



Research, part of a Special Feature on [Networking the Environment: Social Network Analysis in Environmental Management and Local Ecological Knowledge Studies](#)

Using social network analysis to identify key stakeholders in agricultural biodiversity governance and related land-use decisions at regional and local level

Jennifer Hauck^{1,2}, Jenny Schmidt¹ and Anja Werner^{3,4}

ABSTRACT. In 2013 the European Commission launched its new green infrastructure strategy to make another attempt to stop and possibly reverse the loss of biodiversity until 2020, by connecting habitats in the wider landscape. This means that conservation would go beyond current practices to include landscapes that are dominated by conventional agriculture, where biodiversity conservation plays a minor role at best. The green infrastructure strategy aims at bottom-up rather than top-down implementation, and suggests including local and regional stakeholders. Therefore, it is important to know which stakeholders influence land-use decisions concerning green infrastructure at the local and regional level. The research presented in this paper served to select stakeholders in preparation for a participatory scenario development process to analyze consequences of different implementation options of the European green infrastructure strategy. We used a mix of qualitative and quantitative social network analysis (SNA) methods to combine actors' attributes, especially concerning their perceived influence, with structural and relational measures. Further, our analysis provides information on institutional backgrounds and governance settings for green infrastructure and agricultural policy. The investigation started with key informant interviews at the regional level in administrative units responsible for relevant policies and procedures such as regional planners, representatives of federal ministries, and continued at the local level with farmers and other members of the community. The analysis revealed the importance of information flows and regulations but also of social pressure, considerably influencing biodiversity governance with respect to green infrastructure and biodiversity.

Key Words: *actor analysis; common agricultural policy; coproduction of knowledge; green infrastructure; Net-Map; stakeholder analysis*

INTRODUCTION

In Europe, where agrarian landscapes are perceived to be cultural entities from which society expects multiple benefits, conflicts between intensive agricultural production and environmental conservation are well known (Young et al. 2005). When users of the same resource have divergent values and conflicting interests it becomes necessary to understand the different perspectives of the actors involved to enable successful governance (Cash et al. 2006, Reed et al. 2009, Primmer et al. 2014). Therefore, policy makers have started to promote participation and the involvement of stakeholders into decision making and policy implementation (Reed 2008, Prager and Nagel 2008). Participation has shown to benefit the legitimacy of recommendations more generally but also the social outcomes of management (Bryson 2004, Young et al. 2013). Recent examples are participatory approaches recommended for the green infrastructure (GI) strategy, launched by the European Commission (EC) in 2013 to foster biodiversity conservation among other goals (EC 2013a, Kettunen et al. 2014). The strategy suggests GI implementation concerning landscapes that are dominated by conventional agriculture, where biodiversity conservation currently plays a minor role at best and emphasizes the need to involve local stakeholders to avoid conflicts and ensure prompt application (EC 2013a). Further, it is suggested to integrate the strategy in existing policies; in the case of agricultural landscapes the EC points to the Common Agricultural Policy (CAP). This integration poses the challenge that while the GI strategy is meant to be implemented bottom up, the CAP implementation usually follows a top-down approach (Repohl et al. 2015)

For a bottom-up approach, however, identifying key actors and stakeholders has been found crucial (Welp et al. 2006, Prager and Nagel 2008, Reed et al. 2009, Kok and Veldkamp 2011, Young et al. 2013) and actor analysis, also often called stakeholder analysis (Reed et al. 2009, Prell et al. 2011), has proven to be useful in governance contexts (Hermans 2008, Reed et al. 2009, Young et al. 2013). Although single actors are certainly important, it is essential to look at the governance network with its institutionalized relations, which develop because of shared interests in solving a problem (Newig et al. 2010). Prell et al. (2008, 2009, 2011) demonstrate how knowledge gained from analyzing their social networks can be harnessed for selecting stakeholders. Similar to Reed et al. (2009), or Gamper et al. (2012), Prell et al. (2011) suggest using a combination of methods e.g. to combine results from classical social network analysis (SNA) with a qualitative analysis of stakeholder knowledge to improve understanding of the relations (see also Beilin et al. 2013, Lienert et al. 2013, Stein et al. 2014, Bellotti 2015, Borg et al. 2015, Hauck et al. 2015).

The research conducted for this paper served to identify and select stakeholders relevant in the context of agricultural biodiversity governance and related land-use decisions at regional and local level in preparation for a participatory scenario development process to analyze consequences of different implementation options of the green infrastructure strategy (EC 2013b). The aim of this paper is to present the results of the identification and analysis of (a) actors at regional and local levels, (b) actors from other affected policy sectors, and (c) the vertical and horizontal interplay between actors at different levels and from different policy sectors.

¹Helmholtz-Centre for Environmental Research - UFZ, ²CoKnow Consulting - Coproducing Knowledge for Sustainability, ³Ökolöwe - Umweltbund Leipzig e.V., ⁴Grüne Liga Sachsen e.V.

METHODS

General description of data collection and analysis

Based on the suggestion by Hauck et al. (2015) to use participatory network analysis to coproduce network knowledge together with stakeholders, the data collection was done using the Net-Map tool. Net-Map involves collecting network data and at the same time participants provide descriptions of network relationships. These “network narratives” provide insights into the intersubjective meanings that actors attribute to relationships (Fuhse and Mützel 2011). The different data sets allow for triangulation between network structures and narratives (Gamper et al. 2012). There are many descriptions of data collection processes using the Net-Map tool (e.g., Hauck 2010, Schiffer and Hauck 2010, Aberman et al. 2012, Bell et al. 2013, Campbell et al. 2014, Stein et al. 2014, Hauck et al. 2015), therefore, we only briefly describe it here.

Before the Net-Map interviews, the research question is developed. In the beginning of the interview it is explained, e.g., “Who influences XY policy development?” Then the interviewee (s) are asked to name the actors they see as influencing the issue and write them down on actor cards, e.g., Post-its®. The cards are then fixed to a large sheet of paper. In the second step of the interviews, links between actors, e.g. information flow, are recorded by drawing arrows between the actor cards. During the whole interview process, it is of utmost importance to record the narratives that are provided by the interviewees, e.g., why the networks are important or concrete examples for links between actors. To capture the perceived influence of the described actors, in the end, interviewees are asked to assess the influence of each actor on the Net-Map with reference to the issue at hand, and influence towers, made of flat round discs, are stacked proportionately beside the actor cards. This relational influence rating allows for a later comparison between the single interviews.

