Agri-food clusters: Is French policy in line with real spatial dynamics? *

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Abstract:

In this paper, we attempt to ascertain to what extent the clusters identified in the agricultural and agri-food space rely on a spatial dynamic involving real agricultural and agri-food activities in the relevant geographic area. We use explanatory spatial data analysis (ESDA) to detect the spatial structure and dynamics of agri-food activities and to connect them to the competitiveness clusters' locations. Results show that the six clusters specifically studied have different profiles because of their proximity to dynamic areas of agricultural and agri-food production and because of their collaborations with other clusters.

Keywords: Competitiveness clusters, Spatial dynamics, Agriculture, Agri-Food activities.

* This work was supported by the PSDR-GO (CLAP). The views defended here are the authors' and not necessarily those of the organizations mentioned.

1. Introduction

The *cluster* concept is increasingly used to enhance the economic momentum of territories that compete with one another in a context of globalised economies. France is clearly an adherent of the concept, which has become a pan-European trend following the Lisbon strategy defined in 2000 and laid out in the Europe 2020 plan, a strategy that seeks to make the European Union a competitive economy based on knowledge development. Under the strategy, governments are encouraged to increase expenditures devoted to research and development for innovation (objective of 3% of GDP). Hence, France is adopting a specific policy—based on the cluster models set out in the literature—to enhance territories' economic development through the establishment of competitiveness clusters [*pôles de compétitivité*]. In addition to that national-level effort, local authorities, which have their own economic development responsibilities, are also investing in the development of such clusters.

The French Government's competitiveness clusters policy was adopted in 2005. The first phase was the launch of a call for proposals to give the competitiveness clusters official accreditation. The 2005 selection lists 66 competitiveness clusters, rising to 71 in 2009.

In this paper, we shall endeavour to ascertain to what extent the clusters identified in the agricultural and agri-food space rely on a spatial dynamic involving real agricultural and agri-food activities in the relevant geographic area. Thus, in the first part we present France's policy on competitiveness clusters, then, in the second part, we outline the clusters and spatial statistics indicators used for the analysis of the agricultural and agri-food dynamics, and finally we analyse the cooperative relationships between the competitiveness clusters looked at.

2. French policy on competitiveness clusters

The policy that led to the implementation of competitiveness clusters was initiated following the 14 September 2004 meeting, convened by the Prime Minister, of the Interdepartmental Spatial Planning and Development Committee (CIADT).

A *competitiveness cluster* is defined as the combination, within a given territory, of businesses, training centres and research units:
- collaborating on an undertaking aimed at generating synergies through the execution of innovative shared projects, and
- having the necessary critical mass for international visibility.

Thus, the policy is clearly grounded in the concept of a *cluster* as defined by Porter (1998): "Clusters are geographic concentrations of interconnected companies and institutions in a particular field." Competitiveness clusters are clusters that benefit by specific actions undertaken by governments to support their development, in particular seeking to maintain employment within the country and to achieve international visibility.

The first phase of this French government policy was the launch of a call for proposals to give the competitiveness clusters official accreditation. The clusters may be defined by type as follows: worldwide clusters (7 projects), potentially worldwide clusters (11 projects, including Végépolys), and national clusters (53 projects). The objectives to be achieved and the level of funding are a function of this categorisation.

Money is being spent to support the competitiveness clusters' development. For the first phase (2005–2008), the Government had set aside an envelope of 1.5 billion euros, with as much again being allotted to competitiveness clusters in 2009–2011. That budget goes primarily to the worldwide (50%) and potentially worldwide clusters (25%). In addition to that financial envelope, businesses that develop cooperative innovative projects with the clusters enjoy tax exemptions. Local authorities, primarily the regions and metropolitan areas, may also contribute to the financing of the competitiveness clusters within their jurisdictions. The clusters identified allow a balance to be struck in terms of representation of sectors and regions.

Cluster governance is through an associative structure comprising businesses, research centres, teaching institutions, professional associations and territorial communities. In concrete terms, it is these entities' responsibility to develop cooperative projects involving research, teaching and businesses that seek to promote innovation to achieve added value, employment and, if possible, a higher international profile for the territory.

The competitiveness clusters policy is an ambitious one in that it calls on stakeholders to cooperate among themselves to stimulate innovation while still competing with one another in the open market; their cooperation is intended to generate added value. Many authors have studied the logical underpinnings of the creation and implementation of a cluster within a given territory. Some have looked at the types of relationships existing between firms in order to establish a typology (Gordon and McCann, 2000), while others have investigated the degree of proximity between them (Rallet and Torre, 2005), taking into consideration the spatial and temporal dimensions of the clustering phenomenon. Following the recent work of Amisse and Muller (2010), we shall attempt to combine these various approaches in order to find co-location rationales that work in a number of dimensions.

The authors that looked at proximity between firms (Rallet and Torre, 2005) found that it took two main forms: geographical proximity and organised proximity. Geographical proximity means the physical distance between the players. Organised proximity means the players' ability to interact, whether in a formal relationship or otherwise.

As regards the study of organised proximity, we have relied on the work of Porter (1990, 1998) and, for industrial districts, of two Italian authors (Becattini,1992; Brusco, 1982). These papers are concerned with the nature of the relationship between firms. Porter highlights the importance of formal and strategic contacts. He holds that cooperation between firms, and hence their solidarity, emerges from the identification of common problems and objectives. The relations established as a result are strategic; they are short-term relations aimed at stimulating innovation. The Italian literature posits another type of business relationship: one that develops through informal contacts, based on mutual trust between the partners. Two basic rationales for the cluster dynamic have been proposed (Amisse and Muller, 2010). Under one rationale, short-term strategic cooperation is undertaken upon the cluster's establishment or after a crisis, following the identification of objectives and problems common to the stakeholders; this is the professional rationale. Under the so-called historical rationale, trust and informal relationships are established for the long term; these go beyond short-term cooperative behaviours and lead to the forging of lasting alliances based on common interests. Thus, these two rationales constitute a temporal approach to the clusters policy.

Other elements may explain how relationships arise in the case of organised proximity (Torre, 2006; Vicente, 1999, 2005; Bocquet, Brossard, 2008). Two such elements may be mentioned. The first is belonging: the fact that two players belong to the same organisation or network facilitates interaction and, outwardly at least, fosters communication. The second is likeness: the fact that the members of an economic entity share the same references or knowledge system eases interaction between them.

In the current literature, however, it appears difficult to distinguish between these various patterns, as relations between firms may involve an alternation of competition and cooperation, and short-term alliances may be combined with more lasting ones.

Table1: Rationales for collaboration between firms

<table>
<tr><th></th><th>Historical</th><th>Professional</th><th>Belonging</th><th>Likeness</th></tr>
<tr><td>Organised proximity</td><td rowspan="2">Long term, forging of historical alliances, cooperation</td><td rowspan="2">Short term, Strategic,</td><td>Belonging to same network</td><td>Same references or knowledge system</td></tr>
<tr><td>Geographical proximity</td><td></td><td></td></tr>
</table>

In this paper, we shall attempt to determine whether competitiveness clusters are based on a purely geographical combination of firms or on their complementarity, with clusters identified at the national level. Also, we shall endeavour to ascertain whether the geographical area of clusters matches the spatial dynamic of the relevant agricultural and agri-food activities, then study the interactions between clusters through an analysis of the cluster network.

3. Analytical method

3.1. Competitiveness clusters studied

The only competitiveness clusters considered in the analysis are those subject to MAAP (the French ministry of agriculture, food, fisheries, rural life and land use planning) that carry on an activity concerned with agri-food and/or agriculture and are strongly tied to the territory in which that activity is conducted. Clusters related to sea products were not included, nor were the InnoViandes and Prod'Innov clusters, inasmuch as in 2010 they lost their national "competitiveness cluster" accreditation. Finally, biotechnology, health and nutrition clusters were not looked at because they are highly R&D-oriented and less directly tied to the agricultural and agri-food sectors. The clusters studied were the following: Industrie et Agro-ressources (IAR), Nutrition Santé Longévité (NSL) and Vitagora. All clusters mentioned will however be taken into account in the last part of the study—network analysis—since all of them collaborate with the agricultural or agri-food competitiveness clusters.

