Session 2 ***EAAP 2008*** ***Vilnius***

The contribution of livestock farm diversity to ensure the sustainability of small ruminant systems in the Mediterranean region.

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Summary

The aim of this presentation is to analyse how diversity of farming systems (including intensity of farming) is important to consider for ensuring a global sustainability of small ruminant farming in Mediterranean areas. In our context, managing complementarity at local scale between diverse farming systems is of particular interest to meet consumer expectation for quality products and to increase contribution of these systems in management of natural resources. We will focus on two case studies: one deal with dairy goats farming and concerned all producers (30) delivering milk on a dairy cooperative producing PDO cheese 'Pelardon". The other deals with sheep farming and concerned all sheep farms (90) involved in management of rangelands on the territory of Luberon regional park. We characterised farms in these situations through size, general planning for production, level of animal production, ability in combining rangelands and cultivated areas to provide forages. A large diversity is identified and this diversity is favourably linked with the management of milk supply and with environment conservation. We will discuss these results in terms of evaluation of farming practices considering farms as included in a whole. On a methodological aspect, from this point of view, the objective is not to produce an optimal and definitive ideal farming system, but to enrich the decision-making process by imagining a set of possible options and evaluating them.

1. Expectations toward livestock farming are changing

The context in which livestock activities are carried out has radically changed in recent decades. The problems of farming modernization make way for those of sustainable development. So the question of the transformation of farmer activities is no longer put in the same terms. The recent agricultural policy reforms, as well as the law of farming orientation of 1999 in France, illustrate this evolution. As underlined by Joly and Paradeise (2003) this law aims more at stimulating by "procedural standards" the processes of defining problems and solutions than to promote "substantial standards" fixing operational methods in response to predefined problems. For research, the problems of sustainable development raise questions about "coherence and management of balance over the long term" rather than "absolute objectivation of the things of the world" (Hubert 2002). This change in context calls into question the idea of directing farmer practices to become aligned on benchmark livestock farming models, centred overall on a micro-economic optimisation at field or farm scale. Beyond the substitution of an intensive model for an alternative model with the virtues of the moment (ecologically correct for example) it is the very idea of the existence of benchmark models objectively validated for a broad spectrum of situations which is called into question. Great things are expected of farmers as to their participation in development projects defined at the level of the territories. Work concerning the dynamics and diversity of livestock systems must then aim:
- at reasoning these activities with regard to local and territorial dynamics
- at developing the capacities of farmers to interact with other players and on reinforcing their capacities to organise complementarities and synergies (Ploeg et al., 2000), including within the farming world itself.

The Mediterranean areas were much less concerned by the homogenisation of livestock systems than the northern regions of Europe. Industrial livestock models never completely succeeded in imposing themselves as an absolute reference, for cultural reasons, but also for reasons of adaptation of practices to local characteristics. The Mediterranean livestock farms have in fact a strong diversity from the

point of view of the species reared, the productions, and the levels of intensification (forage in particular) and livestock management practices (de Rancourt et al, 2006);

This diversity results from various forms of adaptations developed by farmers to adjust herd management to the territory they have at their disposal. The farmers often compensate for the little control of spontaneous and fodder resources, subjected to strong climatic risks, by designing grazing calendars that rely on combinations throughout the year of a diversity of resources and environments cultivated and not cultivated. They thus contribute by their practices to maintaining a diversity of the territories in the Mediterranean hinterland. They contribute to maintaining a mosaic of natural areas and cultivated area, which contributes to the landscape and environmental quality of these areas (Riedel et al., 2007). (e.g. in the Mediterranean region 80% of the biodiversity of species). Livestock farming thus represents a structuring activity both from the point of view of its economic importance and from its role in the structuring of space. In parallel, the livestock production networks have preserved for their products strong images related to the local "terroir", and emphasis the link between farming practices and the territory.

Livestock farming under such conditions in a way predisposes farmers to reason their activities with regard to local and territorial dynamics, and in a convergent way high demands are made of them in this direction. The question is therefore relatively open concerning the forms of livestock farming it would be desirable to develop for the future, and the synergies and complementarities between different work management systems.