Some of the steps in the Net-Map interview, such as the eliciting of actors and the assessment of their relationships are similar to other SNA techniques (see, for example, Scott 2000, Prell 2012). Other steps, like the building of influence towers and the visualization, are complementary (for a detailed analysis of the benefits and limitations of Net-Map please see Hauck et al. 2015).

The analysis of the diverse data requires mixed methods. We used an approach suggested by Herz et al. (2015), who propose a combination of structural and content analysis, by posing questions to the network visualizations and narratives. The questions serve to structure and guide the analysis and are not meant to complement the research questions: “Which actors connect actors that would have otherwise been unconnected?”; “Which influence do the actors hold?”; “Which other characteristics do the actors have?”; “What kinds of relations do prevail?” We combined the approach from Herz et al. (2015) with an approach proposed by Prell et al. (2009), who suggest using the measure of centrality of actors. More details of the analysis are introduced in the case study context below.

The mixed methods approach in the case study context

The research presented in this paper served to select stakeholders in preparation for a spatially explicit scenario development process to explore policy implementation options. For the case study we selected a federal state in Germany, and four spatially explicit research sites in agricultural landscapes, each 400 ha large,

with different amounts of existing GI structures and where complementary ecological research took place. The geography of the research sites roughly defined the network boundaries (cf. Newig et al. 2010).

Data collection at the regional level

We ran three pretest interviews with researchers working with stakeholders in the region using the question: “Who influences biodiversity in the agricultural landscapes in this federal state?” Based on scientific literature, we selected two links beforehand: information flows and regulatory flows. We did not define the links in further detail because we aimed at extracting their meaning from the qualitative data, i.e., the examples for links between actors that are given by the interviewees. A third link, the flows of social pressure, was suggested by one of the pretesters and was included in the interview design. After the links were established we asked the interview partners to rank the influence of the actors and closed the interview by asking whether he/she had any thoughts that he/she wanted to share with us.

We identified our first interviewees with the help of researchers who had worked on biodiversity issues in the area and then followed a snowball-sampling approach. Apart from direct recommendations, we also used the Net-Maps to identify interview partners, i.e., including persons from actor groups that were mentioned repeatedly. In total we conducted 11 interviews at the regional level and 8 interviews at the local level, which took between 1-2 hours. (More information on the interview partners can be found in Appendix 1.)

Data collection at the local level

Preliminary results at the regional level indicated that the biggest influence on biodiversity was perceived to be exerted by farmers via land-use and management decisions. Therefore, at the local level we asked directly, who is influencing farmers’ land-use and management decisions. Another reason for the change of questions was based on unpublished interviews, which revealed that (a) farmers do not necessarily know the term biodiversity or interpret the wording as related to organic farming or (b) they perceive the term as rather negative. We tested the modified question and the three links from the regional level, which worked well and therefore included the pretest interview in our analysis. We also kept the third step of the interview and asked for the influence of the actors concerning farmers’ land-use and management decisions. During the interview, we did ask probing questions that were aimed at farmers’ land-use decisions relevant for biodiversity and green infrastructure but formulated these rather neutral, so as not to steer the conversation into the one or the other direction (pro or contra biodiversity protection).

Data analysis

We transcribed the interviews and listed all actors mentioned on both levels. We then calculated the normalized, average influence, from the number of discs each mentioned actor received during the interview (for more details see Hauck 2010, Schiffer and Hauck 2010), for each level separately and counted how often the respective actors were mentioned. The next step was to digitize the network data. The drawn Net-Maps were translated into a data matrix, i.e., all actors were horizontally and vertically entered into a data sheet and linked with absence/presence for the respective link. In order to have a value with which to compare the average influence, we calculated the degree and betweenness centrality of each actor from all networks but again separated by

Table 1. The table presents the results of the interviews at the regional level concerning the average influence of the actors, the number of times the actors were mentioned, standardized betweenness centrality, and standardized degree centrality.

Actor	Actor abbreviation	Influence	Times mentioned	Betweenness standardized	Degree standardized
Banks	Banks	0	1	0	0.2
Biogas producers	Biogas	0.33	4	0	0.2
Broker	Broker	0.06	1	0	0.8
Communities	Communities	0.25	7	0	1.5
Conservation area administration	ConArea	0.07	3	0	0.8
Consultants	Consultant	0.13	4	0	1.4
Consumer	Consumer	0.07	3	0	0.5
Land cooperation	Coop	0.04	2	0	0.9
County	County	0.08	3	0	1.3
Environmental NGOs	EnvNGO	0.2	10	0	1.5
Farmers' associations	FA	0.26	9	0.1	1.9
Federal state agency for agriculture and forests	FAAF	0.45	11	0	1.6
Farmer	Farmer	0.96	11	0.1	1.9
Federal state ministry of agriculture and environment	FMAE	0.55	8	0	1.7
Federal ministry of state development and infrastructure	FMDI	0.1	3	0	0.8
Federal state nature conservation authority	FNCA	0.23	9	0	1.5
Federal state department of environmental conservation	FSDEC	0.21	7	0	1.5
Federal state office for agriculture, forestry, and horticulture	FSOAFH	0.19	7	0	1.5
Hunters	Hunter	0.12	5	0	1.4
Technical journal	Journal	0.08	3	0	1
Landscape management associations	LMA	0.32	8	0	1.5
General media	Media	0.05	3	0	1
Land owner	Owner	0.14	7	0	1.4
Public	Public	0.06	5	0	1.1
Regional nature conservation authority	RNCA	0.27	9	0	1.5
Science	Science	0.12	6	0	1
Special purpose association (e. g., Water and Soil Associations)	SPA	0.11	3	0	1.3
Wholesaler	Trade	0.14	4	0	0

regional and local level using the SNA software Visone (Brandes and Wagner 2004). Degree centrality is the count of an actor's ingoing and outgoing links. Betweenness centrality is the measure of how often an actor is found on the shortest path between two other actors that are otherwise disconnected (Wasserman and Faust 1994, Calvet-Mir et al. 2015). In our analysis we focused on the following points: (a) actors who were mentioned particularly often, had a high influence, and a high centrality; (b) actors, for whom these values diverged; and (c) actors with weak values. This first quantitative analysis served as starting point to analyze the qualitative data (transcripts), by raising additional questions, guided by those formulated by Herz et al. (2015) mentioned above.

After the aggregated calculation we plotted the networks separated for the local and regional level (see Appendices 2 and 3) but also for the different networks (information, regulation, and social pressure). We looked for links that were mentioned

particularly often because these were perceived by a number of interview partners. We then screened through the transcript material to analyze which information were given for these links and whether we could find a consensus or divergence about the respective social relations.

