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Changing agro-pastoral systems and its implications on cultural landscape: a case study in the Causses and Cévènnes

Mara Almeida

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Institut Agronomique Méditerranéen de Montpellier

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Changing agro-pastoral systems and its implications on cultural landscape: a case study in the Causses and Cévènnes

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Abstract: Human-nature interactions that have shaped landscapes over long centuries are often expressed through farming and pastoral activities. These interactions resulted in cultural landscapes with outstanding universal values and are today recognized to be a part of the world's cultural heritage. The recognition of the values and attributes of these landscapes bring together the challenge to protect this cultural heritage and to guarantee the sustainability of landscapes. Though, the evolutionary character of cultural landscapes and the continuing co-evolution of the agro-pastoral systems, and its inherent traditional practices, raise relevant questions in what concerns to the management of the cultural heritage: *To which extent can agro-pastoral activity change while maintaining the values and attributes of cultural landscape?* This study explores the implications of the trajectories of different agro-pastoral systems on cultural landscape in the Mediterranean context, through a case-study applied in *The Causses and Cévennes*, in southern France, included in the Unesco World Heritage List as an Agro-pastoral Cultural Landscape. Several interviews to key informants and questionnaires applied to land managers representative of different agro-pastoral systems in the study area allowed the identification of (1) the trajectories different systems can assume, according to changes related to land use likely to occur in farm units, and (2) the main aspects related to grazing management affecting those trajectories. Results allow one to interpret the implications of management trajectories in the maintenance of the landscape character and to take a step further on the interpretation of possible limits of change in agro-pastoral systems.

***Keywords**: Agro-pastoral systems, Cultural landscape, Mediterranean region, Grazing management strategies*

***Résumé :** Les interactions homme-nature qui ont façonné le paysage au cours de longs siècles sont souvent exprimées dans les activités agropastorales. Ces interactions ont donné lieu à des paysages culturels possédant des « valeurs universelles exceptionnelles » et sont aujourd'hui reconnus comme une partie du patrimoine culturel mondial. La reconnaissance des valeurs et attributs de ces paysages suscite le défi de protéger ce patrimoine culturel et de garantir la pérennité de ces paysages. Cependant, le caractère évolutif des paysages culturels et la coévolution continue des systèmes agro-pastoraux et ses pratiques, soulèvent une question fondamentale en ce qui concerne la gestion de ce patrimoine culturel : dans quelle mesure l'activité agro-pastorale peut-elle changer, tout en préservant les valeurs et attributs du paysage culturel reconnut comme patrimoine? Cette étude explore les implications des trajectoires des différents systèmes agro-pastoraux sur le site d'un paysage culturel, dans un contexte méditerranéen, à travers une étude de cas dans les Causses et les Cévennes (sud de la France), zone inscrite sur la Liste du patrimoine mondial de l'Unesco comme « paysage culturel de l'agro-pastoralisme ». Un certain nombre d'entretiens avec des informateurs clés et les réponses aux questionnaires de gestionnaires d'exploitations agricoles représentant différents systèmes agropastoraux dans la zone d'étude, permettent d'identifier (1) les trajectoires que les différents systèmes peuvent emprunter, en fonction des changements liés à l'utilisation des terres susceptibles de se produire dans les fermes et (2) d'identifier les principaux aspects liés à la gestion des pâturages affectant ces trajectoires. Les résultats permettent de faire des hypothèses sur les effets des trajectoires de gestion dans le maintien du caractère patrimonial du paysage et, également, d'avancer sur l'interprétation des limites possibles des changements dans les systèmes agro-pastoraux.*

***Mot clés** : Systèmes agro-pastoraux, paysage culturel, région méditerranéenne, stratégies de gestion des pâturages*

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Avant-propos

Ce *Master of Science* du Ciheam est le résultat d'un travail de terrain effectué par Mara Almeida sur le site du Bien « Les Causses et les Cévennes - paysage culturel de l'agropastoralisme méditerranéen », site inscrit sur la Liste du patrimoine mondial de l'Unesco. Mara Almeida a été admise directement en deuxième année de Master, par dérogation, sur la base d'un dossier académique et d'intention, validé par le Secrétariat général du Ciheam.

Ce Master est également le résultat d'une volonté de collaboration entre le Ciheam Montpellier et l'Université d'Evora, en particulier de Teresa Pinto, directrice de l'*Instituto Ciências Agrárias e Ambientais Mediterrânicas.* Les relations entre cet Institut, qui travaille de façon intense et intéressante sur la dimension paysagère des systèmes agraires (ou la dimension agraire des paysages…), se sont renforcées avec la participation de sa directrice et de deux étudiantes de l'Université à la « Semaine de rencontres internationales » que le Ciheam Montpellier a organisée en octobre 2012. Ces rencontres avaient le thème suivant : « *Paysage culturel et développement économique durable : quelle gestion territoriale ? Les Causses et les Cévennes : expériences d'une inscription sur la Liste du patrimoine mondial & coopération avec pays du bassin méditerranéen* ».

Au cours de cette rencontre, Teresa Pinto Correira a présenté, dans un des trois débats publics menés dans le périmètre du Bien (à Florac), son analyse de la relation entre l'économie agricole et le paysage, via l'expérience du *montado* portugais - autre système agro(sylvo)pastoral méditerranéen de valeur « exceptionnelle et universelle ».

Il nous a semblé, au cours de ces échanges, qu'il pouvait être intéressant pour nos collègues portugais d'utiliser les Causses et les Cévennes comme terrain d'apprentissage et d'analyse, et qu'également, une approche ayant des bases analytiques passablement différentes de celles utilisées en France, pouvait être utiles pour la réflexion commune des acteurs du territoire.

Les résultats de cette brève étude de terrain sont présentés dans ce *Master* qui a obtenu la mention « publication », car les membres du jury ont estimé qu'en dépit des limitations démonstratives évidentes liées au petit nombre de cas qui ont pu être enquêtés et analysés, cette « stylisation » des trajectoires d'exploitations pouvait avoir un effet stimulant sur la réflexion. De même, la présentation très ramassée et synthétique du sujet (avec un cadre de référence peu connu en France) et la formulation d'hypothèses simplifiées ont le même intérêt : susciter une réflexion complémentaire et un débat ayant au cœur de ses interrogations la relation entre paysage et système de production.

Le Ciheam Montpellier peut ainsi, avec cette publication dans notre collection Thèses et Masters, participer à ce débat, tout en assumant sa fonction de réseau méditerranéen sur l'enjeu en termes de développement rural des « paysages culturels de l'agropastoralisme ».

François Lerin.

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Chapter I. Introduction

I. The concept of cultural landscapes and management aspects

Society's growing awareness and interest in rural landscapes, evidenced by the increased demand for new goods and services (Pinto-Correia *et al*., 2010; Pinto-Correia and Primdahl 2009), are a reflection of the values society recognizes in the landscape (Esposito and Cavelzani 2006). These values are the result of long-time interactions between humankind and its natural environment and are not exclusively related to landscape productive function (i.e. to the production of food and fiber) (Kienast *et al*., 2009), they are often linked with the externalities of agricultural activities (Carmona *et al*., 2011), such as landscapes' ecological, recreational, cultural and aesthetic values (Alessa *et al*., 2008; Brown and Brabyn, 2012; Brown and Reed, 2000).

The concept of cultural landscapes arises in recognition of the outputs of these human-nature interactions. Even though there is a multiplicity of understandings on the concept of cultural landscapes throughout the European discourses (Jones, 2003 *in* Plieninger and Bieling, 2012), the human–nature interactions seem to be the basis of its different meanings. Cultural landscapes can be understood as *landscapes shaped by traditional forms of land use that are valued as putatively representing the result of a harmonious and unique human-nature relationship* (Kirchhoff *et al.*, 2013). According to these authors, this meaning of cultural landscape has been the most influential, especially in Europe, in the context of cultural and natural heritage protection, landscape planning and environmental management.

The complex interactions between human and nature result in heterogeneous cultural landscapes in which practices sustain a wide range of ecosystem services, highly influenced by the physical constraints and opportunities presented by the natural environment and by social, economic and cultural pressures (Plieninger and Bieling, 2012). In this context, traditional farming practices play an important role in shaping cultural landscapes, in determining the continuing provision of certain ecosystem services and consequently in the maintenance of cultural landscape values. These landscapes are appreciated for allowing a sustainable use of natural resources, through traditional forms of land use, and also for possessing cultural heritage (Pretty, 2011 *in* Plieninger and Bieling, 2012).

The World Heritage Convention became the first legal international instrument to protect cultural landscapes. In 1992, cultural landscapes were integrated in the original two categories of culture and nature of the World Heritage Convention (Unesco, 1972). These landscapes become thus understood as cultural properties, in recognition of the specific interaction between culture and nature at the landscape scale. This category recognizes cultural sites that display the results of strong cultural processes on the

environment (Denyer, 2007) and that are *'illustrative of the evolution of human society and settlement over time, under the influence of the physical constraints and/or opportunities presented by their natural environment and of successive social, economic and cultural forces, both external and internal*' (Unesco, 2003).

There are 3 categories of cultural landscapes considered in the World Heritage convention (Unesco, 2009):

- *Clearly defined landscape designed and created intentionally by man*
- *Organically evolved landscape*
- *Associative cultural landscape*

The second category (*organically evolved landscape*) results from an initial social, economic, administrative, and/or religious imperative and has developed its present form by association with and in response to its natural environment. Such landscapes reflect a process of evolution, in their form and component features. Organically evolved landscapes fall into two sub-categories: *relict landscapes* and *continuing landscapes*. The last sub-category represents those landscapes which exhibit significant material evidence of its evolution over time and in which the evolutionary process is strongly connected to the evolution of human activities (Unesco, 2009).

Many of these landscapes are under pressure, due to global transformation processes and trends in contemporary society, and specific issues inherent in the management of landscapes of outstanding universal value need to be considered. The main challenge to be faced, particularly by site managers, is to protect the outstanding universal value for present and future generations while allowing development of new uses and new meanings and associations (Unesco, 2011a). In this context, special attention must be given to the key elements which created these outstanding cultural landscapes: *people, environment* and also the *processes of interaction* (Denyer, 2007).

Natural and social contexts are determinant in the way processes of interaction occur and change over time. In Mediterranean peripheral regions, especially in mountainous areas, where biophysical conditions often represent constraints for land uses (agriculture, forestry and pastoralism), specific practices were required as an adjustment to unfavorable conditions. This interaction process, within which people adapted to biophysical constraints, has resulted in outstanding cultural landscapes hosting high cultural and biological diversity. The management of such landscapes is often dependent on traditional rural practices. If the continuation of traditional uses over the last centuries indicates that the natural environment is being utilized in a sustainable manner, which supports human life at an acceptable level, these uses have to be maintained in a way this sustainability can be preserved and cultural services can continue to be provided, such as those related to heritage values and cultural identity (Tengberg *et al*., 2012).

Cultural heritage associated to these landscapes incorporate both the physical objects and places that have been passed on from generation to generation: historical objects or landscape features (cultural and natural) and various practices and intangible aspects, such as traditions (Harrison, 2010). Cultural heritage is not only what former generations built up but also the way it is interpreted, valued and managed by contemporary society, thus it is constantly changing and interpreted in various ways by different actors (Tengberg *et al*., 2012). Managing cultural heritage associated with landscapes thus requires a comprehensive approach (Unesco, 2011a), considering a wide range of disciplines, the wide range of actors involved in management and decision making processes, but also a fundamental aspect underlying human-nature interactions – its evolutionary nature.

II. The evolutionary nature of cultural landscapes

1. Concepts on landscape changes

The evolutionary nature of cultural landscapes has a central role in the definition of suitable management strategies and it has been explored and conceptualized in literature, aiming to progress in the understanding and management of landscape changes. In the context of management of cultural landscapes, the main efforts being done are towards the preservation of its values and their underlying land use practices while at the same time seeking to guide landscape changes into sustainable pathways (Plieninger and Bieling, 2012).

Cultural landscapes are a combination of social (governmental, economic, human, built) and ecological (biotic, physical) subsystems (Selman, 2012) and can thus be understood as socio-ecological systems (Kirchhoff *et al*., 2012; Selman, 2012), recognized as a resource that provides a range of goods and services for people. Therefore, a sustainable landscape can be considered as one in which the output of these goods and services is maintained, and the capacity of those systems to deliver benefits for future generations is not undermined (Potschin and Haines-Young, 2006). Drivers such as globalization, agricultural intensification, land abandonment, and urbanization influence and change cultural landscapes (Plieninger and Bieling, 2012; Selman 2013). These changes can occur gradually or rapidly in order to adapt landscape uses and spatial structures in response to social, economic and cultural demands.

As pointed out by Plieninger and Bieling (2012), both cultural landscapes and resilience perspectives share the interest in the protection, management and planning of natural resources, especially of ecosystems and landscapes, being both perspectives located in the interface of human and natural processes, exploring patterns, drivers and impacts of land use changes. The combined approach of these

perspectives allows one to explore the changing character of cultural landscapes under a new point of view.

From a resilience perspective, landscape changes can be considered as consequences of a complex interaction between nature and society (Plieninger and Bieling, 2012). Resilience is understood as '*the capacity of a system to experience shocks while retaining essentially the same function, structure, and therefore identity'* (Walker *et al.*, 2006) i.e. the ability to deal with disturbances without altering the essential characteristics of the system. Therefore cultural landscapes are capable of dealing with disturbances without changing their structure and functions, until they cross certain thresholds (Plieninger and Bieling, 2012), beyond which the systems change to a different state often resulting in the degradation of ecosystem services.

This led us to a relevant aspect concerning the evolutionary character of landscapes – the limits and thresholds for landscape sustainable change. Potschin and Haines-Young (2006), in the context of the sustainability impact assessments, presented a conceptual model to be approached as a basis for understanding landscape changes and its acceptable limits. According to the authors (Potschin and Haines-Young, 2006; 2008) there is a '*choice space'* beyond which some critical point (or limit) of change is reached: as a result of external pressures, the capacity of a landscape to continue delivering a benefit is affected. The '*choice space'* therefore represents the '*room for manoeuvre*' within which there are several possibilities for change (e.g. different trajectories of land use) that allow certain goods and services to be provided by a landscape, what the authors named '*acceptable change'*.

However the assessment of limits of the '*choice space'* is an extremely complex task. As referred by the authors (Potschin and Haines-Young, 2008), this complexity arises from the dependence on '*judgments made by individuals or groups'* based on the '*perceived or predicted consequences or implications of exceeding a given limit'*. Society's perceptions on what could be recognized and valued as cultural heritage is *per se* a complex issue, but particularly in what concerns to cultural landscapes: the diversity of visions and perspectives society has over landscapes makes the definition of limits even more complex, consequently the conservation and management of cultural landscapes, and the definition of its sustainable evolution trajectories, becomes more challenging than other type of cultural heritage.

In addition to the complexity in defining limits**,** those limits can change over time. A sustainable trajectory of land use is one which remains within the limits that society has identified as significant. However, the view that society has about limits can change, and so a trajectory that was once thought of as acceptable can become an unacceptable one. The challenge raised by the authors, through this model is how the evolutionary nature of landscape can be taken in consideration while keeping future options '*open'*. What the authors propose is that a range of alternative configurations (of landscape structure and

function) can sustain ecosystem goods and services currently identified and valued by people (Potschin and Haines-Young, 2006).

2. The role of farming systems

The way landscapes change relies on the complex interaction processes occurring between human and nature, often taking place through farming activities. Transformations in land cover and land use are mainly linked with different evolution pathways of farming systems (Serra *et al*., 2008) which, in the last decades, especially in Mediterranean areas, have been strongly influenced by two relevant driving forces – agricultural abandonment and intensification (Caraveli, 2000). These changes in farming systems can result in a gradual decrease of landscape diversity and complexity and consequently having a negative impact on the environmental, cultural and identity values of traditional farming landscapes. Thus, the range of alternative trajectories of land use changes allowing the maintenance of goods and services provided by a landscape, depends on changes occurring in farming systems and on its evolution pathways (Baudry and Thenail, 2004; Queterier *et al.*, 2005; Van de Steeg *et al.*, 2010).

Farming systems have been widely discussed in literature (e.g. Schiere *et al*., 2012; Deffontaine *et al.*, 1995; Baudry and Thenail, 2004; Carmona *et al.*, 2010), describing patterns and processes characterizing the systems, developing conceptual models to better understand its changes and also by exploring its relationship with landscape. Farming systems can be conceptualized as a sub-set of complex adaptive systems that co-evolve with their environment (Milestad *et al*., 2012). The trajectory of a farming system depends on its the visible characteristics (such as forest cover, grass or crop pattern) but also on variables such as networking, access to information and technology, community values, ability for collective action, or farmer skills (Schiere *et al*., 2012). As a result, relationships between farm components are multiple and complex and relationships with the general socioeconomic environment are constantly changing (Bernuès *et al*., 2011). As context change, changes such as migration, markets, new skills, technologies, policies, and ecosystem behavior, systems tend to change into new modes. However while a basic mode may be efficient (optimal) in one context, it is likely to be inefficient under a different set of conditions, i.e. what is appropriate and what is efficient is all context-dependent (Schiere *et al*., 2012).

