment tool can help to scale-up agroecology • The assessment on territory scale is relevant for policy and decision makers 	<ul style="list-style-type: none"> • Data availability is a key issue in this type of measurement • Without stakeholder participation this measurement attempt loses its relevance, because agroecology is such a value-laden and context-sensitive concept • The results are analytical, without connecting them to another methodology it won't help to facilitate the agroecological transition in the investigated region