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Development of a tool to delimit and characterize the "terroirs" of dairy farming in the cheese production area of the "Massif Central" (France)

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SUMMARY - A delimitation and characterization of the different "terroirs" of dairy farming in the "Massif Central" (France) were realized by summarizing two parallel approaches. By the expression "terroir", we mean a local area with homogeneous environment and homogeneous production systems. A simplified map of the natural environment was obtained by the superposition, with a geographical information system (GIS), of three maps: geological, relief and rainfall. In a parallel way, the data on livestock dairy systems were obtained from three successive surveys, in the "Massif Central" region, department and small zone scale; 43 dairy farming zones were delimited and characterized by their relative homogeneity. A map of the "terroirs" of dairy farming in the "Massif Central" was realized by the superposition, using a GIS, of the livestock dairy system map and of the simplified map of the natural environment. This method, used on 8 departments of the "Massif Central", corresponding to the production area of 7 sorts of AOC cheese made from cows' milk, lead to the identification and description of 55 "terroirs" of dairy farming.

Key words: Livestock farming systems, dairy production, *terroirs*, maps, France.

RESUME - *"Réalisation d'un outil pour délimiter et caractériser les terroirs d'élevage laitier dans la zone de production fromagère du Massif central (France)". Une délimitation et une caractérisation des différents terroirs d'élevage laitier du Massif central ont été réalisées en synthétisant deux approches parallèles. Une carte simplifiée du milieu naturel a été obtenue par la superposition, à l'aide d'un Système d'Information Géographique (SIG), de trois cartes : géologique, hypsométrique et pluviométrique. Parallèlement, des données concernant les systèmes d'élevage laitier ont été recueillies et accumulées au cours de trois niveaux d'enquêtes successifs, respectivement à l'échelle du massif, du département et de la petite zone ; 43 zones laitières ont été délimitées et caractérisées en fonction de leur relative homogénéité. Une carte des terroirs d'élevage laitier du Massif central a été obtenue par la superposition, à l'aide d'un SIG, de la carte des zones laitières à celle simplifiée du milieu naturel. Cette méthode, mise en oeuvre sur 8 départements du Massif central, correspondant à la zone de production de 7 fromages d'AOC à base de lait de vache, a permis de mettre en évidence et de décrire 55 terroirs d'élevage laitier.*

Mots-clés : *Systèmes d'élevage, production laitière, terroirs, cartes, France.*

Introduction

As defined previously (Brunschwig *et al.*, 1996), a *"terroir"* of dairy farming is a local area with a homogeneous environment (soil, climate, relief, etc.) and homogeneous dairy production systems. The characteristics of an AOC (*Appellation d'Origine Controlée*: label of origin) cheese are partly due to its *terroir* of origin: i.e., the natural environment, the raw materials produced locally and the production and maturing processes. Thereby identifying their corresponding *terroir* or *terroirs* is essential. Every AOC cheese has a delimited production area, however this area cannot necessarily be considered as a *terroir*.

With the implementation of European quality recommendations, every AOC cheese organization has tried to strengthen the links between the product and its origin *terroir*. This action is particularly essential in the *Massif Central*. Consequently, the "AOC cheese organization - Massif Central" asked us to specify the characteristics and the boundaries of the various *terroirs* of dairy farming by making an inventory of the dairy farming in the Massif Central: localization and characteristics of the local farming systems and of the related natural environment (Delbruel and Valadier, 1996).

The two main objectives of our investigation were: to draw maps of the main *terroirs* of dairy farming in the *Massif Central* and to establish a list of references as accurate as possible, thus describing the characteristics of the natural environment and of the dairy systems of each delimited zone. We focused our investigation on 8 departments in order to give an overall view of the *Massif Central* rather than a detailed view of each small area.

Methodology

Considering our definition of a dairy farming *terroir*, our research work is based on the synthesis and combination of data and maps related to the natural environment and to the dairy farming systems.

Our study covers the region composed of the zones of 7 sorts of AOC cheese made of cow milk in the *Massif Central*: the *saint-nectaire*, the *cantal* and the *salers*, the *laguiole*, the *fourme d'Ambert or de Montbrison*, the *bleu d'Auvergne* and the *bleu des Causses*. However, we have taken into account the whole departments whether they were concerned only partly or entirely by the AOC zones here above mentioned: i.e., the *Puy-de-Dôme*, *Loire*, *Corrèze*, *Cantal*, *Haute-Loire*, *Lot*, *Aveyron* and *Lozère* departments.

The criteria to characterize the natural environment were selected according to their effect on the agronomic production. The maps obtained by the combining of several existing maps rapidly highlighted numerous micro-zones. Therefore we reduced our list to 3 criteria which were simplified in order to have a limited number of classes per map. The map of the natural environment was obtained by combining: the geological aspects, the soil and substructure characteristics (volcanic, base, calcareous, sedimentary non-calcareous), the altitude (altitude <750 m, very likely growth of maize; between 750 and 1,000 m, intermediate zone; >1,000 m, mainly grassland), the rainfalls (if annual precipitation <900 mm, dry summer for the grassland but no constraints regarding the growing of dry cereals; between 900 and 1,200 mm, intermediate zone; if >1,200 mm, no drought during the summer but an excess of water for the growing of dry cereals). This data (Emberger and Perichaud, 1978; Serryn, 1971; Météorologie Nationale 1988) was processed with 2 cartographic software: Arc/Info and Map/Info.

