Streamlining transition towards Sustainable Intensification: The role of societal contexts and knowledge brokerage

Katharina Schmidt[a], Lorena Tudela Marco[b], Anita Beblek[a]

[a]*agrathaer GmbH, Eberswalder Str. 84, 15374 Muencheberg, Germany,* *katharina.schmidt@agrathaer.de; anita.beblek@agrathaer.de*

[b]*Universidad Politécnica de Valencia, Camino de Vera S/N, 46022 Valencia, Spain,* *lorenatudelamarco@gmail.com*

Abstract: *Where new farming arrangements like Sustainable Intensification (SI) transitions can be tested and compared in experimental settings, implementation and adoption is strongly related to stakeholder interaction. Social capital has been found to be a key enabling factor for transition towards SI. To streamline transitions towards SI under real-world conditions an insight in the role of the societal interaction between actors and stakeholders is needed dealing with questions related to importance of regional networks, cooperation and knowledge transfer. In order to get a better insight in the societal context in adoption and feasibility of SI practices our research focuses on the identification and characterisation of actor and stakeholder roles and mutual relationships within actor networks.*

We therefore cross-compared two case study regions using a pre-defined common set of questions. The methodology of Social Network Analysis (SNA) and participatory stakeholder workshops is used to define the societal interaction, thus enabling us to identify most promising pathways among stakeholders to promote SI practices. As a result, this cross-comparative analysis allowed us to assess how different ways of interaction among main stakeholders may have a different potential to promote the transition towards SI systems within the case study regions. Preliminary results show that desirable SI transition fall into the field of 'regional integration and coordination'. These actions at regional level should be based upon a clear and strategic understanding of who the stakeholders are, what they do, what their needs and aspirations are and what may be areas for intervention and facilitation from a policy perspective.

Keywords: *Regional integration, Social Network Analysis, stakeholder co-creation, participatory workshops, sustainable intensification, Europe*

Introduction

Europe is expected to face increasing pressure on agricultural systems. Meeting the increasing global demand for food has to rely on increasing the production of the existing agricultural areas (Erb et al., 2013). While at the same time growing societal demands for a wide range of ecosystem services, public goods and biodiversity protection (Wolff et al., 2015; Zasada, 2011) call for transitions towards agricultural systems that have minimal detrimental environmental effects (Verburg et al., 2013). Such a sustainable intensification (SI), that is matching or increasing agricultural yields while at the same time minimizing negative impacts on the environment (Bommarco et al., 2013) is believed to be of great importance for meeting future demands on agricultural systems (Tilman et al., 2011). The concept of SI has received different definitions over time depending on the scenario or particular social–ecological-economic contexts. However, they all focus on the main idea: the desire for agriculture to produce food without environmental harm, or even positive contributions to natural and social capital. This understanding is based upon the framework of agroecology but complementing it with a social science approach, taking societal aspects into consideration as a main driver for transition processes. Transitions towards agroecology falls into the field of SI and is therefore regarded in the study as one opportunity for SI transitions. For this study, we take the definition of Pretty (1997), who understands SI as a process or system that allows increasing agricultural yields without causing a negative environmental impact or increasing the agricultural land. Starting from the idea that there are

many pathways towards agricultural sustainability and not only a single configuration of technologies and management techniques, it is important to highlight that social configurations of social capital of relevant actors and stakeholders play a key role towards unlocking the full potential of SI. In much of the specialized literature, there is a consensus that agricultural systems with high levels of relations of trust have been found able to exchange information and promote transfer of knowledge in an optimal way (Pretty and Ward, 2001; Friis-Hansen, 2012). In short, agricultural systems with high level of social capital assets increase face to face learning process and lead to better deployment of lessons learned within the agricultural community.