RESULTS and DISCUSSION

We conducted 11 interviews at the regional and 8 at the local level, which took between 1-2 hours. (More information on the interview partners can be found in Appendix 1.)

Actors and their influence

In total, for both the local and the regional level, 72 different actors were mentioned, with 41 in local and 61 in regional interviews. Tables 1 and 2 show the actors with their average influence, who were mentioned two times or more and the betweenness and degree centrality.

Table 2. The table presents the results of the interviews at the local level concerning, the average influence of the actors, the number of times the actors were mentioned, standardized betweenness centrality, and standardized degree centrality.

Actor	Actor abbreviation	Influence	Times mentioned	Betweenness standardized	Degree standardized
Banks	Banks	0.06	2	0	0.15
Biogas producers	Biogas	0.1	2	0	0.15
Broker	Broker	0.23	2	0	0.19
Communities	Communities	0.15	5	0.1	1
Conservation area administration	ConArea	0	0	0	0
Consultants	Consultant	0.09	4	0	0.7
Consumer	Consumer	0.05	1	0	0.1
Land cooperation	Coop	0.18	3	0	0.9
County	County	0.03	1	0	0.2
Environmental NGOs	EnvNGO	0	0	0	0
Farmers' associations	FA	0	3	0.1	0.9
Federal state agency for agriculture and forests	FAAF	0.5	8	0.1	1.12
Farmer	Farmer	0.83	8	0.3	1.6
Federal state ministry of agriculture and environment	FMAE	0.15	3	0	0.4
Federal ministry of state development and infrastructure	FMDI	0	0	0	0
Federal state nature conservation authority	FNCA	0.14	3	0	0.7
Federal state department of environmental conservation	FSDEC	0.07	1	0	0.4
Federal state office for agriculture, forestry, and horticulture	FSOAFH	0.1	2	0	0.4
Hunters	Hunter	0.13	4	0	0.9
Technical journal	Journal	0.32	5	0	0.6
Landscape management associations	LMA	0	0	0	0.7
General media	Media	0.26	2	0	0.10
Land owner	Owner	0.43	9	0	0.8
Public	Public	0.01	1	0	0.3
Regional nature conservation authority	RNCA	0.06	3	0	0.6
Science	Science	0	1	0	0.3
Special purpose association (e. g., Water and Soil Associations)	SPA	0	1	0	0.3
Wholesaler	Trade	0.2	4	0	0.4

“Which influence do the actors hold?,” “Which other characteristics do the actors have?,” and “Which actors connect actors that would have otherwise been unconnected?”

Some similarities appear between the local and the regional level: Farmers were mentioned in all interviews, were rated the most important actors, and have both the highest betweenness and degree centrality. The federal state agency for agriculture and forests (FAAF) was likewise mentioned in all interviews, and was rated the second most important actor, albeit receiving only half of the influence rating compared to farmers. Its betweenness and degree centrality was also high on both levels. The third most influential group of actors at the local level were the land owners, a group that consists of private land owners, churches, and the federal republic of Germany. They were mentioned in seven of the eight local interviews. Although they were also mentioned 7 times out of 11 at the regional level, their perceived influence was

rated rather low there. More than half of the interviewees at the local level stated technical journals to be important, which however did not receive much attention at the regional level. Rather often (about half of the interviews) trade (agricultural wholesaler) was mentioned, but its influence was rated relatively low. Although not perceived to be very important, communities received high betweenness and degree centrality values at the local level. They did not play any role at the regional level.

The analysis of the actors at the regional level revealed a large number of influential actors from administrative institutions. Particularly important in terms of biodiversity at the regional level appears to be the federal state ministry for agriculture and environment (FMAE). Although it was mentioned by only three interview partners at the local level and given little influence, it was deemed important by eight interviewees at the regional level with the second highest influence score and high betweenness and

degree centrality values (even higher than the FAAF). Almost as important at the regional level are the federal state nature conservation authority (FNCA) and the regional nature conservation authority (RNCA).

Widely differing perceptions in terms of influence and centralities can be found when looking at farmers' associations (FA) and to some extent the landscape management associations (LMA). They were mentioned by most regional interview partners and were also given greater influence. Both actors belong to a group called representatives of public interests (German: *Träger öffentlicher Belange*) and their influence is derived from the possibility to submit their statements, e.g., when a regional plan is updated or when regional implementation of the CAP is designed. The FA was mentioned by three local interview partners only and was perceived as not being influential at all while the LMA was not even named.

Links drawn between actors

“What kinds of relations do prevail?”

Similar to the actor characteristics, the networks were analyzed separately for the local and the regional level. All interview partners at both levels drew the information and regulation networks. At both levels some interview partners were uncomfortable drawing links for social pressure, so only four networks for each level were drawn. At the local level, only the social pressure between owners and farmers and social pressure within the group of farmers were mentioned in more than one interview. At the regional level some links of social pressure were drawn in three or four interviews, namely the ones between FA and farmers, between farmers and community, environmental NGOs and FA, environmental NGOs and FMAE (each three times), the public and farmers, owners and farmers, and environmental NGOs and farmers (each four times). Network visualizations for all links together can be found in Appendix 2 and 3.

Information flow and regulations were mentioned most as links between actors. An analysis of the qualitative data revealed that although regulations are mainly institutionalized relations like the payment of money or duties that need to be fulfilled to receive that money, some land owners hold certain values and concepts attached to land use and therefore force or push farmers toward certain practices. Information flows include mandatory exchanges, for example, between farmers and FAAF, but also cover farmers talking to other farmers about practices.

As stated in the methods section, we used the quantitative parts of the analysis to raise questions for the analysis of the qualitative material. Some of the differences in the answers between the local and regional level can of course be attributed to the alteration of the question for the local interviews. However, most of the regional interview partners also explained that the main actors influencing biodiversity are farmers because they make the final land-use and management decisions, and much can be understood when looking at who is influencing these decisions. Therefore, we attributed difference of perceived influence not simply to the different questions but tried to find explanations in the network flows and qualitative data. Based on the description of the actors' influence and the quantitative analysis of the network data, we formulated questions guiding our qualitative data analysis.

Networks of information flows, regulation, and social pressure

“Why do farmers and the federal state agency for agriculture and forests (FAAF) have such high perceived influence as well as high centrality?”