According to DATAR, 14 clusters are subject to MAAP, of which 6 meet our criteria. We therefore selected the following clusters:

Table 2: Competitiveness clusters studied

Name of cluster	**Location of cluster headquarters**	**Main issues dealt with**
Agrimip Innovation	Castanet Tolosan, Midi-Pyrénées	Food supply chains
Céréales Vallée	Saint-Beauzire, Auvergne	Cereals
Pôle Européen Innovation Fruits et Légumes	Avignon, Provence-Alpes-Côte-d'Azur	Fruits et légumes
Qualiméditerranée	Montpellier, Languedoc-Roussillon	Fruits and vegetables, wine-growing, cereals and Mediterranean crops
Valorial	Rennes, Bretagne	Foods of tomorrow, milk, meat and egg products, agri-food technologies and nutrition
Végépolys	Angers, Pays-de-la-Loire	Varietal selection, horticulture, specialised plants, landscapes, wine-growing, market gardening

In order to bring out the interrelations of the clusters, agricultural activities and agri-food industries, the sectors directly relevant to each cluster have to be identified.

Table 3: Agricultural and agri-food sectors associated with each competitiveness cluster

<table>
<tr><th></th><th>Sector</th><th>Agrimip Innovation</th><th>Céréales Vallée</th><th>PEIFL</th><th>Quali-méditerranée</th><th>Valorial</th><th>Végépolys</th></tr>
<tr><td>Agriculture (prod.)</td><td>Field crops</td><td rowspan="2">X</td><td rowspan="2">X</td><td rowspan="2"></td><td rowspan="2">X</td><td rowspan="2"></td><td rowspan="2"></td></tr>
<tr><td>IAAs</td><td>Cereals/ grains</td></tr>
<tr><td>Agriculture (prod.)</td><td>Fruit</td><td rowspan="3">X</td><td rowspan="3"></td><td rowspan="3">X</td><td rowspan="3">X</td><td rowspan="3">X</td><td rowspan="3">X</td></tr>
<tr><td>Agriculture (prod.)</td><td>Market gardening/ horticulture</td></tr>
<tr><td>IAAs</td><td>Fruit/ vegetables</td></tr>
<tr><td>Agriculture (prod.)</td><td>Milk</td><td rowspan="2">X</td><td rowspan="2"></td><td rowspan="2"></td><td rowspan="2"></td><td rowspan="2">X</td><td rowspan="2"></td></tr>
<tr><td>IAAs</td><td>Dairy products</td></tr>
<tr><td>Agriculture (prod.)</td><td>Meat</td><td rowspan="2">X</td><td rowspan="2"></td><td rowspan="2"></td><td rowspan="2"></td><td rowspan="2">X</td><td rowspan="2"></td></tr>
<tr><td>IAAs</td><td>Meat Products</td></tr>
</table>

We study the following agricultural and agri-food sectors: field crops/cereals-grains, fruit/market gardening-horticulture/fruits and vegetables, milk/dairy products and meat/meat products. We also look at the data regarding all sectors taken together.

3.2 Data used

The data on agricultural activities is taken from departmental agriculture accounts for 1990 and 2006 (production volume by sector, at the department level) (Ben Arfa et al., 2010). The data on agri-food industries (IAAs) is taken from the 1996 and 2005 EAE surveys [Enquête Annuelle d'Entreprises] (number of establishments per sector, at commune level). This data was aggregated at the employment zone level, which was seen as the most relevant scale for the study of agri-food activities. The data on clusters comes essentially from DATAR (establishments of businesses belonging to the cluster, within the employment zone).

3.2.1 Data processing: mapping and statistical analysis

The first step is to analyse the competitiveness clusters' location and catchment area. For that purpose, we map the places where the clusters are active and measure their reach (number of employment zones covered by the cluster/total number of employment zones) and concentration (concentration index).

To analyse the degree of spatial clustering of competitiveness clusters, as evidenced by the presence of clusters in the neighbourhood, we use a join-count autocorrelation test. The join-count statistic is a global autocorrelation test specifically designed to measure the spatial arrangement of spare outcome data. The statistic is derived from three primary components classically referenced as the number of BB, WW, or BW joins. A BB join represents the number of neighbouring areas where there are no competitiveness clusters, WW joins represent the number of adjacent area where there are competitiveness clusters, and BW the number of areas where a competitiveness cluster exists but there is none in the connecting area.

The standard error of the expected number of BB, WW, or BW joins gauges where differences between the observed and expected joins are significantly different from random.

On the basis of the results (Table 4), an initial cluster typology can be established showing catchment areas. Some clusters, like Végépolys, have a low concentration and a large catchment area. Others, like Agrimip, cover fairly small areas and are quite concentrated. We attempt to relate this information, taken from an analysis of cluster location, to the dynamic of agricultural and agri-food activities and to inter-cluster collaborations.

Table 4: Geographical indicators for competitiveness clusters

	Dispersion/concentration Join-Count (Standard error WW)	**Size of catchment area (in % of French territory)**
Céréales Vallée	Scattered 1.2804	3,2%
Agrimip Innovation	Concentrated 12.4532***	3,5%
Qualiméditerranée	Slightly scattered 9.8357***	3,5%
Valorial	Concentrated 15.58***	9.7%
PEIFL	Concentrated 12.5952***	10.8%
Végépolys	Slightly scattered 8.0976***	11.7%

****, p<0.01*

To detect the spatial structure and dynamics of agri-food activities and to connect them to the competitiveness clusters' locations, we use explanatory spatial data analysis (ESDA). We first calculate Moran's *I* tests for spatial autocorrelation. Data $\{z_i\}$ are said to be spatially autocorrelated if neighbouring values are more alike than those further apart.

Moran's *I* statistic is defined as[1]:

[1]. Cliff and Ord (1981) provide a formal derivation of this formula.

$$I_t = \frac{n\sum_{i=1}^{n}\sum_{j=1}^{n} w_{ij}(z_{it}-\bar{z}_t)(z_{jt}-\bar{z}_t)}{(\sum_{i=1}^{n}(z_{it}-\bar{z}_t)^2)\times\sum_{i,j}^{n} w_{ij}}, t = 1,......,T \quad (3)$$

where w_{ij} is the (i,j)th element of the matrix W, describing the spatial contiguity of the *zones d'emploi* [employment zones][2] under study. There are different ways to define the spatial weight matrix: a binary contiguity matrix, a distance-based spatial weight matrix with or without a critical cut-off, and many others (Anselin, 1988; Fingleton, 2003). The one we use to calculate Moran's *I* statistic is the queen first-order spatial contiguity matrix, where w_{ij} is equal to one if locations share at least a common border and zero otherwise.
Moran's *I* has a sampling distribution which is approximately normal. The expected value of Moran's *I* is $E(I) = -\frac{1}{n-1}$, and the interpretation is similar to that of the product moment correlation coefficient. Informally, +1 indicates strong positive spatial autocorrelation (*i.e.* clustering of similar values), 0 indicates random spatial ordering, and -1 indicates strong negative spatial autocorrelation (*i.e.* a checkerboard pattern). Given *I*, E(*I*) and Var(*I*), we can easily test the null hypothesis (H_0) of no spatial autocorrelation against the two-tailed alternative (H_1) that the data are spatially autocorrelated. Note that the use of standardised variables makes the Moran's *I* statistics comparable across time.
Table 5 displays Moran's *I* statistic for different food-processing industries for different sectors for the years 1996 and 2005 for the 348 French employment zones. Inference is based on the permutation approach with 9999 permutations (Anselin 1995). It appears that all Moran's *I* statistics differ in a statistically significant way from zero, and that all agri-food sectors are positively spatially autocorrelated. This result suggests that the distributions of agri-food industries are by nature clustered over the two periods. This clustering is higher for 2005 than for 1996. The most clustered agri-food sector is cereal processing industries.

Table 5: Moran's *I*, 1996 and 2005[3]

	1996	2005
Cereals	0,3174	0,3709
Dairy_products	0,2064	0,2970
Fruits_veg	0,0855	0,2516
Meat	0,2559	0,3119
All AFF	0,1676	0,2044

Moran's *I* statistic is a global statistic and does not allow us to assess the regional structure of spatial autocorrelation. In order to gain more insight into how areas with high or low agri-food industries are located in France, we then analyse local spatial autocorrelation using Local Indicators of Spatial Association (LISA) (Anselin 1995). Local spatial autocorrelation

2 An employment zone is a geographical area in which most of the labour force live and work. Carried out jointly by INSEE and the statistical unit of the labour ministry, the breakdown into employment zones constitutes a division of the territory suited to local studies of employment and its attendant conditions. Source: <http://www.insee.fr/fr/methodes/default.asp?page=definitions/zone-emploi.htm>

3 GeoDa® software is used to calculate Moran's *I*.

statistics provide a measure, for each unit in the region, of the unit's tendency to have an attribute value that is correlated with values in nearby areas.
The LISA for each region i and year t is written as:

$$I_{it} = \frac{n}{\sum_{i,j}^{n} w_{ij} \times \sum \left(z_{it} - \bar{z}_t\right)^2} \left(\left(z_{it} - \bar{z}_t\right) \sum_{j=1}^{n} w_{ij} \left(z_{jt} - \bar{z}_t\right) \right) \qquad (4)$$

where z_{it} is the observation in region i and year t, and $\bar{z}_t$ is the mean of the observations across regions in year t.
The high-high and low-low locations (positive local spatial autocorrelation) are typically referred to as spatial clusters, while the high-low and low-high locations (negative local spatial autocorrelation) are termed spatial outliers. While outliers are single locations by definition, this is not the case for clusters, and the cluster itself likely extends to its neighbours as well.