In order to provide windows of opportunity for SI transition, an important knowledge gap is the lack of insight in the role of societal context (Buckwell et al., 2014) in adoption and feasibility of SI practices. Social capital has been found to be a key enabling factor for transition towards SI, at the same time increased social capital has also been observed as an outcome of SI practices (Pretty et al., 2011; Settle and Hama Garba, 2011; Rosset and Martínez-Torres, 2012). For instance, social networks are crucial in facilitating the adoption of innovations by farmers, particularly regarding the evaluation of costs and benefits of such innovations (Steenwerth et al. 2014). Changes in institutional setups affect land use system dynamics and resilience (Niedertscheider et al., 2014).This has led to include social capital and social networks at the core of SI developments and metrics (Smith et al., 2015). Therefore, an insight in the role of the societal interaction is needed to streamline transitions towards SI dealing with questions related to importance of regional networks, cooperation and knowledge transfer (under real-world condition). In order to get a better insight in the societal context in adoption and feasibility of SI practices our research focuses on the identification and characterisation of stakeholder roles and mutual relationships within regional stakeholder networks by actively involving them into the research design via co-creation, and finally aiming at developing practical sound solutions (impact) to streamline transitions towards SI.

The study was conducted within the European project VITAL (Viable InTensification of Agricultural production through sustainable Landscape transition (2016-2019)) which aims to analyse European agricultural systems dynamics towards SI. Two different European regions served as case study regions for the analysis. The Rhinluch region, located in the North-eastern part of Germany close to the capital Berlin and the Utiel-Requena region, located in the west of the province of Valencia in Spain. Both case study regions are characterised by different settings/conditions concerning climate, geography, landscape, regional history, market functioning, regulation settings, crop variety and other social and economic variables.

The case study region of Rhinluch is a drained peatland that had been historically under strong intervention into the hydrological regime to optimise agricultural production. As a result, the area is characterised by having a record of very intensive livestock production and the cultivation practice today ranges from intensive arable farming, including maize for bioenergy and asparagus, to extensive pasture. Efforts to increase water tables in order to protect biodiversity and reduce greenhouse gas emissions partly exist. Some farmers have established short food supply chains to Berlin. The area is also the largest migratory crane resting place in Europe and therefore of ecological importance beyond the region itself. However, greenhouse gas emissions due to the drainage required for grassland use and a high proportion of intensive arable farming account for a negative image of the land use system in the region.

Utiel-Requena in Spain is dominated by vineyards, sometimes combined with almond trees and cereal crop. The history of grape cultivation and winemaking in the area of Utiel-Requena goes back to ancestral times. Currently, Utiel-Requena is the major production area of the Valencian Community and the wine industry is the economic engine of the region. The wine production industry is based around a Protected Designation of Origin (PDO) created in 1932, to which most of the wineries belong. The wine system in Utiel-Requena is very heterogeneous, including different size of cooperatives and wineries with very different technological and productive practices. In the last two decades, vineyards in Utiel-Requena have undergone important processes of productive intensification. Two main transformations

took placed in the area. Firstly, new irrigation systems were constructed. Secondly, changes of varieties were introduced, and harvesting was further mechanized. This caused a number of impacts on landscape-level, including groundwater exploitation, alteration of green infrastructure and crop visual patterns.

Objectives

The objective of this study is to identify and assess if and how different ways of interaction among main stakeholders may have a different potential to promote the transition towards SI systems, including agroecology and new farming arrangements, within the case study regions. To obtain these results, we firstly analysed and characterized stakeholder roles and mutual relationships within the stakeholder networks of the two case study regions, the Rhinluch region in Germany and the Utiel-Requena region in Spain. Secondly, we identified pathways and measures in both regions that could promote transitions towards SI practices. And finally, we cross-compared the results in both case studies regarding their ability to foster the uptake of regional SI strategies to a European scale.

Methodology

The methodology used consists of a social network analysis (SNA) and a participatory co-creation process with local stakeholders through regional stakeholder workshops. SNA and co-creation are established approaches to analyse how stakeholders interact among themselves. While the SNA aims to identify stakeholder roles and mutual relationships within the stakeholder networks, the participatory stakeholder workshops aim to identify and discuss collaboratively relevant pathways and strategies that could promote SI practices. The cross-comparison of results across the case study regions helps to determine common patterns within the networks and the potential to foster the upscaling of results.

Social network analysis (SNA)

Social network analysis (SNA) is the process of mapping and measuring relationships between stakeholders through the use of networks and graph theory. SNA provides both a visual and a mathematical analysis of relationships (Wassermann et al., 1994). In this study we used this methodology for studying communication and socio-technical networks within the implementation of Intensification (SI) practices in the case study regions.

