The determinants of local collective action on erosive runoff. An analysis of farmers' geographical proximities in Upper Normandy, France

Alexandre Joannon*

UMR-1048, INRA-INAPG SAD APT, Bât. Eger, BP 01, 78850 Thiverval Grignon, France
(e-mail: joannon@grignon.inra.fr)

André Torre

INRA, UMR SAD-APT, 16 rue Claude Bernard, F-752321 Paris Cedex 05, France
(e-mail: torre@inapg.inra.fr)

Véronique Souchère

UMR-1048, INRA-INAPG SAD-APT, Bât. Eger, BP 01, 78850 Thiverval Grignon, France
(e-mail: souchere@grignon.inra.fr)

Philippe Martin

INAPG, UMR SAD-APT, Bât. Eger, BP 01, 78850 Thiverval Grignon, France
(e-mail: pmartin@inapg.inra.fr)

Abstract: Runoff disregards territorial boundaries, affects farmers as well as other users of space, and necessitates collective action if it is to be combatted. In this article, based on the case of Upper-Normandy, we show that geographical proximity can play a determining role in the struggle against erosive runoff, and we present a new tool for analysing relations of proximity between farmers. First we use three examples to show that farmers have only limited knowledge of the problem of erosion and are largely incapable of carrying out concerted collective action. That is why *Syndicats de bassins versants* were set up to provide organized proximity. Then we present a new tool for analysing relations of geographical proximity between farmed land and farmsteads, in order to assess the possibilities of coordination between farmers within catchment areas. Our results, based on the characterization of 1409 communes, clearly show that long distances, the size of farmed agricultural land and the high number of external farmers constitute major obstacles to the creation of ad hoc cooperative processes.

Keywords: erosion, coordination, geographical proximity, runoff, Upper-Normandy.

* Author for correspondence.

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Biographical notes

Alexandre Joannon is an agricultural scientist. He is a postdoctoral researcher at the Sciences for Action and Sustainable Development Department of the National Agronomic Research Institute in France. His PhD (in agronomy, in 2004) examined what were the technical possibilities to modify farmers' practices and their spatial organization inside the farm territory (crop sequences, crop management) in order to reduce erosion in a watershed. He is involved in several research projects on managing erosion problems.

André Torre is Director of Research at the INRA (National Institute of Research in Agronomy) in Paris, and invited Professor at several French universities. His research is devoted to analysing proximity relations and their importance in the processes of coordination between various actors, and focuses essentially on two fields of application. Firstly, the study of interactions between innovating firms, and more specifically of the role played by geographical proximity in the diffusion of knowledge. Secondly, the study of land-use conflicts, for which a multi-disciplinary approach is necessary in order to identify, define and determine the modes of conflict resolution.

Véronique Souchère is an agricultural engineer at the Sciences for Action and Sustainable Development Department of the National Agronomic Research Institute in France. She has a PhD from the Paris–Grignon National Agronomics Institute. Her research interests are in soil erosion modelling using GIS, and how farmers could change their agricultural practices (cropping pattern, crop management) in order to control erosion.

Philippe Martin is an agronomist. He is working as a lecturer at the Institut National Agronomique Paris-Grignon (France). His PhD (in agronomy, 1997) examined the dynamics of soil surface states under different cropping systems and their consequences on both runoff and erosion. He is conducting several projects on environmental issues involving spatial organization of cropping systems: erosion in Normandy; sustainability of agro-forestry systems in Vanuatu (collaboration with CIRAD). He is in charge of a research team working on these subjects in the UMR INRA/INAPG SAD APT.

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1 Introduction

Some of the environmental problems challenging agriculture, such as non-point source pollution by nitrates, are related to cumulative effects with no real spatial component. With others the spatial component is unavoidable and requires a radically different approach in which the resolution of environmental problems necessarily involves ad hoc or organized coordination between local actors. Erosive runoff in Upper-Normandy corresponds to this type of situation. Because this problem transcends territorial boundaries and their hierarchical organization, it requires cooperation and coordination

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between local and regional actors – farms, municipalities or larger geographical areas – and between the various users of rural space. The main phenomenon is hardly visible for the uninitiated because it concerns diffuse runoff that flows without causing any damage upstream from agricultural catchment areas. Downstream, however, it forms deep ravines that are a real problem to farmers, and water carrying large amounts of soil can result in muddy floods on roads and in the towns situated further down (Boardman *et al*., 2003). Groundwater used for domestic purposes is frequently polluted in this way. It is the damage caused outside agricultural land that is the most detrimental (Amstrong *et al*., 1990).

Whereas for a long time the damage caused by erosive runoff in Upper-Normandy, and more generally in the loamy plains of northern Europe, was minor compared with that of the Mediterranean regions or areas with steep slopes, it increased substantially in the mid-1970s (Papy and Douyer, 1991; Boardman *et al*., 1994; Verstraeten and Poesen, 1999). This pollution, which directly affects farmers, also concerns the rest of a population characterized by a process of distinct peri-urbanization. Because its scope is region-wide, it mobilizes most of the population and public authorities when the consequences are particularly serious. However, farmers are frequently left alone to deal with the problem of erosion, owing to a lack of infrastructure and/or structures to organize dialogue on these issues. Their solutions are often far too local and individual, owing to a lack not only of consultation but also of awareness of the general and collective nature of the problem. Hence, the problem of erosive runoff is characterized by a disconnection between areas producing runoff upstream of the catchment areas, and downstream areas from which soil is carried away owing to the concentration of sediment-loaded runoff. The problem requires collectively planned and coordinated control of the entire catchment area.

Studies carried out on the problems of erosive runoff in the different catchment areas of Upper-Normandy suggest that the damage caused by runoff can only be fought through local collective action (Papy and Torre, 2002). The various users of the space concerned, especially farmers, must be made aware of the mechanisms at work in erosive runoff and of how their practices affect these mechanisms. This first step is a prerequisite for the establishment of more extensive coordination, for it reveals the futility of isolated action. In this article we posit that geographical proximity (Torre and Gilly, 1999) between farmsteads and the catchment areas in which the farmers operate is a significant factor in this awareness, and hence in the collective actions that need to be set up locally. Indeed, Mathieu *et al*. (2003) have shown that when there is close geographical proximity between the farmstead and the catchment area, farmers have, on the whole, limited knowledge of the water's path through the different sections of the catchment area. Only actors likely to spend a lot of time on the sites of erosion, and capable of maintaining frequent and prolonged interactions, can be made aware of the phenomenon in its entirety and try to implement concerted rather than individual solutions.