Using the results obtained, mapping may be done to identify the presence of local clusters or specific spatial units whose value is opposite to their neighbours'.

4. Analysis and results

4.1 Analysis of spatial dynamics

On the basis of the indicators referred to above, we produce maps displaying agricultural and agro-industrial spatial dynamics. The maps of the relevant sectors for each of the clusters studied are presented in a matrix (Table 3). For agricultural sectors we present the 1990 and 2006 maps as well as the 1996 and 2005 maps for agri-food activities (1990 and 1996 attached). Thus, we present activity locations for each competitiveness cluster and the spatial dynamics of sectors pertinent to these clusters' activities.

<u>All agricultural and agri-food sectors (2005-2006) and the Agrimip cluster:</u>

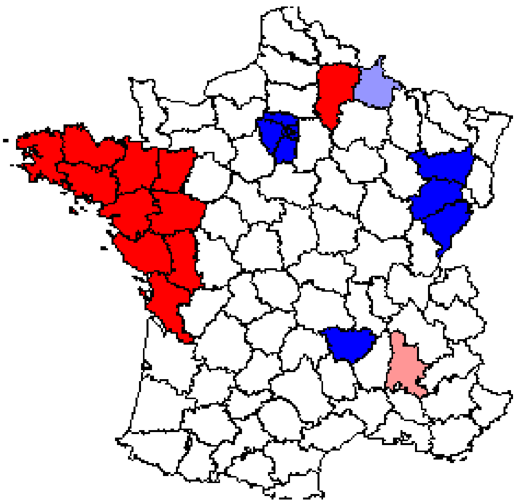


Figure 1: 2006 Agricultural Production

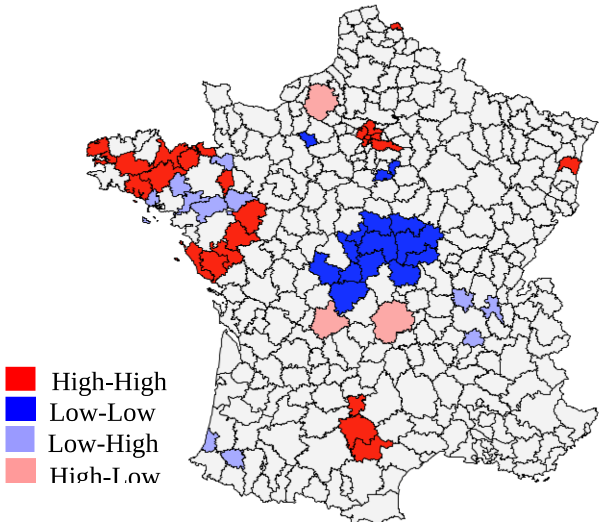


Figure 2 IAAs all sectors, 2005

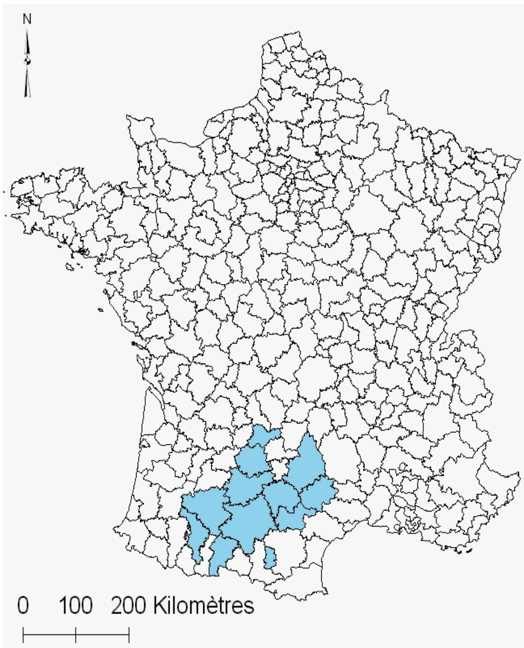


Figure 3 Agrimip Innovation cluster

The maps in Figures 1 and 2 show the Grand-Ouest region to be the locomotive for agriculture and agri-food. For all IAAs, in 1996 (Figure i) a main cluster was observed in the Grand-Ouest region and 2 smaller ones in Île-de-France and in the Lyon area (HH zones). In 2005 (Figure 2), a main cluster is still shown in Grand-Ouest and a smaller one in Île-de-France, while a new cluster makes its appearance in Midi-Pyrénées.

The Agrimip Innovation cluster (Figure 3) is not located in Grand-Ouest, the most dynamic region both for agriculture and for agri-food industries. It is, however, located in the southwest, in Midi-Pyrénées, where a positive industrial dynamic has recently developed.

Field crops (2006), Cereal industries (2005), the Céréales Vallée and Qualiméditerranée clusters

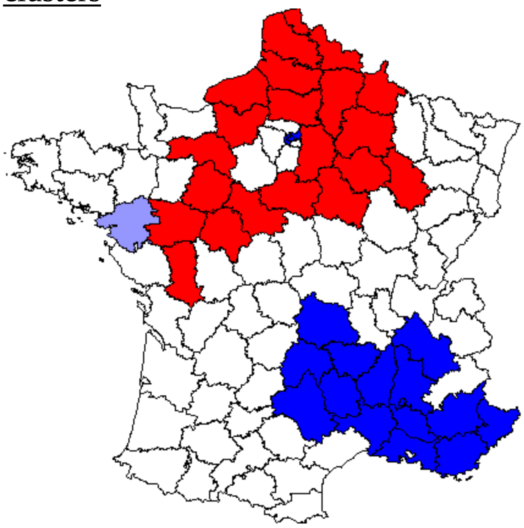


Figure 4 2006 Production of Field Crops

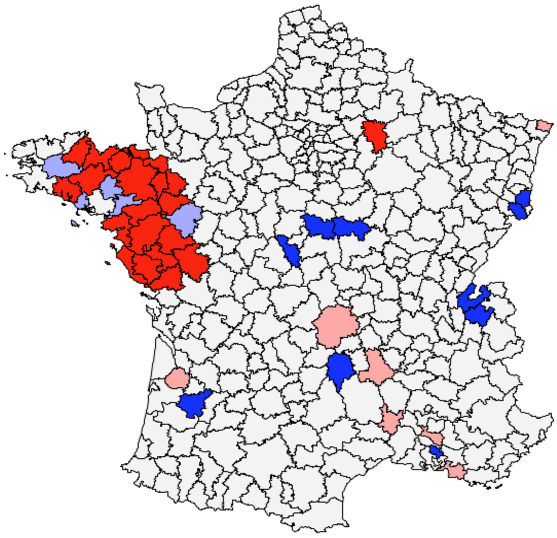


Figure 5 2005 Cereal Industries

The spatial dynamic of field crops, including cereals, covers a relatively large territory. Between 1990 (Figure c) and 2006 (Figure 4), there was a westward shift of regions with a positive dynamic. For the industrial grains sector, one main cluster is found, in Grand-Ouest, showing little change between 1996 (Figure d) and 2005 (Figure 5). Animal feed industries account for the greater part of this cluster, as Grand-Ouest is an important livestock region.