To understand the transition process of SI implementation and future potential, we have evaluated the influence of actors and stakeholders in regional networks among themselves. These measures give us insight into the various roles and groupings in a network, such us: who are the connectors, mavens, leaders, bridges, isolates, who is in the core of the network, and who is on the periphery?

So far we conducted the first step of the SNA which is a stakeholder analysis leading to the development of two regional stakeholder maps (Tudela Marco et al., 2017; http://vital.environmentalgeography.nl/wp-content/uploads/2016/05/D2.1.pdf) The stakeholder maps were developed and visualized as preliminary results of the study using Creately's online diagramming tool. The stakeholder maps show identified stakeholders that are relevant for the promotion of SI in the case study regions, categorized by groups as well as by type of existing relationships between stakeholder groups (see figure 2 and 3).

To determine relevant stakeholder groups a structured desktop research in each case study region was conducted. Stakeholder categories were defined as a result. Individuals from initial stakeholder categories were identified and interviewed by snowball sampling method (Bishop et al., 1975). This means the successive respondent in each stakeholder category was identified during the interviews. We have been aware of the fact that the sample may be biased by the social network of the first individual in the snowball sample. However, in order to avoid this and to ensure a common methodological approach in both case studies, a

protocol was prepared to select the first list of informants in each region and to structure the main information to be obtained in the initial interviews.

In a second step semi-structured in-depth interviews with farmers and other stakeholder groups in both case study regions were executed following the same overall guidelines to safeguard the possibility to compare the results between both case studies. In total, 18 preliminary stakeholder interviews were carried out in both regions in summer 2016 (9 interviews in the Rhinluch region and 9 interviews in Utiel-Requena). These semi-structured interviews gave us in-depth insights into the stakeholder composition and their mutual relationships. Moreover we got a broader understanding on how innovative transitions take place in the regional networks.

The next step of the SNA will be the measurement of influence of stakeholders in the social network to assess the influence level different stakeholders (nodes) can exert over others to promote productive SI practices. Therefore, relevant topics that are meaningful for the study region will be chosen and the influence among stakeholders will be measured by an expert group on the basis of the knowledge gained from the interviews and the workshops. The main question that will be raised is: How does stakeholder A influence the stakeholder B´s decision regarding the identified topic? The influence between Stakeholders will be measured on an ordinal scale (see Table 1). This information will then be used to create data matrices (one per topic) that indicate the relationships influence between stakeholders.

Table 1. Procedure of weighting of influence between stakeholders on an ordinal scale.

Code	Weight of influence
0	No influence
1	Low or medium influence
2	high influence or mandatory

Following this data analysis we will finally be able to quantify the degree of influence among stakeholders regarding different SI issues relevant to the case study regions. We hypothesize, that the knowledge about the stakeholder network, the relationships between them and the influence among them will allow us to evaluate the success of the stakeholder´s efforts to strengthen (or not) their collaborations in the implementation process of SI practices.

Participatory stakeholder workshops

To identify currently applied measures and potential future measures for SI in the case study regions, a participatory stakeholder workshop was carried out in each region, in which identified relevant regional stakeholders participated. A number of 20 regional stakeholders attended the German workshop and 38 participants attended the Spanish workshop. In order to enable a cross-comparative analysis for the two regional case studies, common guidelines were elaborated addressing the objectives and the method for conducting the workshops. This was necessary, because both case studies are dealing with different and region-specific topics that are relevant for the regional development, e.g. stakeholder constellation, land use, triggers and constraints for SI transitions and conflict potentials. To react on these regional specifics, the workshop guidelines consist of a common workshop setting and a region specific guideline. This was essential to ensure the comparability of the workshops in both case study regions.

The participatory stakeholder workshops were conceptualized as pre-structured, facilitated discussions attributing an equal stake to all participating stakeholders at the round table discussion. This enabled us to capture unfiltered viewpoints from all participants reducing the risk of bias by our research team which facilitated the workshops. To attract stakeholders to participate (stakeholder benefit) we chose for the workshops setting a mixture of input-presentations and roundtable discussions, whereas the roundtable discussions were the key

part to reach the anticipated goals by actively involving (co-creation) the stakeholders. The specific goals were to 1) verify the SI pathways identified in literature and preliminary interviews and adapt them to the regional background 2) to identify currently applied SI measures in the region, 3) and to identify and discuss potential future SI measures.