This corresponds to one of the founding hypotheses of contemporary socio-economics, as proposed for example by Granovetter (1973), who emphasizes the importance of networks of actors and the advantage of promoting interpersonal relations between different actors. However, we also refer to interface relations at local level. In doing so, we try to verify, using this particular case, one of the postulates of proximity analyses (Filippi and Torre, 2003; Rallet and Torre, 2005). Indeed, we retain the hypothesis according to which there are two types of proximity. *Organized proximity* rests on two types of logic, a logic of similitude and a logic of belonging. According to the

logic of belonging, actors are close when they belong to the same space of relations (firm, network…), i.e. actors between whom interactions of different nature take place. According to the logic of similitude, actors are close when they are alike, i.e. when they possess the same space of reference and share the same knowledge, so that the institutional dimension is also important. *Geographical proximity* is the counterpart of organized proximity from the perspective of the relations between agents. Referring to a great extent to the location of firms, it integrates the social dimension of economic mechanisms, or what is sometimes called functional distance. In other words, the reference to natural and physical constraints is an important aspect of geographical proximity, but other aspects are equally important in its definition: the aspect of social structures, such as transport infrastructures that facilitate accessibility, or the financial mechanisms that allow the use of certain communication technologies. On this basis, we aim to test both the criteria of geographical proximity – and therefore of distance – between farmers, and the criteria of organized proximity, i.e. of their ability to work together, consult each other about problems they may face, and find common solutions.

In the first part of our paper we analyse three situations characteristic of varying degrees of collective action in Upper-Normandy, from a total lack of dialogue to the establishment of local coordination structures, the *Syndicats de bassins versants*. Thus we show how organized proximity may help to overcome the lack of relations between the different actors involved, in particular when they are institutionally based. In the second part we present a new method for analysing geographical proximity between farmsteads and farmed fields, tested on the same zone on the basis of data drawn from CAP (Common Agricultural Policy) documents. This method provides indications of how the representatives of the catchment basin can set up a local coordination process to fight efficiently against erosive runoff. Let us note now that the method proposed has a limitation: the data used for our analysis were available only at municipal scale and not at the scale of catchment areas, the boundaries of which are quite different from those of *communes*. We shall discuss this point further at the end of the article.

2 From pollution caused by erosive runoff to the search for collective solutions: the case of Upper-Normandy

Owing to its pervasiveness, erosive runoff affects relatively large groups of local actors. Any solutions, whether they concern minor technical actions (change in the direction of tillage, hedges, etc.), the construction of infrastructure (e.g. storage basins) or the destruction of roads or buildings (i.e. elimination of an impermeable surface that reduces the absorption of water by the ground), always have a significant collective impact. Only rarely can they be implemented effectively by an isolated actor, for the impact is either relatively weak or the action is not approved by the other actors, who often have different conceptions and uses of rural space. Consequently, many small collective actions at municipal level or in particular catchment areas can be expected. In the case of Upper-Normandy few actions of this type are undertaken. Actions to fight erosive runoff problems are taken at a larger scale, i.e. at the *département* or region level. Geographical proximity between the actors and the victims of runoff is not enough to generate common solutions, as the Doudeville and Gonzeville cases show. Only larger scale projects

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organized and run by the public authorities are likely to be supported and to mobilize local actors around the struggle against erosive runoff.

2.1 The Doudeville commune: lack of knowledge about runoff patterns and weakness of local coordination

Doudeville, a commune in Upper-Normandy (2500 inhabitants, 1450 ha) is a typical example from the point of view of an analysis of erosive phenomena (Cartier, 2002). Formerly exceptional, these phenomena are now clearly recurrent. The commune is characterized by a large proportion of farmland devoted to various activities and farmed by households in which at least one person also has a salaried job. Evidence of erosive runoff is clearly visible.

Our study reveals that most farmers farming within the bounds of the municipality of Doudeville are concerned about the runoff affecting their fields or the elementary catchment area within which they are situated, if only because they suffer the consequences of the resulting pollution [1]. Yet they have very limited knowledge of the overall processes at play and generally fail to perceive them in their entirety. Although farmers are generally familiar with the flow of runoff in their own fields, they know little about where the water comes from and where it flows to. More importantly, they have little knowledge of what happens in neighbouring lands, at best limited to adjacent fields and most often anonymous. Farmers do not envisage collaboration with their closest neighbours, which limits their efforts to solve problems of erosive runoff to purely local solutions. At best, these involve adjustments to farming practices. Thus, most farmers do not take their downstream neighbours into account. They channel or divert water into their neighbours' fields, without changing their practices. A minority, more concerned about the consequences of their acts, try to reduce the runoff from their fields and thus to limit the risk of erosion downstream.

Cases of concerted management are extremely rare. Only two farmers, out of the 45 in the town, concerned about the ravine formed by erosion, built a compacted bank together and thus tried to limit runoff in fields downstream. This cooperation between the two farmers resulted in a better control of farm practices in fields situated upstream, thus avoiding some effects of erosive runoff. However, the coordination around the problem of erosion was rooted in earlier cooperation. Cooperation was possible because collaborative relations between the two neighbours already existed. The geographical proximity [2] of fields and the common problem facing the neighbours were in no way at the origin of the cooperation, and even less of collective actions involving larger numbers of farmers around a thalweg or a catchment area.

Explanations for the refusal to take collective or concerted action are complex. First, they relate to a local tradition of individualism, to excessive expectations of action by the public authorities – considered to be in the best and most legitimate position to act in such situations (Cartier, 2002) – and even to a real lack of knowledge about runoff patterns. Another cause relates to the characteristics of local farming networks, which are not based on geographical proximity but on existing relations or membership of communities (relations we qualify as organized proximity). These farming networks are formed by people from the same family or on the basis of 'good neighbourly relations' between farms. They may also be based on membership of the same CUMA (agricultural equipment cooperative) whose scope is broader than the commune. In the case of

Doudeville, the survey shows that few networks exist in the territory of the commune. This further limits possibilities of cooperation and dialogue.