To characterize the dairy farming systems, we selected the following criteria: the breed and the size of the cattle herds, the replacement and breeding of the livestock, the quota and the average production level of milk, the food and the origin of the forage, the nature and the management of grassland, the conservation method of the forage. Our approach remains entirely technical and we have set aside the economical aspects. The data regarding the milk collection and stocking was excluded because of its strong links with the technology used in the cheese production.

The data regarding the dairy farming systems was obtained from experts through indirect surveys which were carried out at 3 levels: the region, the departments and the small dairy zones. At each step, we were able to define and to improve the data collected previously. A data form with 50 variables classified in 5 themes was established for every zone: economic position of the dairy activity, characteristics of the livestock, land utilization, forage crops and farm buildings, human and historical characteristics. These forms and the geographical limits of the zones were validated by the experts of the departments. The data collected enabled us to attach a detailed list of references to the map of the dairy zones; due to a lack of space, these items will not be enumerated here.

The boundaries (e.g., of the dairy zones) were digitized with the software Arc/Info, which was also used to superimpose several different maps in order to obtain synthetic maps. With the map obtained by the superimposition of the dairy-zone map with the synthesis of the natural environment map, we were able to make out the homogeneity degree of the natural environment within each dairy zone. We thus identified the dairy farming *terroirs* on the entire zone of our investigations. We divided a farming zone into 2 dairy farming *terroirs* only when the heterogeneity of the environment was too great.

All the maps were drawn and edited with a 1:1.750.000 scale. Furthermore, with the data-base created with the data form of each dairy zone it is possible to make maps of the area studied from any of the criteria selected and to establish thematic maps.

Results

The natural environment

The synthetic map of the natural environment is a very complex and broken-up map. However important and very distinctive zones stand out, such as:

(i) The heart of the *Cantal*, the North-east of the *Aveyron* or the South-west of the *Puy-de-Dôme*, characterized by high and humid volcanic soils.

(ii) The centre-South of the *Haute-Loire* with low and dry volcanic soils.

(iii) The North and the West of *Lozère*, North-*Corrèze* and the West of the *Loire* characterized by high and wet base soils.

(iv) The North-east and the North-west of *Haute-Loire*, the North-west of the *Puy-de-Dôme*, the North-west of *Cantal*, the South-west quarter of *Aveyron*, etc. which are the main zones of the low and dry base soils.

(v) The centre-South of *Lozère* as the only high and wet calcareous zone, the other calcareous zones being almost entirely low and dry.

(vi) The South of *Lot*, the South of *Aveyron*, the heart of the *Puy-de-Dôme* and the centre of the *Loire* which are mainly sedimentary non-calcareous zones.

The dairy zones

We have recorded 43 dairy zones according to the homogeneity of their dairy farming system. A margin of error of the surface of one commune (municipality) is possible on either side of the borders of each zone. The dairy zones have unfixed dimensions; from a third of a department to a few communes. These zones usually only concern one department, however 3 zones overlap 2 departments. 4 zones are discontinuous and show that homogenous farming systems are possible in such an environment. The non-dairy zones are quite important and cover over a quarter of the studied region.

The dairy farming *terroirs*

The analysis of the map obtained from the superimposition of the dairy zones and the simplified map of the natural environment clearly shows 3 sorts of dairy farming zones amongst the 43 identified dairy zones. The first kind of dairy farming zone corresponds to 15 relatively homogeneous zones with a strong link between the homogeneity of natural environment and that of the farming systems. According to our definition, these 15 zones may be considered as dairy farming *terroirs*. The second kind corresponds to 16 zones located in an environment not as homogeneous, but the heterogeneity does not appear important enough to justify a break-down into several *terroirs*. A very precise study is necessary to confirm that each of these zones is indeed a dairy farming *terroir*. The third kind corresponds to 12 heterogeneous zones with regards to the natural environment, therefore each zone has had to be divided into 2 *terroirs*. A further investigation would sustain this point. In the present state of our investigation, this classification leads to the identification of 55 dairy farming *terroirs* (cf. Fig. 1). However, the borders of these new *terroirs* are not clearly outlined.

These dairy farming *terroirs* can be examined according to different criteria: for example the ratio of permanent grassland (or temporary but on a long term basis) in the usable agricultural area of the dairy farms. In order to distinguish strictly grazing zones from intermediate zones and zones of intensive cultivation of forage, they were classified in four groups: (cf. Fig. 1). The zones with over 75% of permanent grasslands are mainly volcanic or base areas usually at a high altitude with heavy annual rainfalls. Permanent grasslands represent 50 to 75% of the usable agricultural area in drier zones at a medium or high altitude; there are few rangeland and limited intensification. In the lower zones, the permanent grasslands only represent 25 to 50% of the usable agricultural area; there may

be heavy annual rainfalls; the small proportion of permanent grasslands is thus due to a strategy of intensive cultivation of forage.