The method of roundtable discussions is an opportunity for participants to get together in an informal setting to examine issues without a formal agenda, but with specific topics and a clear focus. We conducted two discussion rounds during each case study workshop. In the first round, currently applied SI measures were identified and in the second round potential future SI measures were identified. In each round specific core questions were discussed and the answers were visualized on a framework template (Weltin et al., 2016; http://vital.environmentalgeography.nl/wp-content/uploads/2016/05/VITAL_D1.1.pdf). Figure 1 shows the four SI pathways identified from literature and preliminary in-depth stakeholder interviews. On farm level identified Si pathways fall in the field of agronomic development or resource use efficiency, whereas on regional level Si pathways fall in the field of land use allocation or regional integration. Table 2 shows the core questions that were raised in the three discussion rounds.

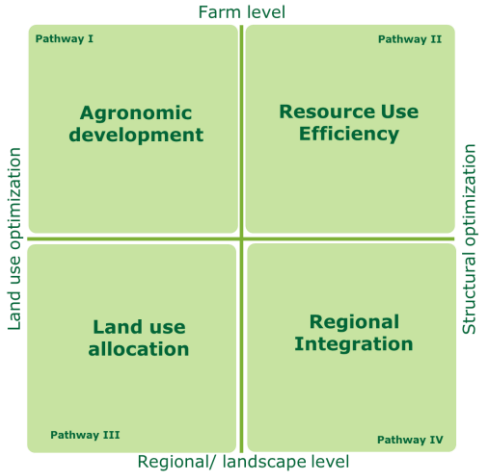

Figure 1. Framework template for conducting the method of roundtable discussion, showing four previously identified SI pathways: Agronomic development, resource use efficiency, land use allocation and regional integration (Weltin et al., 2016,).

Table 2. Overview of core questions that were raised in the two discussion rounds.

1. Discussion Round: Currently applied SI measures	2. Discussion Round: Potential future SI measures
In your opinion, what are the appropriate land use adaptions in your region?	In your opinion, what are the appropriate land use adaptions in your region for the future?
What kind of SI strategies are already implemented and applied in your region?	To which of the 4 SI pathways would you associate these potential development strategies?
Do you apply strategies that are not yet identified in our approach but can still be regarded as SI strategies?	How would you name these potential development strategies?
How do you assess the allocation of development strategies to the 4 SI pathways?	What are the requirements for future application and implementation of SI strategies in agriculture?
Do you agree with the wording of the SI pathways and development strategies, or would you call them different?	

The workshops were completed by an anonymous questionnaire containing questions about the regional stakeholder composition and existing stakeholder networks. The questionnaire helped us to validate preliminary results of the stakeholder maps.

The results are visualised in two tables (Table 3 and 4) showing the currently applied and the suggested future SI measures identified by the workshop participants. The frequency of SI measures that were mentioned by the stakeholders was counted.

Results

The results obtained from the stakeholder analysis as part of the SNA are shown in a stakeholder map per case study region (Figure 2 and 3). They provide a detailed analysis of all relevant stakeholders in the two regions that could influence the transition towards SI. Each one of the stakeholder maps displayed below includes the key actors and the relationships between them, also distinguishing different types of actors and relationships.

In the second step regional SI pathways were identified and validated. Moreover the stakeholders also rated future SI measurements against currently applied Si measures. These ratings allow for assessing SI pathways that have the greatest potential for uptake not only on a regional but on a pan-European scale. The detailed results are shown in the following two tables (Rhinluch, Germany: Table 3 and Utiel-Requena, Spain: Table 4).