One of the reasons for the weakness of these networks is probably to be found in the location of farms operating within the territory of the commune. In fact, only a minority of farmers (40%) who farm in the Doudeville municipal area have their farmstead in the commune, and the useable agricultural area of these farms is mainly located elsewhere. This can be explained by the retirement of a large number of local farmers and by transmission through inheritance. Because farmers farming adjacent or neighbouring fields are often from different communes, at varying distances from Doudeville, professional relations between farmers hardly exist. Relations between neighbours are minimal today compared with inclusion in larger organizational spheres, such as interpersonal social or professional networks. Thus, while geographical proximity between fields leads to no concerted or collective action, it is interesting to consider geographical proximity between farmed fields and farmsteads, which could constitute an interesting incentive for local collective action. We posit that actors who are strongly present at local level and can meet frequently for long periods are more likely to carry out collective action than those who meet only briefly and occasionally. This is in keeping with some of the points highlighted in the proximity analysis: the importance and the frequency of interactions to generate long-term relations within groups or networks of actors (Kirat and Lung, 1999).

2.2 The Gonzeville catchment area: the difficulty of ad hoc cooperation

Because the results presented above suggest that fragmentation of the field pattern and dispersion of farmers limit possibilities of collective management of a catchment area, it is interesting to analyse a situation in which farmsteads are not too geographically dispersed and the field pattern not too fragmented. The Gonzeville catchment area, situated 8 km north-east of Doudeville and spread over four communes, with a useable agricultural area of 438 ha, has these characteristics. It is farmed by 14 farmers, nine of whom farm 96% of the useable agricultural area, including all the fields situated at the centre where water concentrates and ravines are likely to form. The other five own fields located on the periphery [3]. One of the characteristics of the relations between farmers in the Gonzeville area is the geographical proximity between farmsteads, eight of which are in the catchment area or on its periphery. Only one is in a neighbouring commune (1.5 km away). Each farm has at least 20% of its useable agricultural area in the catchment area, with a mean of 40%. Calculation of the fragmentation of fields into blocks in the catchment area shows a range of one to four blocks: four farms have their fields in the catchment area, in one or two blocks, and five farms are divided into three or four blocks. This situation, in which fields are relatively well grouped together, is partly the consequence of land consolidation between 1978 and 1986 in the three communes situated in the Gonzeville catchment area. Thus, this area presents a favourable configuration for collective management. The geographical proximity between farmsteads that have a large portion of their fields in the catchment area corresponds to a largely united field pattern.

The data gathered during research at local level (by Pivain in 1997 and Joannon in 2001) suggest the need for reflection on the possible role of geographical proximity in furthering knowledge on the mechanisms of erosion and water flow in a catchment area.

The list of problems encountered by farmers (runoff, ravines, sediment, etc.) is almost sufficient to justify the reconstruction of the main network of water flow in the area. Yet, when questioned on possible causes of runoff and erosion, farmers never spontaneously mentioned the nature of the farming activities upstream (Pivain, 1997). Once again, we note that they have precise knowledge of water flows in their fields but little awareness of the spatial runoff patterns in the catchment area as a whole. The hypothesis that farmers' geographical proximity to the catchment area improves knowledge of these mechanisms is therefore only partially verified here.

The analysis of cooperation reveals that seven of the nine farmers studied help each other (a much larger proportion than in the Doudeville area). Yet this mutual assistance is only occasional, for harvesting in the autumn, and mostly involves farmers who farm outside the catchment area. This was particularly true of two farmers who relied heavily on mutual help. For one this help was situated within the family, whereas for the other it was limited to specific help with his potato crops. In both cases cooperation was with a farmer outside the Gonzeville catchment area. The inventory of all tasks not performed alone shows that farmers use agricultural firms rather than mutual help or grouped purchases of farm equipment.

The Gonzeville example suggests that geographical proximity between actors may to some extent facilitate the implementation of collective solutions. Yet even in this case conditions are not optimal: knowledge of the field, although better, is still incomplete, and when cooperation between farmers does exist it is not necessarily between farmers in the same catchment area. Coordination by an outside institution therefore seems necessary. This corresponds to farmers' opinions on the matter. They are in favour of the creation of a catchment area association in charge of collective management; the association would comprise farmers, local elected representatives and public authorities (Pivain, 1997). This is probably why a number of institutions have been created to promote collective action against erosive runoff on a broader scale, at regional or provincial level. The *Syndicats de bassins versants* (catchment area syndicates) are a good example.

2.3 Syndicats de bassins versants*: a collective solution to erosive runoff?*

We have seen that collective action to fight erosive runoff is not organized spontaneously. This is partly due to farmers' and other local actors' lack of knowledge about water flows, and to the field patterns, which do not allow for close geographical proximity between farms' decision-making centres, and which in turn explains the farmers' lack of concern for local problems. This does not mean that there is no concerted action in this respect in Upper-Normandy. On the contrary, it does exist, but it concerns incentives or actions by the public authorities to coordinate actors around water issues. The *syndicats de bassins versants* are a good illustration of coordination that transcends municipal level.

In view of the difficulty of ad hoc cooperation, the public authorities decided to set up local institutions to promote coordination and create opportunities of dialogue between the different actors concerned. Various services, agencies or missions are in charge of water affairs, but it is above all the *Syndicats de bassins versants* that play a key role in collective management of erosive runoff problems. Following the episodes of erosion that have affected Seine-Maritime in recent years, 22 *Syndicats* corresponding to the main catchment areas have been set up since 1999 across the *département* [4]. Supported by existing institutions (prefecture, water agency, districts, community of communes, etc.), they benefit from a transfer of competencies on environmental matters through the

creation and maintenance of any undertaking aimed at curbing runoff. Such undertakings range from the replacement of hedges to the construction of storage basins, the digging of ponds or the planting of grass on previously cultivated land. These measures aim to protect fauna and restore habitats, to protect sources of drinking water, and to safeguard public health and the safety of populations and their possessions, all of which are more or less directly concerned by the problem of floods or erosive runoff, from the point of view of both treatment and prevention. According to the law, the aim of the creation of *Syndicats de bassins versants* was an equitable sharing of water resources between different users, and reconciliation between uses of water. The stated goal was thus harmonious development of communities in a sustainable development perspective.