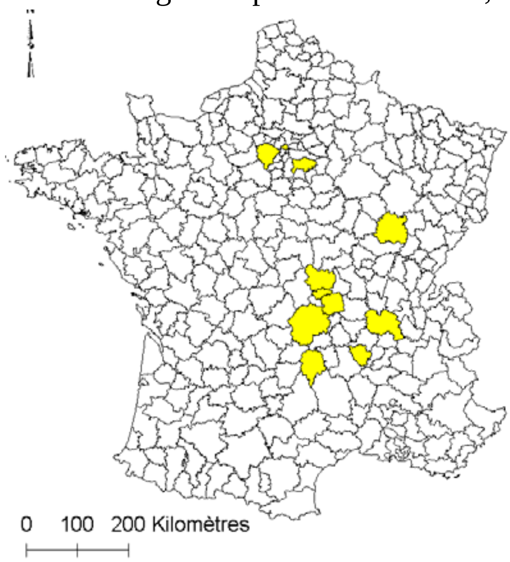


Figure 6 Céréales Vallée cluster

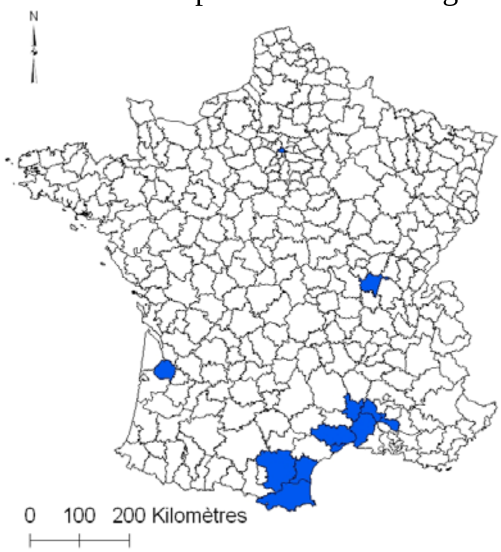


Figure 7 Qualiméditerranée cluster

The Céréales Vallée cluster's catchment area (Figure 6) does not include agricultural or industrial sectors with any notable spatial dynamics, except in Île-de-France, where a positive dynamic is found in the field crops sector. It is, however, located in an area with atypical HL behaviours (being dynamic as regards the cereals industry whereas its neighbours are not). Nor does the Qualiméditerranée cluster (Figure 7) appear to inhabit an area with clustering dynamics in the cereals and field crops sector.

Fruit production (2006), market gardening/horticulture (2006) fruit/vegetable industries (2005)

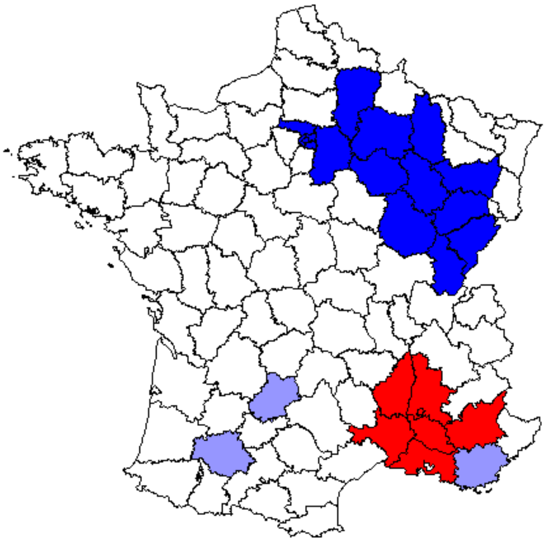


Figure 8: 2006 Fruit Production

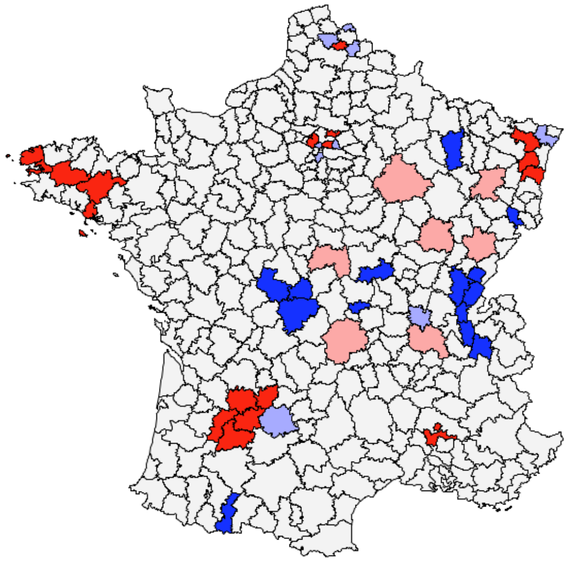


Figure 9 Fruit/vegetable industries, 2005

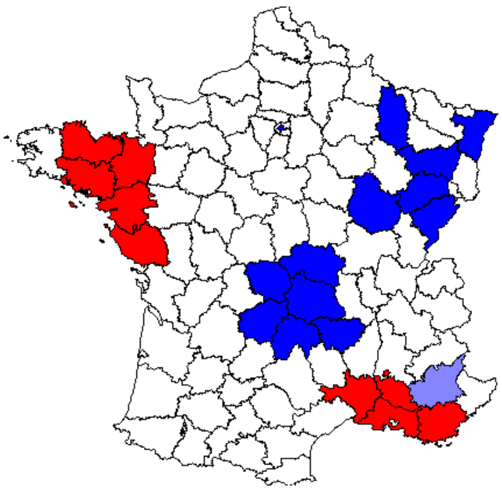


Figure 10: 2006 Vegetable and Horticultural Production

The dynamics of fruit production were found to be stable between 1990 and 2006 (southeastern France, Figure 11). The Bouches-du-Rhône department is the largest vegetable producer and has a highly positive dynamic. Between 1990 (Figure f) et 2006 (Figure 10), other departments strengthened their market gardening and horticulture position, forming a relatively dynamic cluster in western France (Brittany, Pays-de-la-Loire). The Valorial and Végépolys clusters are located there.

For the fruit and vegetable industry (data for the fruit sector alone is unavailable) (Figure 9), the clustering zones are small. Three clusters are found in Brittany, Aquitaine and Alsace. Smaller clusters are also found in Île-de-France and Rhône-Alpes (agricultural fruit production cluster). The Aquitaine cluster gained one employment zone between 1996 (Figure e) and 2005. That was the only notable change between those two years.

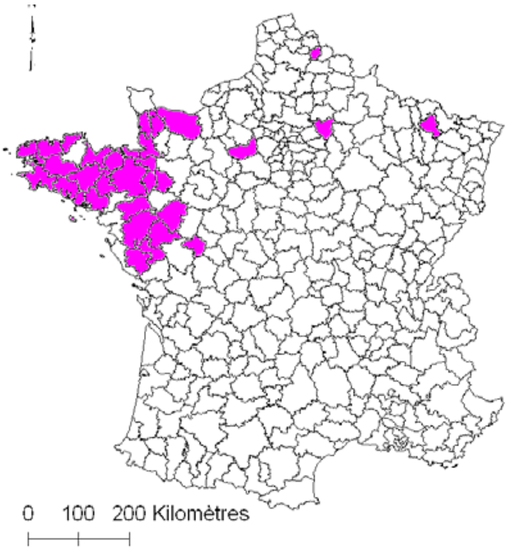


Figure 11: The Valorial cluster

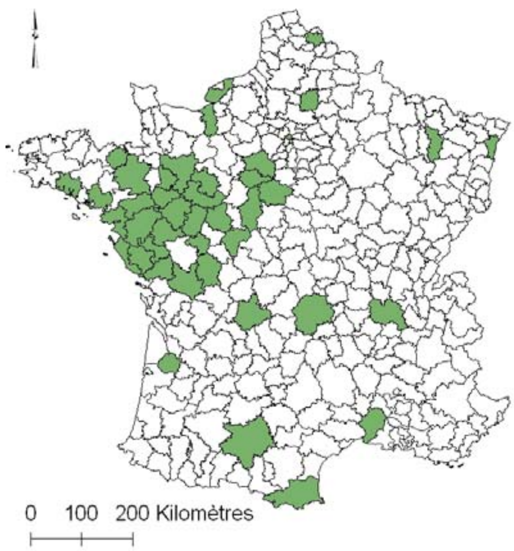


Figure 12 The Végépolys cluster

Valorial (Figure 11) is located in zones where industrial activities have a positive dynamic (Grand-Ouest in particular). Végépolys (Figure 12) has a principal catchment area in the Grand-Ouest that is unrelated to the fruit and vegetable production cluster also found there. It also has members near the Alsace and Aquitaine industrial clusters. The presence of this cluster in the South may reflect a desire on the part of some stakeholders to ride on the coattails of the main horticultural and fruit production cluster.