Wider temporal and spatial perspectives beyond the farm scale are required in order to understand relationships between human activities and the biophysical processes involved (Bernuès *et al*., 2011), however, it is at the farm level where the decision-making takes place (Carmona *et al.*, 2010; Bernuès *et al.*, 2011). Pressures resulting from changes in the socio-economic environment can lead farmers to adopt alternative management strategies: they exercise choice, engage and designing their system, nudging it into a different trajectory (Elzen *et al*., 2012; Schiere *et al*., 2012). This choice can be enabled or

constrained by context and therefore, context and farming systems co-evolve as farmers explore new models of farming.

III. Cultural landscapes shaped by agro-pastoralism

Farming systems differ widely in terms of their use of resources, degree of intensification, species and orientation of production, local/regional socio-economic and market context, cultural roles, etc (Bernuès *et al*., 2011) and specific conditions, within these dimensions, determine the occurrence of different types of farming systems. Within the wide diversity of Mediterranean farming systems, agro-pastoralism is one of the most representatives and well adapted to the biophysical and environmental conditions and highly relevant in both environmental and social terms, with great ecological, landscape and cultural diversity (Bernuès *et al.*, 2011).

Agro-pastoralism can be understood as '*an agrarian system that combines extensive animal farming and crops in two clearly separate areas: on the one hand the so-called natural spaced reserved for grazing and on the other cultivated, organized spaces devoted to crops and strongly marked by human activities'* (Luginbühl, 2010). In a broad perspective, pastoralism can be considered as an adaptation to regions with strong climatic and topographical constraints where farming practices are in general difficult to develop (Bourbouze and Chassany, 2007). In many areas in the Mediterranean region the absence of optimal conditions for the development of a competitive farming turned into an opportunity for pastoralism, that in combination with specific agricultural practices, created a wide diversity of agro-pastoral systems well adapted to specific environmental, social and economic contexts.

In this context, low input- pasture-based farming, such as agro-pastoral systems, have a central role in the maintenance of Mediterranean cultural landscapes (Boerma and Koohafkan, 2010; Chassany, 2010; Luginbühl, 2010; Marty *et al*., 2007). However agro-pastoralism is facing several environmental, social and economic pressures. Important changes have occurred in these systems during the last decades, mainly due to the modernization and intensification of agriculture, which have caused a continuous reduction or abandonment of livestock farming in rural areas (Plieninger 2006). The abandonment of marginal land and the decline of traditional farming practices have generally led to undesirable environmental consequences (Plieninger *et a*l., 2006). As a result, these areas tend to be highly susceptible to the encroachment of forests (Girard *et al.*, 2007; Plieninger, 2006). A general process of shrub and forest invasion can occur, and apart from the biodiversity loss, shrub encroachment also threatens a diverse landscape mosaic compromising the values of open woodlands and meadows. Agro-pastoral systems in Mediterranean areas should therefore be considered strategic in shaping a rich variety

of landscapes and habitats as well as in preserving their related attributes, as the built heritage, the water structures or the paths networks, result of an evolutionary human activity.

Agricultural and pastoral activities have been considered in the the World Heritage List of Unesco, mainly under the category *ii* of cultural landscapes, as defined in the Operational Guidelines for the Implementation of the World Heritage Convention, and referred to as organically evolved landscapes (Rossler, 2007). With regards to their representation on the World Heritage List, several landscapes, mainly from the European continent, have already been inscribed because of their outstanding universal value related to agricultural activities: vineyard landscapes, among which the *Wachau Cultural Landscape* (Austria), the *Tokaj Wine Region Historic Cultural Landscape* (Hungary), the *Upper Middle Rhine Valley* (Germany), the *Jurisdiction of Saint-Emilion* (France) or the *Alto Douro Wine Region* (Portugal); and landscapes where agricultural activity has produced particularly beautiful scenery, as in the *Val d'Orcia and Costiera Amalfitana Cultural Landscapes* (Italy).

Also, even if under-represented in the World Heritage List (Denyer, 2007; Rossler, 2007), several landscapes particularly related to pastoral and transhumant societies, have been considered, among which the example of *Madriu Perafita-Claror Valley* (Andorra)*, The Transhumance: The Royal Shepherd's Track* in Italy (considered under the *Tentative list* of cultural landscapes in Italy), that specifically target the phenomenon of transhumance and linear landscapes, and *The Causses and Cévennes* in France, included in the World Heritage List in 2006 as an Agro-pastoral Cultural Landscape.

Besides the recognition of the outstanding universal values related to agro-pastoralism, the aim of these nominations is to preserve outstanding cultural landscapes currently threatened by their environmental, economic, social and cultural contexts. Therefore, the maintenance of the integrity and authenticity of cultural landscapes and the protection of its living traditional cultures are needed to face the threats currently affecting this heritage. Though, the need for heritage protection and conservation is strongly connected with the continuing character of cultural landscapes and this fact raises an important challenge: being agro-pastoral landscapes shaped by an evolutionary process that relies (though not exclusively) on the evolution of the agro-pastoral activity, how can this activity change? and how can this evolution occur in a way that guarantees the maintenance of this cultural heritage?

The challenge now, considering the continuing character of these agro-pastoral landscapes, is to deal with pressures from environmental, economic and social constraints that agro-pastoral activity is facing today in order to safeguard the landscape character as valued today by society. At the same time as the specific dynamics of the different agro-pastoral systems have determined the landscape character until today, future changes in these systems can also determine changes in this character. As a result, the trajectories

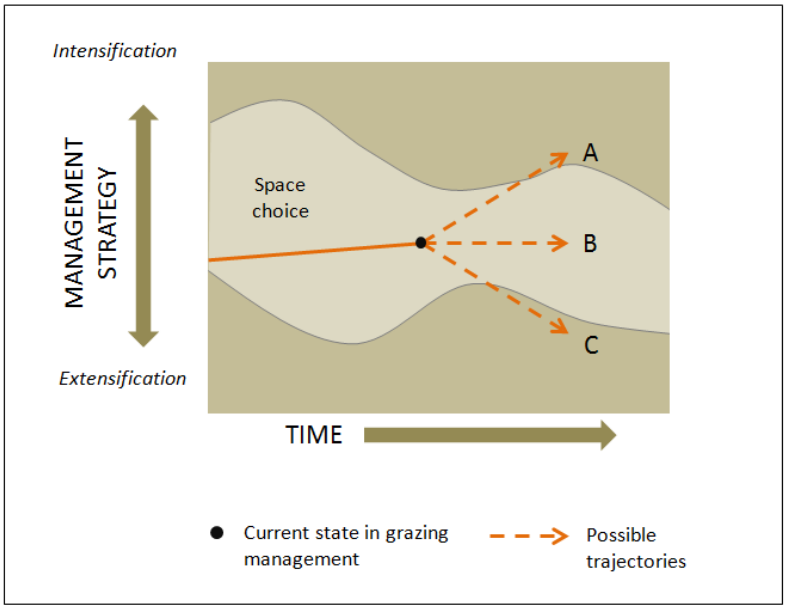
these systems can assume can be understood as a key factor in the conservation of the cultural heritage (Quetier *et al*., 2005).

The variability in land management practices, leading to changes in land use, has a direct impact on the landscape structure and composition (Carmona *et al*., 2010; Verburg *et al*., 2009). Thus the evolution of agro-pastoral systems relies in the changes likely to occur at the farm level, defined by the management options assumed by land managers, especially in what concerns to grazing management. A more profound knowledge on the trajectories these systems can assume may in fact contribute to better understand the role of these systems in the maintenance of the continuing cultural landscape and in heritage conservation.

IV. Aims of the study

Applying the concept of 'choice space' in the context of the evolution of the agro-pastoral activity in cultural landscapes, it can be assumed that different trajectories are available and that different grazing management strategies can be developed in the farms, allowing the maintenance of the goods and services provided by this cultural landscape (Figure 1).

Figure 1. The concept of 'choice space' applied to changes in grazing management strategies.



(Adapted from Potschin, and Haines-Young, 2008): the range of options land managers have, to respond to both external and internal pressures affecting agro-pastoral activity, can define different trajectories, tending to more intensive (A) or more extensive (C) land uses. Changes in grazing management occurring within the limits of the 'choice space', i.e. keeping land use functions within acceptable limits (B), can ensure the provision of landscape cultural goods and services. Beyond those limits changes in grazing management will compromise the provision of those goods and services (A and C).

Even if the assessment of the limits of the 'choice space' is an extremely complex task, the assessment of the possible changes that can occur in the farms and its implications on land use changes can be a step further in the interpretation of those limits. Taking this in consideration, the general aim of this study is therefore **to explore the implications of the trajectories of different agro-pastoral systems in the cultural landscape**, through a case-study applied in the Agro-pastoral Cultural Landscape of the Causses and Cévennes, in southern France. The present study will explore how farms can change while maintaining values of cultural landscape. In this sense two specific objectives will be considered:

1. To identify the possible strategies different farming systems can assume, according to changes related to land use likely to occur in farms;
2. To identify the main aspects related to grazing management affecting those strategies;
3. To discuss how different land use trajectories can affect the main attributes of the cultural landscape.

It will allow one to better interpret the implications of different management options in the maintenance of the landscape character and to take a step further on the interpretation of possible limits of change in agro-pastoral systems.

In the following section the study area will be presented (**Section 2**), with special focus on the aspects characterizing the landscape values and attributes shaped by agro-pastoralism and the main aspects currently influencing the evolution of this cultural landscape. Subsequently, the sources and methods used to develop the study are described (**Section 3**) and results are presented: firstly describing results on the characterization of the agro-pastoral activity and the observed trends in the study area (**Section 4**); and secondly presenting the possible trajectories in agro-pastoral systems identified in the Site (**Section 5**). In the subsequent section results are discussed, concerning the impacts of different trajectories on land use and how these changes can affect the maintenance of cultural heritage (**Section 6**). Finally some concluding remarks are outlined (**Section 7**).

Chapter II. The Mediterranean agro-pastoral cultural landscape of the Causses and Cévennes

The Causses and Cévennes is one of the cultural landscapes inscribed in Unesco's World Heritage List as a Mediterranean agro-pastoral Cultural Landscape. The site, composed of 302,319 ha located in the southern part of central France (Figure 2), includes 231 communes (134 communes in the core area and 97 communes in the peripheral area) distributed for four administrative departments (*Aveyron, Hérault, Gard,* and *Lozère*) in two administrative regions (*Midi-Pyrénées* and *Languedoc-Roussillon*). The site is characterized by distinctive geologic structure and physical conditions (Figure 3) that have created an exceptional variety of landscapes: the Lower *Cévennes* characterized by the valleys and the schist mountains; the Higher *Cévennes* composed of two granitic massifs, the highest within the site (at south *Mont Aigoual* with 1567 meters and at north *Mont Lozère* with 1699 meters); and the *Causses*, composing one of the most important set of karstic formations in the west Europe – large sedimentary surfaces shaped between 750 and 1200 meters of altitude (e.g. *Causse du Larzac*, *Causse Méjean*, *Causse de Sauveterre* and *Causse Noir*), associated with the gorges limiting these surfaces. The diversity of landscapes in the *Causses* and *Cévennes* reflect the Atlantic, Continental and Mediterranean influences that contributed to an exceptional natural context: a wide diversity of habitats and species conferring high levels of biodiversity (Unesco, 2011b).

Figure 2. Location of the Site *The Causses and Cèvennes* included in the World Heritage List: two regions *Midi-Pyrenees* and *Languedoc-Roussillon* (a) and four administrative departments (*Aveyron, Hérault, Gard,* and *Lozère*) (Adapted from: http://www.causses-et-cevennes.fr)

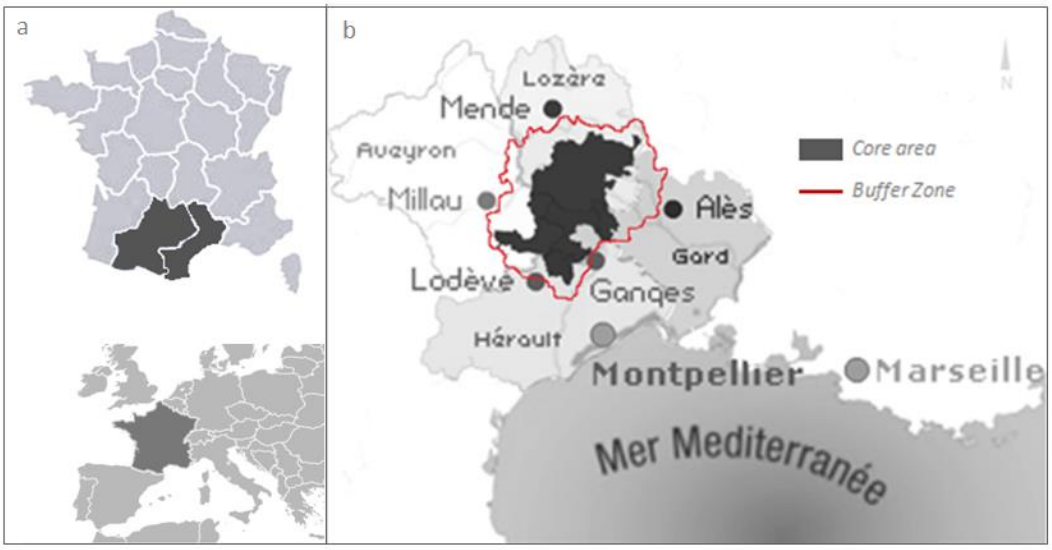
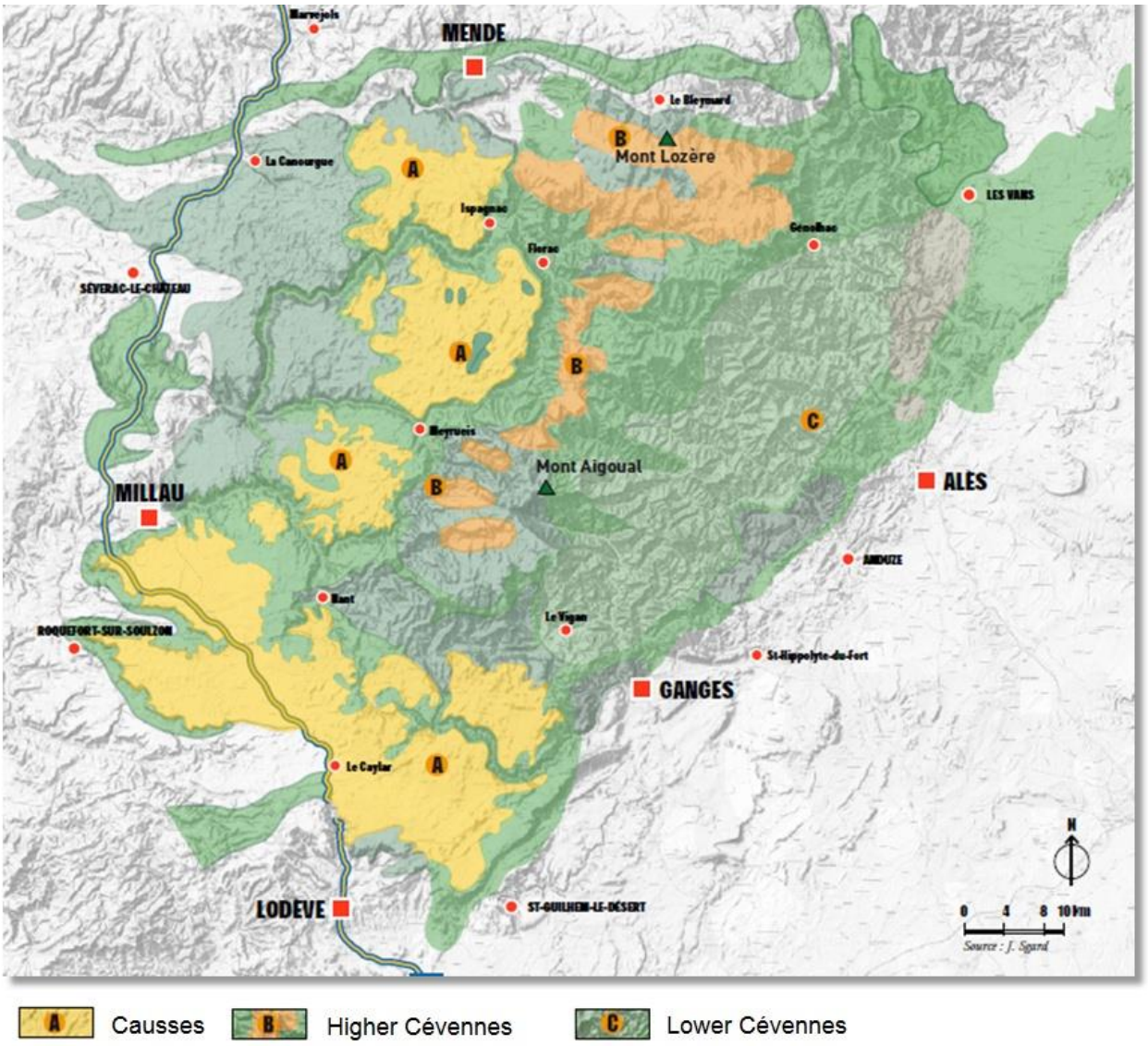


Figure 3. Main geological features characterizing the landscape differentiation in the Site. (Adapted from: Unesco, 2011b)



The Mediterranean agro-pastoral cultural landscape of the *Causses* and *Cévennes* integrates the World Heritage List since 2011. Its nomination was proposed based on two criteria (Unesco, 2011b): ***Criterion (iii)****: The Causses and the Cévennes, manifest an outstanding example of one type of Mediterranean agro-pastoralism. This cultural tradition, based on distinctive social structures and local breeds of sheep, is reflected in the structure of the landscape, especially the patterns of farms, settlements, fields, water management,* drailles *and open grazed common land and what it reveals of the way this has evolved, in particular since the 12th century. The agro-pastoral tradition is still living and has been revitalized in recent decades;* and ***Criterion (v)****: The Causses and the Cévennes can be seen as an exemplar of Mediterranean agro-pastoralism and specifically to represent a response common to the south-west of*

Europe. The landscape areas manifest exceptional responses to the way the system has developed over time and particularly over the past millennia.