From two concrete examples, in this text we will analyse a different way of assessing livestock systems. One relates to sheep meat farming on the territory of the Regional Natural Park of the Luberon and the other dairy goat farming in the Cevennes in the catchment area of a co-operative particularly involved in the development of AOC Pélardon cheese. We will then discuss the issues specific to the evaluation of livestock systems in this context and the methodological developments which result from this to accompany the transformations of farmer activities.

2. Two local situations with important issues… and links to the dynamics of the livestock system

2.1 Diversity and dynamics of sheep farming systems and their relations with the maintenance of the environmental qualities of the territory

The territory of the Regional Natural Reserve of the Luberon (175000 ha) is recognized for the richness of its fauna and flora. Several agri-environmental operations have aimed at supporting farming practices contributing to this richness. Livestock farming, primarily sheep, is directed towards the production of meat. The 90 farms (totalling 30000 ewes) vary in terms of size of farms, orientation of production, insertion in the industry and relations with the territory. The combinations of cultivated area and natural area as farm forage bases result from this diversity.

The description of the livestock farms rests on an exhaustive investigation carried out in 1998, brought up to date in 2008, dealing with orientations of production and herd management methods. Further surveys, carried out between 1998 and 2005, were directed at farm trajectories. The analysis of these trajectories makes it possible to characterize the genesis of the various types of farming in relation to the evolutions of production conditions and incentives from public policies at work during recent decades (Lasseur, 2005).

The present diversity of livestock farms

The mixed-cropping livestock farmers with small herds: The grazed territory is grouped around the farm buildings, herd mobility is low. The relative proportion of rough pasture and forage area in feeding the herd fluctuates greatly. Herd reproduction is organised to allow the workforce to be available for the other farm productions. All the farmers produce heavy milk lambs

Local pastoral livestock farmers: The size of the herd can reach 600 ewes. The feed is based on intensified fodder crops occupying the main part of the cultivated areas of the farm. The farm structures are similar to those of the preceding type, the territory remains grouped. Forage resources for the herd come from the cultivated land and the grasslands used primarily by shepherding. Flock

reproduction is organized in periods: spring and autumn, with the aim of making best use of the grazed forage resources.

The producers of lambs: the flocks are quite large (approximately 1000 ewes). The main part of forage is produced on the cultivated area. Off-season lambing adds value to the lambs at the times when prices are highest in "quality label" sectors. The flocks are exclusively managed in enclosed grasslands to limit the workforce.

The new pastoral farmers have quite large flocks (approximately 1000 ewes). The animals, of a low level of individual productivity, draw the essential of their feed from natural areas. These flocks are capable of great mobility to make use of open territory. The lambs produced are grass lambs that are not highly valued in the organized industry, marketed by direct sale or wholesale.

Local farming dynamics and emergence of these types of livestock farms

In the 1960s, sheep farming was primarily composed of small flocks (less than 150 ewes) present in diversified mixed-farming-livestock family farms. The "mixed-cropping livestock farmer with a small flock" type corresponds to this form of livestock farming. In 1998 a high proportion of the farmers of this type planned to stop livestock farming. The inventory of 2008 confirms that it is among these farmers that the highest proportion of abandonment resides (- 25 % in ten years).). However this group, numerically the most significant in 1998, remains considerable in 2008. Their disappearance considered for two decades to be inescapable by many operators of the sector, deserves to be explained in more detail.

But sheep farming in the hills of the Provencal hinterland has undergone profound changes over the last decades. The most noticeable feature of this evolution is the emergence of specialised holdings. This specialisation began to operate between the 1950s and the late 1970s in a context of considerable growth in sheep production: a protected national market with insufficient supplies. The intensification of forage productions allowed for considerable growth in flock numbers. The type we have called “local pastoral farmers » corresponds to this evolution. Questions relating to the improvement in the individual productivity of the ewes and the best added value of products by off-season production and by joining labelled sectors were presented in recent years as the ways to develop these livestock farms. Repeated episodes of drought and the increase in the cost of animal feed led some of these farmers to formalise evolutions explicitly aimed at organising production to make best use of the resources available on the farm, thus affirming a particular conception of their work.

The choice of increased specialisation of activities and improved economic productivity of the farm were very much encouraged in the 1980s to compensate for the opening of the national market and the drop in sheep meat prices. The form of livestock farming of the " lamb producer » type is the result of this. But, during the last decade, the increase in the size of flocks could not continue only on the basis of forage intensification. Rehabilitation of grassland areas was then observed. The present technical challenge is to ensure evolutions while continuing to aim at the production of the highest possible added value in lambs in very integrated sectors. It involves providing lambs when the enhanced value is at its peak.