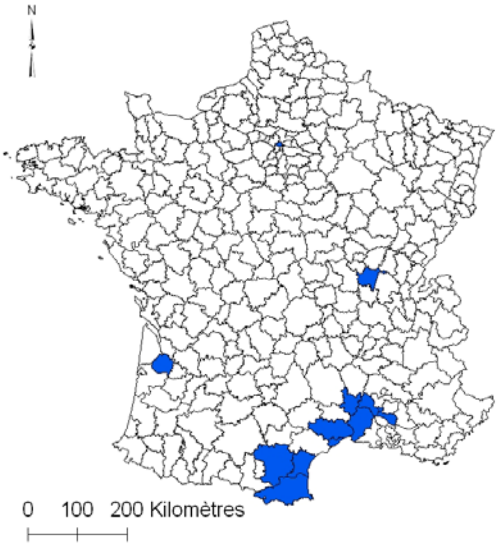


Figure 13 Qualimediterrannée cluster

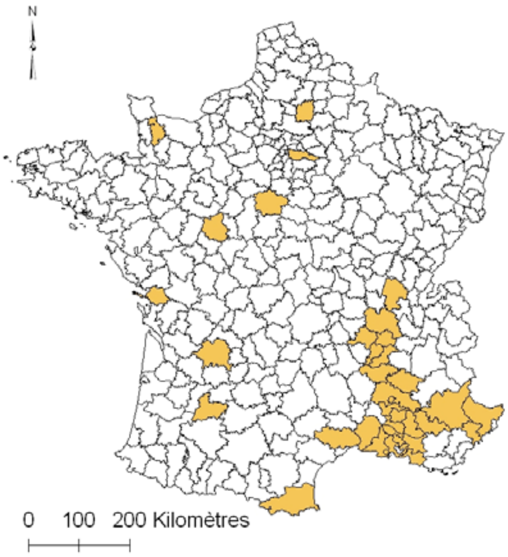


Figure 14 Pôle Européen d'Innovation Fruits et Légumes

Qualiméditerranée (Figure 13) is preponderantly based in the South, near but not right inside the most dynamic fruit production area. It also has a presence in Aquitaine, in the same employment zone as Végépolys, near the Aquitanian industrial cluster.

PEIFL (Figure 14) also has an important presence in the fruit production cluster in the Southeast, and has members near or within the Aquitanian industrial cluster and the small Île-de-France cluster. The Qualiméditerranée cluster (Figure 13) is preponderantly based in the South, near the most dynamic market gardening area. PEIFL too (Figure 14) is an important presence in the southeastern market gardening cluster and has members near or within the Aquitanian industrial cluster.

Livestock production: Milk (2006), dairy industries (2005), pig, poultry and cattle production (2006) and meat industries (2005)

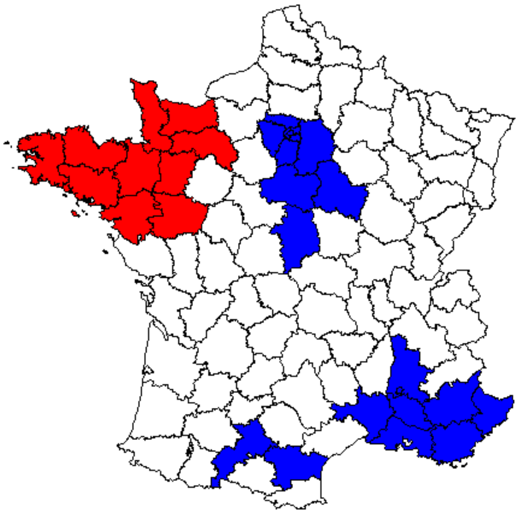


Figure 15 2006 Dairy Production

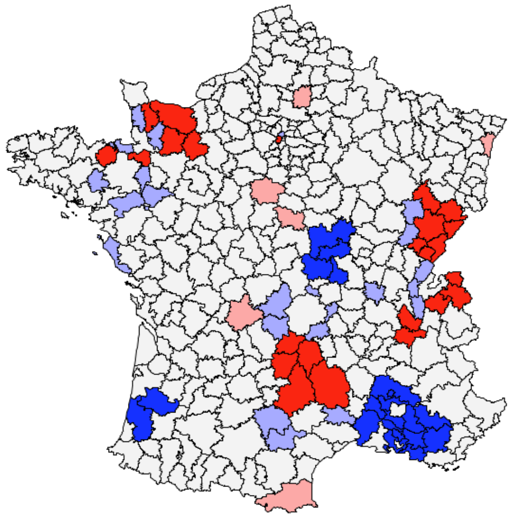


Figure 16 2005 Dairy Industries

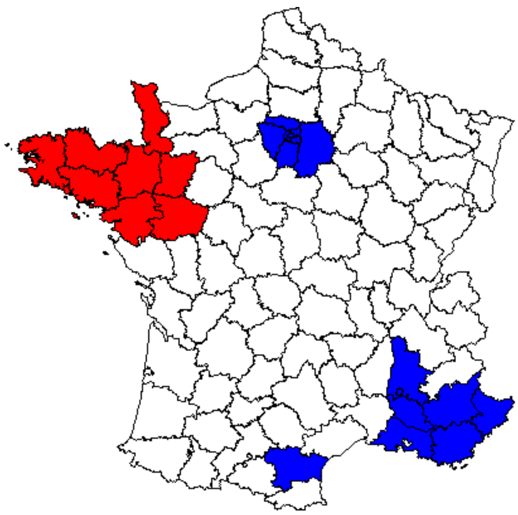


Figure 17 2006 Meat Production

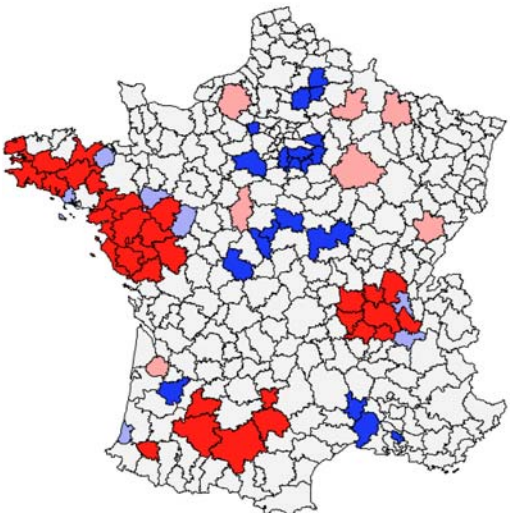


Figure 18 2005 Meat Product Industries

France's Grand-Ouest region has a positive dynamic for milk (Figure 15). As regards dairy industries (Figure 16), positive spatial dynamics are more scattered (Lower Normandy, Franche-Comté, Rhône-Alpes and southern Auvergne).

Positive dynamics for meat production are mainly found in the Grand-Ouest region. That cluster expanded recently to Normandy thanks to beef production (see Figure g attached). Three large clusters may be identified for the meat products processing sector (Figure 18): one in the Grand-Ouest, one in Midi-Pyrénées and one in Rhône-Alpes.

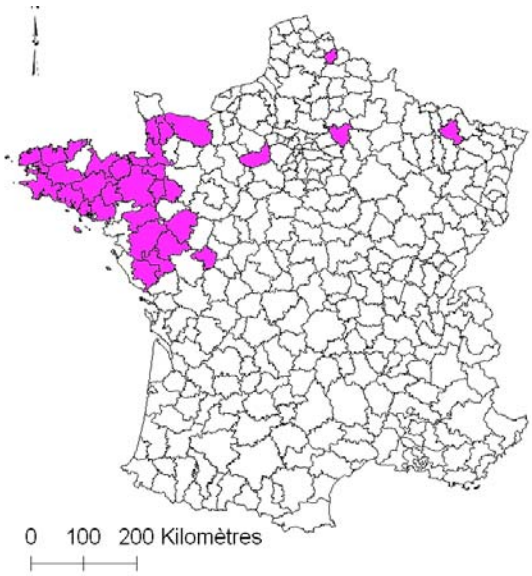


Figure 19 The Valorial cluster

The Valorial cluster (Figure 19) is mainly located in Grand-Ouest, at the heart of dairy production activities. As far as the dairy sector is concerned, this cluster's spatial correlation appears to be more with agricultural than industrial activities. More generally, it is located in the area where a positive dynamic exists for husbandry, both on the farm and in terms of processing industries.

An analysis of the link between cluster location and spatial dynamics indicates that some clusters rely on a strong local dynamic in agricultural and/or agri-food activities. Such is the case, for example, of the Valorial and Végépolys clusters and the Pôle Européen d'Innovation Fruits et Légumes (PEIFL). In other cases there is not so clear a link to local production dynamics. Examples of this would be Céréales Vallée, Agrimip Innovation and the Qualiméditérranée cluster.

After this first stage of analysis, which deals with the relationship between competitiveness clusters' emergence, their geographic extent and the spatial dynamics of the agricultural and agri-food sectors concerned, we look at whether cooperative dynamics or other interactions beyond mere geographical proximity are operative between the clusters.