The *Syndicats de bassins versants* (hereafter referred to as Syndicates) make it possible to mutualize costs. A Syndicate is generally set up at the initiative of the Prefecture, which requires local authorities to take measures to avoid floods (among other things), draws up the statutes of the Syndicate and organizes its founding meetings. The Water Authorities, which acts in accordance with the State-Region Plan, are also a key element and control the Syndicate's steering committee. The Syndicate's budget provides for the creation and maintenance of the services mentioned above, from funds derived from the contribution of the associated communes, from income from the Syndicate's property, from public administrations and associations in exchange for a service rendered, and from taxes and contributions for certain services (e.g. collection of domestic refuse). The main actors in these Syndicates are the State (the Environment Ministry, which controls national water policy and is responsible for the planning, regulation and supervision of the Water Authorities, and other Ministries (Agriculture, Infrastructure, Industry) which control water on the ground via local and regional administrations), the Water Authorities (government bodies under supervision of the Environment Ministry, which participate in the definition of water policy in the catchment areas and play a key financial role), the local authorities (most responsibilities concerning water reside in the communes, which finance close to 60% of all investments), as well as institutional bodies and associations (environmental agencies, natural parks, syndicates of people living on river banks, etc. are associated with the work of the Syndicate in a partnership approach).

Collective action is possible owing to dialogue between the different representatives of local actors who meet and take collective decisions to curb or reduce the erosive runoff process. Hence, there is mediation around problems encountered by farmers and other users of the space, discussed by these spokespersons along with solutions to be proposed to local actors or immediately implemented. This is in keeping with the ideas developed in several studies on the mobilization of the potential benefits of geographical proximity through organized proximity, and in particular through the institutional dimension of the organization of collective projects (see Filippi and Torre, 2003). Geographical proximity alone is not sufficient; it must be accompanied by relations of organized proximity, in particular through the implementation of common projects, mostly supported by local organizations recognized by all actors and capable of mobilizing people at local level. The conflicts and tensions that emerge between local actors are thus resolved by implementing procedures of consultation between local actors. These procedures of consultation must be supported by organized proximity and concern the measures that must be implemented as well as the very rules and methods of the on-going negotiation (Rallet and Torre, 2005). The role of the representatives of the catchment area is then

essential, as they must organize the group of actors, and more specifically the farmers, in order to reach acceptable solutions for all the actors concerned by the phenomena.

The idea of managing water per catchment area is to obtain a global view of the territory affected by the risks of runoff and, above all, better knowledge of its use and pressure on the environment. With such information it is easier to act locally on a problem by avoiding negative impacts elsewhere in the area. Moreover, this type of management is supposed to facilitate the implementation of measures that will help to raise the awareness of local actors and mobilize them while taking local constraints into account, and to create a sense of belonging to the environment. As shown above, this awareness and sense of belonging is, on the whole, lacking among farmers. Yet recent experience in the creation of Syndicates shows that their organization also involves a number of constraints. In particular, the administrative areas of the different local government levels often overlap with several catchment areas and therefore complicate harmonization of policies. In that case it is difficult to raise awareness in a municipality in which most residents are situated outside the catchment area concerned by a specific action, or municipalities with divergent objectives. The leaders of the Syndicates need tools for managing dialogue and concrete actions on the ground. The following section consists of a presentation of this type of tool.

3 How to facilitate collective action: a method for analysing geographical proximity between farmed fields and farmsteads

The cases studied above suggest that control of erosive runoff in catchment areas would be facilitated if farms were located in close proximity to the problems facing farmers, because geographical proximity enhances knowledge on erosive phenomena (with the help of the catchment areas' representatives). In reality, the territory of a farm is often spread across several small catchment areas and several *communes*, so that the task is difficult, especially for the officials of the Syndicates who have to deal with very different situations. These range from *communes* in which farmers are in close geographical proximity to catchment areas exploited by external farmers from different areas, with little coherence. In the current context of establishment of Syndicates, it seems useful to develop a tool for classifying small catchment areas in terms of farmers' geographical proximity, which Syndicates could use to orient their action. Indeed, until now, the first actions undertaken by the Syndicates have mainly consisted of making diagnoses on the vulnerability of the catchment basins and the risks of erosion (Souadi *et al*., 2000), in order to decide what facilities should be built in priority to protect the most exposed residential areas. With regards to agricultural land, the syndicates have, without identifying priority areas, subsidized farmers who developed intermediate crops during inter-crop periods. At a later stage they implemented collective actions on agricultural land, necessitating in particular coordination between the farmers. The tool proposed would help them to identify situations in which coordinating the farmers would potentially be more difficult than in others.

3.1 Typical cases

We have identified four main types of relation between farmed land in the commune and external farmers (Figure 1). For each case the commune studied is shown in light grey,

while dark grey is used to represent those communes in which farmers farming land in the commune are situated [5]:

- Agricultural land of a commune may be farmed by farmers from a small number of communes (Types 1 and 3) or from many different communes (Types 2 and 4). It is therefore *the number of external communes* that is important here;
- Likewise, *distances between the commune studied and the communes in which farmers live* vary widely. They may be small (Types 1 and 2) or big (Types 3 and 4). As suggested above, it is probable that situations close to Type 1 are far easier to manage than more complex situations such as Type 4;
- The *surface area of communes farmed by external farmers* is a third criterion to take into account [6]. It can affect the other two criteria: if the surface area farmed by external farmers is small, it seems that the situation will be relatively easy to manage.

Based on these three criteria, we show how this analysis can be performed on the scale of the Upper-Normandy region.

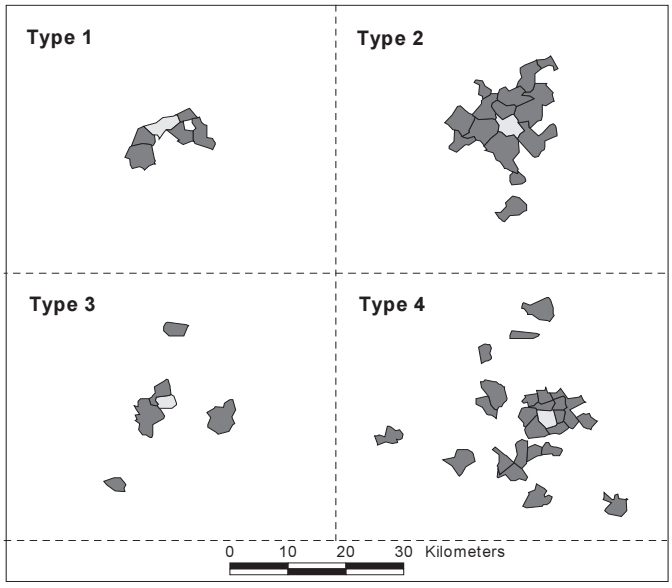

Figure 1 Examples of geographical proximity for four typical communes.