Based on these criteria, the *Causses* and *Cévennes* were therefore recognized to manifest an outstanding example of one type of Mediterranean agro-pastoralism and to demonstrate almost every type of pastoral organization that can be found in the Mediterranean region (agro-pastoralism, silvo-pastoralism, transhumance and sedentary pastoralism). This area retains numerous testimonies of the evolution over several centuries of its pastoral societies, such as their important built heritage, landscape characteristics, and intangible associations that reflect traditional pastoralism (Unesco, 2011b).

As defined by UNESCO's cultural landscapes classification (Unesco, 2009), The *Causses* and *Cévennes* is a *Continuing landscape*, a landscape "*which retains an active social role in contemporary society closely associated with the traditional way of life, and in which the evolutionary process is still in progress, and at the same time it exhibits significant material evidence of its evolution over time*". This evolutionary process relies (though not exclusively) on the evolution of the agro-pastoral activity. This activity was recognized as the unifying factor in the Site of the *Causses* and the *Cévennes* by the time of its nomination (Unesco, 2011b). Nevertheless, the role of agro-pastoralism and its evolution has been acknowledged through the course of the history as a central factor shaping these landscapes and as a basis for the analysis of the interactions between human activities and ecosystems in this territory (e.g. Pillet, 1981). Likewise, in the present study the agro-pastoral activity and its evolutionary process will be the basis for exploring possible changes on cultural landscape, considering the cultural landscape as it is valued and recognized today by society. Therefore, in order to better understand the possible impacts of this activity on the maintenance and management of the cultural heritage, an overview on the attributes and unique features of the cultural landscape is needed.

I. The unique features of the agro-pastoral cultural landscape

In the context of the Unesco nomination, the unique features of the agro-pastoral cultural landscape of the *Causses* and *Cévennes* were identified and presented as the support for the recognition of an outstanding cultural landscape. They are here briefly described, according to the Unesco nomination file (Unesco, 2011b):

i. Landscape structure

- The landscape structure, coupled with the physical characteristics and the environment (harsh climate, irregular water regime and important natural forest cover), is the basis of the territory of the *Causses* and *Cévennes*, supporting a common agro-pastoral culture. The itinerant pastoralism

shaped the landscape through a network of 300 kilometres of paths (*drailles*) and unified the different territories: the schist valleys in the *Cévennes*, the limestone plateaus in the *Causses* and the granitic mountains of *Mont Lozère* and *Mont Aigoual*. All the large territories defining the landscape structure in the Site are monumental - sometimes in violent life conditions imposed to its inhabitants, have demanded an effort of adaptation of agro-pastoral societies.

ii. Landscapes resulting from the natural context shaped by agro-pastoralism

- The valleys of the *Cévennes* and the gorges of the *Causses*; the landscapes of the high plateaus; and the mountainous landscapes.

iii. Forms of human settlements

- Three types of architecture resulted from geological structures: the schist architecture in the *Cévennes* valleys; the granite architecture in the mountainous areas and; the limestone architecture in the plateaus and gorges of the *Causses*.

iv. Attributes of the cultural landscape

The open landscapes:

- The open landscapes composed of grassland (*pelouses*) and scrubland (*landes*) occupying the diverse territories of the *Causses* and *Cévennes*, e.g. the steppe grasslands on the *Causse Méjean*, the altitude grasslands, and the heathers in the schist and granite areas.

The natural areas:

- Open spaces are at the origin of specific and rare natural environments in terms of fauna and flora. Agro-pastoralism has helped maintain these open spaces and therefore its biodiversity. The most interesting environments, in a heritage perspective, are the crop areas in association with rangelands.
- In areas where surface water is scarce or absent, the *lavognes* (basins serving as drinking troughs for flocks) in the *Causses* represent exceptional environments. They host species associated with aquatic environments, some of which are rare and protected. The maintenance of these structures is a functional need for agro-pastoralism and it is also essential for the conservation of unique species.
- The *clapas* (mound of piled up stones), resulting from a practice of clearing lands of stone to create new plots to cultivate, are an attribute of the agro-pastoralism generator of an original biodiversity by creating shelter and safe refuge for many species.
- The heather moorlands are important natural spaces in the *Cévennes*, characterized by small shrubs, *Calluna vulgaris* or *Erica cinerea*. These spaces have an undeniable landscape interest. They are also important for beekeeping: very popular for the production of the *Cévennes'* honey, hosting remarkable bee species.

The marks of the history

- The structural attributes demonstrating the use of the territory: the flock paths (*drailles)* and associated with them are the bridges, the boundary marks, the hydraulic rack, the water mines, canals, tunnels, aqueducts and dams;
- The attributes revealing the uses of agro-pastoral activity in the territory: the summer rangelands; the *buissières*, hedges of boxwood which form covered corridors protecting the flocks from the bad weather and sun; the terraced slopes; the isolated farms and hamlets, built with local materials and adapted to the harsh weather conditions; the cheese caves; the *lavognes*, etc;
- The attributes illustrating a culture of the territory: the places for fairs, for agro-pastoral exchanges and trade; the chapels, manifesting the link between religious practices and the pastoral activities; the pastoral traditions particularly related to the observation of the territory; the pastoral rites and social organization, particularly related to transhumance; and the scientific and technical reference on agro-silvo-pastoral practices accumulated over nearly half a century.

v. A living agro-pastoralism:

- A new agricultural dynamic based on a wide variety of animal breeds well adapted to the specificities of the territory, e.g. *La brebis Lacaune, La brebis Raïole, La Caussenarde des Garrigues, La Blanche du Massif central, L'Aubrac*;
- The diversity of productions valorizing the territory: several national (AOC) and European (PGI, PDO) labels devoted to the quality of local products, according to the farming methods and breeds traditionally raised (meat products, such as *Agneau de l'Aveyron* and *Agneau de Lozère* (*L'Indication géographique protégée*) and cheeses, such as *Roquefort*, *Pélardon* and *Bleu des Causses* (*L'appellation d'origine contrôlée et appellation d'origine protégée*).

II. The diversity of Agro-pastoral systems

In the *Causses* and the *Cévennes*, in a context of a low productive farming such as in other less competitive areas in the Mediterranean region, the agro-pastoral activity has over a long time adapted to biophysical conditions and to changes in socio-economic context creating specific dynamics in the cultural landscape (Marty *et al.*, 2007). The agro-pastoral systems in the *Causses* and the *Cévennes* are highly diversified: in the types of production (meat and/or cheese); in the way they use the territory (through transhumance or sedentary pastoralism); in the spatial organization of farms (distribution and utilization of different grazing parcels); in its ways of using land cover (for forage production or grazing); and in feed resource management (searching for a balance between grazing and complementary feed resources) (Barjou *et al*., 2009; Lardon et Osty, 2009).

Reflecting this variability in the systems' components, four major types of agro-silvo-pastoral systems were identified in the context of the Unesco nomination (Table 1). The identified types reflect the most representative systems and also the territorial diversity in the Site (Figure 4): the limestone plateaus of the *Causses*, the mountainous areas of *Mont Aigoual* and *Mont Lozère*; and the valleys of the *Cévennes.* The different territories composing the Site, with their specific biophysical, social and economic contexts, developed different management dynamics (Aubron, 2011; Massenet, 2004) revealing the diversity of ways agro-pastoral activity has adapted to the territory and its differentiated potentialities.

Table 1. Types of Agro-pastoral systems identified in the Site.

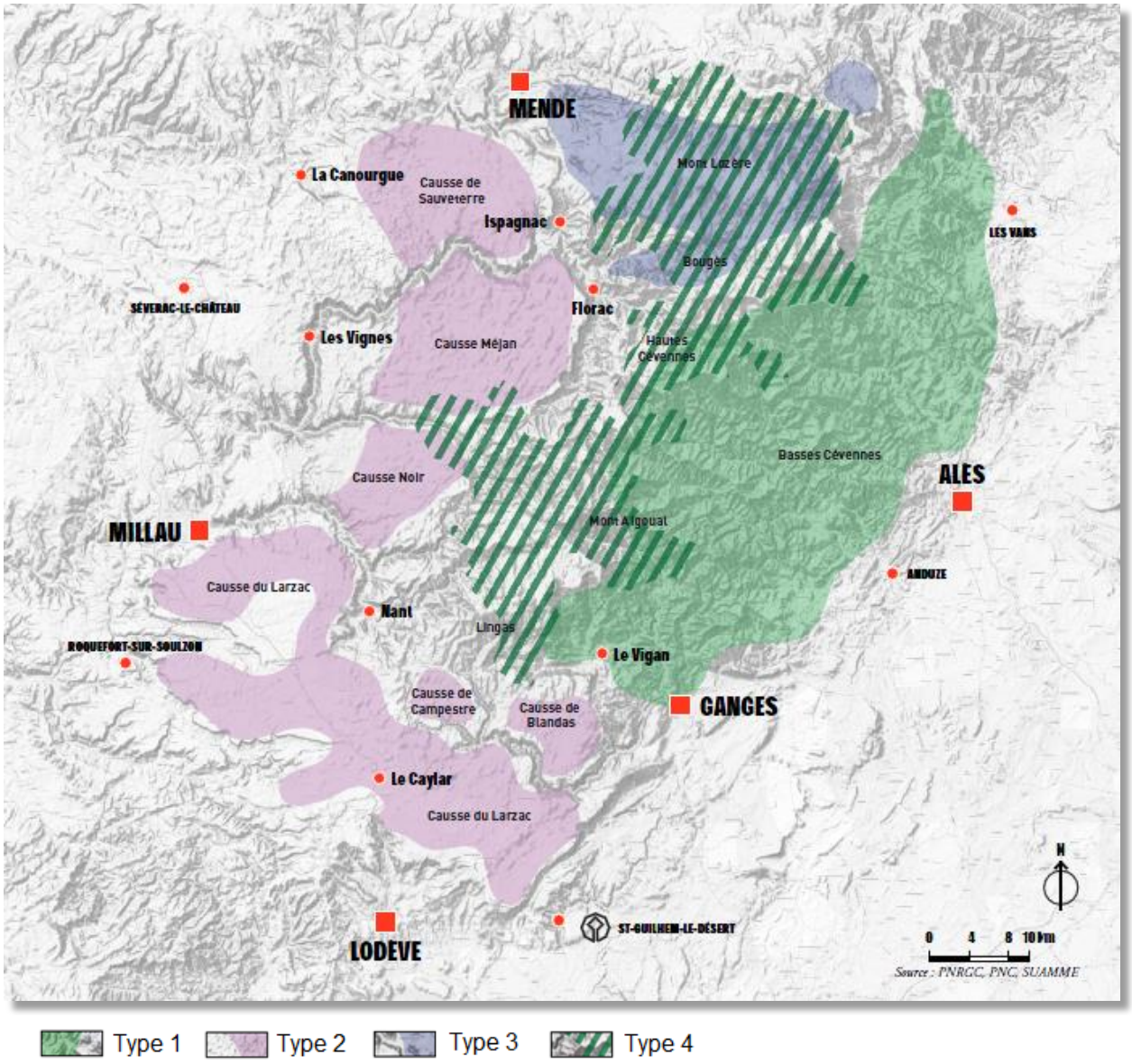
	Main types	***Location***
1	Agro-silvo-pastoral system of meat- sheep (producing lambs), which may be associated with other farming activity or agro-tourism, grazing and valuing the different stages of vegetation; in association with: Agro-silvo-pastoral system of goat for the production of PDO Pélardon cheese in dairy system (delivery of milk to the local cheese cooperative) or cheese (farm production) valuing and grazing different vegetation stages.	***Basses Cévennes***
2	Agro-silvo-pastoral system of meat- sheep (producing lambs), which may be associated with other farming activity or agro-tourism, grazing and valuing the different stages of vegetation; in association with: Agro-pastoral system of dairy sheep (for the production of PDO or PGI cheese) valuing and grazing different vegetation structures in the Causses.	***Causses*** *Causse du Larzac* *Causse de Sauveterre* *Causse Méjan* *Causse Noir*
3	Agro-silvo-pastoral system meat-sheep or cattle grazing and valuing the different structures of vegetation on high granitic lands.	***Mont Lozère***
4	Sheep grazing in summer transhumance from the Lower Languedoc (Garrigues) and Lower Cévennes to the upland granitic areas (Mont Lozère, Bougès, Lingas and Aigoual) or to the plateaus in the Causses, grazing different vegetation structures.	***Upland granitic areas*** *Mont Lozère* *Bougès* *Hautes Cévennes* *Mont Aigoual* *Lingas*

Source: Unesco, 2011b.

The diversity of spontaneous vegetation in this area is a valuable grazing resource and it has being used as the basis for extensive animal production. Traditional practices, involving the use of natural resources, contributed for the preservation of unique landscapes and for the maintenance of a high level of biological diversity (Barjou *et al*., 2009). Rangelands play a central role in the dynamics of all these systems,

although it is often complemented with cultivated areas (both for grazing and forage production) mainly due to the seasonality of spontaneous vegetation resources. Producers manage the grazing activities according to the type and composition of flocks but also according to the natural resources available along the year (i.e. according to floristic diversity, quality and availability).

Figure 4. Spatial distribution of the identified types of Agro-pastoral systems.



Source: Dossier de candidture (Unesco, 2011b)

III. Main pressures affecting the agro-pastoral cultural landscape

In terms of landscape changes, the risk of closure of open areas, particularly of the steppe pastures – a distinctive attribute of this territory, may be emphasized. It is one of the main consequences of changing agro-pastoral practices. Macroeconomic developments, such as the sheep meat markets or the rising cost

of grain used as a complementary feed, are important aspects influencing the options taken by land managers and can lead to the decrease of grazing activities. As a consequence the shrub encroachment, mainly on the less productive areas or of difficult access, lead to progressive closing of open landscapes (Lardon et Osty, 2009). This phenomenon has also impacts on biodiversity since these types of ecosystems are particularly rich in plant species with high heritage value (Unesco, 2011b). In addition to the risk of closing environments, there is also the risk of disappearance of signs and marks of the traditional landscape and of the emergence of new landscape elements. The demographic and farming decline led to the recognized abandonment of some land. This means a risk of progressive disappearance of signs and marks of the traditional landscape: stone walls collapse, obstruction of roads by vegetation propagation, less maintenance of terraces. This is particularly evident in the case of water management structures. Also, the emergence of new landscape elements such as those resulting from changes in the vocabulary of materials and forms of contemporary architecture, housing, agricultural buildings, industrial buildings. Moreover, these spaces face pressure today to welcome wind farms and solar power structures seeking to invest in less populated areas, as in other French territories.

Chapter III. Sources and methods

The methodological approach was designed in order to explore how farms can change, focusing on changes in grazing management and land cover, and how these changes can affect the main attributes of the cultural landscape. In this sense, expert meetings were undertaken and questionnaires were applied to farm managers within the Site. Three stages were considered, as summarized in Figure 5**,** and describe in the following topics:

A. The agro-pastoral activity in the Site

In order to characterize the current status of the agro-pastoral activity in the Site, some variables from statistics databases were analyzed according to the available data for all communes within the study area. The variables considered in this analysis refer to active population currently working on agricultural sector (data from Insee, 2009) and the proportion of existing farms related to agro-pastoral activity. In addition, an analysis on the trends characterizing the activity in the last 20 years was carried out based on available statistical data, focusing on the variation of agronomic variables, such as number of farms, land cover types and animal units. The analysis was developed considering data from the French national agricultural statistics (Agreste, 2010) concerning the period from 1988 to 2010 for all communes included in the Site perimeter, both within the core and the peripheral area.

