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Regional networking as a competitive advantage? Empirical results from German pig production

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Regional networking as a competitive advantage? Empirical results from German pig production

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Abstract. It is often hypothesized that geographical proximity in clusters (or industry districts) has positive effects on access to information and knowledge and on firm competitiveness. We present one of the first empirical tests of this hypothesis in the context of the European agribusiness sector. A large-scale empirical study was conducted in the northwestern part of Germany, which is one of Europe's leading pig production regions. The results of the farmer survey show that the cluster in north-western Germany provides good structural preconditions for the comprehensive network participation of pig farmers. Additional analyses show that farmers' network participation has positive effects on access to information, their perceived level of informedness and the competitiveness of their farms. The results have interesting implications for farm management as well as political decision-making and public administration in regions with high livestock densities.

Keywords: Networks, information exchange, competitiveness, clusters, pig production.

1. Introduction

Increasing production costs as well as growing requirements with regard to quality and safety pose a significant challenge for organizations in agrifood chains. Due to the emergence of new competitors in globalized markets, gaining and sustaining competitiveness is of utmost importance. This applies in particular for the geographically concentrated pig production in the north-western part of Germany, which is heavily challenged by European as well as international competitors[1].

In the literature, it is generally agreed that participation in regional networks and, even more, in clusters can be beneficial to the competitiveness of organisations[2][3]. The north-western part of Germany apparently shows structural elements of a regional cluster and is often referred to as the "silicon valley of the food industry" in Germany[4]. In this region there are above-average numbers of livestock farms, suppliers, food processing companies and specialized service providers. But the location of organizations in regional clusters alone may not necessarily result in advantages for individual firm. Gellynck et al. (2006) [5] state that what is important is not only the particular use of regional facilities or the presence of a strong regional food chain; it is the method of active networking that gives farms and firms access to information and knowledge, which are preconditions for learning processes and innovations[6] [7].

The high geographical concentration of livestock in north-western Germany and the resulting increase in legal regulation of such issues as the dispersion of manure and investment in new stables has had a great impact on pig farmers in particular, leaving them largely unable to further extend their production capacities and to generate additional economies of scale. Thus, on the one hand, agglomerations of firms may cause disadvantages stemming from the proximity of producers and processors, but, on the other hand, cluster-like structures may also provide valuable opportunities for improving competitiveness since it is known that physical, cognitive and cultural proximity can enhance the trustful exchange of information[8][9][10]. Organizations in clusters may profit by better being able to exploit different forms of knowledge that circulate in the specialized network[11]. Participating in a regional network and, in this way, acquiring access to professional information and innovations in terms of new efficient processes that will decrease production costs or enhance product quality may emerge as a significant means of raising competitiveness in future.

Against this background, an empirical survey was carried out in the livestock cluster of north-western Germany in order to describe the tangible and intangible relationships between the firms located there and to analyze the impact of participation in regional networks on the competitiveness of German pig producers. The data of 110 respondents provide interesting in-depth insights into farmers' embeddedness in formal and informal networks and allow a more comprehensive understanding of how farmers benefit from using their regional networks.

2. Regional networking and clusters—A theoretical overview

Although the globalization of markets and economic relationships has intensified in recent years, at the same time, scientists as well as practitioners have nonetheless observed a "renaissance of regions"[12]. Famous examples such as "watches from Switzerland" or "IT from the Silicon Valley" have drawn attention to the specific strengths of spatial regions. Numerous articles investigating the relationships between agglomeration and competitiveness have made the term *cluster* well known and, to some extent, even a buzzword[13]. Porter (2000)[2] defines clusters as "[…] geographic concentrations of interconnected companies, specialized suppliers, service providers, firms in related industries, and associated institutions (universities, standards agencies, trade associations) in a particular field that compete but also cooperate".

Current cluster theory has been influenced by previous research approaches, which have in common that they highlight the regional network as an important aspect. In the early concept of *industrial districts*, Marshall (1920)[14] characterized industrial districts as regional networks of specialized small and medium-sized firms in particular localities. On the one hand, the high level of specialization allows the development of firm-specific competencies. On the other hand, the essential division of labour often entails long-term contracts between supply chain partners or binding commitments in business relationships. Goods as well as knowledge are exchanged through these interfirm relationships, where the exchange of knowledge is especially enhanced by trust between the business partners. In industrial districts the geographical proximity of the organizations facilitates trust-building between the persons involved through a higher frequency of direct conversation as well as shared social and commercial norms and conventions[15]. This enhances product expertise and decreases transaction costs[16]. The success of the industrial district, therefore, depends on strong links in the regional network and on the evolution of a unique local cultural identity [17].

Firms in agglomeration areas, like livestock-farms in north-western Germany, often have to cope with bounded possibilities to extend their production facilities due to scarcity of land or additional legal requirements. In these cases, firms have to optimize the efficiency of existing assets and equipment, which often forces them to innovate. Thus, we see the development of what has been termed *innovative milieu*. Camagni (1991)[18] defines an innovative milieu as "[…] the set, or the complex of mainly informal social relationships on a limited geographical area, often determining a specific external 'image' and a specific internal 'representation' and sense of belonging, which enhance the local innovative capability through synergetic and collective learning processes." The concept is based on the assumption that innovations will be completely generated neither in the internal structure of a firm alone nor solely in its business environment. Moreover, innovations develop in formal and informal relations as well as in business and social networks[19][20]. Such unique regional networks cannot completely be replaced by modern information technologies so that geographical proximity has not lost its relevance for fostering innovativeness[16].

The above-mentioned theoretical concepts show that economic activity is often encased in durable systems of social relations. In this context, Granovetter (1973)[21] established the term *embeddedness*, which he later further clarified as follows: "By embeddedness I mean that economic action, outcomes, and institutions are affected by actors' personal relations, and by the structure of the overall network of relations. I refer to these respectively as the relational and the structural aspects of embeddedness"[22]. Relational embeddedness characterizes the quality of the relationship between two actors. Where there is a high level of relational embeddedness, trust emerges due to common attitudes and shared values, hence uncertainty decreases. If, in a dyadic relationship, a partner is considered to be trustworthy, he may receive access to valuable resources and knowledge that external actors cannot obtain[23][16]. Structural embeddedness refers to the extent to which "[…] a dyad's mutual contacts are connected to one another"[22]. This means that partners do not have relationships only with each other but also with third parties, and, in this way, many parties are linked indirectly. Thus, in time, reputation or opportunistic behaviour will become public throughout the entire network[15].