3.2 The data used

Considering the significant statistical apparatus that France has to describe its territory and agriculture, one would imagine that it would be easy to obtain information on the geographical dispersion of farmers in the communes of Upper-Normandy. Yet this is by no means the case. Most statistical data do not enable one to identify all users of farmland in a commune. For example, the General Agricultural Census (RGA) has recorded a set of descriptors relative to farms according to a standard methodology used throughout the European Union – hence its interest. But these data concern only one indication of locality

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for each farm: the farmstead. For the 2000 census, farmers were asked to specify the distribution of the useable agricultural area of the farm, per commune. But the entire useable agricultural area of farms is, by convention, always attached to the commune in which the farmstead is situated. Consequently there is no breakdown in terms of the real location of fields. In our case, the allocation of a farms' surface area to the commune of the farmstead is an unacceptable approximation. We need data enabling us to link the useable agricultural area to a specific territory, for the entire region.

Such data can be found in applications for compensation submitted in the framework of the Common Agricultural Policy (CAP). Farmers who have a surface area with cereals, oilseed crops and high-protein crops that exceeds a certain threshold have to discard part of their crops in order to benefit from an indemnity to compensate for the drop in the price of these crops. The surface areas declared annually by farmers are allocated to a commune in relation to the real location of fields. The nomenclature used for these CAP data specifies which crops qualify for indemnities (wheat, rape, sunflower, maize, flax, pea, surface area set aside, surface area under grass, etc.) but combines surface areas under other crops (orchards, sugar-beet, potatoes, etc.). Moreover, these lists are not exhaustive because only farms that have been subject to a CAP procedure are recorded. Yet the necessity to declare the land under permanent grass in order to obtain subsidies has resulted in exhaustive lists: 92% of the data of the total useable agricultural area of Upper-Normandy (source: Agreste) is available and considered reliable by the Upper-Normandy regional agriculture and forest authorities. The CAP data, available since 1995 from the *Office National Interprofessionnel des Céréales*, give the surfaces areas, for every commune, farmed by farmers who have their farmstead in any other commune in the region. Aggregated to the communal scale for the sake of confidentiality, they are coupled to the geographic database of the *Institut Géographique National* (BD GéoFLA® – 5th edition – 2001) which groups together all the communes of France. Distances between the centroids of the communes can thus be calculated. We analysed the CAP 2001 data – the most recent in our possession – on a regional scale. We also chose to focus on the total useable agricultural area in order to obtain a global view of geographical dispersion.

3.3 Analysis method and results

In this section we analyse the distribution of the 1409 communes of the Upper-Normandy region for the three criteria presented above, i.e. number of external communes; distance from the commune studied; and surface area under external control. For each criterion the distribution of communes in Upper-Normandy is studied in relation to the total number of communes of the region and then in relation to the total useable agricultural area (UAA) of the region. Indeed, the number of communes is not in itself a satisfactory indicator in so far as the UAA can vary considerably from one commune to the other. In compliance with the analyses carried out by proximity economists (Rallet and Torre, 2005), we consider that the collective management of erosive runoff is facilitated by (i) the organization of farmers into networks and their ability to group actors at local level and (ii) the geographical proximity between the farmers and between the farmers and the land they farm.

The first criterion is *the number of farmers who farm the surface area under external control in each commune.* CAP data provide only the number of external communes. It is nevertheless reasonable to assume that a high total number of actors will correspond to a high number of communes. We know that each commune in the database has a minimum

of three farmers, otherwise the commune would have been removed from the database for the sake of statistical secrecy.

Analysis of Figure 2a shows that the useable agricultural area of 70% of the communes in Upper-Normandy is farmed by farmers from between six and 15 different external communes. Moreover, the fields of approximately 16% of the communes are farmed by farmers from over 16 different communes. This adds up to a high number of external farmers. Figure 2b shows that the distribution of the useable agricultural area of the region in relation to categories of 'number of external communes' is fairly similar to the distribution of the total number of communes. It is the category '6–10 external communes' that groups together the highest percentage of total useable agricultural area, with 38%. Note that nearly 48% of the useable agricultural area in Upper-Normandy is farmed by farmers from over 11 different external communes. This high level of dispersion leaves little hope for ad hoc coordination and points to problems in the implementation of collective actions.

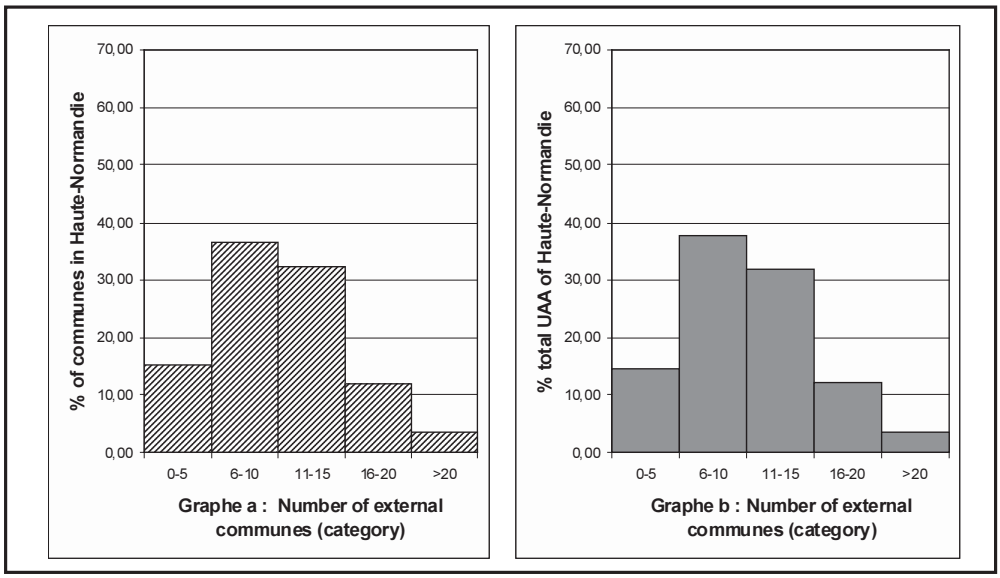

Figure 2 Distribution of Upper-Normandy communes in relation to number of external communes.