At the heart of the period of intensification which saw the emergence of the type of farm that we have just described, many grassland areas were abandoned by livestock farming. In a concomitant way, in the prolongation of the ‘return to the soil’ movement of the Seventies, new agricultural workers from outside farming sought to set up in livestock farming. Having at their disposal only the gaps left vacant by the evolution of farms belonging to local people, they had no other choice than to organise their livestock on these areas. This created a very pastoral type of farming "the new pastoral livestock farmers". The present challenges for these farms are to perpetuate their farm structures to allow them to be passed down, to use their knowledge in the use of pastoral areas and the management of these environments to solve agri-environmental problems. They have to cope with new competition in this field from farmers of the “lamb producer” type, and they also have to ensure sales outlets enhancing the value of their lambs that will benefit from an image of natural, typical products, by developing specific marketing circuits.

So the forms of local livestock farming have evolved over recent decades and are continuously questioned and redefined by the contexts in which the activity and specific issues of each one are

carried out. Complementarities and competition, specific properties of each type are revealed, and can be exacerbated depending on the conditions of the moment. The question of the linking between farm dynamics and territory dynamics does not seem to arise in terms of the prescription of a production model to be respected, but in terms of the prospective consideration of the various issues, and the capacities of evolution and complementarities of these various systems regarding these issues. The question of good territorial governance cannot be raised as farm modernisation was: To encourage those which have the resources to set up farms in conformity with the model promoted on the basis of the disappearance of their neighbours.

2.2 In the Cévennes : developing goat production in a region in decline

We were interested in two valleys (vallée Française and vallée Borgne), situated in the area around the National Park of the Cévennes, in which goat production was the driving force of the local development project in the 1960s. The key to this local challenge, it was at the same time under the influence of the policies and incentives of the goat industry. This area makes it possible to characterise the duality – or convergence according to periods – between local and industry development issues, via the trajectories of the livestock management methods.

Deep valleys, the Cévennes are virtually covered in woodland. A few meadows cover the valley floors or surround the villages on the hillsides. The main activities are goat production and tourism.

Comprehensive interviews were carried out with i) farmers to understand the organisation and evolution of the production process in relation to incentives and issues perceived by the farmers ii) managers of the co-operative to reconstitute the evolution of the marketing strategy. This text is based on the cross-disciplinary reading of these chronicles, and on the analysis of relations between the trajectory of the co-operative and the evolution of the members' production systems.

The livestock systems today: There are about forty livestock farms in these valleys. 28 of them produce milk, delivered to a co-operative. The others process and sell on the local markets. The size of the herds is relatively modest (80 goats on average for the milk-producers and 50 for the cheese-producers). We will later turn to the dairy herds. The production methods can be characterised in three categories with respect to the territories mobilized.

"Forage" farming systems. The farm, often located in the bottom of a small valley, has 12 to 20 ha of cultivable and forage areas. This size is quite large for the area. It was acquired over the generations. The herd, 80 to 110 goats is composed of selected animals (700 to 800l/year). The feed for the herd is based exclusively on cultivable and fodder areas and if necessary on the purchase of hay. The births are either off-season in autumn, or in two periods (autumn and end of winter).

Livestock systems that combine forage and grassland areas. These are local farmers, often located in the villages on the hillsides. More limited in forage or cultivable areas (5 to 8 ha), they have set up a management method combining grasslands and the surrounding woods throughout the grazing period. Size of the herd: 70-80 goats; dairy production: 600-700l. The births are either in two periods, or in only one period at the end of winter.

Pastoral farming systems. The farmer has mainly forest areas (pines, holm oaks). They are often neo-rural farmers, who were established in the 1970s and 1980s. The herd is of average size (50 to 70 goats). The individual production of the animals is lower than 500-600 L. Births take place at the end of the winter. The herd is kept in the woods and on the rough grassland. The rare meadows, supplement this grazing in spring and autumn. The low productivity of the herd is compensated by extremely reduced overheads for feed for the herd.

The co-operative processes 1.5 million litres of milk, collects from 28 farmers and "provides a living for 50 families in the valleys".