Summing up the central ideas of the various cluster and network concepts, three central constructs can be extracted that are considered to influence networking and directly or indirectly benefit regional competitiveness:

- geographical proximity
- actors' structural and relational embeddedness
- trust among the network partners

From a theoretical point of view, these constructs influence the intensity and quality of regional networking and, thus, impact firms' ability to gain access to information and knowledge.

In the general management literature, there are several studies on clusters and regional networking on such subjects as information exchange in networks in the Silicon Valley[24], innovations in the biotechnology sector[25][26] and learning processes in automotive clusters[27]. Agricultural economists have only rarely examined the topic of regional networking (see, for instance, Gellynck et al. 2006[5]). With regard to German agriculture, Dannenberg's 2006[16] study of a region in eastern Germany is almost the only study focussing on the farm level. In general, little empirical data is available—especially with regard to German agriculture—on the subject of how firms benefit from actively participating in regional networks.

3. Conceptual framework

In order to fill the research gap identified above, a large-scale explorative empirical survey was designed. First, the theoretical concepts of clusters and embeddedness were applied to develop a measurement model. The regional network represents the core theoretical construct of the model, determined by the farmers' socio-institutional embeddedness, trust between the network actors and their geographical proximity (see Figure 1). It is assumed that the regional network of a farmer consists of formal horizontal relationships due to his or her affiliations with such organizations as producer cooperatives or farmers associations. Furthermore, farmers may have formal vertical relations with other organizations, through, for instance, backward integration into piglet farming, membership in cooperative livestock trading organizations or delivery contracts with slaughterhouses. These relationships are referred to as the farmers' *business network.*

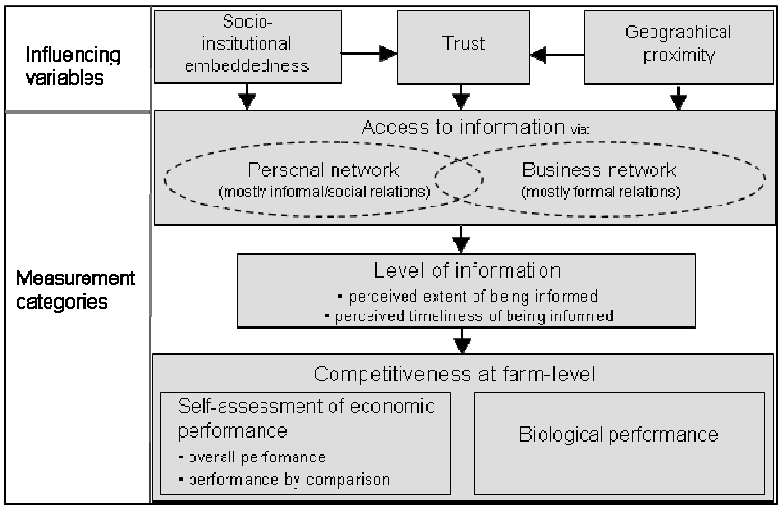


Figure 1. Measurement model

Besides their business network, farmers often have distinct informal and social relations with people in their nearby surroundings, such as neighbouring farmers, friends or family members. This is what we call farmer's *personal network*. These relations are a form of social network and do not seem to be business-related at first sight. However, Granovetter (2004)[28] states that social structures affect economic outcomes because social networks influence the flow and quality of information. We assume that some business-related information is subtle, nuanced and difficult to recheck. Therefore, "[…] actors do not believe impersonal sources and instead rely on people they know"[28].

When analyzing famers' network participation, it must be considered that personal networks and business networks may overlap[29]. This is the case if a dyad is based on formal as well as social relations. For instance, a farmer may have a formal agreement of cooperation with another farmer who is also in his circle of friends. Overlapping may lead to multiplex relations, which are considered to be much more intensive and stable[30]. Furthermore, the mix of personal and business networks leads to an increase in the number of potential interaction partners. Yao and McEvily (2001)[31] point out that a firm's position in a network strongly determines its access to information circulating among network members. In everyday business, some tasks, like ensuring compatibility between animal health and productivity in livestock

farming, are complex and cannot be managed without cooperation with others. These situations often require the application of tacit knowledge, which can be achieved only through interaction with knowledgeable network partners[28].

Consequently, "level of information", as perceived by the farmers, is the central measurement category. It is represented by farmers' feeling of being informed and the perceived timeliness of information[32]. Hofstede (2003)[33] points out that, in today's complex and rapidly changing environment, effective information exchange is the key to improving value chain performance and competitiveness. In this context, competitiveness on the farm level forms a further measurement category. In order to account for the problem of the multiplicity of factors determining competitiveness, the category "competitiveness" can be operationalized in different ways. On the one hand, it is represented by farmers' self-assessment regarding their overall competitiveness as well as their competitiveness in comparison with other livestock farmers. On the other hand, competitiveness is measured using biological pig production data, such as feed conversion, weight gain per day and mortality.

4. Focus area and research methodology

4.1. Focus area

The survey was carried out in the German states of Lower Saxony and North Rhine–Westphalia, a pig production agglomeration area. Windhorst and Grabkowsky (2008)[4] characterize in particular the western part of Lower Saxony as one of the most efficient agricultural areas worldwide. In 2007, 53 % of German pigs were kept in farms in Lower Saxony and North Rhine–Westphalia (see Figures 2 and 3)[34]. At the farm level, the northwestern part of Germany has imposing above-average parameters. Whereas in 2007 nationwide, an average of 340 pigs (including all categories of pigs) were kept per owner, the corresponding number in Lower Saxony was 573 and in North Rhine-Westphalia 493. In leading districts in Lower Saxony, there were, on average, nearly 1,100 pigs kept per owner. In these districts, too, fattening farmers invested in new buildings, and, in the period from 2003 till 2007, the new fattening units had an average capacity of 2,000 pigs[35][36].