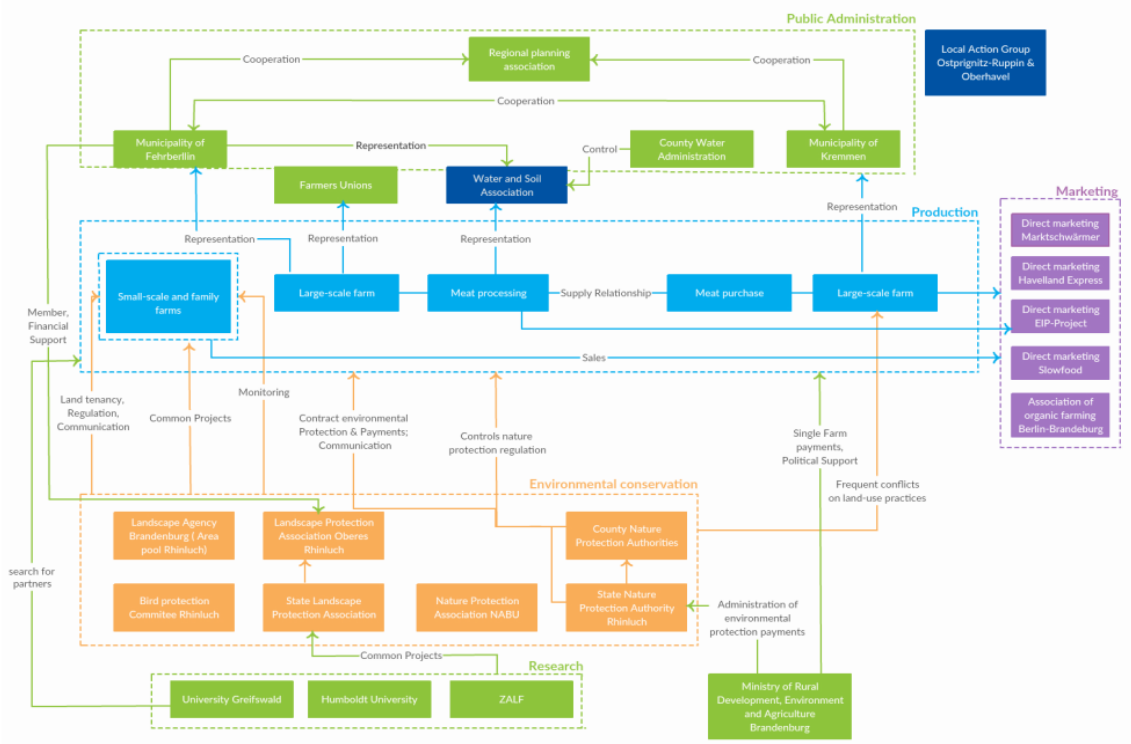

Figure 2. Stakeholder map of the Rhinluch region in Germany based on the results of the preliminary in-depth interviews and participatory stakeholder workshops (Tudela Marco et al., 2017).