In order to estimate farmers' proximity to the lands they farm, we also need to assess the *distances between external communes and the commune under study*. For that purpose we can use the geographic database of the Institut Géographique National (BD GéoFLA® – 5th edition – 2001) which covers all the communes of France. Distances are calculated from the centroid of a commune to the centroid of another commune. Because these distances are calculated 'as the crow flies', they are systematically underestimated. To obtain a value per commune studied, it is necessary to calculate the mean distance between the commune studied and external communes.

Figure 3a shows that fewer than 14% of the communes in Upper-Normandy have fields farmed by external farmers who live close by, i.e. at a maximum of 5 km. The most common range of mean distances in the region is 6–10 km. This concerns over 60% of the

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communes. Note that in over 28% of cases the distances travelled to farm lands in another commune are in excess of 11 km. In terms of the useable agricultural area concerned (Figure 3b), it is the category 6–10 km that corresponds to the major part of that area in the region. The first category, 0–5 km, accounts for under 8% of the useable agricultural area. We therefore have a very large factor of distance to take into account. In over 85% of cases the average distance is over 6 km (and even more, given the underestimation of distances). When fields are far away, farmers simplify cropping systems where they can in order to limit travelling. One must nevertheless bear in mind that the surface area for which each farmer travels is unknown. If this area is large, the farmer will have to travel often and therefore will probably have a better knowledge of the problems of erosive runoff likely to exist in distant fields. The surface area of distant fields can therefore influence the effect of distance.

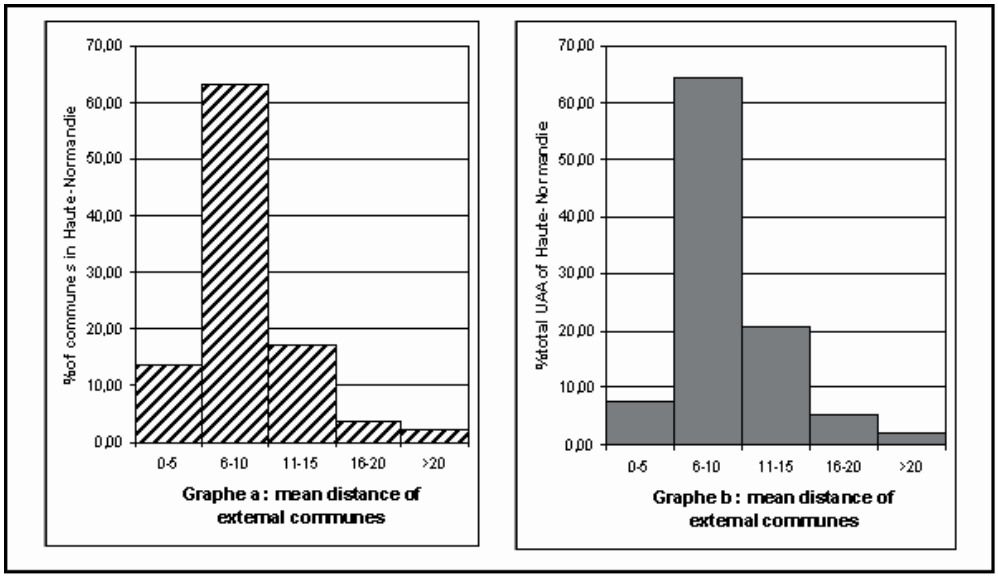

Figure 3 Distribution of communes in Upper-Normandy in relation to mean distance of external communes.

The last criterion analysed is *the surface area under external control* (Figure 4). Note that particular cases corresponding to surface areas under no external control or, on the contrary, under external control equal to the total useable agricultural area of the commune, account for only a small proportion of Upper-Normandy communes: 0.2% and 3.4% of the total number of communes, respectively (Figure 4a). Figure 4b shows that the weight of these communes is even weaker in terms of surface area: respectively 0.03% and 0.8%. This means that these particular cases correspond to communes in which the useable agricultural area is small and probably farmed by a small number of farmers.

If we now turn to the distribution of the other communes, we note that the majority (42.7%, amounting to 50.2% of the regional useable agricultural area) have between 30 and 50% of their useable agricultural area farmed by external farmers. If we combine this category with the following one (50–99% of the external useable agricultural area), it appears that close to 75% of the communes in Upper-Normandy have over a third of their

useable agricultural area farmed by external farmers. This set of communes also accounts for 75% of the region's useable agricultural area. The ratio of farming of land by external farmers is therefore relatively high. This 'surface area under external control' factor will therefore have a negative impact on farmers' geographical proximity. Not only do farmers farm lands situated at a large distance from their farmstead, in addition the farmed surface area is large. Once again, this finding suggests that ad hoc collective action is difficult, and also that coordination such as that of the Syndicates is essential in view of the amount of land cultivated by external farmers and its volume in terms of surface areas concerned by erosive runoff. Indeed, the absence of daily face-to-face interactions between farmers prevents the spontaneous implementation of relations of organized proximity, and thus presents the risk of unsolved tensions and conflicts. Setting up institutions such as the Syndicates is then essential as they provide a structured framework for discussion and negotiation, in which actors can consult each other and find common rules.