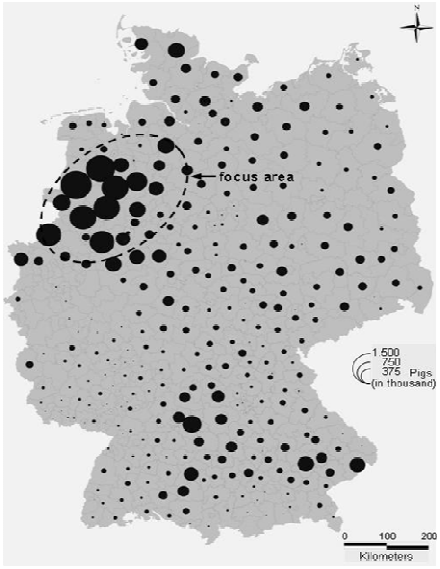


Figure 2. Geographical allocation of livestock

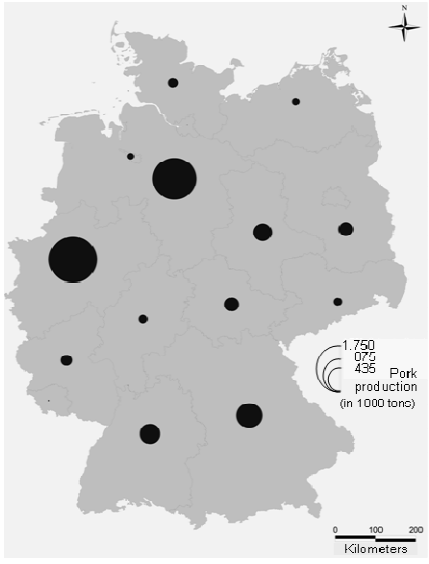


Figure 3. Allocation of pork production[37]

North-western Germany is also characterized by obvious agglomerations of abattoirs and meat processors. Nearly 30 % of the pigs slaughtered in Germany were processed in Lower Saxony in 2007. In Lower Saxony, 190 firms with more than 24,000 employees generated an annual turnover of more than 6.7 billion Euro in 2006, of which 763 million Euro were earned in export markets[35]. In accordance with the high intensity and density of livestock farming, several well-known feedingstuff companies are located in the focus area. These are specialized companies producing and selling compound feedingstuff, mineral nutrients and feedingstuff additives. Furthermore, innovative companies in the business segments

of livestock housing and feeding technology that have emerged as global market leaders in recent years still have their headquarters in the north-western livestock cluster.

4.2. Research methodology

The theoretical framework outlined above guided a large-scale empirical study in the north-western agglomeration area of German pork production. Between November and December 2008, 110 pig fattening farmers were surveyed in extensive face-to-face, questionnaire-based interviews. The questionnaire consisted for the most part of five-point Likert scales from "-2 = totally disagree" to "+2 = totally agree". For data analysis, SPSS 17.0 for Windows was used. The design of the survey reflected the following goals: a) a detailed description of farmers' embeddedness and their regional networking, b) an evaluation of the famers' perception of informedness and c) an analysis of the relationship between the level of information and competitiveness.

5. Empirical results and discussion

The farmers interviewed are on average 39 years old. About 73 % of the respondents are farm managers; another 24 % are successors working actively on the farm. Thus, nearly all the questionnaires were completed by respondents who take part in the farms' decision-making processes; this strongly contributed to the informative value of the study. Most of the farmers have a high level of agrarian education. More than 43 % of the farmers have an advanced agrarian education and 35.5 % have a master craftsman's certificate; another 15.5 % studied agricultural sciences at university. Almost 93 % of the respondents earn their living solely from their farms, with pig fattening generating, on average, 60 % of their agricultural income. The farmers interviewed keep on average 1,745 pigs (median: 1,350), with a minimum of 250 and maximum of 12,000 pigs. Although the respondents already have above-average herd sizes, 60 % of the farmers state that they are planning to expand their capacities in the near future (average expansion projected: 1,100 pigs). These figures indicate that mainly future-oriented farmers were interviewed.

5.1 Variables influencing regional networking

In line with the theoretical model, the first step was to analyze the **geographical distance** between the members of the cluster surveyed. Figure 4 illustrates that the farmers collaborate mainly with suppliers and customers located in their local (same rural district) or regional (same administrative region) surroundings. This applies especially to suppliers of feedingstuff and livestock technology.

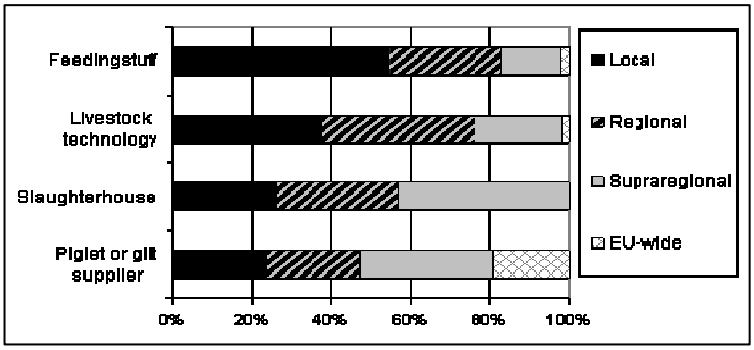


Figure 4. Provenance of farmers' suppliers and customers (n=110)

In contrast, with regard to piglet and gilt suppliers, there is a relatively high degree of contact with supraregional and international actors. The result is not surprising since it is known that the north-western part of Germany has a continual deficit in the piglet production necessary for supplying the local pig fattening farms[38]. Farmers in the focus area often import piglets from the Netherlands and Denmark.

Figure 5 shows a distinct geographical proximity between farmers and their agricultural service providers. The low geographical distances between farmers and public authorities and the chamber of agriculture were expected since these institutions have local offices in almost every district. Due to the relatively high geographical proximity between farmers and their legal consultants, insurance companies and banks, it

can be stated that these service providers reveal a high level of specialization in the agribusiness sector in the focus area. Farmers apparently make use of these specialized service offers.