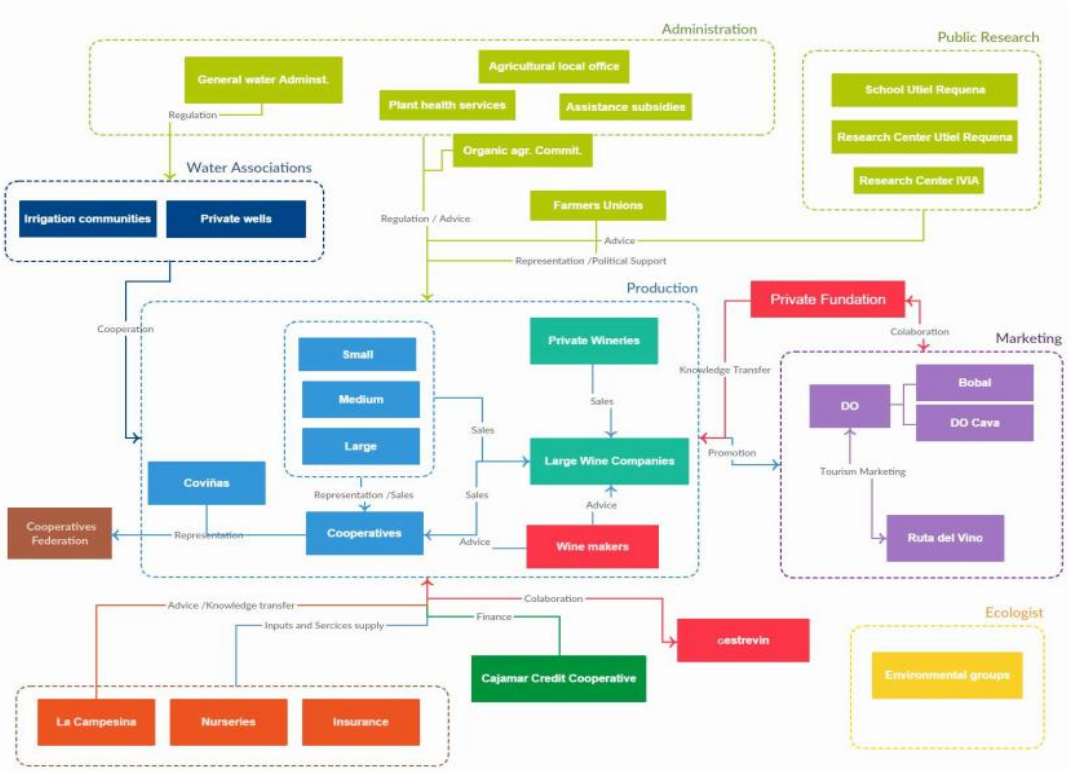

Figure 3. Stakeholder map of the Utiel-Requena region in Spain based on the results of the preliminary in-depth interviews and participatory stakeholder workshops (Tudela Marco et al., 2017).

Table 3. Template of four identified SI pathways with aligned SI measures mentioned by regional stakeholders in the Rhinluch region in Germany.

	Currently applied measures N[1]	Suggested future measures N[1]
SI pathway 1: Agronomic development		
Spatial solutions	3	1
Adapted soil cover & animal husbandry/ density	10	4
Good agricultural practice	1	0
Data-based farming and side-adapted technology	0	3
In total	**14**	**8**
SI pathway 2: Resource use efficiency		
Adaptive income planning (product innovation, niche products, diverse income structure, direct marketing)	5	1
Reduction of pesticides	1	0
Fertilizer use efficiency	0	1
Process monitoring and evaluation (long-term)	0	1
Crop residue and manure use for bioenergy	0	1
In total	**6**	**4**
SI pathway 3: Land use allocation		
Infrastructure development	4	2
Spatial targeting (Conservation contracts, temporal increase of protection zones, declared nature protection, conservation and landscape planning concepts)	4	3
Land use planning	6	4
Long-term planning	0	1
In total	**14**	**10**
SI pathway 4: Regional integration		
Landscape administration (water administration)	6	6
Regional value creation (tourism, direct marketing, food lables)	4	4

		Currently applied measures N[1]	Suggested future measures N[1]
Regional cooperation and excange		4	7
Research & Innovation (e.g. new cultivation methods)		0	1
	In total	**14**	**22**

[1] Frequency of measures mentioned.

Table 4. Template of four identified SI pathways with aligned SI measures mentioned by regional stakeholders in in the Utiel-Requena region in Spain.

		Currently applied measures N[1]	Suggested future measures N[1]
SI pathway 1: Agronomic development			
Organic farming		1	0
Integrated farming		1	0
Good agricultural practice		1	0
Tillage adapted to the concrete necessities of each plot		0	1
	In total	**3**	**1**
SI pathway 2: Resource use efficiency			
Irrigation (drip irrigation)		1	0
Irrigation (underground drip irrigation)		0	1
General improvement in resource use		2	1
Organic farming		1	1
Energy efficiency		1	1
Data-based farming and side-adapted technology		0	1
	In total	**4**	**4**
SI pathway 3: Land use allocation			
Public aids (for organic or integrated farming)		2	0
Payments for environmental services (landscape, etc.)		0	1
Land sharing		3	0
Crop diversification		0	1
	In total	**14**	**10**
SI pathway 4: Regional integration			
Fertirrigation (organised by irrigation districts)		1	1
Biological control		1	1
Definition and regulation of grape quality standards by the DO		1	0
Knowledge transfer		0	6
Integrated Water Resources Management plan.		0	1
Food system improvements		0	1
Building social capital		0	1
Raising farmers' awareness on sustainability		0	1
Research & Innovation		0	5
Professionalization of technical staff		0	1
	In total	**3**	**18**

[1] Frequency of measures mentioned.