B. Possible trajectories for the different Agro-pastoral systems

Discussions with key informants were carried out in order to validate the analysis on the agro-pastoral activity and its trends (stage 1) and to explore other possibilities of evolution and factors affecting the agro-pastoral activity. Experts closely linked with the agro-pastoral activity and developing their professional activity having a direct contact with land managers were the priority for this analysis, as well as key informants directly related to farmers associations. The discussions were based on interview guidelines previously defined (Annex V) and considered:

- Interviewees opinion and considerations on the presented results;
- The main aspects characterizing the dynamics of the different agro-pastoral systems in the Site (feed resources, grazing practices), based on their knowledge; and
- Their opinion on possible changes likely to occur in the farms.

In order to identify and analyze the management options likely to be adopted by land managers, case studies were also developed in representative farms of two different agro-pastoral systems. Questionnaires applied to land managers (Annex V) considered:

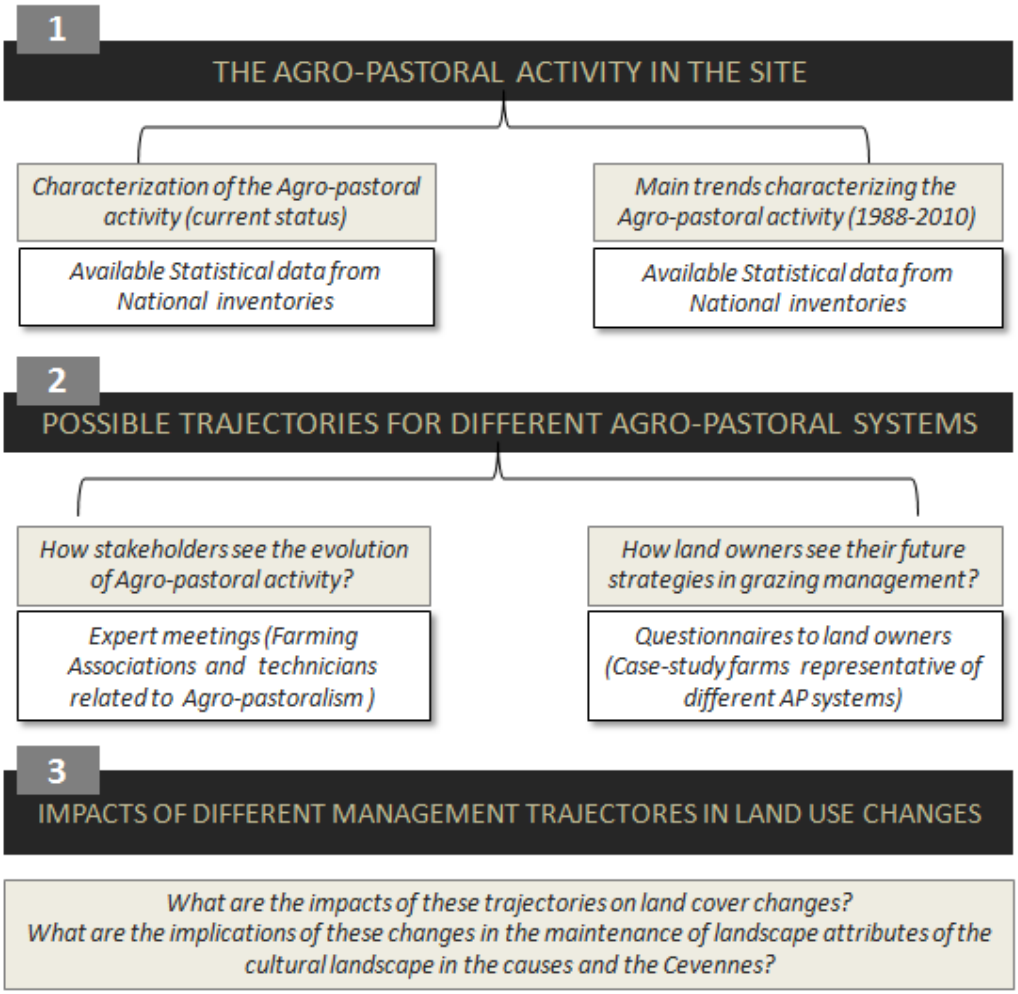
- Characterization of the farm (land cover, labour, main production and flocks composition);
- Grazing management (feed resources, flock management and feed calendar);

- Future changes in the farm in response to the main trends (as previously identified).

C. Impacts of management trajectories in land use changes

Based on the identified strategies and on the changes likely to occur in the case-studies farms, the impacts on land use were analyzed and discussed. Also, an analysis was carried out in order to explore the implications of these land use changes in the maintenance of the landscape attributes of the *Causses* and *Cévennes*.

Figure 5. Methodological approach.



Chapter IV. The Agro-pastoral activity in the *Causses* and *Cévennes*

I. Characterization of the Agro-pastoral activity - current situation (2010)

Overview on farming activity in the Site

An analysis of some variables considering the 231 communes composing the Site (134 communes in the core area and 97 communes in the peripheral area), allow a general characterization of the current status of the farming activity and an overview on the proportion of agricultural holdings directly related to the agro-pastoral activity. In 2010, according to data on National Agricultural Inventory (Agreste, 2010), the Site is composed of 2372 farms and the Utilized Agricultural Area represents 68.3 % of the territory, corresponding to 206385 ha. Pastures are the most significant cultures representing 70% of the Utilized Agricultural area (Figure 6). The most recent demographic data (Insee, 2009) shows that, considering the active population in all communes of the Site (78333 residents), the proportion of population currently employed in the farming sector is of 2%, corresponding to 2873 residents (Figure 7).

Figure 6. Proportion of the different cultivated areas considered in the Utilized Agricultural Area. Source: Agreste 2010

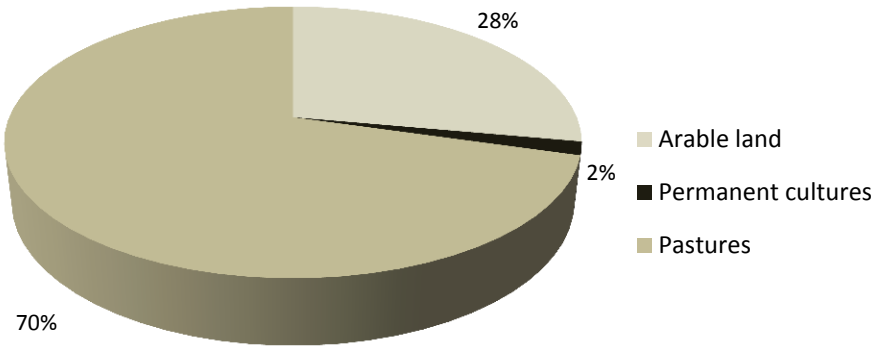
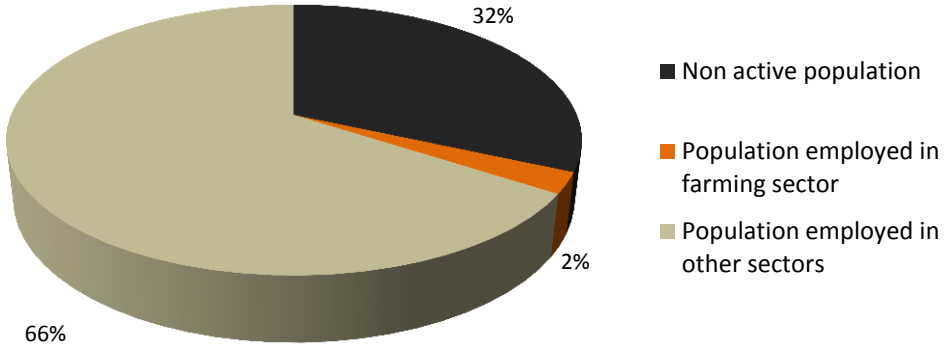


Figure 7. Distribution of active population in the Site.

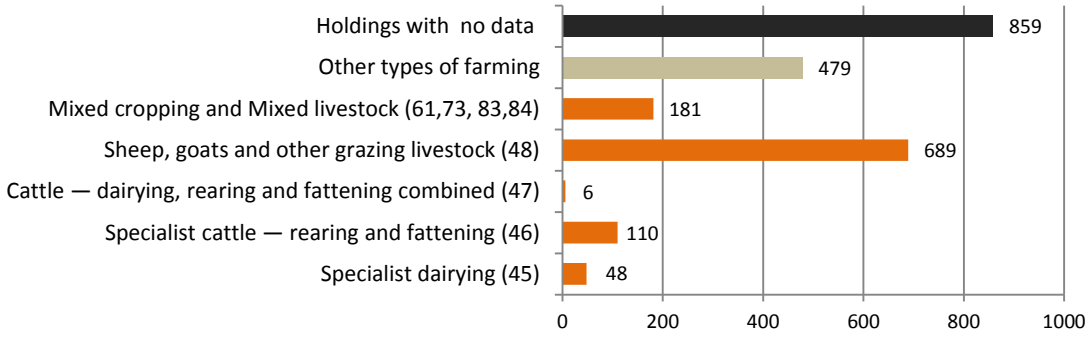


Source: Insee, 2009

Farms related with agro-pastoral activity

Farms related to agro-pastoral activity were selected according to data on type of farming in agricultural holdings (Agreste, 2010), by commune (Figure 8). Types of farming related to agro-pastoral activity were considered to be those having animal production as main economic activity (with exception for indoors animal production) according to EU typology (Annex I). In 2010, the number of farms related to agro-pastoral activity represents 68% of the 1513 farms with data in the Site, with farms specialized in sheep, goats and other grazing livestock being the most significant (46%). About 32% of the farms are related to other types of farming, such as specialized in field crops (cereals, industrial cultures, etc), in horticulture, or in permanent crops (vineyard, orchards, etc).

Figure 8. Number of farms by OTE in the Site of The *Causses* and the *Cévennes* (2010)



Source: Agreste, 2010.

Data on types of farming presented by commune in the national agricultural statistics (Agreste, 2010) is not available for all communes in the site, being referred as '*data subject to statistical confidentiality'*. Therefore, considering the total number of farms by commune, a considerable proportion of the farms (36%) has no information on the main type of production. Despite this limitation, results show that about 32% of the farms with data are specialized in crop production, meaning that the main activity in these farms is not animal production. Nevertheless, these farms may include animal production even if in a low number or not as economically relevant as crop production. Thus, within these 32% there may be a proportion of farms also linked with pastoral activity.

It should be also considered that farms being specialized in crop production, such as cereal production, may have a relevant role on the pastoral dynamics, since they can represent an important resource for animal production in the Site. In addition, considering the lack of data on 36% of farms we can consider the hypothesis that also within these farms some of them can be linked with pastoral activity: as main production or as a less significant part of the production in the farm. We can then assume that 44% of the farms (minimum) are directly linked to agro-pastoral activity but this proportion can be higher, showing that this activity has a highly significant role in the farming dynamics within the study area.

II. Main evolution trends observed in a 20- year period (1988-2010)

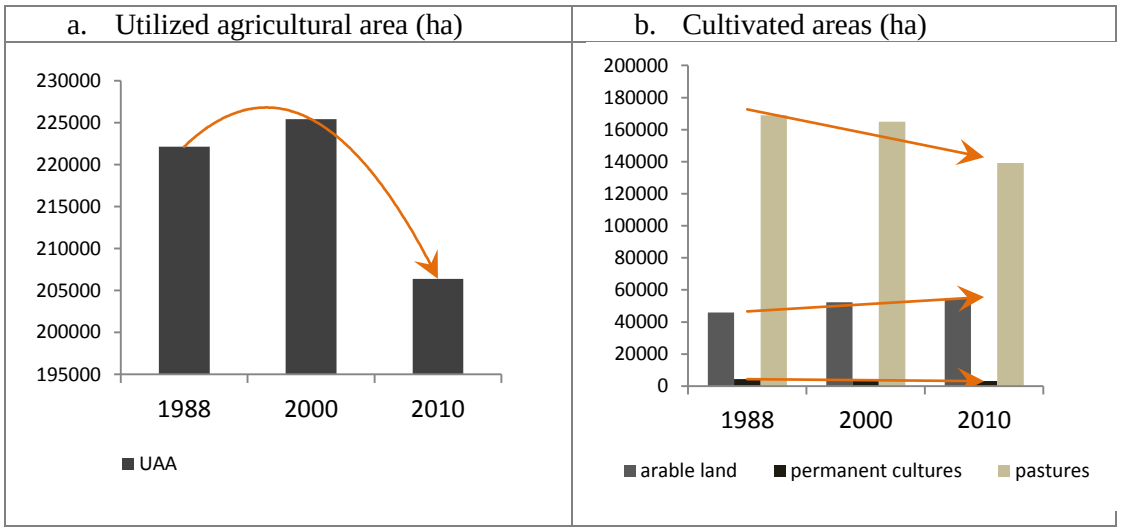
Utilized Agricultural area and types of cultivated areas

Through the available data on National Agricultural Inventory for three different moments, 1988, 2000 and 2010 (Agreste, 2010), some general trends in farming activity can be identified in the Site of the *Causses* and *Cévennes*.

From 1988 to 2010 the utilized agricultural area decreased 7.1% (Figure 9a and Table 2). Pasture areas (Rangelands) represent the most significant land cover category in the Site and at the same time the one that reveal the most accentuated decrease in this 20-year period (a decrease of 30000 ha). Arable Land surface increased almost 9000 ha while the surface of Permanent Cultures decreased 1242 ha (Figure 9b and Table 2).

Some limitations on these data must be taken into account: data on pastures do not include a significant part of areas used for grazing, namely pastured areas associated with forest and within communal areas. This information was not available in order to assess the total proportion of pastures available for grazing in the study area. Given the limitations it is assumed that the decrease trend on rangelands is not clear, though some questions on the evolution of these areas will be further explored both through case-studies and expert consultation.

Figure 9. Main trends in Utilized Agricultural Area and types cultivated areas in the Site (1988-2010°



Source: Agreste, 2010.

Table 2. Variation on Utilized Agricultural Area and types of cultivated areas (1988-2010)

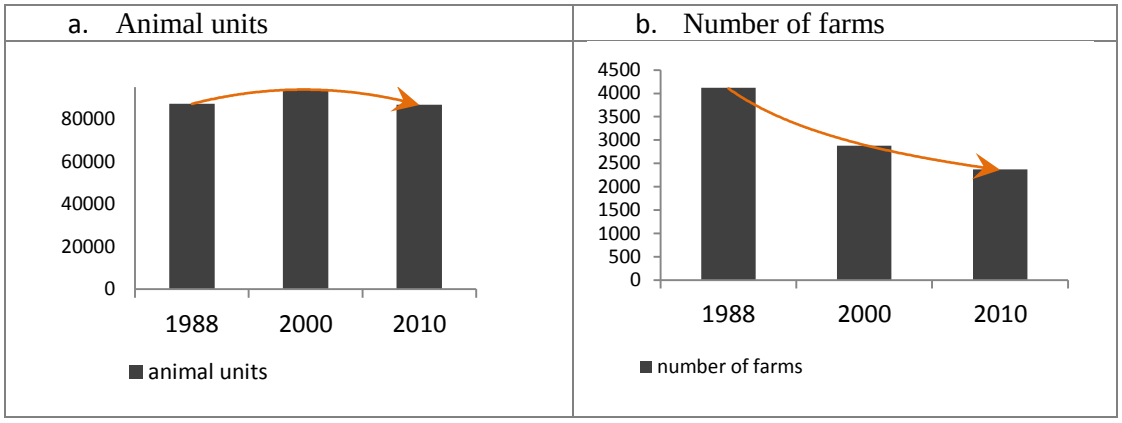
Variables (ha)	1988	2000	2010	Variation 1988-2010	%
Utilized Agricultural Area (Core area)	160002	162431	149024	-10978	-6.9
Utilized Agricultural Area (Peripheral area)	62141	62977	57361	-4780	-7.7
Total area	**222143**	**225408**	**206385**	**-15758**	**-7.1**
Arable land (Core area)	26254	29073	32519	6265	23.9
Arable land (Peripheral area)	19739	23238	22433	2694	13.6
Total area	**45993**	**52311**	**54952**	**8959**	**19.5**
Permanent cultures (Core area)	1912	1744	1641	-271	-14.2
Permanent cultures (Peripheral area)	2444	1931	1473	-971	-39.7
Total area	**4356**	**3675**	**3114**	**-1242**	**-28.5**
Pastures (Core area)	131385	127850	109717	-21668	-16.5
Pastures (Peripheral area)	37596	37140	29391	-8205	-21.8
Total area	**168981**	**164990**	**139108**	**-29873**	**-17.7**

Source: Agreste, 2010.