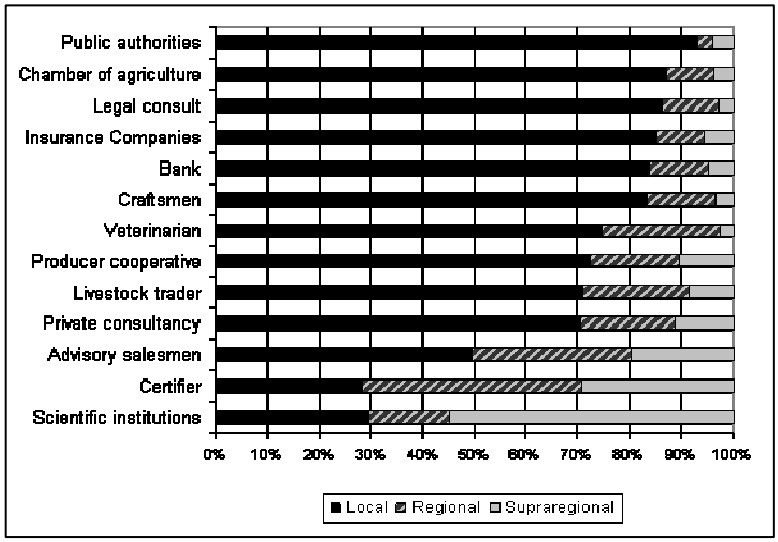


Figure 5. Provenance of farmers' service providers (n=110)

At this point it can already be hypothesized that the existing spatial structures may benefit the exchange of business-related information as well as enhance generating cluster-specific know-how. This is most relevant with regard to so-called "sticky" information and knowledge[39], which is tied to a specific locality. All in all, the results show that geographical proximity to suppliers, customers and service providers is an obvious characteristic of the region under analysis.

The farmers' **socio-institutional embeddedness** becomes apparent when taking a closer look at the farmers' professional and social engagement in their communities and local surroundings. Of the respondents, 96.3 % are members of the local farmers' association ("Deutscher Bauernverband e.V."). Beyond that, 60 % are members of an agricultural cooperative. Associations with an explicit focus on pig production are pig producer cooperatives (*Erzeugergemeinschaften*, or EZG), working groups and benchmarking circles as well as the Association of Pig Farmers in Germany (ISN e.V.); 50 % of the respondents are members in each of these associations. Besides their engagement in professional associations, more than 83 % of the farmers are participants in more than two local clubs. This may contribute to the fact that more than 80 % of the farmers feel well integrated in the life of their local villages (see Figure 6). Interestingly, the statements in Figure 6 confirm the hypothesis that an overlap of farmers' personal and business networks can exist.

Socio-institutional embeddedness			Totally disagree ⟷ Totally agree				
	μ	σ	-2	-1	0	1	2
I feel well integrated in local village life (n=108)	1.02	0.697				●	
My circle of friends and acquaintances also includes some of my business partners (n=109)	0.17	1.005			●		
My circle of friends and acquaintances mostly consists of people who are affiliated with agriculture (n=109)	0.24	0.769			●		
I often talk about agricultural topics with my friends and acquaintances (n=109)	0.42	0.773			●		

Figure 6. Farmers' social networks

In line with Granovetter (1990)[22], it can be observed that farmers' structural embeddedness influences their regional networking. Thus, nearly all respondents (97 %) state that unfair behaviour quickly becomes common knowledge in the regional network. In this context, 71 % of the farmers agree that they do not deal with a company if it has a bad reputation. As part of relational embeddedness, trust is seen at the basis of all business as well as private relationships. Moreover, 42 % of the respondents fully agree that they trust people only if they go back a long way, whereas 47 % neither agree nor disagree. At this point, the results suggest a more detailed analysis of trust as another variable influencing farmers' regional business networks.

It is a widely shared opinion that **trust** is an essential precondition for durable and prosperous (business) relationships in the agri-food chain[9][40]. The results of the present survey indicate varying levels of relationship quality depending on the positions of farmers' business partners in the netchain. Asked about the relationship to their suppliers, nearly 81 % of the farmers state that they have always had long-standing and successful relationships with the same suppliers. Moreover, nearly 90 % say that cooperation with these suppliers is fair. Both statements correlate at a level of r = 0,521** (level of significance: p≤0,05*; p≤0,01**; p≤0,001***). Furthermore, the duration of the relationships correlates slightly with the statement "I have a personal relationship with my suppliers" (r = 0,293**). The latter is affirmed by 62 % of the farmers.

Farmers' trust in processors is much lower than their trust in suppliers. This may be caused, at least in most cases, by the lack of direct contact between farmers and slaughterhouses noted by almost 60 % of the respondents. As a consequence, nearly 50 % of the farmers characterize their relationships with slaughterhouses as very impersonal; only 22.6 % say that the management of the slaughterhouses take farmers' interests into account. But the assessment of the relationship quality varies, which is expressed in a high standard deviation. These differences may be caused by a varying general perception of relationship quality among the respondents as well as the delivery of slaughter animals to slaughterhouses with very different supplier-relationship management (SRM) concepts. Notwithstanding the lower rating of relationship quality, 78.5 % state that they do not switch slaughterhouses to choose the one currently offering the best conditions.

Finally, farmers' trust in other farmers with whom they cooperate is measured by the statement "I cooperate successfully and trustfully with other farmers". Since nearly half of the farmers agree with this statement, it can be concluded that trust is an integral part of horizontal relationships between farmers. Nonetheless, the responses are somewhat inhomogeneous. Whereas more than 33 % of the respondents are neutral, about 17 % go so far as to disagree that their relationships with other farmers are trustful.

5.2 Access to business-related information through networking

Regarding farmers' **personal networks,** the hypothesis is confirmed that a distinct social embeddedness benefits respondents' access to information. Accordingly, 67 % of the farmers state that they can profit from important information received at an early stage if they actively take part in local village life. Only 6.4% reject this statement. Hence, social events such as public meetings or festivities in the village are regarded as good sources of information by 50.4 % of the farmers.