A page of local history

1960: the Cevennes were in decline. Family agriculture, diversified and domestic, was disappearing. Natural areas and grasslands were becoming invaded by shrubs. A handful of local players constructed a local development project based on goat farming. Precursors for the time, they conceived a system of dairy farming enabling them to make good use of forage areas and animals. They created a dairy cooperative, as well as a goat selection station which was to have an essential consulting role for the farmers. The farming systems were homogeneous: trough feeding, restoration of cultivable and fodder areas, selected goats, births in spring.

1975-1980: return to the soil movement: neo-rural people moved into the wooded areas. They gradually set up pastoral livestock farming systems.

… During this time, 1960 – 1980, the co-operative had no problems in selling the production to local customers. It was closed in winter.

1990-2000: Undergoing the repercussions of the crises concerning goat production in France, and subjected to requirements making the processing line conform to standards, the co-operative had to increase its product volumes, and extend its sales towards the regional supermarkets, (Napoléone M., Boutonnet J.P., 2006).

To penetrate these markets, it had to propose cheeses all through the year. This encouraged the producers to increase their herd production and produce milk in winter, therefore modifying their reproduction practices to ensure off-season production. So it encouraged the farmers to adopt the intensive dairy model considered as the model of the future by the majority of development structures. Sensitive to the effort they had to make for the co-operative, and to the modernity presented by the dairy model, the majority of non-pastoral farmers tried off-season breeding, and increased the size of their herd. Pastoral farmers stayed with spring births, and this made it possible for the animals at the beginning of lactation to benefit from the herbaceous resources on the rare meadows. In addition, they did not conceive of using artificial practices such as hormonal treatments. Locally, the livestock systems were placed in opposition: those who managed to deliver in winter and the others, who kept to more traditional practices with births in spring.

2000 - 2008: the players in the sector asked for the recognition of their cheese in AOC (decree August 2000). This certification had great consequences on the dynamics of the time, at the level of production practices and processing practices.

- "*production aspects":* The AOC raised questions about herd management practices. Pasture today seems to be a means of giving an image to the product. The AOC thus gives legitimacy to a certain return towards the use of grazing, which was perceived as backward-looking at a time when an intensive dairy model prevailed. In addition, grazing seems a means of reducing feed costs, of purchase of hay. The intensive systems evolve, to reintroduce grazing into the feed. The ones with sufficient land evolve to grassland systems, and often remain with off-season births. Others move towards systems combining forage areas and rough grassland. Lastly, the pastoral farms, since their installation, were gradually able to have use of some forage areas, which they keep for grazing the herd as a backup for the rough grasslands. The livestock farming systems evolve and diversify.

- *Processing aspects:* The specifications of the AOC prohibit the use of frozen curd for the manufacture of cheeses. This clause obliges the transformers of Pélardon, a cheese with a short maturing period, to adjust in *real time* a very seasonal collection to a demand that is not at all seasonal. Deprived of the possibility of using existing stock, between June and December the company does not have the milk to satisfy demand. The combination of complementarities between various management methods becomes essential to make upstream and downstream adjustments. The way of qualifying and assessing the livestock systems in relation to the marketing network is evolving. It is no longer a question of placing the accent on the farming systems closest to the dairy to reduce collection costs, and producing the most volume in winter, but of assembling a diversity of technical systems so as to balance the collection as well as possible.

At the same time, tourism in the Cevennes is developing (in 2007, 800,000 people visited the National Natural Reserve of the Cevennes). The local communities lay the stress on the landscape interest and the link with human activities in the PNC (the only inhabited park in Metropolitan France).

To think of the diversity of livestock systems, their spatial establishment, and their contribution to the constitution and management of a fabric of resources thus becomes a challenge both for the marketing network and for the management of the territories.

3. Discussion

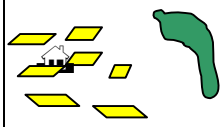
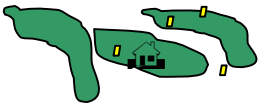
3.1. Consolidating livestock activities to contribute to the development of the territories

The analysis of the diversity of farms and their transformations during recent decades clarifies features common to our two case studies. Three forms of livestock farms can overall be characterised on the basis of orientation of production and their relations with the territory.