Discussion and conclusion

This study presents a first identification and characterization of the stakeholder composition and relationships among stakeholders within two European case study regions as well as the identification of SI pathways and measures which are currently applied in the regions and which are suggested to become more important in the future. In spite of the differences existing among these case studies regarding market functioning, regulation settings and other social and economic variables, several commonalities regarding stakeholders' roles and their contribution to streamline transition towards SI in practice can be highlighted from the analysis conducted so far.

Stakeholders have been classified into several stakeholder categories or spheres of action of which 5 categories were found to be similar in both case study regions. These common stakeholder categories are (public) administration, (public) research, production and marketing. Other stakeholder groups were considered to be associated. These groups tackle the field of environmental protection and include environmental protection agencies and water associations. Farmers were also split into different groups, according to the farm size (small to large farms). Besides, 9 different types of relationships/interaction between stakeholders could be distinguished. Interactions among stakeholder that were identified to be similar in both case study regions include regulation interdependencies in terms of legal frameworks or regulations, control mechanisms were identified between authorities on higher and lower levels, as well as control of e.g. environmental standards through nature protection authorities. Sales and/or supply relationships mainly occur within and/or between the stakeholder categories production and marketing. Farmers are often represented through regional associations (e.g. farmers unions or farmers' cooperatives). Interdependencies which rely on advice and/or support often exist between research, administration other associations and farmers. Financial support was either identified between credit cooperatives and farmers or administration and research or other associations. Collaboration and cooperation patterns exist on location-specific management adaptation between few farmers, NGO`s, private foundations and nature protection. The analysis indicates that collaborations and cooperations are organized diversely. Organisational structures of transdisciplinary collaborations are for instance working groups on specific topics, project based corporations or informal networks. Conflicts mainly occur between farmers and environmental conservation on management and/or water associations.

The analysis of the stakeholder maps allows a common interpretation for both case studies, indicating that public agencies play a key role in promoting SI practices, by different ways of intervention (incentives, mandatory rules, support to knowledge transfer etc.). Farmers' organizations also seem to have an important function in the stakeholder networks as they are closely related with producers. However, the assessment suggests that they are not always able to play an effective role in the decision-making process regarding SI transitions. Furthermore in both case study regions the formal structures of knowledge exchange and transfer seem to be insufficiently developed. Most of the knowledge transfer takes place on a random and informal basis. There are great differences among large and small farms, and the mutual relationships between them appear to be limited and also communication between farmers and environmental agents seems to be complex and difficult. The results show that SI innovations are rather implemented at farm than at regional level. The coordination and cooperation with actors and stakeholders at the regional level therefore is also seen as insufficient. The initial stakeholder mapping shows ,that even the SNA is not fully completed as of yet, significant gaps and shortfalls in stakeholder network development which hinder a continuous knowledge exchange and transfer amongst all relevant regional stakeholder.

Furthermore, the study gives a first overview of currently applied SI measures in both regions as well as suggested future SI measures for the regions. From the assessment preliminary development patterns concerning SI transitions could be identified that are similar in both regions. Currently, SI innovations seem to be implemented at the farm level rather than the regional level. The coordination and cooperation with actors and stakeholders at the regional level is insufficient. Both case studies coincide in that most of the actions desirable for SI are still to be implemented, and fall into the field of "Regional integration". Looking at the suggested future developments' at farm level, in both case studies the SI pathways agronomic development and resource use efficiency no further developments are estimated by workshop participants. The SI pathway regional integration instead is estimated to increase significantly. This indicates that a stakeholder's view of future SI transitions shifts from technical innovations to collective innovations which are more linked to collaborative actions on regional level rather than individual actions on farm level.

At this stage of the study we were able to identify similarities and common pattern concerning transitions towards SI practices in both case study regions. However understanding the identified gaps within the social relationships of regional stakeholder

networks is essential to develop an adoption strategy for the policy level to foster the transition towards SI on a regional and pan-European scale.

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