As central parts of personal networks, the respondents' families and circles of friends must be analyzed with regard to their influence on farming businesses. Nearly 90 % of the farmers agree that their families provide valuable help in making business decisions and, furthermore, more than 58 % of the respondents consider their families to be important advisers. Only 12 % say that family members cannot help them make operational decisions. With regard to managerial decisions, 40.7 % of the pig farmers profit from information and suggestions from their circle of friends, whereas 19.4 % disagree with this statement.

The exchange of knowledge with other farmers represents an important source of operational information for more than 77 % of the pig farmers (see Figure 7). Although competition between farms has been increasing, nearly half the respondents agree that this has not so far been an obstacle to information exchange. Nonetheless, 35 % are neutral and more than 16 % of the respondents believe that increasing local competition between farms constrains communication between farmers.

Interaction with other farmers (n=110)			Totally disagree ⟷ Totally agree				
	μ	σ	-2	-1	0	1	2
Exchanging experiences with other farmers is very important for my operational decisions	0.93	0.673					
Little interesting information is exchanged among farmers due to increasing intercompany competition	-0.39	0.968					
Neighbouring farmers' actions have no influence on my operational decisions	0.19	0.953					
If my neighbour builds a stable or buys new machines, it is a stimulus for me to invest likewise	-1.07	0.786					

Figure 7. Knowledge exchange between farmers

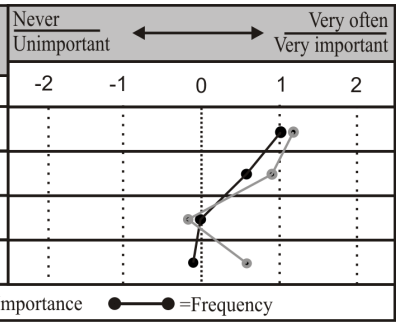
Regardless of the strong regional concentration of pig fattening farms in the focus area, above 33 % of farmers surveyed state that the investigation of neighbouring farmers' operations is not very important for

their own businesses. But 44.5 % cannot fully disagree with this statement and nearly 20 % say that neighbouring farmers' actions influence on their own business decisions. However, 80.9 % of the respondents disagree that they feel compelled to start their own investment projects as a result of large investments by neighbouring farms.

An analysis of the items regarding farmers' **business networks** reveals that the importance of information exchange with a particular interaction partner correlates significantly with the actual frequency of information exchange with this partner. Correlations can be found with regard to all suppliers, customers and service providers (correlation coefficients range between r = 0.5** and r = 0.8**). But with regard to some network actors, there are discrepancies between farmers' stated relevance of information exchange and the actual intensity of communication.

Analysis of the respondents' relations with their suppliers clearly indicates interactions between the farmers and their feedingstuff companies (see Figure 8). Nearly 82 % of the pig fattening farmers state that they "frequently" or "very frequently" exchange business-related information. Similarly, this information is considered "important" or "very important" for the competitiveness of the farm by more than 86 % of the respondents. More than 55 % of the farmers have frequent contact with their piglet or gilt suppliers, whereas immaterial interaction with livestock technology companies is less marked. This suggests the assumption that information exchange takes place only with priority in the case of a technical investment.

Exchange of information with suppliers and customers (n=110)	Frequency of information exchange		Importance of information exchange for competitiveness	
	μ	σ	μ	σ
Feedingstuff company	1.01	0.784	1.13	0.731
Piglet or gilt supplier	0.51	1.031	0.88	0.894
Livestock technology	-0.07	0.965	-0.19	1.054
Slaughterhouse	-0.15	1.229	0.53	1.119



μ=Mean σ=Standard deviation

Figure 8. Exchange of information with supply chain partners

In comparison to the relationship with suppliers, the exchange of business-related information between farmers and the slaughterhouses they deliver to takes place less frequently. Almost 38 % of the farmers surveyed reveal that they "rarely" or "never" obtain business-related information from their slaughterhouses. But the level of communication is heterogeneous; more than 33 % of the farmers receive such information "frequently" or "very frequently", and 28.7 % report that they only occasionally communicate with their slaughterhouses. Despite the relatively low frequency of communication, the majority of the farmers consider an exchange of information with slaughterhouses significant for the competitiveness of their own pig fattening operations. However, even though farmers consider communication with their slaughterhouses crucial for their own businesses, they perceive the amount of information received so far as insufficient.

Figure 9 shows the exchange of business-related information between pig farmers and their service providers. It is clear that veterinarians are key actors in farmers' business networks; more than 84 % of the respondents state that they communicate frequently or very frequently with them. Correspondingly, nearly 93 % perceive the information received from their veterinarians as significant for success in livestock farming.

Discrepancies between the stated relevance of information exchange and the actual intensity of communication can also be seen with regard to the relationships with private consultants as well as banks. It can be assumed that the relatively high importance of banks is due to increasing investment volumes in livestock housing construction, which add weight to the banks as financing partners. Furthermore, the debt ratios of livestock farmers with growth strategies have been increasing sharply in recent years.

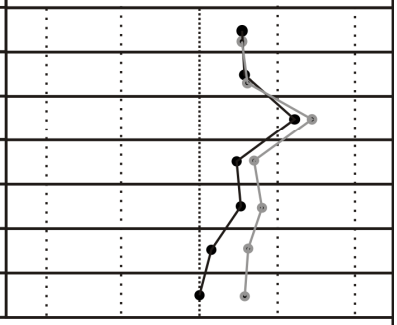
Exchange of information with service providers (n=105 up to n=110)	Frequency of information exchange		Importance of information exchange for competitiveness		Never / Unimportant ↔ Very often / Very important
	μ	σ	μ	σ	-2 -1 0 1 2
Livestock trader	0.40	1.298	0.41	1.267	
Advisory salesmen	0.41	0.890	0.44	0.917	
Veterinarian	1.24	0.732	1.40	0.652	
Producer cooperative	0.43	1.328	0.59	1.220	
Chamber of agriculture	0.46	0.831	0.78	0.886	
Bank	0.15	0.826	0.64	0.896	
Private consultancy	0.04	1.151	0.54	1.040	
μ=Mean σ=Standard deviation					=Importance =Frequency

Figure 9. Exchange of information with service providers

Both intensity and importance of information exchange receive mostly negative ratings with regard to service providers such as insurance companies, public authorities, legal consultants, certifiers and scientific institutions.