- livestock farms installed when farming modernisation was predominant ("forage" goat farmers, "lamb producer" sheep farmers) followed the precepts of agricultural intensification. Sensitive to the expectations of the sectors, and/or the image of modernity and technicality, they intensified their practices, and they concentrated on the most productive agricultural areas, developing their activity by investing in equipment and innovative techniques.

- livestock farmers who perpetuate a certain traditional form of farming (local pastoral sheep farmers, goat farmers combining forage areas and rough grassland…). They are sensitive both to the heritage value of their work and production factors. A significant proportion of their know-how lies in the capacity to organise the production process to make the best possible use of the resources which they have at their disposal. In their territorial dimensions these farms use both cultivated areas and natural areas.

- farmers who constructed alternative systems, often their only means of becoming a livestock farmer, i.e. of making a livestock farm function, in spite of the difficulty of their environment. The resources which they mobilize (animal breeds or pastoral areas) and production processes which they adopt, can return to old forms of farming. However, they do not result from nostalgia for the past, but from a search for adaptation of their livestock system to the difficulties of the surroundings.

Type of LFS	**"Modernised" farm**	**"Traditional" farm**	**Pastoral farm**
The main goal	Making best use of forage areas and herd	Making best use of farm resources	Managing a herd only using the rough grasslands
Farm territory Cultivated areas Rangeland Farmstead			

These distinctions between types of livestock farming are close to those made by Lémery (2003) in sociological terms on the way in which cattle farmers of the Charolais region justify their activities. This underlines the interest for the analysis of farm diversity to cross reference approaches analysing technical coherences of the livestock systems, the conceptions of the work which underlie them and the nature of local debates which are carried out in the various professional or proximity networks. These debates define the standards framing the activities of the farmers.

The movements of disqualification-requalification of livestock farming practices, their consequences on the emergence of different farming types is another point of convergence of the two situations studied and undoubtedly more widely in the Mediterranean region. These evolutions involve at the same time a diversity of farmers and other players (operators of the sector or project holders on the territory). Until the 1990s, the intensification of productions, the centring of the farming activity on cultivated areas did not seem to meet with any disagreement. The other livestock farming forms were then regarded as vestiges of the past with no future or as marginal and marginalising attempts to attain the status of livestock farmer. The widening of the questions asked in the livestock world, whether in the field of the

environment or in the development of a quality network anchored in a local 'terroir' modifies this established fact. The legitimacy of some practices is recognized locally. The various forms of livestock farming, far from being put in opposition, become interesting in order to organise complementarities. This is the case for example of pastoral dairy farms directed towards a spring production which contribute to the image of the AOC and the provisioning of the co-operative at a period when the other types of farming are in low production. This diversity of practices is even the basis of innovations allowing greater adaptability of the livestock farms to the new local production context. Thus the redeployment of "lamb producing" sheep farmers on the pastoral area to benefit from expectations that livestock will maintain the open environments is facilitated by the cohabitation of farmers of this type with new pastoral farmers from whom they borrow practices, and which then become innovative

3.2 Consequence for the evaluation of livestock systems:

We could schematize two ways of considering the evaluation of the livestock systems and the territory.

	During the farming modernisation phase	With the emergence of questions of sustainable development
sector	To increase productivity to lower prices	Territorialise production to stand out from the rest,
territory	To concentrate on areas enabling productivity to be increased	To make best use of the landscape, to manage biodiversity, to contribute to the local development action
Properties sought	Sectional, based on the search for intensification of resources	At several levels, based on the capacity to maintain oneself and organise complementarities, to interact positively with society
	Optimum ?	
Evaluation criterion	Unit productivity	Place in an organisation, complementarities, contribution to local dynamics

There could not be any simple and unique vision of the way of evaluating an optimal intensity which would apply to the livestock systems of a same region or of a catchment area of a commercial structure. The actions of directing farmer activities (advice or policies) were thought out within the framework of farming modernisation in a normative way by promoting a particular model supposed to solve the question with which one was confronted. It often involved increasing production and satisfying the very monolithic expectations of the industry. The question resided in the best way of moving a farm on from one production method to another (from one type to another) and of identifying those which deserved this investment, even favouring the dismembering of the others (with no future) to allow for the transformations of the first. The evaluation of the qualities of such or such a system was relatively simple and univocal. From the present point of view, our examples illustrate in the context of Mediterranean agriculture the changes of paradigms at work:

The evaluation is relative to the role of the farm within a unit constituted of the territory or the sector. It is therefore *situated* taking into consideration locally-defined issues. No farm could be evaluated independently of its role within the unit in which it is positioned. For the same region, the farms can therefore be evaluated on different objects according to their role and their contribution to this unit.