The high importance of farmers can be attributed to the fact that farmers make the final land-use and management decisions that in any way affect biodiversity. Their high centrality shows that farmers are connected to many other actors. When looking at the qualitative information concerning these connections it becomes apparent that many different actors influence or try to influence farmers' decisions on biodiversity directly but also indirectly through general land-use or management decisions. Most respondents stated that the decisions are mostly influenced by the direct payments of the CAP. The payments are related to certain conditions that have to be fulfilled and farmers receive information on these from the FAAF, explaining its strong appearance in the local information network. More importantly the FAAF is responsible for paying out the money of the CAP, controlling cross-compliance adherence, and executing environmental programs. Although certainly less important concerning influence and centrality, there is a second administrative actor in the regulatory context that is influencing farmers' decisions: the RNCA, which is responsible for controlling implementation of environmental measures and reporting violations, e.g., in the context of cross-compliance or agri-environmental measures, which can lead to a reduction of CAP-payments.

Although local interviewees depicted only the FAAF as an important source of information among administrative agencies, regional interview partners linked other agencies, such as the federal state office for agriculture, forestry, and horticulture (FSOAFH), RNCA, or FNCA with farmers. However, even though information was exchanged with (some) farmers, certain important information about opportunities concerning agri-environmental schemes had not reached the farmers we interviewed. This might be an explanation why these actors do not appear to be important at the local level. Another explanation might be that other bodies than the FAAF are not perceived as actors because they communicate with farmers through the FAAF.

Within the group of farmers social pressure takes place. As an example, interview partners reported that farmers usually closely observe the practices of each other and “tease” each other, for example when one is late with a particular task or when fields are getting “untidy.” This fits quite well with an observation made by Wood et al. (2014), that farmers' information sources are mainly other farmers, and before they try something new they want to know if fellow farmers are partaking and what their experiences are. Sutherland et al. (2012) also found that social relations among farmers plays a crucial role in adopting new farming methods and it has also been shown for the uptake of agri-environmental measures (see Lastra-Bravo et al. 2015 for examples). Two farmers explicitly emphasized that emotional conceptions and their own awareness of environmental contexts plays a major role in their land-use decisions. Contrary to findings from other authors (e.g., Lastra-Bravo et al. 2015) one farmer found his connection with the land important and perceived differences between farmers who were born in the area and those who had moved there later

in their lives. This last point was supported by the interviewed agricultural consultant who stated that farmers planning to hand the farm over to an heir, would farm their land more sustainably.

“Where does the difference in influence perception and centralities between the local and regional level concerning the federal state ministry of agriculture and environment (FMAE) but also other administrative agencies come from?”

The FMAE is responsible for the final decision making concerning the detailed design of the measures in the context of the CAP but also for other programs, e.g., with regard to biodiversity conservation. It also, through its subordinate agencies like the FSOAFH, influences biodiversity-relevant aspects of farming like giving advice for which and how much pesticides to use. High centrality values at the regional level can be explained in this context, namely that the FMAE receives additional information and recommendations for program design from many different actors and also provides information about the programs to them. Most local interview partners were unfamiliar with these structures and hence did not consider them. Further, although the FMAE makes the decisions, the implementation (via information and regulations) and thus the experienced impact on farmers is ascribed to the FAAF, which is therefore most important for farmers.

A number of interview partners from the local level also mentioned that information from farmers concerning requirements, for example, on practicality of measures was submitted to the FMAE via the FAAF. However, farmers felt that their concerns were not taken into consideration by the FMAE. Although there could be valid reasons, e.g., that farmers' requirements would be counterproductive for biodiversity protection, decisions seem not always to be transparent or inclusive, which may be counterproductive for the adoption of measures (Prager and Nagel 2008, Ingold 2014).

“What makes land owners and technical journals influential actors for decision making at the local level?”

Similar to findings by Steen-Adams et al. (2015), our qualitative data revealed that when farmers pay rent to the land owners, they are bound to use the land in exactly the way defined in lease agreements. Changes in land use that would lead to a reclassification of the land, e.g., planting a hedge or converting arable into grass land, are not possible. Although what can and cannot be done with the land is fixed, crop management, e.g., how often pesticides are used or how much fertilizer is applied, is usually not part of lease agreements. However, farmers and other interviewees reported that land owners prefer to have their land kept in a “tidy” state, implying for example strict weed control. Because of high competition for land based on increasing bioenergy production and financial investments, owners have a strong position because farmers are interested in renewing their lease agreements, which usually only run for 10 years. Therefore, farmers try to maintain good relations with land owners, who in turn can use this to influence farmers' decisions.

A source of information often ignored at the regional level, relevant particularly among the interviewed farmers, were technical journals such as *top agrar* or *Bauernzeitung*. These provide information about prices of crops and supplies or weather forecasts and product reviews, important when it comes to decision making about harvesting or sowing dates or the

application for certain fertilizers or pesticides but also which agri-environmental measures are worthwhile or how to efficiently fulfill CAP requirements.

“Why do interview partners at the local level, and here farmers in particular, not attribute any influence to farmers' associations (FA), despite comparably high centralities and importance attributed at the regional level?”

An interesting link at the regional level is the link between farmers and farmers' associations. Farmers pay a membership fee and expect the FA to represent their interests. This kind of relationship seems, however, not to influence farmers' decisions and one farmer reported that he sees the association more as an ambassador of the farmers toward society. Another interviewee explained that particularly at the EU level, he does not feel well represented because he has the feeling that the umbrella organization of FAs is trying to influence decision making in favor of large scale farming and traders.

“Which roles do communities play in land-use decision making?”

In the area, the community basically equals the inhabitants of the villages within which the farmers and other land users, like members of the LMA, live. These inhabitants use the landscape for recreational uses, some are land owners that lend their property out to farmers, and many are interested in a well-maintained grey infrastructure and a tidy and orderly appearance of the landscape particularly close to their homes. Farmers have certain ordinances, such as not to work late at night to avoid noise disturbance. Further, for example, they can be held responsible when they damage dirt roads with their heavy vehicles or when they plough too close to field margins or water bodies. However, sometimes violations become necessary, e.g., when in summertime, harvesting is determined by good weather and working late hours cannot be avoided. Usually, communities overlook these violations because they also depend on farmers, who often help with winter services or the maintenance of hedges. So even if there are concerns or even complaints voiced by members of the community, farmers are frequently spared.

“Why are LMA considered influential at the regional but not at the local level?”

The differences in the perceived influence between local and regional level concerning the LMAs can probably be attributed to the different questions, as well as to the fact that the farmers we interviewed were not involved and hence their decisions were not influenced by the LMA. However, the FA, interviewed for the regional level, told us that the LMA does inform farmers about breeding birds so they can spare the respective parts of the fields. The LMA also implements a number of other measures toward biodiversity conservation themselves.