Finally, the results of the survey confirm the theses of such researchers as Camagni (1991)[18] and Hofstede (2003)[33] that access to information is a fundamental precondition for competitiveness. Nearly 94 % of the respondents consider a timely supply of information about relevant developments in pig production to be "important" or "very important" for the competitiveness of their own farms (see Figure 10).

Level of information (n=110)	μ	σ
How important is it for the competitiveness of your farm that you are informed about relevant developments in pig production in a timely manner?[1]	1.35	0.672
At which point in time do you usually receive this information?[2]	1.28	1.019
In general, to what extent do you feel informed about new developments in pig production regarding the competitiveness of your farm?[3]	7.36	1.336
[1]Scale ranges from -2 = "unimportant " to +2 = "very important" [2]Scale ranges from -3 = "always to late" to +3 = "always in time" [3]Scale ranges from 0 = "not a bit informed" to 10 = "totally informed"		

Figure 10. Level of information

Although farmers perceive some communication deficits (mainly with regard to their slaughterhouses) (Figures 8 and 9), 84 % of the respondents feel that, all in all, they are kept well informed in a timely manner. Thus, farmers rate their informedness at a high level of 7.36 (scale ranges from 0 = "not at all informed" to 10 = "fully informed") with a relatively low standard deviation. This parallels earlier findings in the region, which also revealed a high level of information among livestock farmers[32]. Thus, at this point, the analysis already indicates that the structure of the focus area provides favourable conditions for the exchange of information and knowledge within the farmers' regional networks.

5.3 Networking, informedness and competitiveness

In order to account for the multiplicity of factors determining **competitiveness** at the farm level, the construct is operationalized by using biological data as well as farmers' perceptions of their economic success. The biological data comprise the pigs' feed conversion rate, weight gains per day and mortality. Compared to secondary data in the focus area[41], all the farms surveyed show average or slightly above-average performance levels. Accordingly, the respondents assess the statement "How would you estimate the biological performance of your farm in comparison with other pig fattening farms?" positively (see Figure 11). Since this statement correlates positively with farmers' self-assessment of their economic success (r= 0.433***) and their success in comparison with other farmers (r=0.530***), farmers also rate their business success positively.

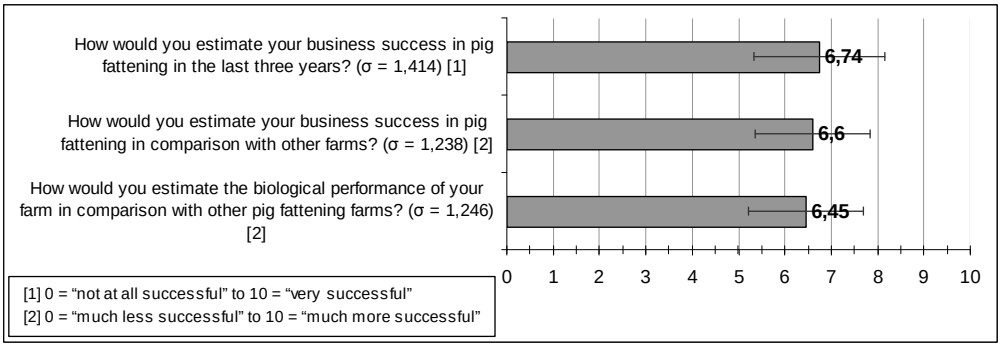
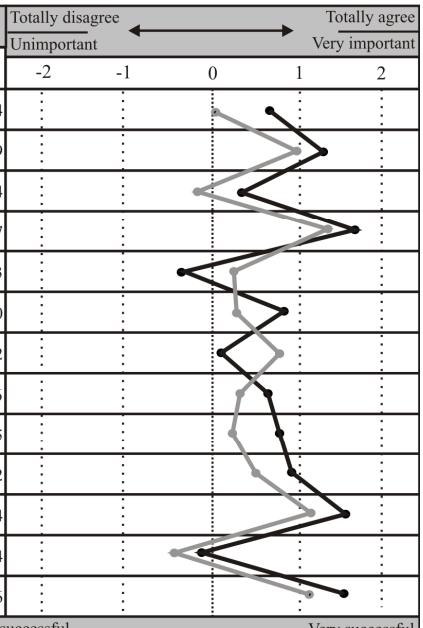


Figure 11. Farm performance

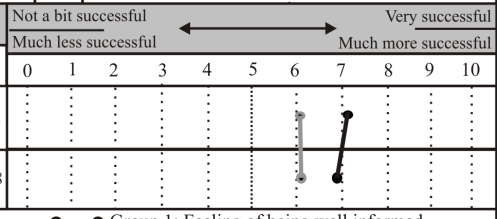
Referring to the conceptual framework (see Figure 1), we investigate below the relationship between farmers' networking and their access to information in greater detail. Furthermore, we examine the relationship between farmers' level of informedness and their competitiveness. This is done by classifying the farmers into groups and using mean comparison tests to identify differences between the groups.

Due to a correlation (r = 0.649***) of the items "In general, to what extent do you feel informed about new developments in pig production regarding the competitiveness of your farm?" and "When do you usually receive such information?" the factor "level of informedness" was generated (80.35 % explained total variance). Both statements have a factor loading of 0.896 and Cronbach's alpha value is 0.739. Depending on the value of the calculated factor scores for each respondent, the farmers were classified into two groups: well informed farmers (Group 1, n = 66) and suboptimally informed farmers (Group 2, n = 42). Because the normal distribution assumption is not met, all mean comparisons are conducted with non-parametric analyses using Mann-Whitney-U-Tests (see Figure 12).