The evaluation is evolutionary; it is not given once and for all. It evolves with time according to how the issues evolve. If we take the Cévenol example, when the principal challenge is to reduce collection costs, the farms closest to the co-operative, often the most productive are of unquestionable interest. The pastoral farms, less productive, more difficult of access, implementing practices little recognized at the time, are of little interest for the collection. In this case, diversity is experienced as a handicap. On the other hand these various management methods have a new interest for the managers of the sector or of the territory when it is advisable to manage regularity of collection, to give products

a local traditional image, to organise and manage a network of resources to build the landscape, or to limit fires.

The evaluation rests on the search for complementarities. The questions of territorial development and sustainability involve the search for synergies between activities. The question put to the goat farms in the Cevennes in terms of sector development can be treated by favouring complementarities; questions of environment and development of territories in the Luberon do not promote a single model. If attention is given to the preservation of the most emblematic natural areas and the structuring of the heart of the forests to prevent fires, the interest is in a specialised type of livestock farming, mobile and able to intervene over large stretches of territory. If the interest is now in the mosaic between cultivated area and natural areas and in preserving harvest flower species such as the cornflower and the poppy, then we are talking about small-scale mixed-farming livestock farms.
Society expectations are by definition multiform and depend on negotiations between players. The complementarities between livestock systems constitute a factor of flexibility, making it possible to develop "collective" capacities to adapt the local farming system. We could therefore define a capacity of adaptation at individual level (modification of livestock practices to answer society expectations), and at collective level resulting from local interactions existing between the activities present. These evolutions are not only the result of the adoption of innovations promoted from outside but also of transformation in the collectives. From this point of view, diversity in the forms of livestock farms and exchanges is the driving force for innovation.

4. In conclusion

Given that evaluation is relative and evolutionary, and that it must take overall issues into account, methodological questions are raised for the researcher.

To propose a planning and assembly model of technical systems would raise the question of the adoption by the players of this model, and its robustness in an evolving context. The issue is rather to help players to construct a collective action to achieve negotiated objectives, around the sustainable management of a common resource. We are not in a logic of transfer either, but in an approach aimed at contributing to the organisational learning between players.

However, locally the question of sustainable development of the territory concerns a diversity of activities and players, each with their own logic, and having only a partial vision of the whole of the activities present, their interaction and their dynamics. Accompanying a learning process between players, for the management of a common resource, must be based on a structure supporting exchange between players, and on the means of reading and sharing the situation. The knowledge gained must therefore be integrated in a support structure for local players (Röling, N. et Wagemakers A.E., 2000; Napoleone et al., 2008).

For livestock system researchers, the support posture leads:

To working on the possibility of accounting for the processes in progress (Moulin et al 2008). The characterisation of evolution trajectories of farming activities constitutes for example a means of helping the players to imagine possible scenarios (Napoléone, 2008). More than a technical assessment at a given moment, it is the capacity to analyse transformations which should be preferred.

To make zootechnical indicators evolve. To accompany the readings of changes, we consider that these indicators should show certain characteristics:

- to be applicable to the farmer’s management entities (the batch or the herd, more than the individual),
- to be readable by the farmer and the other players, (factual indicators, more than ratios)
- to have a coherent period of time with respect to the management of activities. An annual period, whilst making assessments possible, gives little information about the organisation processes. This period of time is not definable in advance as it depends on how the activity progresses.
- to be applicable to common concerns and other activities (e.g. the spatialization of territorial dynamics and livestock practices).

To reconsider the way of constructing typologies. These become tools, no longer to facilitate a diagnosis in reference to a model, but to facilitate the reading and analysis of the diversity of

production processes and underlying logics, situated in local contexts. For example, in the approach to farming styles, the types constructed are indissociable (Commander, 2006).

In the Mediterranean hinterland, not very much influenced by the homogenisation and intensification of the technical models, a great diversity of livestock systems and practices survive. Research on the livestock systems is therefore faced with a formidable challenge to help in the legibility of these systems, in the recognition of their diversity and a renewal of their legitimacy with respect to the local and territorial development project.[1]

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