Animal units and number of farms

In 2010 the total number of farms was 2372 and since 1988 an accentuated decrease occurred (42%) (Figure 10a and Table 3). From 1988 to 2000 total animal units increased almost 7.7 % and from 2000 until 2010 decreased 8.3%, considering the entire study area (Figure 10b and Table 3). The general trend in total animal units shows that in the last 20 years no significant changes have occurred. Still, in this variable it can be observed different trends within the Site: in the peripheral zone (composed of 97 communes) total animal units have decreased (6.7% - 2519 animal units) while in the core area of the Site (composed of 134 communes) the total animal units increased about 4.1% (2007 animal units).

Figure 10. Main trends in Animal units and Number of farms in the Site (1988-2010)



Source: Agreste, 2010.

Table 3. Variation on number of farms and animal units (1988-2010) *Source:* (Agreste, 2010)

	1988	2000	2010	Var 1988-2010	%
Number of farms (Core area)	2269	1628	1411	-858	-37.8
Number of farms (Peripheral area)	1848	1251	961	-887	-48.0
Total number of farms	**4117**	**2879**	**2372**	**-1745**	**-42.4**
Animal units (Core area)	49504	55081	51511	2007	4.1
Animal units (Peripheral area)	37717	38865	35198	-2519	-6.7
Total animal units	**87221**	**93946**	**86709**	**-512**	**-0.6**

III. Main evolution trends and some hypothesis on its future trajectories

Considering the above mentioned limitations on statistical available data, results here presented, as summarized in Table 4, are merely indicative and must be considered as a proxy regarding the characterization and evolution trends of the Agro-pastoral activity in the Site. Even if the weight of agro-pastoral activity and its characterization could not be precisely assessed, the general analysis of the agronomic variables available for the study area allow one to raise some hypothesis in order to support a discussion on some relevant aspects of the dynamics of these activity.

Table 4. Summary on the observed trends and on current situation of the Agro-pastoral activity in the Site

Observed trends in the last 20 years (1988-2010):
A significant decrease in the total number of farms (42.4%);
An increase in total animal units of the core area (4.1%)
An increase in Arable land (19.5%);
A decrease in Permanent Cultures (28.5%);
In 2010, considering the total number of farms with available data:
2/3 of the farms related to agro-pastoral activity (1034 farms);
1/3 of the farms are specialized in crop production or indoor animal production (479 farms);

The trend for a decrease on number of farms and the trend for an increasing number of animal units, such as identified in the core area of the Site, can lead to significant changes in the agro-pastoral systems. In a broad way, it can be considered that a higher number of animals in a fewer number of farms means that the stocking rate in farms is getting substantially higher. Though, depending on the management strategy, i.e. on the practices chosen by land managers in response to these (observed) trends, this may not necessarily result in a higher grazing pressure.

If arable land tends to increase while rangelands tend to decrease, the stocking rate would become higher and the availability of grazing resources would become lower. It must be referred that these trends do not necessarily mean that the increase of arable land is associated with the conversion of pasture areas into arable crops (it can be associated to the conversion of abandoned areas). Nevertheless, land managers can overcome the lack of pastured areas in the farm by using other feed resources (rangelands, production of forage or buying feed supplement). Changes within farms, and consequently in the landscape character, would occur. But in order to keep the changes of landscape character within acceptable limits - the 'choice space', new farming strategies would be necessary to overcome this increasing stocking rate. Being aware that different management options have different implications on the evolution of the agro-pastoral systems, several aspects in the management dynamics can be questioned and several hypotheses can be specified (Table 5).

In the study area, considering a scenario in which farmers tend to increase number of animals, and number of farms continues to decrease, some changes would occur in the farms, having different impacts on land use. For example:

- If farmers choose to increase purchase of fodder and concentrates, the apparent stocking rates in the farms will increase, but the extensive and traditional character of land use by grazing will be maintained;

- If farmers decide to use external grazing areas it will promote the maintenance of rangelands and the extensive character of the grazing system, also supporting the preservation of common agro-pastoral structures (such as *drailles* and *lavognes*), leading to the preservation of traditional land use practices;

- It can also be hypothesized that, if in such a scenario, farmers do not adapt their grazing practices, the grazing pressure would increase (since grazing areas and feed resources do not change to compensate a higher number of animals). In this case the system tends to change towards land use intensification, leading to the simplification of landscape patterns.

Table 5. Different hypothesis considering a scenario of increasing number of animals, with different implications on land use.

(hypotheses) Number of farms is decreasing and animal units increasing. if farmers:		**Resulting in different impacts on land use:**
1 Increase purchase of fodder and concentrates	⇨	Do not increases the grazing pressure (because the pasture consumption of each animal decreases as the number of animals increases); and few changes in the extensive and traditional character of the use of the grazing area.
2 Start using external areas (rangelands outside the farm?)	⇨	promotes extensive production and the maintenance of semi-natural areas (pastures); promotes the maintenance of common agro-pastoral structures (*drailles-lavognes* etc) **(promotion of traditional land use)**
3 Increase pasture area (converting permanent cultures or arable land in pasture)	⇨	promotes pastures and maintain the level of grazing pressures (by enlarging the grazing areas to compensate a higher number of animals) **(maintain the extensive land use)**
4 Increase farm size (amalgamation)	⇨	changes property structure by enlarging the holding
5 Nothing needs to change in the farm	⇨	increases the grazing pressure in the existing grazing areas (because nothing changes to compensate a higher number of animals); the system tends to get moreintensive **(land use intensification)**

Assessing farmers' future management options leading to land use changes would enable one to explore the possible impacts of these land use changes on the cultural landscape and on its main attributes.

V. Results

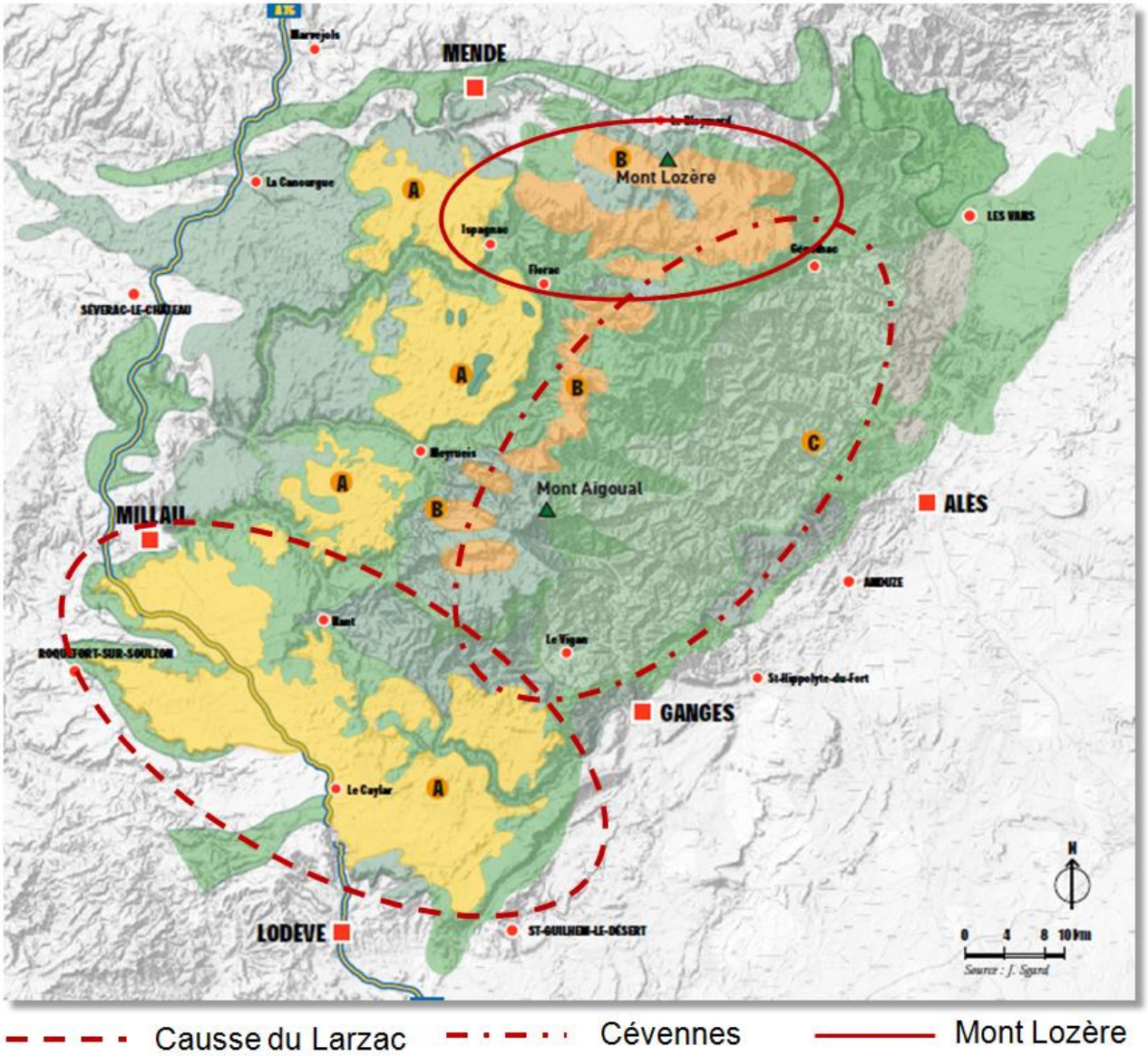
In this section, results of the expert meetings and of case-study farms are described considering, in the first part, stakeholders opinions and perspectives on the evolution of agro-pastoral activity and, in the second part, characterization of the farms and future management options considered by land managers in response to the observed trends in the Site.

I. How stakeholders see the evolution of Agro-pastoral activity

Interviews were conducted with experts, selected because of their long experience and strong involvement with the agro-pastoral activity, developing their professional activity having a direct contact with land managers, as well as key informants directly related to farmers associations. Some restrictions of contacts and availability of the target stakeholders limited the number of interviews to two technicians from the *Chambre d'agriculture* (*Département de Gard* and *Département de Lozère*) – a local semi-public body which have as one of its main roles developing relationships among farmers and facilitating the diffusion of technical resources, and one representative of an association of land managers. Also, as a complementary data, some discussions based on the same interview guidelines (Annex IV) were applied to land managers that, during the field work period, showed availability and interest in discussing these topics.

Nevertheless, and despite the limited number of interviews undertaken, the collected information reflects the **key aspects** characterizing the agro-pastoral dynamics in the *Causses* and *Cévennes*. In addition, the interviews conducted in this stage allow one to explore the **territorial differentiation** characterizing the Site, with each one of the interviewees focusing on specific aspects of three different territories that compose the Site: *Causse du Larzac; Cévennes* and *Mont Lozère* (Figure 11). Therefore, results here presented describe the main management aspects influencing agro-pastoral activity in the Site and the future directions of evolution identified by expert opinion (as summarized in Table 6).

Figure 11. Territorial differentiation expressed in the expert meetings. Three different territories considered and discussed in the interviews. (Adapted from: Unesco, 2011b)



A. Considerations on the agro-pastoral management in the last years

Main trends observed in the last 20 years

The discussions revealed that the main trends observed in the last 20 years, as presented in the beginning of the interview, reflect, in general, the dynamics of the agro-pastoral activity in the three discussed territories. The decrease in number of farms is associated to a general increasing of farms area. As experts pointed out, the main aspect contributing for the decreasing number of farms relates to the retirement of elder farmers, by selling the farms to other land managers or by family succession and subsequent amalgamation of several holdings, lead to a general increase of farms' surface. Often, at the time of the

definition of new largest holdings, land managers opt to increase the size of main flocks, reflecting the observed trend of increasing animal units.

Meanwhile the observed trends on main types of cultures reflect a territorial differentiation and trends are not evident in the three territories. The increasing surface of arable land can be observed in the *Causse du Larzac* and in the *Cévennes*, mainly reflecting the increase in forage and cereal production as a feed complement for main flocks. In *Mont Lozère* this trend is not obvious and the possible increase on arable land might be associated to an increase in cultivated pastures for forage production but not for concentrates, since cereal production is not significant in the area mainly due to the lack of optimal conditions for cereal cultures. The increase on arable land and decrease on pasture areas might be explained, as referred by experts, by the conversion of some rangelands (*Causse du Larzac*) or abandoned areas (*Cévennes*) in arable land, both for cereal and forage production.

Main feed resources

Considering the main feed resources it is evident the different dynamics in the three territories, being notorious in each one of them how different biophysical conditions result in different resources to be used for extensive production. In the *Causse du Larzac*, rangelands (mainly grassland and scrubland) and forage and concentrates, produced by land managers, are the main feed resources. Here forested areas, despite not being significantly used as grazing resources, are increasingly being included in the grazing management, mainly by the use of fenced areas as grazing plots in specific periods. In *Mont Lozère*, rangelands are the main resource during summer and forage, produced by land managers, is used as main feed complement during winter, although rangelands are also used along the year according to the availability of different vegetation layer (grassland, scrubland and forested areas). In the low *Cévennes* the *silvo* component is more significant. Here rangelands, mainly forested areas (chestnut trees or oaks), and the pasture areas in the valleys are the most important feed resources and as a complement land managers purchase concentrates and forage. The highlands of the *Cévennes*, such as *Mont Aigoual*, represent a significant grazing resource especially during summer, used by transhumant flocks.

Other aspects in the agro-pastoral dynamics

As referred by experts, the available grazing resources in the Site are also used by external flocks, i.e., from agricultural holdings external to the Site. In *Mont Lozère* and in the *Cévennes*, although there are several producers using the rangelands in the site, especially during summer, there is not an evident increasing on its number. Labor is an important aspect in the dynamics of the activity and that is also reflected on landscape. Number of shepherds is decreasing and their role on landscape management is changing: shrub control by fire, for example, was one of the practices developed by shepherds. They used

to manage landscape in a more active way and currently the increased use of fenced areas for grazing does not require shepherding, leading to a different dynamics in the grazing management. In addition, the use of mechanization increased, labor costs are higher (leading to a less active management), and the daily work time for direct management (in the field) decreased.

B. Considerations on the future trends and possible changes in the dynamics of agro-pastoral activity

Considering a scenario of a continued increase of number of animals in the Site, experts expressed their opinion on how farm managers would, in general, adapt their grazing management and on what would change in the farms. In the *Causse du Larzac* the increase of farm surface, by purchasing land, and the increasing use of rangelands external to the farms (by renting land) would be the general response of farm managers. Though, it was referred that natural grazing resources in this territory (rangelands) are currently being used in a sustainable way and that the increase of animal units in the future would jeopardize the availability of grazing resources and the extensive character of the agro-pastoral systems. Shepherding practices would continue to decrease and producers would increasingly use fenced areas for grazing (mainly due to labor costs). It was also mentioned that this trend could result in a spatial differentiation of grazing pressure since the increase animal units would occur in specific areas depending on the availability of land to buy or rent.

In *Mont Lozère*, the general response to the increasing size of flocks would be the purchase of complementary feed resources (forage and concentrates). Although in this area, with an increasing number of animals, producers would lose autonomy: the costs for feed production are high and in general producing forage and concentrates in the farm might not be considered by farmers, consequently the purchase of complementary feed resources would be the strategy. Considering expert opinion, available resources currently allow a sustainable use and this sustainability would be compromised by the increase of animal units. Labour, natural feed resources and livestock pressure were referred as the main aspects in grazing management defining the evolution of this landscape.

Concerning the territory of the *Cévennes* and according to expert opinion, the trend for an increase of animal units is not likely to continue in the future, even being observed in the last years. The decrease in number of animals in main flocks is more likely to occur. According to expert opinion, market changes are determinant in the definition of new farm strategies and the producer's adaptation to price variation generally occurs towards the maintenance or improvement of farm productivity and in some situations can lead to the decrease in number of animals. As an example, selling elder lambs in order to increase profits would lead to a reduction of main flocks. In addition, in this territory farms often combine different productions: animal (sheep and goats) farming (arable crops, mainly onion) and forestry

production (chestnut forest). The strategies adopted by farmers in response to socioeconomic changes might consider the development of other activities than animal production.