Statement	Group 1		Group 2	
	μ	σ	μ	σ
I cooperate successfully and trustfully with other farmers **	0.61	1.021	0.07	0.894
There is fair cooperation between my suppliers and me **	1.20	0.853	0.98	0.909
My circle of friends and acquaintances also includes some of my business partners **	0.38	0.947	-0.17	1.034
Trust is the basis of all business and personal relationsships *	1.63	0.486	1.36	0.577
In general, I am sceptical of the information I receive from my slaughterhouse **	-0.33	0.934	0.20	0.813
I can in good conscience recommend my slaughterhouse to other farmers ***	0.76	0.681	0.23	0.800
The relationship between me and my slaughterhouse and is very impersonal**	0.12	1.398	0.70	0.992
My slaughterhouse always treats me fairly **	0.66	0.718	0.32	0.756
Importance of cooperation with producer cooperatives for competitiveness *	0.75	1.222	0.22	1.275
Importance of information exchange with the chamber of agriculture for competitiveness **	0.97	0.859	0.45	0.832
Importance of information exchange with the veterinarian for competitiveness **	1.53	0.503	1.17	0.794
Importance of information exchange with public authorities for competitiveness *	-0.08	0.997	-0.48	1.154
General importance of being informed in a timely manner about developments in pig production***	1.53	0.561	1.14	0.566



Statement	Group 1		Group 2	
	μ	σ	μ	σ
How would you estimate your business success in pig fattening in the last three years ?***	7.11	1.218	6.12	1.501
How would you estimate your business success in pig fattening in comparison with other farms ?**	6.86	1.239	6.15	1.108



μ=Mean value σ=Standard deviation
Level of significance: p ≤ 0.05 *; p ≤ 0.01**; p ≤ 0.001 ***

Group 1: Feeling of being well informed
Group 2: Feeling of being suboptimally informed

Figure 12. Well informed versus less informed farmers

The results (see Figure 12) show that a trustful relationship with other farmers as well as with suppliers obviously benefits farmers' level of informedness. In particular, with regard to the customers farmers deliver to, the group of better informed respondents have higher confidence in the information they receive from their slaughterhouses. In general, it can be seen that better informed farmers assess the quality of their relationship with their slaughterhouses significantly more positively.

Moreover, differences in the mean values with regard to the item "My circle of friends and acquaintances also includes some of my business partners" confirm the hypothesis that an overlapping of respondents' personal and business networks enhances informedness. Above all, Figure 12 shows that the group of better informed farmers attaches significantly greater importance to their participation in business networks for their own competitiveness than the other group does. This applies in particular to the exchange of information with producer cooperatives, the chamber of agriculture, veterinarians and public authorities. According to this, the better informed respondents more clearly consider timely information about pig production to be important.

Finally, the responses to the questions about farmers' success suggest a positive relationship between the level of informedness and business success as perceived by respondents (see Figure 12). This is also confirmed by analyzing the correlations. For instance, the item "How would you estimate your business success in pig fattening over the last three years?" correlates positively with the item "In general, to what extent do you feel informed about new developments in pig production regarding the competitiveness of your farm?" ($r = 0.404$***) as well as the perceived timeliness of the information received about developments in pig production ($r = 0.200$**). Moreover, farmers' estimation of their business success in pig fattening in comparison with other farms correlates, on the one hand, with the perceived timeliness of the information ($r = 0.254$**) and, on the other, with the degree of farmers' feeling of informedness about new developments regarding the competitiveness in pig production ($r = 0.284$**).

In order to analyze this relationship in greater detail, respondents were further classified according to their competitiveness. In order to deal with the multiplicity of factors determining competitiveness, the index "competitiveness" was constructed This construct includes respondents' assessment of their business success over the last three years and in comparison with other farms. Additionally, farmers' ratings of their pigs' average weight gain per day and average mortality per rotation are also included in the index. (See the appendix for a list of all the variables included and their weightings.) By using the 50th percentile, a group of more competitive farmers (Group 1, n = 49) can be distinguished from a group of less competitive farmers (Group 2, n = 59).

Mean comparison tests (see Figure 13) show that more competitive farmers have a higher frequency of information exchange with their piglet suppliers. One possible—although debatable—explanation for this relates to aspects of animal health in livestock. Blaha (2004)[42] states that an efficient exchange of information between pig fattening and piglet production may enhance the status of animal health in pig fattening as well piglet production. Some outcomes of animal health are included in the index "competitiveness" through data on pigs' weight gain and mortality and, thus, may impact the index score positively. Furthermore, farmers classified in Group 1 have greater confidence in the information they receive from piglet suppliers than do respondents in the comparison group.

Statement	Group 1		Group 2		-2 -1 0 1 2
	μ	σ	μ	σ	
How often do you exchange business-related information with your piglet/gilt supplier?[1] *	0.72	1.015	0.36	0.968	
The information received from my suppliers is not always reliable[2] **	-0.53	0.819	-0.03	0.928	
Importance of cooperation with private consultants for competitiveness[3] **	0.02	1.229	0.49	1.040	

[1] Scale ranges from -2 = "never" to +2 "very often"
[2] Scale ranges from -2 = "totally disagree" to +2 "totally agree"
[3] Scale ranges from -3 = "unimportant" to +2 "very important"

Group 1: Higher level of competitiveness
Group 2: Lower level of competitiveness
Level of significance: p ≤ 0.05 *; p ≤ 0.01**; p ≤ 0.001 ***

Figure 13. Information exchange with suppliers and competitiveness

The significant differences in Figure 13 indicate that the less competitve farmers consider cooperation with private consultants more important for their competitiveness. This finding needs further in-depth analysis regarding the significance of individual service providers in farmers' networks and their contribution to the competitiveness of farms.

Further comparisons of mean values between the two groups indicate significant differences with respect to the origin of the piglets bought by fattening farmers. More competitive farmers purchase considerably more piglets from foreign suppliers (see Figure 14).

	Group 1	Group 2
Location of piglet/gilt supplier in the same rural district as respondent *	1 %	14 %
Location of piglet/gilt supplier in a foreign country (EU-wide)*	27.2 %	9.8 %
Percentage of business-related information coming from personal contacts *	36.5 %	27 %

Group 1: Higher level of competitiveness
Group 2: Lower level of competitiveness
Level of significance: $p \leq 0.05$ *; $p \leq 0.01$**; $p \leq 0.001$ ***

Figure 14. Competitiveness and purchasing behaviour

These findings confirm current tendencies in the focus area[43]. Experts state that the import of piglets into the north-western German pig production area has increased considerably in recent years, especially from Denmark (4.7 million piglets in 2008) and the Netherlands (2.3 million). Evidence from pig fattening practitioners reveals that piglets from Denmark in particular are healthier and perform better during the fattening process. Although the results of the present study tend to support these statements, further research is needed in order to analyze the relationship between the origin of piglets and competitiveness of pig fattening.