4. Network analysis of competitiveness clusters

Inter-cluster links—their nature, number, and density—are studied based on a network analysis. The term "network" means a set of interconnected entities that allows the circulation of tangible or intangible items between each of the entities (nodes) according to well defined rules. In our case, collaborative inter-cluster networks are considered: two clusters are linked if they both participate in a research and development (R&D) project accredited by the Joint Ministerial Single Fund (FUI) under the Government's competitiveness clusters policy.

We analyse inter-cluster linkages and their nature (geographic proximity, complementary activity…); this provides indications as to the competitiveness clusters' collaboration strategies: geographic or organised proximity, belonging or likeness. It also provides guidance on the each cluster's position in the network (central position, intermediate, or end of the network…).

This study is conducted using Ucinet social network analysis software (Borgatti et al. 2002) and its NetDraw network visualisation plug-in. This software can perform measurements to characterise the network of clusters we are studying—size, number of links, network density, average distance between two nodes—and visualise the network. The results of this initial data processing step are shown in Table 6.

Table 6: Collaborations between competitiveness clusters (response to FUI call for proposals)

	Agrimip Innovation	Céréales Vallée	IAR	Innoviandes	NSL	PEIFL	ProdInnov	Qualimédi-terranée	Valorial	Végépolys	Vitagora
Number of CFPs	12	6	12	2	8	4	7	8	6	7	10
Agrimip Innovation					1S		1G	1G			
Céréales Vallée											
IAR											1S
Innoviandes								1S			
NSL	1S							1S		1S	1S
PEIFL								1G			
ProdInnov	1G										
Qualiméditerranée	1G			1S	1S	1G					2S
Valorial										1G	
Végépolys					1S				1G		
Vitagora			1S		1S			2S			
Axelera	1S										
Enfant									1G		
Fibres Grand Est	1S										
PASS			1S								
Plastipolis		1	3S								1S
Pôle européen de la céramique			1S								
Trimatec		1				1G		1G			
Xylofutur	1G										

Source: Datar, 2008

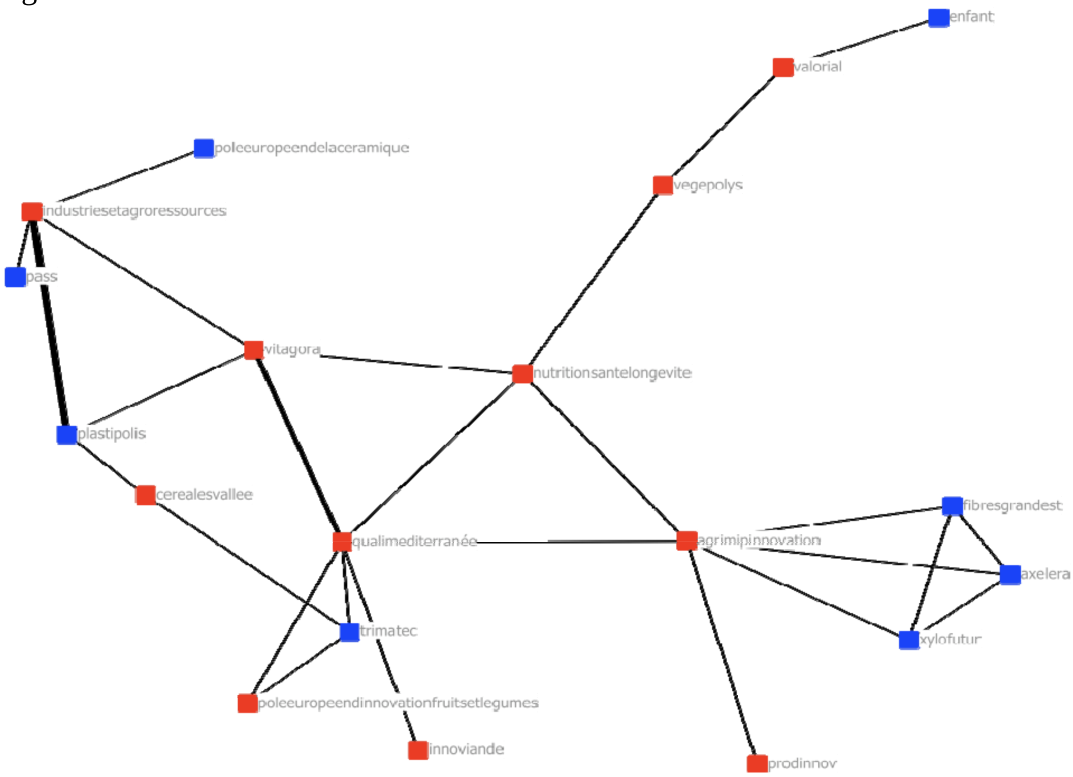
The first row contains the total number of CFPs (calls for proposals) bid on by each of the clusters reporting to the agriculture ministry. The figures indicate the number of collaborations between the clusters concerned. The letter S or G indicates the type of collaboration. G collaborations are more geographic in nature, as they took place between clusters physically close to one another (geographical proximity). S collaborations are more strategic, as the clusters entered into partnerships because, for example, their activities are complementary. Such collaborations may be considered to reflect organised proximity.

Table 7: Partner clusters of those reporting to the agriculture ministry

Competitiveness cluster	Headquarters location	Type of business
Axelera	Lyon, Rhône-Alpes	Chemistry
Children	Cholet, Pays-de-la-Loire	Goods and services for children
Fibres Grand Est	Épinal, Lorraine	Bioresources / Materials
PASS	Grasse, Provence-Alpes-Côte d'Azur	Consumer goods / Bioresources / Chemistry
Plastipolis	Bellignat, Rhône-Alpes	Materials
Pôle européen de la céramique	Limoges, Limousin	Consumer goods / Materials
Trimatec	Pont-Saint-Esprit, Languedoc-Roussillon	Energy Engineering / Services
Xylofutur	Gradignan, Aquitaine	Bioresources / Materials

Inter-cluster links relating to responses to calls for proposals are shown (Figure 20). This figure incorporates the clusters referred to in Table 6. Thicker lines mean a more intense relationship, i.e. more inter-cluster links.

Figure 20. Network visualisation of inter-cluster collaborations



Additional measures may be used to characterise the network.

Network density may be calculated based on the actual number of links out of the possible number of links L, where $L = N*(N-1)/2$ and N is the number of network elements ($N = 19$ in our case). The average density is 0.17. As density can vary from 0 (no relations) to 1 (all potential links occur), we see that our network of relationships is sparse.

Geodesics may be used to evaluate the accessibility of network members. The shortest path connecting two nodes is called a geodesic. Ucinet® calculates an average geodesic distance of

3, a relatively high value indicating relatively difficult access within the network. This means that on the average, clusters need two intermediaries to become connected.
Specific measures are given for each cluster in the network. Degree, in Table 8, means the number of relationships each cluster is part of:

Table 8 Measurement of degree for each cluster

	1 Degree
qualimediterranÈe	7.000
industriesetagroressources	6.000
agrimipinnovation	6.000
plastipolis	5.000
vitagora	5.000
nutritionsantelongevite	4.000
trimatec	3.000
axelera	3.000
xylofutur	3.000
fibresgrandest	3.000
cerealesvallee	2.000
poleeuropeendinnovationfruitsetlegumes	2.000
vegepolys	2.000
valorial	2.000
enfant	1.000
innoviande	1.000
prodinnov	1.000
pass	1.000
poleeuropeendelaceramique	1.000

Of all clusters, Qualiméditerranée, Agrimip and Industries Agroressources are those that maintain the largest number of relationships with others.

Betweenness is a measure of a node’s capacity to play the role of an intermediary, a point through which information must pass. Technically, it is a node’s propensity to lie on a geodesic, that is, the shortest path between two network members (Table 9).

Table 9: Measurement of betweenness

	1 Betweenness
qualimediterranÈe	61.500
agrimipinnovation	59.000
nutritionsantelongevite	57.500
vitagora	51.000
industriesetagroressources	33.000
vegepolys	32.000
valorial	17.000
trimatec	10.500
plastipolis	7.500
cerealesvallee	3.000
enfant	0.000
axelera	0.000
poleeuropeendinnovationfruitsetlegumes	0.000
fibresgrandest	0.000
poleeuropeendelaceramique	0.000
innoviande	0.000
prodinnov	0.000
pass	0.000
xylofutur	0.000

This table shows the strategic position of some clusters within the network. The Qualiméditerranée and Agrimip clusters act as intermediaries respectively 61 and 59 times during inter-cluster collaboration. Potential inter-cluster relationships must often go through them, as they occupy a first-class strategic position.