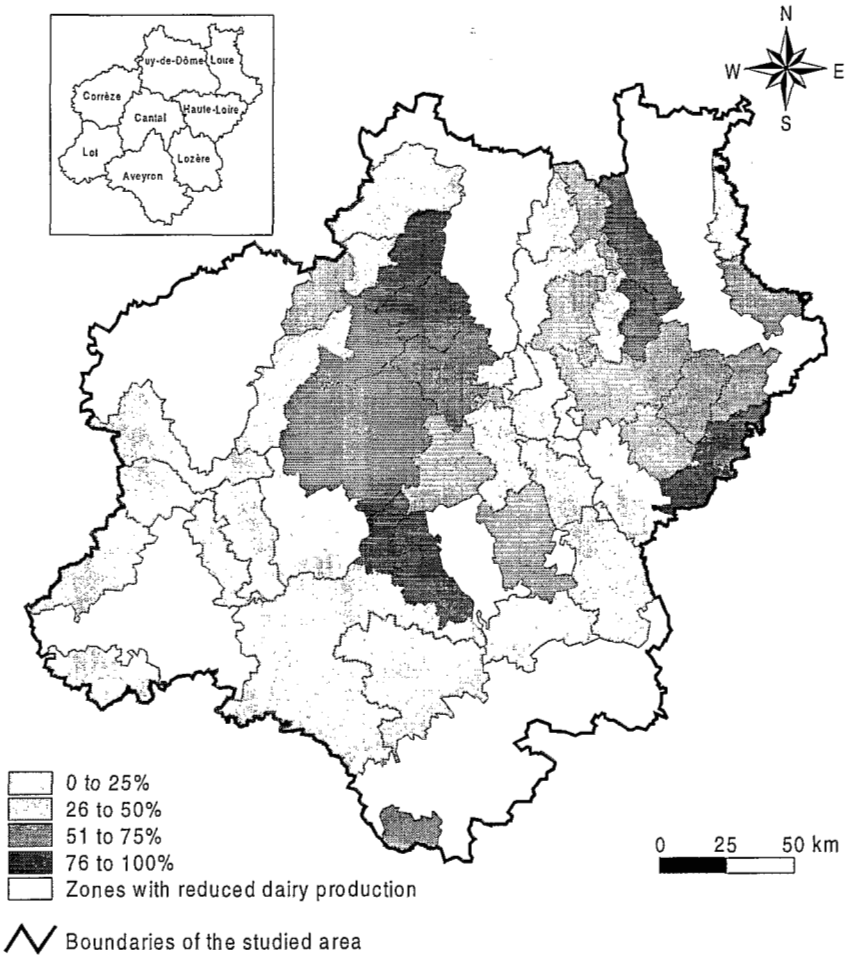

Fig. 1. Part of the permanent grassland in the usable agriculture area of the dairy farms in the *terroirs* of dairy farming in the Massif Central (France) (from Debruel and Valadier, 1996).

Discussion

The results of our investigation emphasize the diversity of farming conditions in the *Massif Central* whether considering the natural environment conditions or the dairy farming systems. However, combining these 2 different criteria ended up not being as complex as we had anticipated. In most cases, the dairy zones are relatively homogeneous if we consider the natural environment and the farming systems. The 12 zones which were divided into 2 *terroirs* are well spread out in our investigation area. They are mainly non-dairy zones. This may be why they are generally less familiar to the experts we interviewed unless the reason is due to the fact that the farming systems used alternate more often and are therefore more difficult to determine. The link between natural environment and dairy farming systems appears clearly. The interest for dairy farming *terroirs* is therefore entirely justified. This link is not as strong when the dairy production decreases in a specific zone.

The accuracy of the maps and the borders of the zones remain however modest, first because of the size of the area studied and second because of the variable quality of the experts surveyed. The data collected was not always as precise as requested and we were not always able to make up for this lack of precision by cross-examining several surveys. Furthermore, our way of studying the farming systems was not always in accordance with the administrative or departmental limits.

In the method described in this document, the investigators gave their own definitions of what was a homogeneous natural environment in a dairy farming zone and decided whether a zone was to be divided or not. These decisions were taken according to the graphical analysis made but should be confirmed with appropriate statistical methods (discriminatory graphical analysis, etc.).

Conclusion

With the method heretofore presented, we were able to draw synthetic maps giving concurrently information both on the natural environment and on the corresponding dairy farming systems; in addition to these maps an important data-base is now available to study the homogeneity of the AOC cheese production zones. Together with an historical study, these maps should concur to a better definition of a *terroir* for the AOC cheese. Besides, this kind of investigation should be associated to a study on the technologies used in milk production.

This method, that was elaborated and used on an area mainly interested in bovine production systems, appears easily transferable in regions where small ruminant production systems are dominant.

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