CONCLUSION

The research conducted for this paper served to select stakeholders in preparation for a scenario development process to analyze consequences of implementation options of the European green infrastructure strategy (EC 2013b) with a focus on agricultural landscapes. We chose a mixed methods approach combining the analysis of quantitative and qualitative social network data, to not only identify key stakeholders but to also reveal their relationships concerning information, regulation, and social pressure.

Unsurprisingly, actors related to the implementation of the CAP at the regional and local level turned out to be important. Because farmers are the ultimate land-use decision makers, e.g., in choosing from a variety of types of ecological focus areas within the greening measure of the CAP (for example, between cash crops and field elements like hedge rows or flower strips), they were identified to have considerable influence on how effective these measures will work to benefit biodiversity in rural areas.

Based on our analysis we invited the identified stakeholder groups to the initial scenario development workshop. For the groups that were rather broadly defined, such as “community,” we tried to identify representatives such as the mayor. Also we identified the farmers who farmed within our research sites. Although we made efforts to include different stakeholders in our workshop, particularly local actors did not join. Because our analysis, similar to Ingold (2014), revealed the importance of the local level stakeholders, we decided to organize additional local field visits and invited farmers, community representatives, landscape management agencies, as well as local branches of the farmer associations.

The mixed methods approach was time intensive, not only because the interviews were rather long at sometimes two hours and more, but also because they yielded a wealth of data that had to be processed and analyzed. Nevertheless, we conclude that we were not only able to identify key stakeholders, but also to get a rich understanding of the different perspectives influencing or being affected by biodiversity governance. This knowledge helped us further to engage stakeholders in their preferred ways, assisted us in finding the right language to address the different stakeholder groups, and facilitated the co-production of knowledge relevant to stakeholders particularly in connecting them with each other in the research process.

Responses to this article can be read online at:
<http://www.ecologyandsociety.org/issues/responses.php/8596>

Acknowledgments:

This research was funded by the ERA-Net BiodivERsA, with the national funder BMBF, part of the 2011-2012 BiodivERsA call for research proposals.

LITERATURE CITED

Aberman, N.-L., M. Johnson, K. Droppelmann, E. Schiffer, R. Birner, and P. Gaff. 2012. *Mapping the contemporary fertilizer policy landscape in Malawi. A guide for policy researchers*. IFPRI Discussion Paper 01204. International Food Policy Research Institute, Washington, D.C., USA.

Beilin, R., N. T. Reichelt, B. J. King, A. Long, and S. Cam. 2013. Transition landscapes and social networks: examining on-ground community resilience and its implications for policy settings in multiscale systems. *Ecology and Society* 18(2):30. <http://dx.doi.org/10.5751/es-05360-180230>

Bell, A. R., N.-L. Aberman, F. Zaidi, and B. Wielgosz. 2013. Progress of constitutional change and irrigation management

transfer in Pakistan: insights from a net-map exercise. *Water International* 38:515-535. <http://dx.doi.org/10.1080/02508060.2013.827893>

Bellotti, E. 2015. *Qualitative networks: mixed methods in sociological research*. Routledge, London, UK.

Borg, R., A. Toikka, and E. Primmer. 2015. Social capital and governance: a social network analysis of forest biodiversity collaboration in Central Finland. *Forest Policy and Economics* 50:90-97. <http://dx.doi.org/10.1016/j.forpol.2014.06.008>

Brandes, U., and D. Wagner. 2004. Analysis and visualization of social networks. Pages 321-340 in M. Jünger and P. Mutzel, editors. *Graph drawing software*. Springer, Berlin, Germany. http://dx.doi.org/10.1007/978-3-642-18638-7_15

Bryson, J. M. 2004. What to do when stakeholders matter. Stakeholder identification and analysis techniques. *Public Management Review* 6(1):21-53. <http://dx.doi.org/10.1080/1471-9030410001675722>

Calvet-Mir, L., S. Maestre-Andrés, J. L. Molina, and J. van den Bergh. 2015. Participation in protected areas: a social network case study in Catalonia, Spain. *Ecology and Society* 20(4):45. <http://dx.doi.org/10.5751/es-07989-200445>

Campbell, N., E. Schiffer, A. Buxbaum, E. McLean, C. Perry, and T. M. Sullivan. 2014. Taking knowledge for health the extra mile: participatory evaluation of a mobile phone intervention for community health workers in Malawi. *Global Health: Science and Practice* 2(1):23-34. <http://dx.doi.org/10.9745/ghsp-d-13-00141>

Cash, D. W., W. Adger, F. Berkes, P. Garden, L. Lebel, P. Olsson, L. Pritchard, and O. Young. 2006. Scale and cross-scale dynamics: governance and information in a multilevel world. *Ecology and Society* 11(2):8. [online] URL: <http://www.ecologyandsociety.org/vol11/iss2/art8/>

European Commission (EC). 2013a. *Technical information on green infrastructure (GI)*. Commission staff working document. Accompanying the document. Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions. Green Infrastructure (GI) - Enhancing Europe's Natural Capital. COM(2013) 249 final. EC, Brussels, Belgium. [online] URL: <http://eur-lex.europa.eu/legal-content/EN/TXT/PDF/?uri=CELEX:52013SC0155&from=EN>

European Commission (EC). 2013b. *Green infrastructure (GI) - enhancing Europe's natural capital*. Communication from the Commission to the European Parliament, the Council, the European Economic and Social Committee and the Committee of the Regions. COM(2013) 249 final. EC, Brussels, Belgium. [online] URL: http://eur-lex.europa.eu/resource.html?uri=cellar:d41348f2-01d5-4abe-b817-4c73e6f1b2df.0014.03/DOC_1&format=PDF

Fuhse, J., and S. Mützel. 2011. Tackling connections, structure, and meaning in networks: quantitative and qualitative methods in sociological network research. *Quality & Quantity* 45:1067-1089. <http://dx.doi.org/10.1007/s11135-011-9492-3>

Gamper, M., M. Schönhuth, and M. Kronenwett. 2012. Bringing qualitative and quantitative data together: collecting network data with the help of the software tool VennMaker. Pages 193-214 in M. Safar, and K. A. Mahdi, editors. *Social networking and*