Regarding farmers' sources of business-related information, as can be seen in Figure 14, among more competitive farmers, a significantly higher percentage of information comes from personal contacts. Thus, it can be assumed that some complex information is valuable for farmers' competitiveness but requires the use of rich communication media, such as personal contact in face-to-face conversations[44]. Implicit information, for instance, is more difficult to express and communicate and needs additional interpretation by the transaction partners who receive it[45]. Last but not least, the comparison of mean values underlines the positive relationship between level of informedness and farm competitiveness. Thus, when responding to the question "In general, to what extent do you feel informed about new developments in pig production regarding the competitiveness of your farm?" (scale from 0 to 10), farmers in Group 1 ($\mu = 7.67$; $\sigma = 1.136$) rate their informedness level slightly but significantly higher than do farmers in Group 2 ($\mu = 7.20$; $\sigma = 1.284$).

6 Conclusions and implications

The generally high level of respondents' feeling of informedness and the frequency of their interaction with various actors indicate that the northwestern part of Germany provides good structural preconditions for farmers' comprehensive network participation. These structures comprise a relatively high number of specialized institutions and the geographical proximity of the actors involved in pig production. In general, the farmers surveyed make use of these advantageous structural conditions even if there are some differences among the respondents. Interaction with other farmers enhances respondents' access to information as well as the competitiveness of their farms. Furthermore, the overlapping of farmers' business and personal networks has been seen to be fruitful, as well. At least a part of farmers' socio-institutional embeddedness can be traced back to their membership in local associations and their integration into local village life.

Moreover, the results also indicate that the intensity and quality of farmers' relationships with their suppliers—especially with piglet suppliers—are important factors in the competitiveness of their farms. Regarding further research, this implies an urgent need to analyze in greater detail whether increasing cooperation with foreign piglet suppliers may complicate the relationship, especially considering possible trade barriers in case of crisis due to risks of epidemic animal plagues.

Furthermore, in comparison with less informed farmers, better informed farmers rate the quality of their relationship with the slaughterhouses they deliver to significantly higher. This is reflected in, for instance, a higher confidence in processors' actions and transmitted information. However, the high standard deviation, even within the group of the better informed farmers, indicates that farmers' perceptions of their relationships with slaughterhouses do, in fact, vary. Irrespective of respondents' classification into the more competitive or the less competitive group, the majority of farmers perceive a discrepancy

between the intensity of the exchange of timely information with slaughterhouses and its importance for the competitiveness of their own pig fattening activities. This illustrates a need to optimize communication between pig fattening farmers and slaughterhouses and, thus, confirms previous studies on the transparency of food supply chains[32] and the need to improve relationship management in meat supply chains[46].

Furthermore, our findings illustrate the importance of interaction with specific service providers for farmers' level of informedness. These service providers include the producer cooperative, the chamber of agriculture, the veterinarian and public authorities. The results of mean comparison tests also confirm the positive relationship between the intensity of farmers' participation in the regional network and their level of informedness. In this context, the intensity of a farmer's networking comprises the number of different partners the respondent interacts with and the quality of those relationships, which is mainly determined by the level of trust.

Compared to earlier research, the results of our survey show that a higher level of informedness tends to increase farmers' competitiveness. Moreover, personal contacts as sources of information also appear to enhance respondents' competitiveness. In the focus area, actors' geographical proximity emerged as a precondition for such communication events as face-to-face conversations. But, on the other hand, the findings imply that proximity alone may not guarantee active informational relations. In this regard, anecdotal evidence suggests the existence of the problem of "wishful-thinking clusters"[47], which can be found in some mainly policy-driven cluster initiatives. Nonetheless, politicians and public administrators can contribute to the competitiveness of animal production by providing a legal and administrative framework for high livestock densities in specific regions. Although it is sometimes considered more advantageous from an environmental perspective to deconcentrate livestock farming, our results indicate that this may reduce the competitiveness of production.

From a methodological point of view, detailed network analyses in agrifood netchains provide interesting insights into which actors are central in respondents' networks for gaining access to information and knowledge and, thus, to competitiveness. Moreover network analysis is a tool for investigating the intensity, quality and multiplexity of relationships in farmers' personal as well as business networks. In this way, potential means of improving cooperation can be identified in order to stimulate innovation and sustain the competitiveness of the focus area.

Our network analysis implies a need for further research into piglet production in north-western Germany, which appears to be unable to keep up with the specialization and growth of regional pig-fattening structures. A more detailed analysis is necessary in order to ascertain whether this development should be viewed as a so-called "lock-in effect". The term *lock-in effect* refers to path dependencies resulting from high switching costs, which prevent actors from changing to more efficient solutions[48]. In the north-western Germany, the regional network may have resulted in over-specialization in pig fattening, whereas the structural development of piglet production has received only scant attention. Further research should analyze in greater detail whether such lock-in effects can be a negative outcome of cluster structures and, thus, represent a threat to regional competitiveness.

In addition, further research might conduct the present survey in other agglomeration areas of pig production, like Gelderland in The Netherlands, or in non-agglomeration areas, such as regions with a mixed farm structure, in order to obtain a more comprehensive understanding of the impact of geographical proximity on individual networking and competitiveness.

Acknowledgment

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Appendix

Index “competitiveness”: Included items and weightings
How would you estimate your business success in pig fattening in the last three years? [1]
How would you estimate your business success in pig fattening in comparison with other farms? [2]
What was your pigs’ average weight gain in the last three years? [3]
What was your pigs’ average mortality per rotation in the last three years? [4]
Weightings: [1] Scale ranges from 0 = “not at all successful” to 10 = “very successful” [2] Scale ranges from 0 = “much less successful” to 10 = “much more successful” [3] Up to 600 grams per day = 2; 600-700 = 4; 700-800 = 6; 800-900 = 8; more than 900 = 10 [4] Over 8% per rotation = 2; 6%-8% = 4; 4%-6% = 6; 2%-4% = 8; under 2% = 10