The final study subject was cliques within the cluster network. Cliques are cohesive cluster subgroups that choose to collaborate with one another. Belonging to the same clique means maintaining special relationships with other clusters in the clique. In this network we identified 5 cliques.
We showed these cliques within the network using NetDraw:

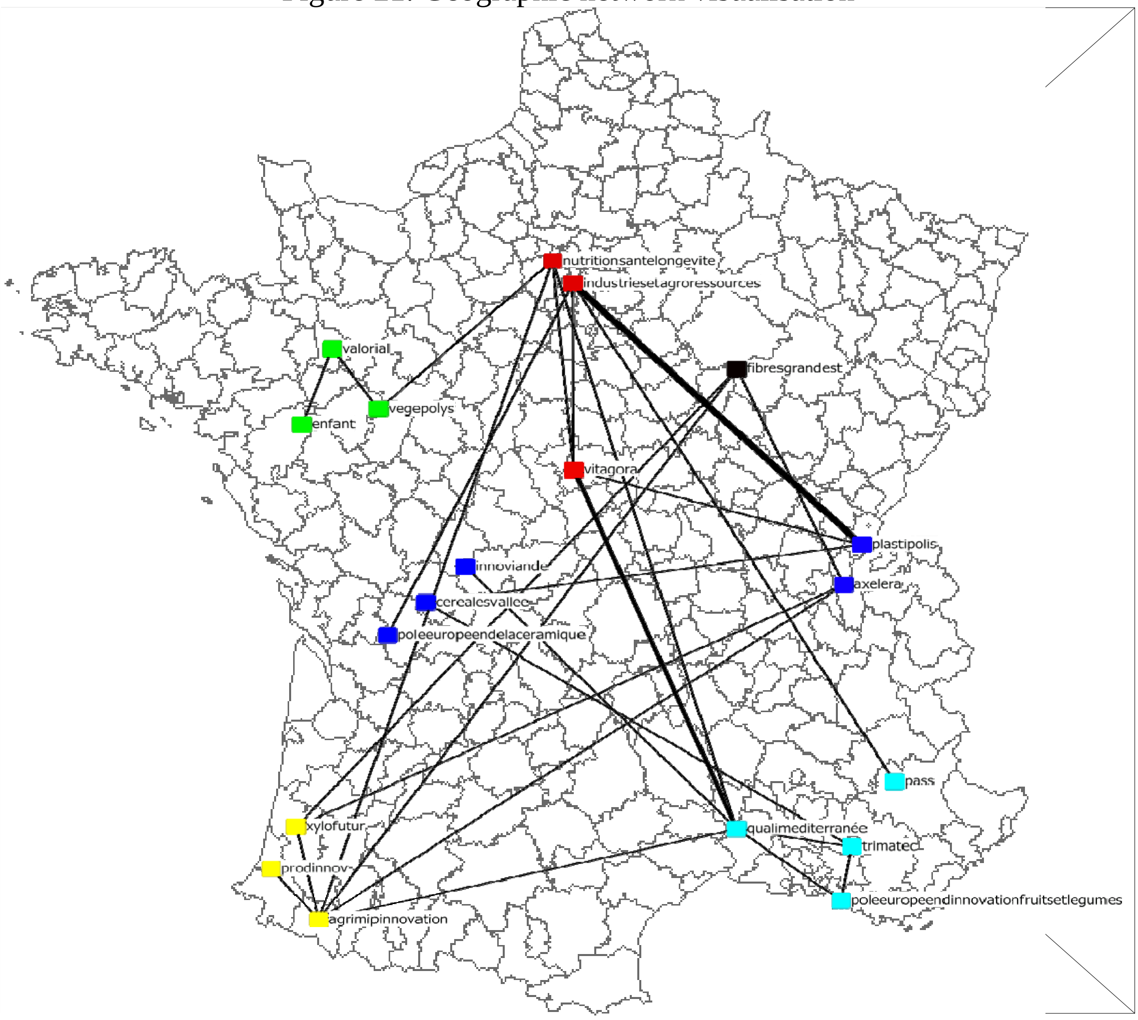
```
1:  agrimipinnovation axelera fibresgrandest xylofutur
2:  agrimipinnovation nutritionsantelongevite qualimediterranÈe
3:  industriesetagroressources plastipolis vitagora
4:  poleeuropeendinnovationfruitsetlegumes qualimediterranée trimatec
5:  nutritionsantelongevite qualimediterranée vitagora
```

Clusters with a high betweenness coefficient are also those that belong to several cliques: Agrimip (2) and Qualiméditerranée (3). These clusters have a truly strategic position within the network studied.

A final network visualisation (Figure 21), showing both the geographic distribution of clusters and the links between them, has been used to summarise the nature of their collaborations (geographical or otherwise).

Essentially there are three areas in which clusters collaborate for reasons of geographical proximity: the Northwest, Southeast and Southwest. In other areas, the collaborations observed arise instead from organised proximity, mainly technological complementarity.

Figure 21: Geographic network visualisation



This analysis reveals the general characteristics of the network of clusters, such as density and geodesics. But its main usefulness was in identifying the clusters' network positions and strategies.

Table 10: Summary data on clusters' network positions

	Number of links	Betweenness	Belonging to one or more cliques	Nature of links	
				Geographic	Strategic
Agrimip Innovation	6	59	2	2	4
Céréales Vallée	2	3	0	0	2
Qualiméditerranée	7	61,5	3	2	5
PEIFL	2	0	1	2	0
Valorial	2	17	0	2	0
Végépolys	2	32	0	1	1

The Agrimip and Qualiméditerranée clusters play the lead role in the network. They are intermediaries in the collaborations established between clusters and not only create links for reasons of geographical proximity but also establish many strategic relations with clusters throughout France.

Other clusters, like PEIFL or Céréales Vallée, are not tightly integrated into the network. They spark few collaborations and do not occupy a strategic place within the network.

5. Summary of results, conclusion

In this article we have presented a characterisation of France's competitiveness clusters specialising in the fields of agriculture and agri-food, from which it emerges that the six clusters specifically studied have different profiles because of their proximity to dynamic areas of agricultural and agri-food production and because of their collaborations with other clusters, which have recently been encouraged by the French government.

Very clearly, the Valorial and Végépolys clusters (located in the Grand-Ouest region) and the Pôle Européen d'Innovation en Fruits et Légumes (Southwest) are located in areas where there is a clear agricultural and agri-food dynamic (positive spatial autocorrelation of the units observed). These three clusters are also those with the largest catchment areas, as they are a factor in about 10% of France's employment zones. The Céréales Vallée, Agrimip Innovation and Qualiméditerranée competitiveness clusters are less clearly tied to a production dynamic. They are present in a much smaller territory (some 3.5% of the country's employment zones).

At the same time, it appears from a network analysis based on the observation of inter-cluster collaboration that some clusters are strategically positioned thanks to the kind and number of their collaborations. Such is the case of the Agrimip Innovation and Qualiméditerranée competitiveness clusters. It should be noted that in Agrimip Innovation's zone of influence, a positive spatial dynamic has emerged over the last few years in the agri-food sector. The relations developed by these clusters are characterised specifically by strategic or organised proximity, and often involve clusters with complementary activities (e.g. Agrimip Innovation and Fibres Grand Est). Clusters more directly linked to an agricultural or agri-food dynamic develop fewer inter-cluster collaborations and such as do exist tend to reflect mere geographical proximity.

The original work done has made it possible to profile distinct clusters in the agricultural and agri-food area; however, as competitiveness clusters policy is relatively recent, it remains to be seen whether these results will be confirmed in the long term. Furthermore, our analysis has been based on inter-cluster collaborations but ignores international collaborations, even though the clear intent of the policy is to afford cluster members greater international visibility.