- community behavior modeling: qualitative and quantitative measures. IGI Global, Hershey, Pennsylvania, USA. <http://dx.doi.org/10.4018/978-1-61350-444-4.ch011>
- Hauck, J. 2010. Managing social-ecological systems for resilience: fisheries in the small reservoirs of northern Ghana. *ZEF-Ecology and Development Series No. 75*. Bonn, Germany.
- Hauck, J., C. Stein, E. Schiffer, and M. Vandewalle. 2015. Seeing the forest and the trees: facilitating participatory network planning in environmental governance. *Global Environmental Change* 35:400-410. <http://dx.doi.org/10.1016/j.gloenvcha.2015.09.022>
- Hermans, L. M. 2008. Exploring the promise of actor analysis for environmental policy analysis: lessons from four cases in water resources management. *Ecology and Society* 13(1):21. [online] URL: <http://www.ecologyandsociety.org/vol13/iss1/art21/>
- Herz, A., L. Peters, and I. Truschkat. 2015. How to do qualitative strukturelle Analyse? Die qualitative Interpretation von Netzwerkkarten und erzählgenerierenden Interviews. *Forum: Qualitative Social Research* 16(1):9. [online] URL: <http://www.qualitative-research.net/index.php/fqs/article/view/2092/3746>
- Ingold, K. 2014. How involved are they really? A comparative network analysis of the institutional drivers of local actor inclusion. *Land Use Policy* 39:376-387. <http://dx.doi.org/10.1016/j.landusepol.2014.01.013>
- Kettunen, M., E. Apostolopoulou, D. Bormpoudakis, J. Cent, A. Letourneau, M. Koivulehto, R. Paloniemi, M. Grodzińska-Jurczak, R. Mathevet, A. Scott, and S. Borgström. 2014. EU green infrastructure: opportunities and the need for addressing scales. In K. Henle, S. Potts, W. Kunin, Y. Matsinos, J. Simila, J. Pantis, V. Grobelnik, L. Penev, and J. Settele, editors. *Scaling in ecology and biodiversity conservation*. Advanced Books. Pensoft, Sofia, Bulgaria. <http://dx.doi.org/10.3897/ab.e1169>
- Kok, K., and T. A. Veldkamp. 2011. Scale and governance: conceptual considerations and practical implications. *Ecology and Society* 16(2):23. [online] URL: <http://www.ecologyandsociety.org/vol16/iss2/art23/>
- Lastra-Bravo, X. B., C. Hubbard, G. Garrod, and A. Tolón-Becerra. 2015. What drives farmers' participation in EU agri-environmental schemes?: results from a qualitative meta-analysis. *Environmental Science & Policy* 54:1-9. <http://dx.doi.org/10.1016/j.envsci.2015.06.002>
- Lienert, J., F. Schnetzer, and K. Ingold. 2013. Stakeholder analysis combined with social network analysis provides fine-grained insights into water infrastructure planning processes. *Journal of Environmental Management* 125:134-148. <http://dx.doi.org/10.1016/j.jenvman.2013.03.052>
- Newig, J., D. Günther, and C. Pahl-Wostl. 2010. Synapses in the network: learning in governance networks in the context of environmental management. *Ecology and Society* 15(4):24. [online] URL: <http://www.ecologyandsociety.org/vol15/iss4/art24/>
- Prager, K., and U. J. Nagel. 2008. Participatory decision making on agri-environmental programmes: a case study from Sachsen-Anhalt (Germany). *Land Use Policy* 25(1):106-115. <http://dx.doi.org/10.1016/j.landusepol.2007.03.003>
- Prell, C. 2012. *Social network analysis: history, theory and methodology*. Sage, London, UK.
- Prell, C., K. Hubacek, C. Quinn, and M. Reed. 2008. Who's in the social network? When stakeholders influence data analysis. *Systemic Practice and Action Research* 21(6):443-458. <http://dx.doi.org/10.1007/s11213-008-9105-9>
- Prell, C., K. Hubacek, and M. Reed. 2009. Stakeholder analysis and social network analysis in natural resource management. *Society and Natural Resources* 22(6):501-518. <http://dx.doi.org/10.1080/08941920802199202>
- Prell, C., M. Reed, and K. Hubacek. 2011. Social network analysis for stakeholder selection and the links to social learning and adaptive co-management. Pages 95-118 in Ö. Bodin, and C. Prell, editors. *Social networks and natural resource management: uncovering the social fabric of environmental governance*. Cambridge University Press, Cambridge, UK. <http://dx.doi.org/10.1017/cbo9780511894985.006>
- Primmer, E., R. Paloniemi, R. Mathevet, E. Apostolopoulou, J. Tzanopoulos, I. Ring, M. Kettunen, J. Similä, J. Cent, M. Grodzińska-Jurczak, T. Koellner, P. Antunes, J. D. Pantis, S. G. Potts, and R. Santos. 2014. An approach to analysing scale-sensitivity and scale-effectiveness of governance in biodiversity conservation. Pages 241-262 in F. Padt, P. Opdam, N. Polman, and C. Termeer, editors. *Scale-sensitive governance of the environment*. John Wiley & Sons, Oxford, UK. <http://dx.doi.org/10.1002/9781118567135.ch15>
- Reed, M. S. 2008. Stakeholder participation for environmental management: a literature review. *Biological Conservation* 141(10):2417-2431. <http://dx.doi.org/10.1016/j.biocon.2008.07.014>
- Reed, M. S., A. Graves, N. Dandy, H. Posthumus, K. Hubacek, J. Morris, C. Prell, C. H. Quinn, and L. C. Stringer. 2009. Who's in and why? A typology of stakeholder analysis methods for natural resource management. *Journal of Environmental Management* 90(5):1933-1949. <http://dx.doi.org/10.1016/j.jenvman.2009.01.001>
- Repohl, M., J. Schmidt, J. Hauck, and S. Weiland. 2015. *Analyse des Politikintegrationspotentials der EU-Strategie für Grüne Infrastruktur - untersucht am Beispiel der Gemeinsamen Agrarpolitik der EU*. UFZ-Diskussionspapier 10/2015. Helmholtz-Zentrum für Umweltforschung - UFZ, Leipzig, Germany. [online] URL: <http://www.ufz.de/index.php?de=14487>
- Schiffer, E., and J. Hauck. 2010. Net-Map: collecting social network data and facilitating network learning through participatory influence network mapping. *Field Methods* 22(3):231-249. <http://dx.doi.org/10.1177/1525822x10374798>
- Scott, J. 2000. *Social network analysis: a handbook*. Sage, London, UK.
- Steen-Adams, M. M., N. Langston, M. D. O. Adams, and D. J. Mladenoff. 2015. Historical framework to explain long-term coupled human and natural system feedbacks: application to a multiple-ownership forest landscape in the northern Great Lakes region, USA. *Ecology and Society* 20(1):28. <http://dx.doi.org/10.5751/es-06930-200128>