Table 6. Summary of the main aspects characterizing the agro-pastoral activity and the future changes likely to occur in the farms, identified by expert opinion for the three analyzed territories (*Causse du Larzac, Mont Lozère* and *Cévennes*)

	Main grazing /feed resources	Changes in the dynamics of Agro-pastoral activity	Future management options
Causse du Larzac	• Rangelands (mainly grass and shrub areas); • Forage and concentrates produced in the farms; • Fenced areas in forested land used as grazing plots.	• General increase of farms' area; • Increase of flocks dimension in specific areas of the territory; • Increase of cultivated pastures and cereal crops for hay and concentrates; • Changes in labor costs and decrease in shepherding practices (leading to the increasing use of fenced areas).	• The increase of farm surface, by purchasing land, • The increasing use of rangelands external to the farms (by renting land).
Mont Lozère	• Rangelands (grass and shrub areas) ; • Forage produced in the farms;	• General increase of farms' area; • Increase of flocks dimension in specific areas of the territory; • Increase of cultivated pastures for hay production; • Costs of feed production in the farm (mainly labor costs) and the decrease in shepherding practices lead to increased use of fenced areas and disappearance of many management practices (namely shrub control practices).	• The purchase of complementary feed resources (forage and concentrates)
Cévennes	• Rangelands, mainly forested areas (for chestnut production); • Pastured areas in the valleys; • Concentrates and forage as a complement (mainly purchased).	• General increase of farms' area; • Increase of flocks dimension in specific areas of the territory; • Increase of cultivated pastures and cereal crops for hay and concentrates production; • Changes towards specialization in animal production (an observed trend to specialize in one species and decrease of mixed flocks - cattle and sheep).	• An increase in the number of animals is not likely to occur in a short term period

I. How land managers see their future management options

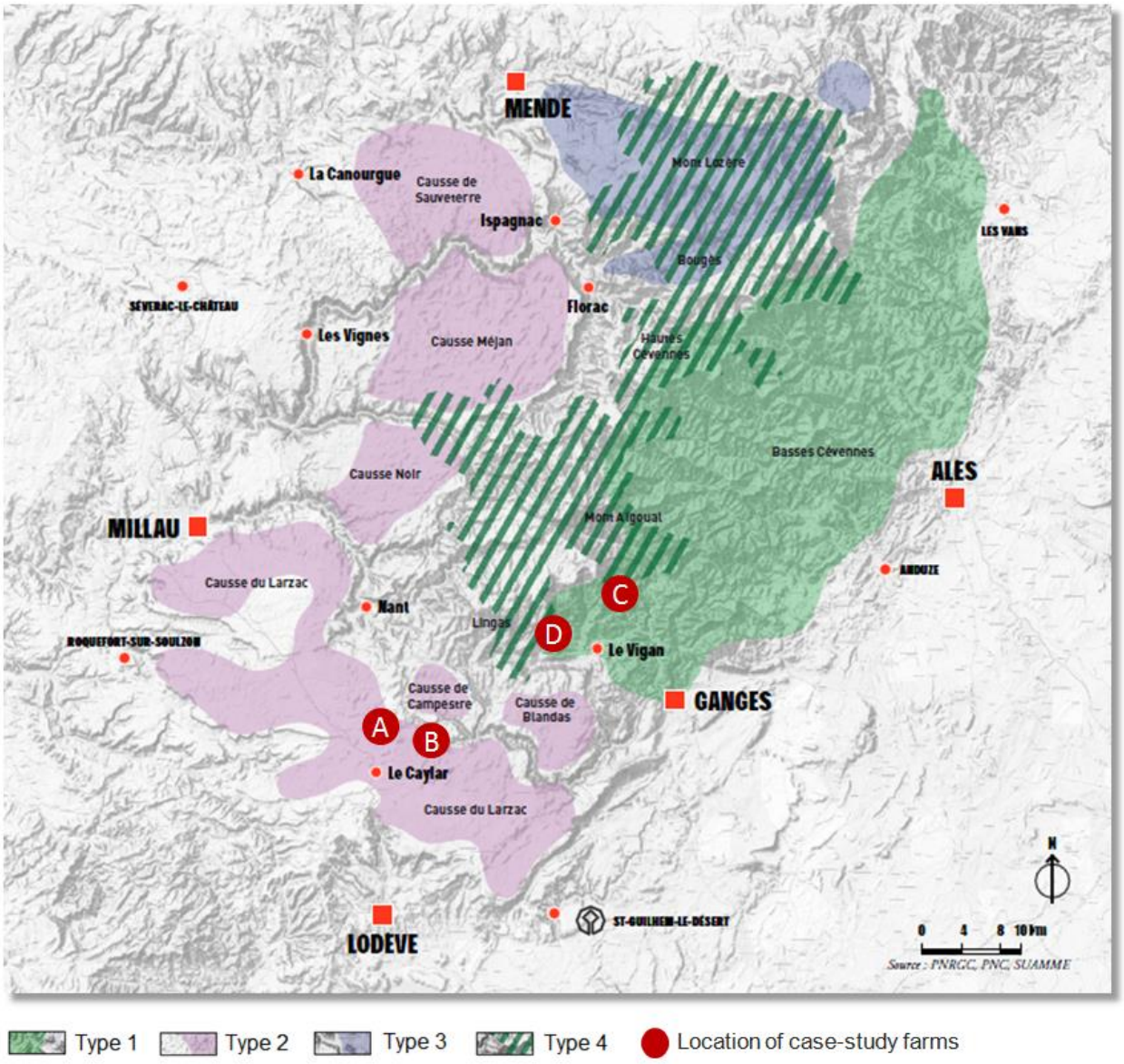
In order to illustrate the different dynamics of the agro-pastoral activity at the farm level, questionnaires were applied in different farms, associated to different agro-pastoral systems, aiming to characterize the farms and to identify the management options likely to be adopted by land managers. As a result of several field work limitations, concerning contacts of land managers and their availability to respond the questionnaire, only Type 2 and Type 4 were e considered for the analysis:

Type 2 - *Agro-silvo-pastoral system of meet-sheep (producing light lambs), which may be associated with other farming activity or agro-tourism, grazing and valuing the different stages of vegetation, in association with Agro-pastoral system of dairy sheep (for the production of PDO or PGI cheese) valuing and grazing different vegetation structures in the Causses*; and

Type 4 - *Sheep grazing in summer transhumance from the Lower Languedoc (garrigues) and lower Cevennes to the upland granitic areas (Mont Lozère, Bougès, Lingas and Aigoual) or to the plateaus in the Causses, grazing different vegetation structures*.

For each type of system, farms were selected (Figure 12) as being representative of the system and questionnaires were applied to the respective managers. A structured direct questionnaire was designed to collect information on the grazing management (grazing areas, type and number of grazing animals, flock management and grazing resources, land cover and labor) together with information on recent changes occurring in the farm and future changes in the grazing management in response to the main trends characterizing the area.

Figure 12. Location of case-study farms selected as representative of different types of agro-pastoral systems. Farms A and B representative of Type 2 and Farms C and D representative of Type 4. (Adapted from: Unesco, 2011b)



The selected farms representative of agro-pastoral system Type 2 are both located in the *Causse du Larzac* and oriented to the production of sheep milk to *Roquefort* cheese (a labeled product with Protected Denomination of Origin).

Farm A (Figure 13) is composed of 300 ha including 230 ha of rangelands (mainly grasslands and scrublands), 55 ha of cultivated pastures for grazing and hay-making and 15 ha of arable land for cereal production to be used as concentrate for animal feeding. the flock is composed of 400 sheep to which grazing represents the main feed resource (52.5%), while 26.7% of livestock feeding is composed of hay

and concentrates produced within the farm and the purchase of complementary resources (concentrates and forage) represents 20.8% of the feed requirements of the flock. The feeding requirements vary along the year and are dependent on the availability of natural resources. In this farm, grazing is more significant during spring summer and autumn with cultivated pastures being the most important resource along with rangelands (especially during summer and autumn). Hay represents an important complement during winter (80% of total feed resources) and concentrates are used all year. Since the farm was settled, in 1983, no changes occurred regarding either the size and type of flock or the type and surface of the different land covers composing the farm. Considering the scenario of an increase number of animals the farm manager expressed a clear opinion: the size of the flock cannot increase since the current grazing management is (1) suitable with the available natural resources and (2) with the labor and economic capacity of the farm.

Farm B (Figure 14) is composed of 423 ha, with 353 ha of rangelands, 55 ha of cultivated pastures (25ha of which are permanent pastures) and an area of 15 ha with arable land. The feed resources for the 340 sheep are mainly from grazing, with rangelands representing the most significant resource, during spring and summer and guaranteeing by itself the livestock feed requirements during autumn. Cultivated pastures are also important for animal feeding in this farm but less significant than rangelands. Forage and cereals are the only resources used during winter and most part of it is purchased. Yearly, 29.4% of feed resources are purchased (forage and concentrates) while 19.6% are produced within the farm. Nevertheless, most part of the flock requirements (51%) are guaranteed by grazing.

The farm was settled in 2007 and since then the number of sheep increased while the type and surface of land cover maintained. Meaning that during this 6 years sheep production has being intensified along with the increasing of the grazing pressure. Though, even with this recent development in the farm, the farm manager do not foreseen a future increase in the flock size, recognizing a limit in the farm capacity but also the sustainable use of the natural resources available in the area of the Causse du Larzac. The general absence of abandoned land and the extensive character of the agro-pastoral system in this area allow a good balance between the available grazing resources and the extensive grazing practices developed by producers (permitting a certain level of livestock feed autonomy in the farms).

Figure 13. Summary of the collected information on Farm A, representative of Agro-pastoral system Type 2.

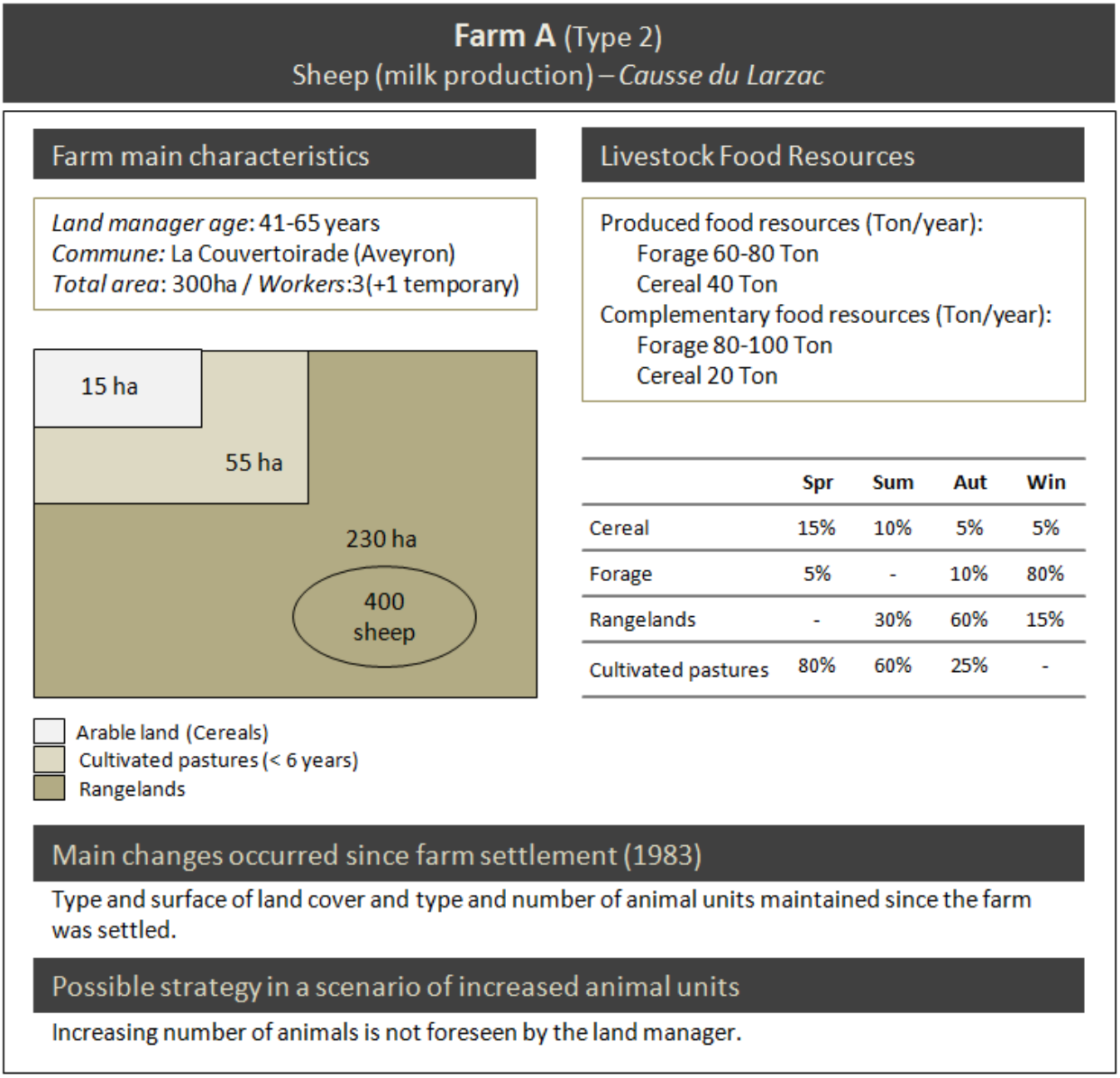
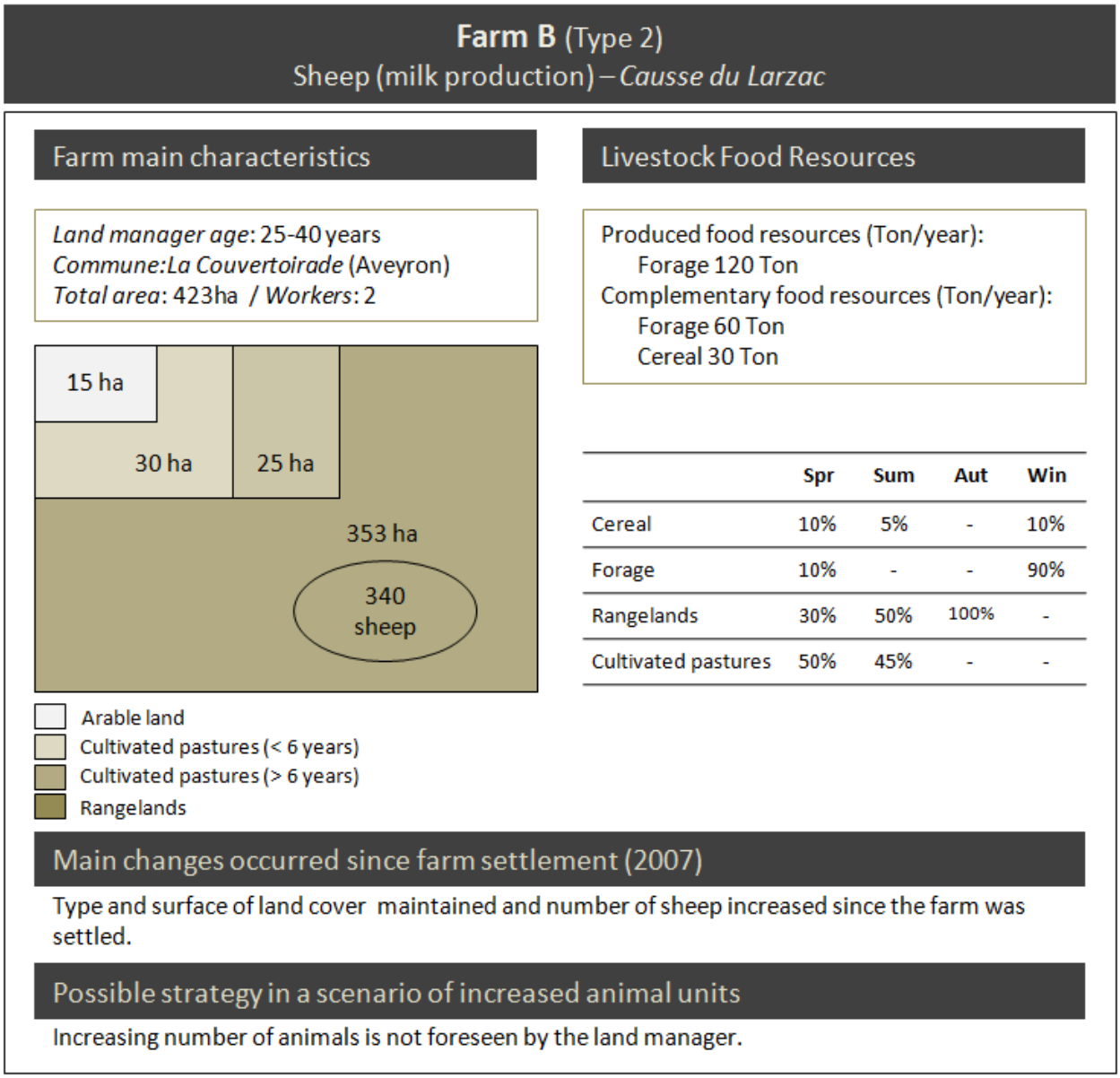


Figure 14. Summary of the collected information on Farm B, representative of Agro-pastoral system Type 2.



Two other farms, representative of agro-pastoral system Type 4, were analyzed. They are both located in the south area of the *Cévennes* and are oriented to the production of sheep for meat, based on the transhumant practices characteristic of the agro-pastoral activity in the *Causses and Cévennes*.