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Appendices

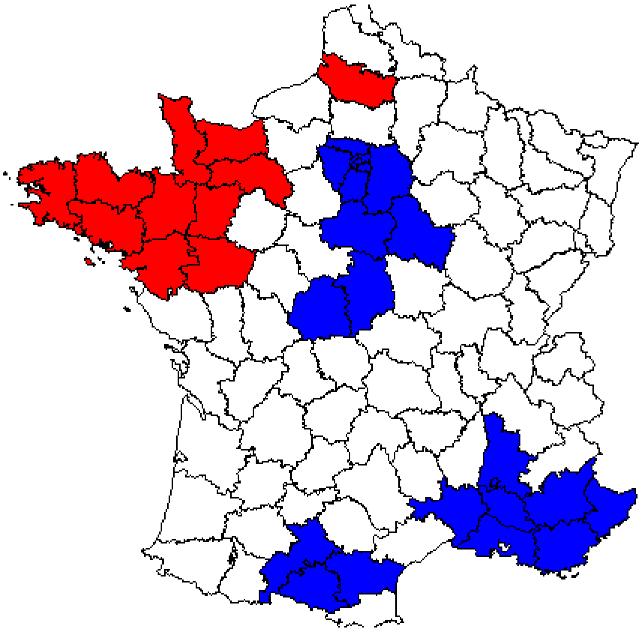

Figure a. Dairy production, 1990

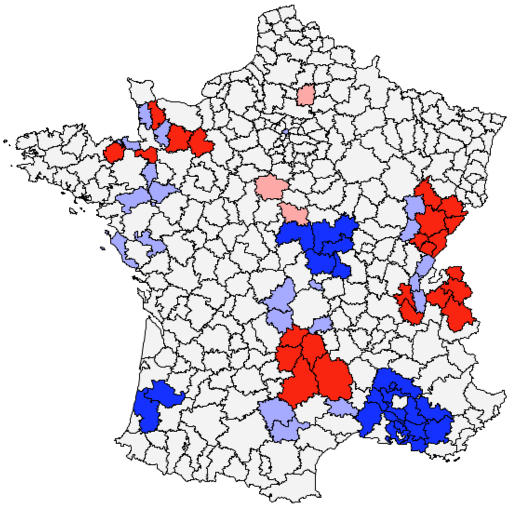

Figure b. Dairy industries, 1996

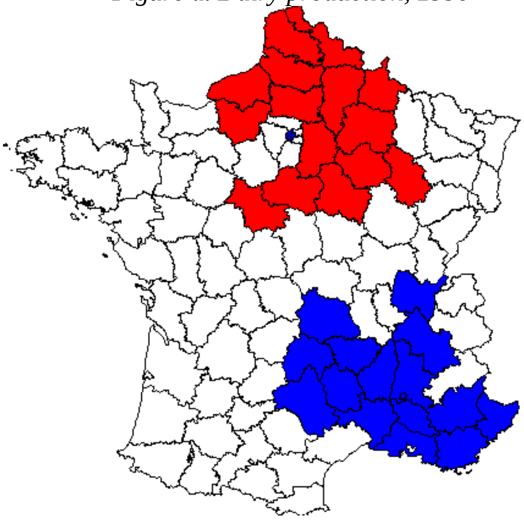

Figure c. Field crop production, 1990

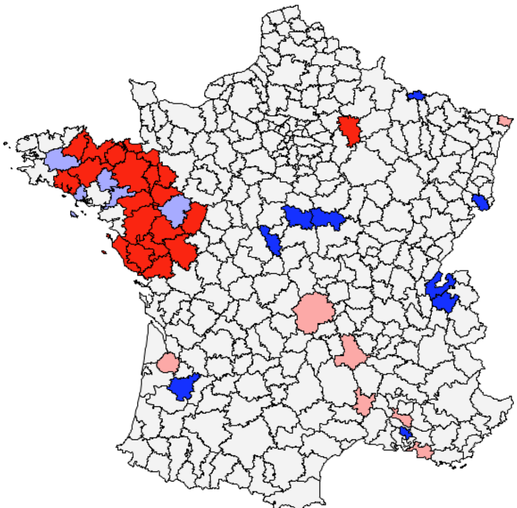

Figure d. Cereal industries, 1996

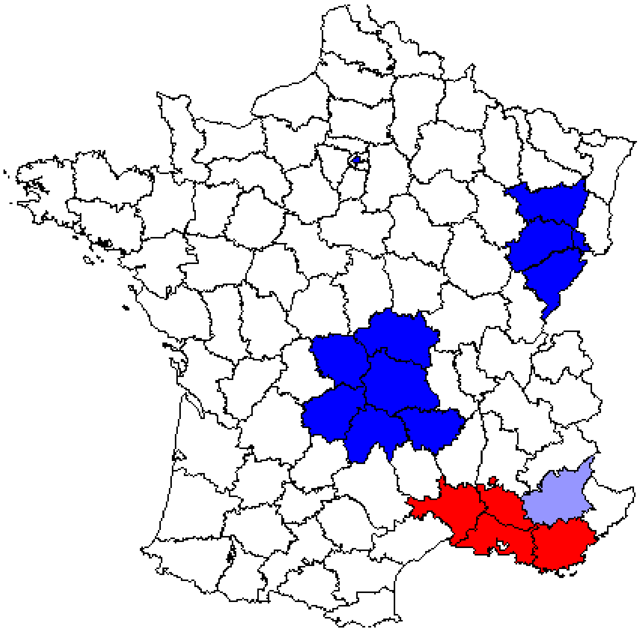

Figure e. Horticultural and vegetable production, 1990

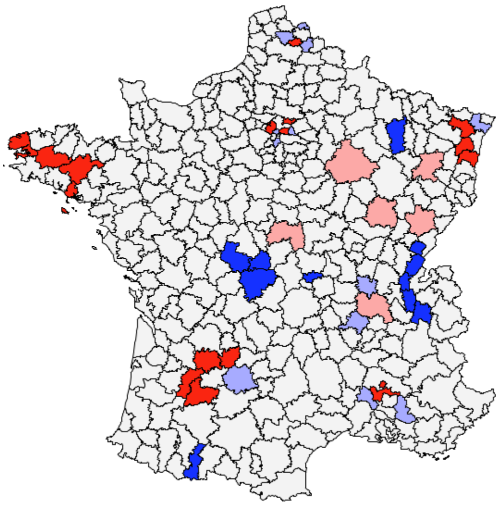

Figure f. Fruit and vegetable processing industries, 1996

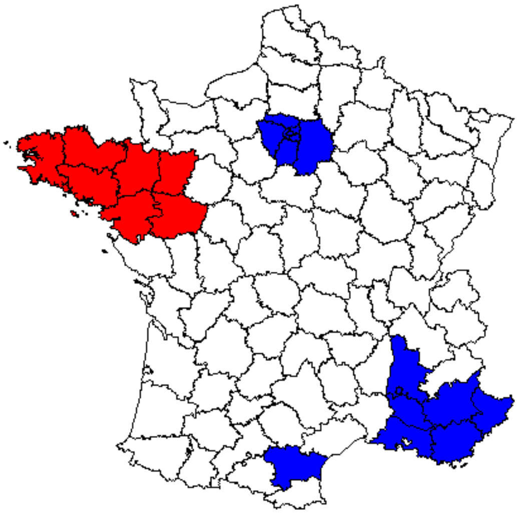

Figure g. Meat production, 1990

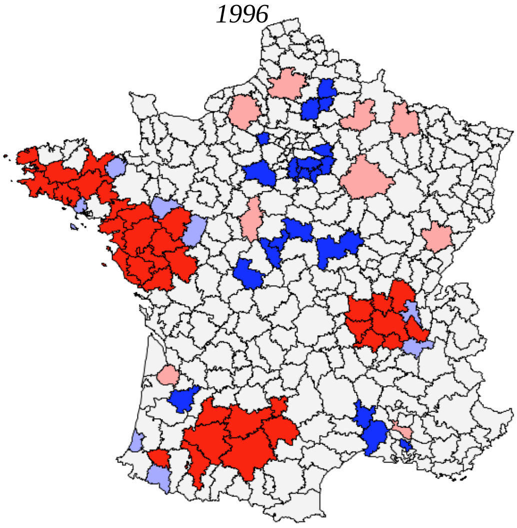

Figure h. Meat products industries, 1996

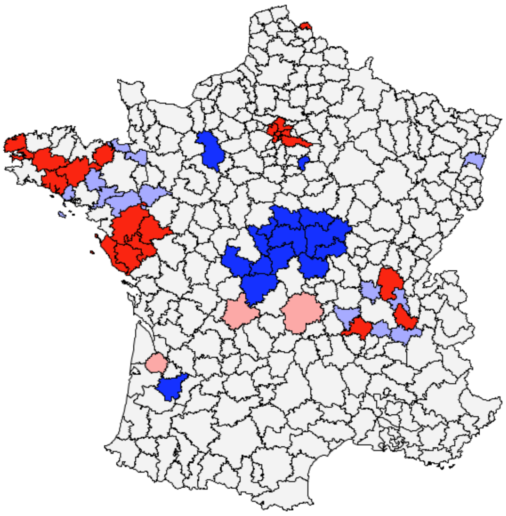

Figure i. All IAAs, 1996