Stein, C., J. Barron, L. Nigussie, B. Gedif, T. Amsalu, and S. Langan. 2014. *Advancing the water-energy-food nexus: social networks and institutional interplay in the Blue Nile*. WLE Research for Development (R4D) Learning Series 2. International Water Management Institute, Colombo, Sri Lanka. [online] URL: <https://www.sei-international.org/publications?pid=2573> <http://dx.doi.org/10.5337/2014.223>

Sutherland, L.-A., D. Gabriel, L. Hathaway-Jenkins, U. Pascual, U. Schmutz, D. Rigby, R. Godwin, S. M. Sait, R. Sakrabani, W. E. Kunin, T. G. Benton, and S. Stagl. 2012. The “neighbourhood effect”: a multidisciplinary assessment of the case for farmer co-ordination in agri-environmental programmes. *Land Use Policy* 29(3):502-512. <http://dx.doi.org/10.1016/j.landusepol.2011.09.003>

Wasserman, S., and K. Faust. 1994. *Social network analysis: methods and applications*. Cambridge University Press, Cambridge, UK. <http://dx.doi.org/10.1017/cbo9780511815478>

Welp, M., A. de la Vega-Leinert, S. Stoll-Kleemann, and C. C. Jaeger. 2006. Science-based stakeholder dialogues: theories and tools. *Global Environmental Change* 16(2):170-181. <http://dx.doi.org/10.1016/j.gloenvcha.2005.12.002>

Wood, B. A., H. T. Blair, D. I. Gray, P. D. Kemp, P. R. Kenyon, S. T. Morris, and A. M. Sewell. 2014. Agricultural science in the wild: a social network analysis of farmer knowledge exchange. *PLoS ONE* 9(8):e105203. <http://dx.doi.org/10.1371/journal.pone.0105203>

Young, J. C., A. Jordan, K. R. Searle, A. Butler, D. S. Chapman, P. Simmons, and A. D. Watt. 2013. Does stakeholder involvement really benefit biodiversity conservation? *Biological Conservation* 158:359-370. <http://dx.doi.org/10.1016/j.biocon.2012.08.018>

Young, J., A. Watt, P. Nowicki, D. Alard, J. Clitherow, K. Henle, R. Johnson, E. Laczko, D. McCracken, S. Matouch, J. Niemela, and C. Richards. 2005. Towards sustainable land use: identifying and managing the conflicts between human activities and biodiversity conservation in Europe. *Biodiversity and Conservation* 14(7):1641-1661. <http://dx.doi.org/10.1007/s10531-004-0536-z>

Appendix 1.

Table A1. Information about interview partners from the regional and local level

No.	Level	Date	Institution
1	regional	26.03.2013	Federal state agency for agriculture and forests
2	regional	30.05.2013	Farmers' associations
3	regional	07.01.2013	Federal state department of environmental conservation_1
4	regional	17.01.2013	Federal state department of environmental conservation_2
5	regional	12.02.2013	Federal state office for agriculture, forestry and horticulture
6	regional	16.01.2013	Advisory board for nature conservation
7	regional	30.11.2012	Scientific organization
8	regional	25.07.2013	Regional nature conservation authority
9	regional	25.07.2013	Regional planning
10	regional	11.11.2013	Association of organic farmers
11	regional	26.07.2013	Technical journal
1	local	01.03.2013	Hunter
2	local	01.03.2013	Farmer_1
3	local	19.03.2013	Farmer_2
4	local	30.03.2013	Farmer_3
5	local	12.07.2013	Farmer_4
6	local	19.03.2013	Agricultural consultant
7	local	29.07.2013	Landscape management association
8	local	29.07.2013	Mayor

Figure A2.2. Regional network when three and more links between actors were mentioned

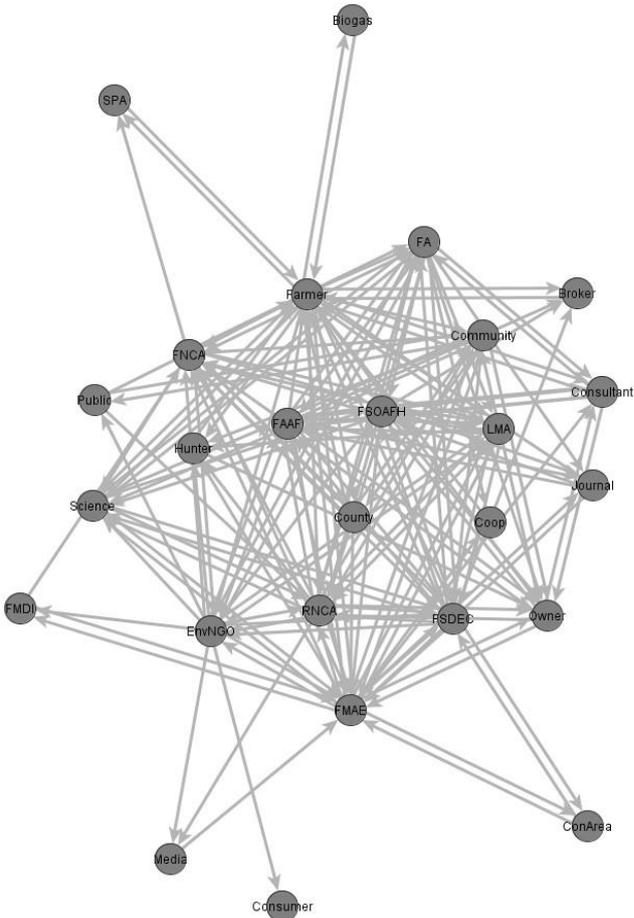


Figure A2.3. Regional network when four and more links between actors were mentioned