Farm C (Figure 15) is mainly oriented for sheep meat production with the onion production complementing the farm income. The 308 ha of the farm are composed of 259 ha of rangelands (grasslands, scrublands and forested areas), 18 ha of cultivated pastures (for hay production), 2 ha of arable land for onion production (*Oignon doux*) and a small parcel (1ha) of orchards. The most important aspect in the dynamic of this farm is the transhumance during the summer and autumn. During this period of 90 days (specifically from 15 June to 15 September) the flock is conducted to the rangelands (mainly

grasslands) of Mont Aigoual (*Dourbies*), through a pastoral group gathering several flocks in the region for summer grazing in the high lands (*Estive collective en Groupement Pastoral*). Therefore, rangelands used during transhumance represent the most significant feed resource for this flock (72% of the total feed requirements in a year). As a complement, during spring and winter the flock is feed with hay produced in the farm (representing 15% in a year) and with purchased concentrates (representing 19% of total feed requirements).

Since the farm settlement, in 1978, the number of sheep increased and along with it the surface of cultivated pastures for forage production and the surface of rangelands for grazing also increased. Therefore, the developments occurred within the farm until today maintained the extensive character of the system, sustaining the autonomy in feed resources. Nevertheless, the increase of flock size is not foreseen by the farm manager. Future developments in the farm would be dependent on the family labor organization and labor costs, and the increase of flock size would require additional labor costs. The alternative strategy would be the decrease of the flock and the investment in onion production (mainly for economic reasons) or even the progressive conversion of the main production in the farm (from specialized animal production to onion production).

Farm D (Figure 16) is mainly oriented for sheep meat production. The holding, with a total area of 507 ha, is composed of 490 ha of rangeland (part of it is rented land) and about 17 ha of cultivated pastures, used partially for grazing and mainly for hay production. The main flock in this farm is composed of 270 sheep. The transhumance to Mont Aigoual, occurring every year for 80 days, guarantees the most important feed resource of the flock. Rangelands are the main feed resource (about 82% of the total feed requirements) while forage produced in the farm represent 7,4 % and complementary feed resources, purchased forage and concentrates, representing 12.4% of total requirements of the flock used especially in autumn and winter periods. Since the farm was settled, in 2002, the number of animals increased, together with the surface of cultivated pastures and surface of rented grazing land (rangelands). Therefore, the developments occurred within the farm until today resulted in the improvement of sheep production maintaining the extensive character of the activity. The increase of forage produced within the farm and the increase of grazing areas guaranteed the maintenance of a higher number of sheep. Nevertheless, even with this recent development in the farm, the farm manager does not foresee a substantial increase of the flock. He acknowledges that the available labor force is not sufficient to support the management of a flock bigger than 320 sheep. Still, with no labor constraints the land manager assumes the strategy would be increase of hay production and of fenced areas for grazing.

Figure 15. Summary of the collected information on Farm C, representative of Agro-pastoral system Type 4.

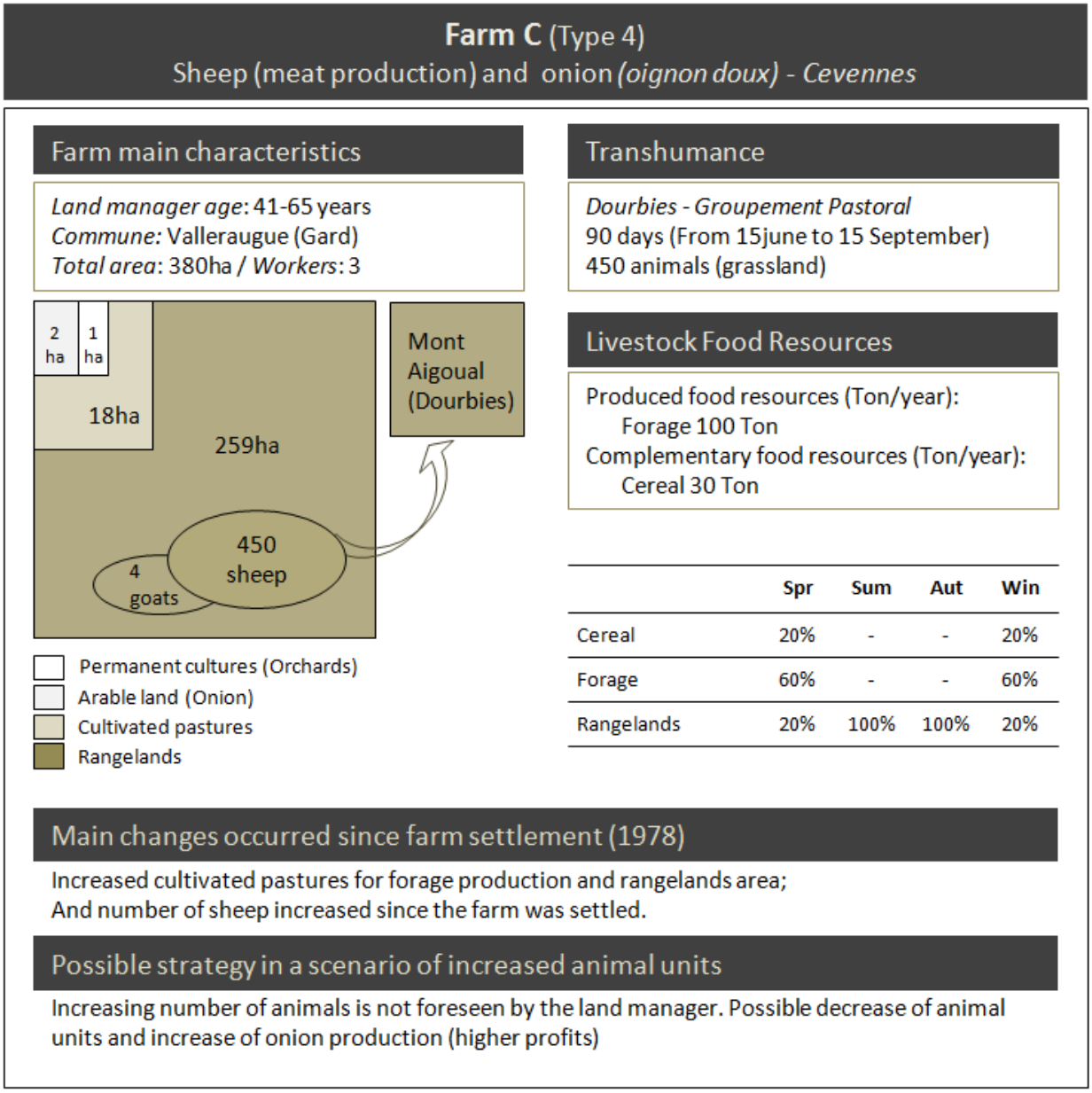
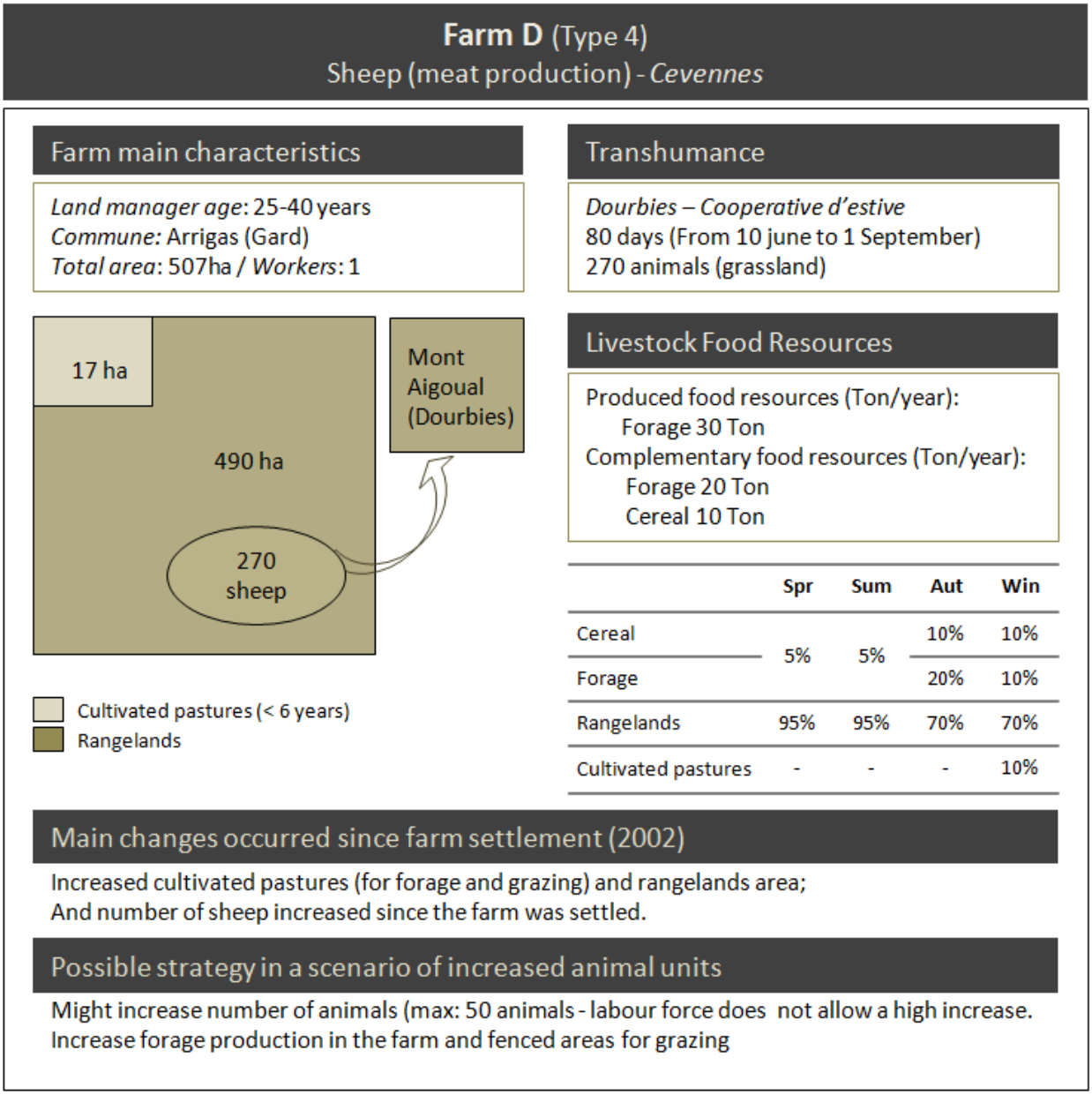


Figure 16. Summary of the collected information on Farm D, representative of Agro-pastoral system Type 4.



VI. Discussion

I. Management strategies and main aspects characterizing grazing management

Results on farmers' management options (past and future) were interpreted as part of a wider management strategy. In this sense Table 7 summarizes the results on the four case-study farms, presented above, and an interpretation of the management strategies characterizing the farms. It must be referred that (1) these results present farmers' intended strategy, i.e. the strategy that is formulated and which managers intend to pursue (Ondersteijn et al. 2003), in this case considering a specific scenario, and (2) the interpretation of these results is exploratory and intend to illustrate the approach. It is not intended to derive generic implications from these case-studies, although they exemplify how the relationship between agro-pastoral activity and cultural landscape can be approached as well as being characteristics of particular types of agro-pastoral systems.

Table 7. Farmers' management options identified by direct questionnaires and strategies derived from these results.

Case-study farms	Recent changes in management	Future management options according to evolution trends	Management Strategy
APS Type 2 Farm A – Sheep milk production (Grand Causses)	Maintained	Stabilization – maintain type and levels of production.	**MAINTAIN AUTONOMY**
APS Type 2 Farm B - Sheep milk production (Grand Causses)	Intensified = land cover; > animal units	Stabilization – maintain type and levels of production.	**MAINTAIN AUTONOMY**
APS Type 4 Farm C- Sheep meat production (and Onion) with transhumance (Cèvennes)	Developed > forage production; > grazing areas (rent); > animal units	changing production goals (decrease animal production, increase arable crops)	**DEVELOPMENT/ CONVERTION**
APS Type 4 Farm D- Sheep meat production with transhumance (Cèvennes)	Developed >forage production; >grazing areas (rent); >animal units	increase forage production; change shepherding practices (increase fenced areas)	**DEVELOPMENT / FORAGE**

Taking into consideration the results both on expert consultation and on questionnaires applied to land managers, natural feed resources, grazing intensity and labor were shown to be central aspects characterizing grazing management and determining the strategies farmers intent to adopt.

In both Agro Pastoral Systems (Sheep milk production in the *Causses* – **APS Type 2** and Sheep meat production with transhumance in the *Cévennes* – **APS Type 4**) management of livestock feed resources

occur mainly according to available natural resources in the respective territory (Table 8). Rangelands play a central role in guaranteeing a high proportion of the livestock feed requirements, although they present different needs of complementary feed resources. In the *Causses* (APS Type 2), grazing represents about 50% of flocks requirements and a significant part of feed resources have to be provided by in-farm production and purchased hay and concentrates. In the *Cèvennes* (APS Type 4) the dependency on purchased resources is significantly lower, with grazing guaranteeing more than 72% of the flocks' requirements.

Table 8. Proportion of feed resources considered by land managers to feed the main flocks: comparative values between farms representative of agro-pastoral systems Type 2 and Type 4.

	APS TYPE 2 (Causses)		**APS TYPE 4** (Cévennes)	
	FARM A	**FARM B**	**FARM C**	**FARM D**
Purchased forage and concentrates	20.8%	29.4%	13%	12.4%
Hay and concentrates produced in the farm	26.7%	19.6%	15%	7.4%
Grazing land (Rangelands)	52.5%	51%	72%	80.2%

The management of feed resources is interconnected with both grazing intensity and farm autonomy, i.e. level of farm dependence on external feed resources. Increasing number of animals needs to be compensated with the increase of available grazing area in order to maintain grazing pressure within acceptable limits. If natural grazing resources (rangelands) cannot supply a high proportion of the livestock feed requirements, farms would be highly dependent on supplementary resources. This would produce changes in the performance of the farm, by financial input requirements for hay and concentrates purchase.

Livestock densities in the case-study farms (Table 9) demonstrate the extensive character of animal production characterizing these systems. Livestock density gives indications on the pressure exerted by grazing on rangeland areas and density values presented by these farms show that grazing pressure is relatively low. Although, and as stated above, managing the variations on flock size must be combined with management on feed resources. As an example, within APS Type 4, Farm C shows the highest livestock density and simultaneously the highest proportion of purchased hay and concentrates comparing to Farm D (Figure 6), meaning that in Farm C less natural grazing resources are available for the main flock. In this case, increasing number of animals would require a largest area of rangelands (by renting or purchasing) otherwise grazing pressure would increase and the land use trajectory would progress towards the intensification in rangeland areas.

Table 9. Livestock density considering the total number of sheep and the available rangeland areas as referred by land managers: comparative values between farms representative of agro-pastoral systems Type 2 and Type 4.

	APS TYPE 2 (Causses)		APS TYPE 4 (Cévennes)	
	FARM A	**FARM B**	**FARM C**	**FARM D**
Number of Animals	400	340	450	270
Animal units (Sheep 0.6)	144	204	270	162
Grazed area (ha)	230	353	259	490
Livestock density (a.u./ha)	**0.63**	**0.58**	**1.04**	**0.33**

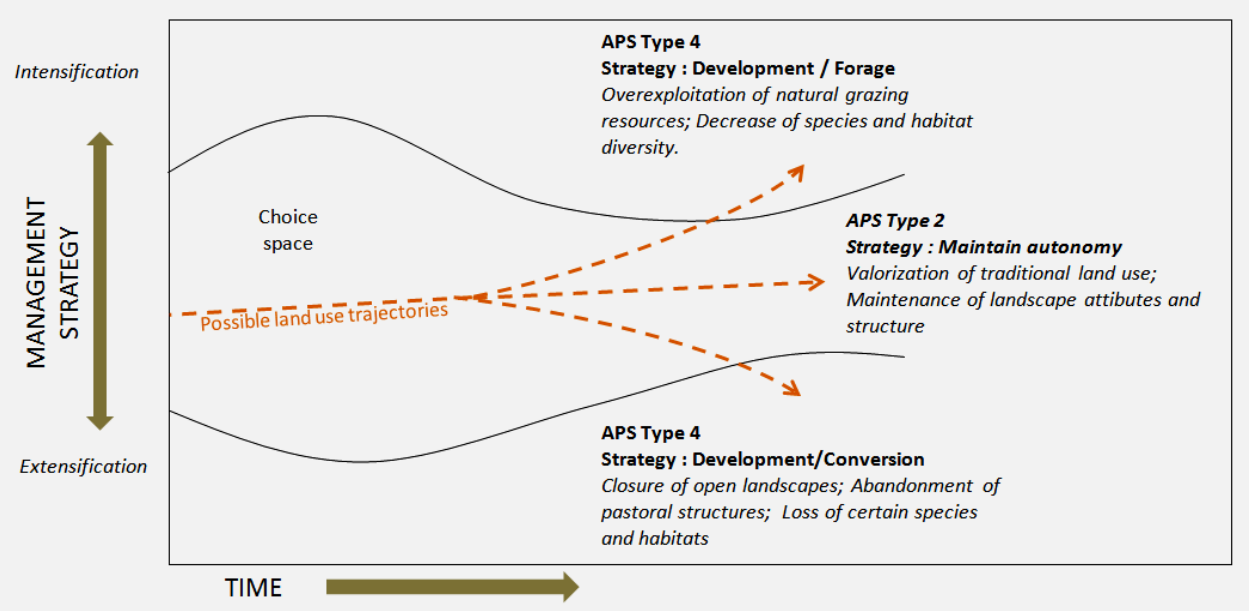
Options taken by the questioned land managers also consider economic aspects. Financial capacity and labor inputs to produce and purchase complementary feed resources or to increase farm area is often a constraint when facing the possibility of increasing the flock size. In general, the balance between grazing intensity, availability of natural feed resources and the autonomy of the farm can allow farmers maintaining or achieving a sustainable use of resources contributing to the maintenance of landscape cultural values.