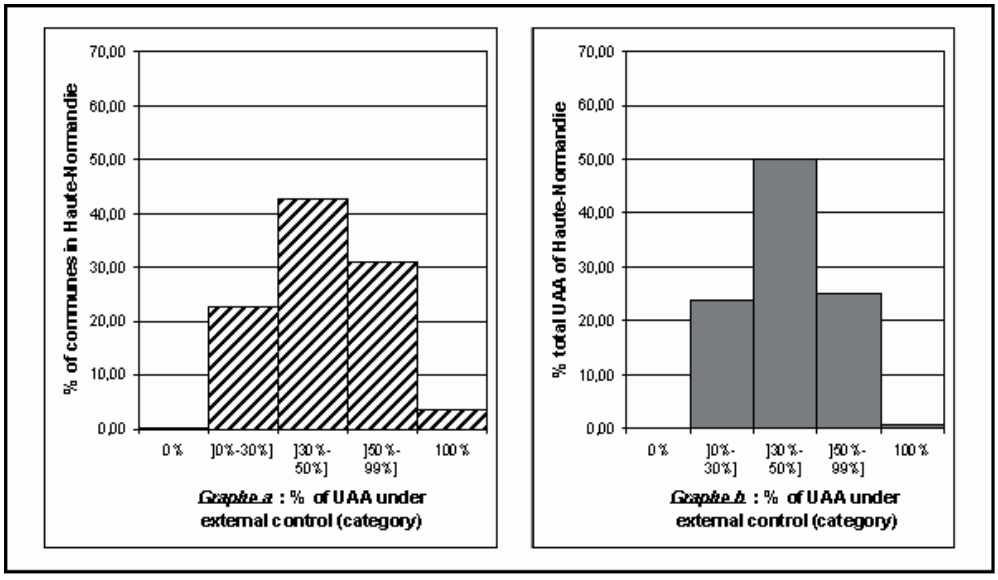

Figure 4 Distribution of communes in Upper-Normandy in relation to the percentage of useable agricultural area farmed by farmers outside the commune.

To take our analysis further, and considering the multiple distances to calculate and the large number of communes in Upper-Normandy, a complete spatialization approach would require the creation of a geographical information system. This system would enable us to take into account, in a more complex way, each parameter studied individually until now. It would thus be possible to calculate the distance of external communes by weighting it in relation to the share of surface area under external control. It would also be possible to take into account the surface area of the commune studied in order to compare several communes. It seems that, for two communes farmed by the same number of farmers, the situation will differ if large differences exist in the surface areas of the communes. Lastly, this method could apply to catchment areas that correspond to several communes, in the framework of large-scale operations, for example. It should also

be noted that because of the closely-knit network of communes that exists in France, this analytic approach could be extended to the French territory as a whole.

3.4 Limits of the method

To obtain a more precise analysis the ideal would have been to know the surface areas actually farmed in each commune, farm by farm, and not in an aggregated form, commune by commune (cf. Section 3.1). This would have enabled us to know the precise number of external farmers. In the Doudeville case study, use of CAP data [7] enables us to obtain a representation of geographical proximity of external communes (Figure 5). On this map we can see that most external communes are situated within a radius of 10 km. Only five are further (between 20 and 27 km). A logical conclusion in this case would have been a high level of geographical proximity. But to confirm that finding one would have to be sure that the majority of external farmers really do have a farmstead in the Doudeville vicinity and not in the five most distant communes.

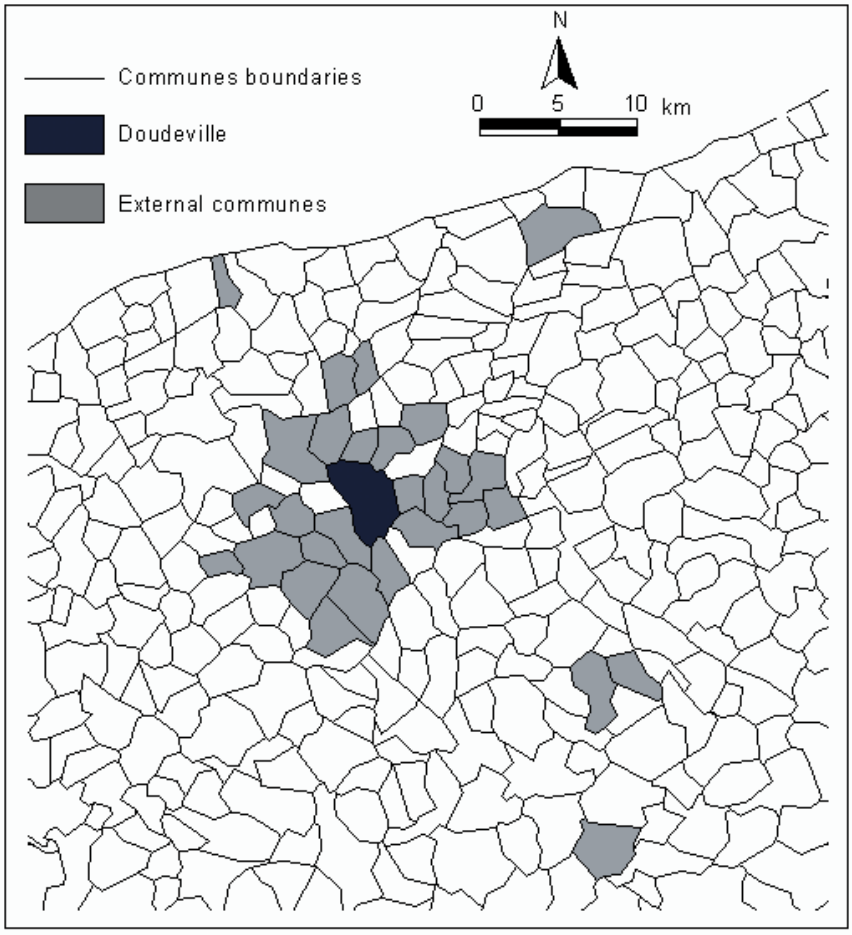

Figure 5 Map of geographical proximity for the Doudeville commune.

The other major constraint concerns the absence of precise information on the location of fields and farmsteads of each farmer in the communes. This limits use of this method when the territory under study does not correspond to the administrative division of communes. The Gonzeville case study can be used to illustrate this point. This catchment area overlaps with three communes (Figure 6) without covering their entire surface area. To evaluate geographical proximity on the basis of CAP data, we mapped (in grey on the map) the external communes attached to the three above-mentioned communes. Contrary to the results of the study (cf. Section 2.2), this map reveals a high degree of dispersion. Most of the communes are located within a radius of 17 km, with the most distant one being 32 km from the catchment area. The reason for this contradiction lies in the fact that CAP data do not enable us to take into account only farmers farming fields in the catchment area.