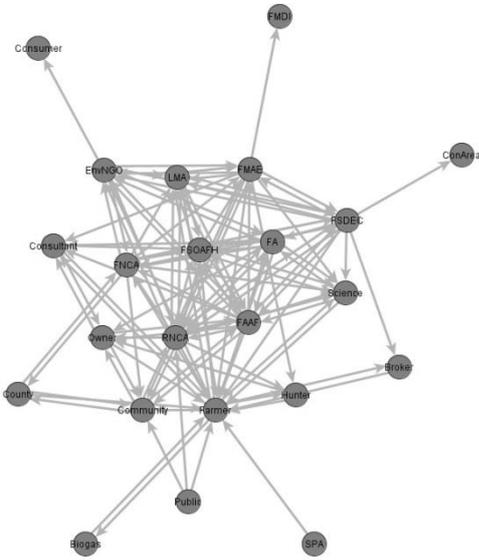
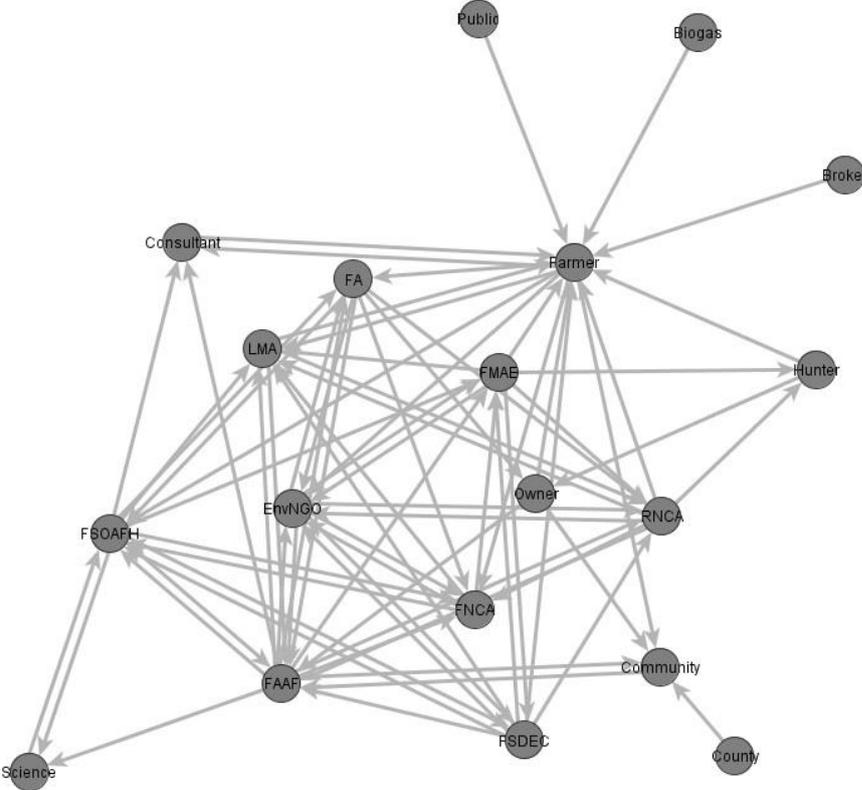


Figure A2.4. Regional network when five and more links between actors were mentioned



Appendix 3.

Figure A3.1. Local network when two and more links between actors were mentioned

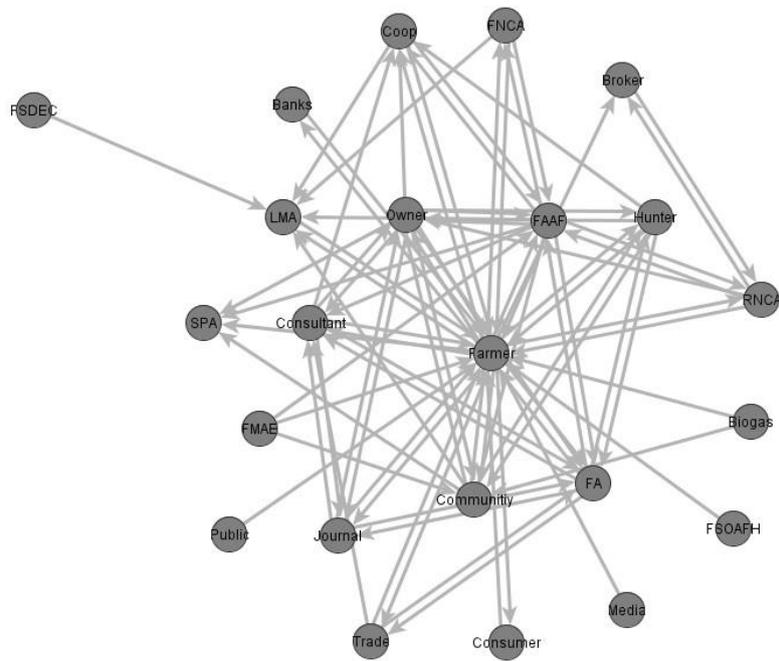


Figure A3.2. Local network when three and more links between actors were mentioned

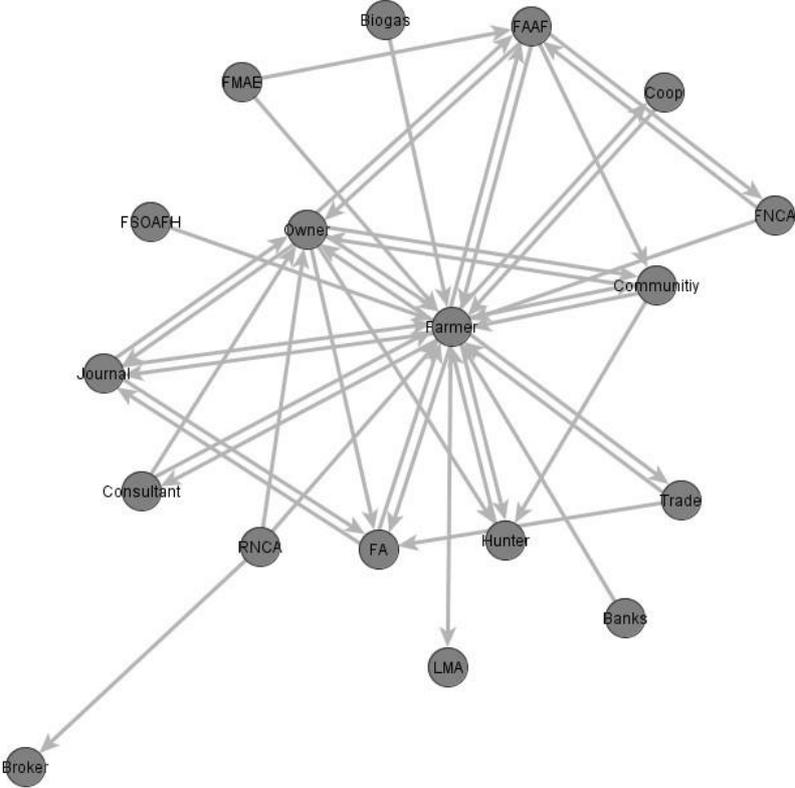


Figure A3.3. Local network when four and more links between actors were mentioned