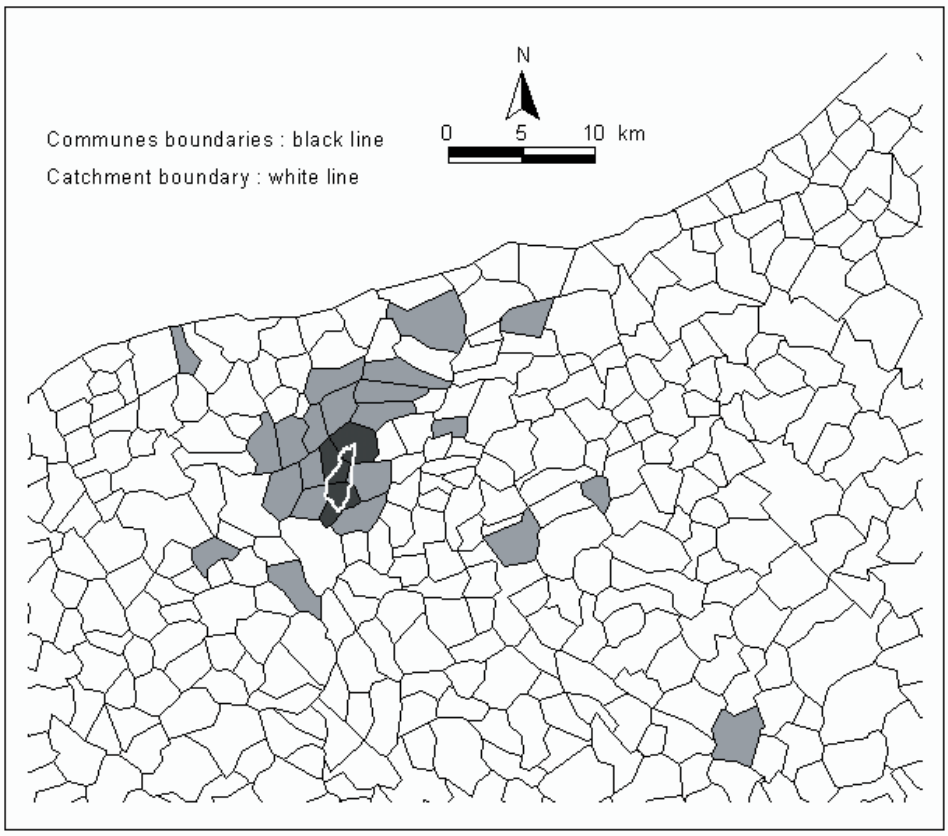

Figure 6 Geographical proximity map of communes in the Gonzeville catchment area.

4 Conclusion

In this paper we have made a hypothesis according to which the criteria of geographical proximity can play a determining role in the struggle against erosive runoff. By definition,

runoff disregards territorial boundaries of farms or communes, affects farmers as well as other users of space, and necessitates collective rather than individual action if it is to be combatted. Yet it is often farmers who are responsible for dealing with this problem, even though they generally have only limited awareness of its extent and characteristics. This case is particularly useful for an analysis in terms of proximity as it is characterized by both relations of geographical proximity between local actors and relations in terms of organized proximity, which rest on the implementation of common actions and negotiation within organized groups of actors. This is the reason why we have chosen this approach, which proves useful for the analysis of the problem discussed here.

In the first part of the paper we used three examples in the Upper-Normandy region to show that farmers have only limited knowledge of the problem of erosion and are largely not in a position to carry out concerted collective action. This is not only because of their lack of knowledge but also because the farmsteads of farmers working on fields in a given commune are spread across many neighbouring communes, thus further reducing possibilities of interaction and coordination. That is why Syndicates were set up to provide concerted management of erosive runoff phenomena and to implement processes of organized proximity, such as consultation and negotiation between local actors.

In the second part we presented a new tool for analysing relations of geographical proximity between surface areas farmed and farmsteads, in order to assess possibilities of coordination between farmers within catchment areas. Based on the three indicators of distance, surface area farmed and number of external farmers, we characterized the 1409 communes in the Upper-Normandy region. Our results clearly show that long distances, the large surface areas farmed and the high number of external farmers constitute major obstacles to the creation of ad hoc cooperative processes. The role of structures such as the Syndicates is all the more essential, as is the availability of tools such as the one presented here for these groups set up for dialogue and common action. This tool helps to highlight problems that arise when farmers are located too far from one another.

Once the representatives of Syndicates have implemented several collective actions involving coordinations between farmers, a useful follow-up to this study would be to evaluate to what extent geographical proximity between farmers has facilitated the implementation of these actions. Indeed, we shall then be able to relate the level of proximity between farmers – by using the tool proposed – and the results of the collective actions undertaken, analysed thanks to more in-depth surveys of the representatives of catchment areas, and regarding various situations. Finally, let us note that, in 2005, the PAC declarations of farmers will be implemented for the French territory as a whole, on the basis of aerial photographic maps of the division of farmers' lands into parcels. Provided they are available, these data will make it possible to better see how the parcels are distributed within catchment areas: the analysis will then no longer be limited by the inadequacy between municipal land division and catchment land division.

5 Acknowledgement

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Endnotes

1 The results presented here are drawn from research performed by D. Nivoit as part of his agronomy engineering thesis (Nivoit, 1995).

2 Geographical proximity here implies the possibility of easily reaching the site of work, which implies both a short distance and easy access, for example being able to go to the site of work daily while carrying out other farming tasks. In the second part of this paper we approximate it to a compound indicator that also takes into account the number of external farmers and the surface areas cultivated.

3 The results presented here are drawn from practical work carried out by Y. Pivain as part of his DESS degree (Pivain, 1997) and from the thesis of A. Joannon (2004). The aim of these studies was to design a tool through which collective solutions could be identified for the farmlands of a catchment area.

4 Information presented here is drawn from a thesis of A. Muselet (2000).

5 Throughout the rest of the article we call these communes 'external communes' and farmers who have their homestead in these communes 'external farmers'.

6 We use the term 'surface under external control' for this third criterion.

7 Although D. Nivoit's research was carried out in 1995, we have not used CAP data from 1995. These are less reliable and complete than data for 2001. Moreover, the comparison of external communes obtained from CAP data for 2001, with those obtained by D. Nivoit's inquiries, shows an absence of change between 1995 and 2001.