In addition, and even not being directly mentioned by experts and land managers, it should be referred that the labels associated with meat and cheese production can also influence the strategies assumed by land managers. Specifications on breeds, practices or types of feed resources are often implied in labeled products with geographical indication, (e.g., *Appellations d'Origine Contrôllée* – AOC). The two case-study farms considered in APS Type 2 are associated with a labeled product – the *Roquefort* cheese. According to study developed by Queterier et al (2005) production rules that are fixed in the AOC specifications, mainly relating to livestock rearing for milk production, strongly affect the way farms are managed. Therefore, the options chosen by the two land managers of APS type 2 may also have been influenced by this factor.

II. Management strategies and its impacts on the cultural landscape

Strategies vary according to management options taken by land managers and according to those strategies new land use trajectories can be defined. These trajectories can progress towards land use intensification or extensification (and both can lead to land cover simplification). In turn, these different trajectories have different implications on the maintenance of landscape attributes and cultural values. These relationships were here explored (Figure 17) using the '*Choice space'* model as proposed by Potschin and Haines-Young (2008), in order to better understand how can cultural heritage be impaired or valued by different evolution trajectories of agro-pastoral systems.

Figure 17. The 'choice space' Model framing the relation between agro-pastoral activity and cultural landscape.



Reducing grazing activities in rangelands can lead to the progressive development of wooded areas and consequently to the progressive disappearance of open landscapes (APS Type 4: Development /Conversion); Intensification of cultivated pastures and excessive increase of grazing pressure in rangelands can lead to overexploitation of natural grazing resources (APS Type 4: Development/Forage). (Adapted from Potschin, and Haines-Young, 2008)

As presented in Figure **17**, considering the strategies identified in the case-study farms, different land use trajectories were identified as well as their implications on the maintenance of landscape attributes:

APS Type 2: Strategy - Maintain autonomy: maintaining the balance between **feed requirements of main flocks, availability of natural grazing resources** and **the economical capacity of the holding** (production income resources; input needs; available labor force).

Land use trajectory: maintenance of the extensive character of agro-pastoral activity with the sustainable use of main natural resources. (Valorization of traditional land use)

Impacts on landscape attributes: valorization of natural resources and natural spaces by the continued use of rangelands in an extensive way; maintaining biodiversity and the cultural identity (traditional practices); valorization of associated structures (*drailles, lavognes*). Maintain land cover diversity.

APS Type 4: Strategy - Development/Conversion: changing production goals towards the investment (financial resources and labor) on crop production and consequent decreasing of practices associated to pastoral activity.

Land use trajectory: reducing grazing practices mainly in rangelands (land use extensification). Produce changes in land cover structure by the spreading of wooded areas (highlands). If

generalized can define a trajectory towards a shift of the agro-pastoral system itself (more significance on the *agro* component of the system).

Impacts on landscape attributes: This would lead to a progressive shrub encroachment and consequently to the closure of open landscapes; abandonment of pastoral structures (landscape elements associated with pastoral activity); loss of certain species and habitats. Progressive landscape simplification (and cover structure).

APS Type 4: Strategy - Development / Forage: increasing forage production and changing grazing practices by the progressive use of fenced areas for grazing.

Land use trajectory: increasing cultivated pastures for hay guaranteeing the continuing of livestock production, still when associated with fenced areas for grazing some changes can occur concerning the land cover structure – a spatial differentiation of grazing pressure can occur in rangelands and wooded areas leading to landscape segmentation. The increasing cultivated pastures for hay production can be associated with decrease of grazing areas (e.g. by conversion of rangelands on cultivated land) - Land use intensification associated with changes in grazing practices. Nevertheless, in this case we can also consider the hypothesis that this spatial differentiation can also result in the maintenance of the grazing pressure in some rangeland areas.

Impacts on landscape attributes: overexploitation of natural grazing resources (rangelands) and the decrease of species and habitat diversity would be the most evident impacts considering the identified strategy.

A land use trajectory can progress within the limits of the choice space, i.e. if changes in land use occur in a way that landscape goods and services continue to be provided (**APS Type 2: Maintain autonomy**). However, if changes in agro-pastoral practices occur towards a progressive intensification of land use (**APS Type 4: Development / Forage)** or towards a progressive extensification (**APS Type 4: Development/Conversion**), a point can be reached in which landscape cannot continue to provide certain goods and services, such as those related to the heritage values of the cultural landscape currently valued by society. The interpretation of the identified strategies in this study, their possible trajectories and respective impacts on landscape, are here understood as merely illustrative of how the limits for change can be approached.

Chapter VII. Concluding remarks

This exploratory work is based on illustrative case-study farms from two different agro-pastoral systems, aiming to progress in the interpretation of how changes at the farm level can conduct a system into new trajectories of land use change. Grazing intensity, available natural grazing resources and the autonomy of the holding are the central aspects determining how farms can change facing internal or external pressures. Different strategies were identified according to farmers' management options, having these strategies different implications on land use changes and therefore on the cultural landscape.

The Unesco nomination and the recognition of landscape values and attributes can be understood as an essential instrument for the preservation of this cultural heritage. Recognizing the unique values of an agro-pastoral cultural landscape, even though they are a reference in a specific moment within an evolutionary process, is determinant as a starting point of the management and conservation process. However, other aspects must be considered in the design of a management tool adapted to this specific context: Firstly, changes in landscape attributes and values are highly correlated to changes in agro-pastoral systems. Agro-pastoral activity and the cultural landscape are strongly interconnected and their evolution is co-dependent. Also, an important conclusion derived from this work is the need to recognize the existence of limits for change (both in landscape and agro-pastoral management). Recognizing the existence of limits for changes in grazing management is an important step to define management plans and strategies contributing to keep the landscape attributes and values in a desirable state (conditions). Third, it is also important to recognize that within those limits several management strategies can be assumed by land managers, which must be adapted to internal and external contexts of the farm (including farmer's own motivations).

Finally, although it is widely assumed that decisions at the farm level are fundamental for landscape changes, exploring approaches at a wider scale (local or regional) is essential for the definition of common management principles. Within such scales there is room for different options and strategies that in its whole can allow changes to occur within acceptable limits. For this reason the combined perspective of landscape and farming systems could be a fruitful approach for the understanding of the evolutionary nature of agro-pastoral cultural landscapes and consequently for the definition of a context-oriented management tool.

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Annexes

ANNEX I
List of Communes within the perimeter of the Unesco Site "Causses and Cévennes"

Aveyron	Gard	
(Core area)	***(Core area)***	***(Peripheral área)***
La Bastide-Pradines	Alzon	Bagnols-les-Bains
Cornus	Arphy	Banassac
La Couvertoirade	Arre	Barjac
L'Hospitalet-du-Larzac	Arrigas	Le Bleymard
Lapanouse-de-Cernon	Aumessas	Brenoux
Mostuéjouls	Bez-et-Esparon	Canilhac
Nant	Blandas	La Canourgue
Peyreleau	Bréau-et-Salagosse	Le Collet-de-Dèze
Roquefort-sur-Soulzon	Campestre-et-Luc	Cultures
La Roque-Sainte-Marguerite	Causse-Bégon	Esclanèdes
Saint-André-de-Vézines	Colognac	Le Massegros
Saint-Beaulize	Concoules	Mende
Sainte-Eulalie-de-Cernon	Dourbies	Le Recoux
Saint-Félix-de-Sorgues	L'Estréchure	Saint-Étienne-Vallée-Française
Saint-Jean-d'Alcapiès	Génolhac	Sainte-Hélène
Saint-Jean-du-Bruel	Lanuéjols	Saint-Hilaire-de-Lavit
Saint-Jean-et-Saint-Paul	Lasalle	Saint-Julien-des-Points
Saint-Rome-de-Cernon	Mandagout	Saint-Martin-de-Boubaux
Sauclières	Mars	Saint-Michel-de-Dèze
Tournemire	Montdardier	Saint-Saturnin
Veyreau	Notre-Dame-de-la-Rouvière	Les Salelles
Viala-du-Pas-de-Jaux	Les Plantiers	La Tieule
	Ponteils-et-Brésis	Le Martinet
(Peripheral área)	Revens	Mialet
Aguessac	Rogues	Molières-Cavaillac
Campagnac	Saint-André-de-Majencoules	Monoblet
La Cavalerie	Saint-André-de-Valborgne	Peyremale
Le Clapier	Saint-Laurent-le-Minier	Peyrolles
Compeyre	Saint-Martial	Pommiers
Creissels	Saint-Roman-de-Codières	Portes
La Cresse	Saint-Sauveur-Camprieu	Robiac-Rochessadoule
Millau	Saumane	Roquedur
Fondamente	Soudorgues	Saint-Bonnet-de-Salendrinque
Paulhe	Sumène	Saint-Bresson
Rivière-sur-Tarn	Trèves	Sainte-Cécile-d'Andorge
Saint-Georges-de-Luzençon	Valleraugue	Sainte-Croix-de-Caderle
Sévérac-le-Château	Vissec	Saint-Florent-sur-Auzonnet
		Saint-Jean-du-Gard
		Saint-Jean-du-Pin
		Saint-Julien-de-la-Nef
		Saint-Julien-les-Rosiers
		Saint-Martin-de-Valgalgues
		Saint-Paul-la-Coste
		Saint-Sébastien-d'Aigrefeuille
		Les Salles-du-Gardon
		Sénéchas
		Soustelle
		Thoiras
		La Vernarède
		Le Vigan

ANNEX I

(continuation)

Hérault	Lozère
(Core area)	***(Core area)***
Le Caylar	Altier
Le Cros	Pied-de-Borne
Gorniès	Balsièges
Montpeyroux	Barre-des-Cévennes
Pégairolles-de-Buèges	Bassurels
Pégairolles-de-l'Escalette	Bédouès
Saint-Étienne-de-Gourgas	Les Bondons
Saint-Félix-de-l'Héras	Cassagnas
Saint-Guilhem-le-Désert	Chadenet
Saint-Maurice-Navacelles	Chanac
Saint-Michel	Cocurès
Saint-Pierre-de-la-Fage	Cubières
Saint-Privat	Cubiérettes
Sorbs	Florac
Soubès	Fraissinet-de-Fourques
La Vacquerie-et-Saint-Martin-de-Castries	Fraissinet-de-Lozère
	Gabriac
(Peripheral area)	Gatuzières
Arboras	Hures-la-Parade
Fozières	Ispagnac
Ganges	Lanuéjols
Lauroux	Laval-du-Tarn
Moulès-et-Baucels	La Malène
Poujols	Mas-d'Orcières
Les Rives	Meyrueis
Romiguières	Moissac-Vallée-Française
Roqueredonde	Molezon
Saint-Jean-de-Buèges	Montbrun
Saint-Jean-de-la-Blaquière	Le Pompidou
Saint-Saturnin-de-Lucian	Le Pont-de-Montvert
	Pourcharesses
	Prévenchères
	Quézac
	Rousses
	Le Rozier
	Saint-Andéol-de-Clerguemort
	Saint-André-Capcèze
	Saint-André-de-Lancize
	Saint-Bauzile
	Mas-Saint-Chély
	Sainte-Croix-Vallée-Française
	Sainte-Enimie
	Saint-Étienne-du-Valdonnez
	Saint-Frézal-de-Ventalon
	Saint-Georges-de-Lévéjac
	Saint-Germain-de-Calberte
	Saint-Julien-d'Arpaon
	Saint-Julien-du-Tournel
	Saint-Laurent-de-Trèves
	Saint-Martin-de-Lansuscle
	Saint-Maurice-de-Ventalon
	Saint-Pierre-des-Tripiers
	Saint-Privat-de-Vallongue
	Saint-Rome-de-Dolan
	La Salle-Prunet
	Vebron
	Vialas
	Les Vignes
	Villefort
	(Peripheral area)
	Badaroux
	Bagnols-les-Bains
	Banassac
	Barjac
	Le Bleymard
	Brenoux
	Canilhac
	La Canourgue
	Le Collet-de-Dèze
	Cultures
	Esclanèdes
	Le Massegros
	Mende
	Le Recoux
	Saint-Étienne-Vallée-Française
	Sainte-Hélène
	Saint-Hilaire-de-Lavit
	Saint-Julien-des-Points
	Saint-Martin-de-Boubaux
	Saint-Michel-de-Dèze
	Saint-Saturnin
	Les Salelles
	La Tieule

ANNEX II

Definitions of variables used in the statistical data analysis

Definitions of variables considered for the analysis:

Superficie agricole utilisée: superficies des terres labourables, superficies des cultures permanentes, superficies toujours en herbe, superficies de légumes, fleurs et autres superficies cultivées de l'exploitation agricole.

Superficie en terres labourables: superficie en céréales, cultures industrielles, légumes secs et protéagineux, fourrages (hors superficie toujours en herbe), tubercules, légumes de plein champ, jachères.

Superficie en cultures permanentes: superficie en vignes, vergers, pépinières ornementales, fruitières et forestières, cultures de miscanthus, jonc, mûrier, osier, arbre truffier, à laquelle s'ajoute la superficie en arbres de Noël en 2010.

Superficie toujours en herbe: prairies naturelles ou semées depuis six ans ou plus.

Definitions of variables considered for the analysis:

Exploitation agricole : unité économique qui participe à la production agricole, qui atteint une certaine dimension (1 hectare de superficie agricole utilisée ou 20 ares de cultures spécialisées ou 1 vache ou 6 brebis-mères ou une production supérieure à 5 veaux de batterie...) et de gestion courante indépendante.

Unité gros bétail tous aliments (UGBTA) : unité employée pour pouvoir comparer ou agréger des effectifs animaux d'espèces ou de catégories différentes (par exemple, une vache laitière = 1,45 UGBTA, une vache nourrice = 0,9 UGBTA, une truie-mère = 0,45 UGBTA).

Definitions of variables considered for the analysis:

Orientation technico-économique: production dominante de l'exploitation, déterminée selon la contribution de chaque surface ou cheptel à la production brute standard.

(s : donnée soumise au secret statistique).

ANNEX III

Community typology for agricultural holdings

RÈGLEMENT (CE) N o 867/2009 DE LA COMMISSION du 21 septembre 2009 modifiant et corrigeant le règlement (CE) n o 1242/2008 portant établissement d'une typologie communautaire des exploitations agricoles

45	Exploitations spécialisées : orientation lait	450	Exploitations spécialisées: orientation lait	Vaches laitières > 3/4 du total des herbivores; herbivores > 1/10 de la production herbivores et fourrage
46	Exploitations bovines spécialisées : orientation élevage et viande	460	Exploitations bovines spécialisées: orientation élevage et viande	Tous les bovins (c'est-à-dire bovins de moins d'un an, bovins de plus d'un an mais de moins de 2 ans et bovins de 2 ans et plus (mâles, génisses, vaches laitières et autres vaches) > 2/3 des herbivores; vaches laitières ≤ 1/10 des herbivores; herbivores > 1/10 de la production herbivores et fourrage
47	Exploitations bovines : lait, élevage et viande combinés	470	Exploitations bovines: lait, élevage et viande combinés	Tous les bovins > 2/3 des herbivores; vaches laitières > 1/10 des herbivores; herbivores > 1/10 de la production herbivores et fourrage, à l'exclusion des exploitations de la classe 45
48	Exploitations avec ovins, caprins et autres herbivores			Exploitations de la classe 4, à l'exclusion de celles des classes 45, 46 et 47
		481	Exploitations ovines spécialisées	Ovins > 2/3 des herbivores; herbivores > 1/10 de la production herbivores et fourrage
		482	Exploitations avec ovins et bovins combinés	Tous les bovins > 1/3 des herbivores, ovins > 1/3 des herbivores et herbivores > 1/10 de la production herbivores et fourrage
		483	Exploitations caprines spécialisées	Caprins > 2/3 des herbivores; herbivores > 1/10 de la production herbivores et fourrage
		484	Exploitations d'herbivores	Exploitations de la classe 48, à l'exclusion de celles des classes 481, 482 et 483»
61	Exploitations de polyculture			
73	Exploitations de polyélevage à orientation herbivores	731	Exploitations de polyélevage à orientation laitière	
		732	Exploitations de polyélevage à orientation herbivores autres que laitiers	
83	Exploitations mixtes grandes cultures herbivores	831	Exploitations mixtes combinant grandes cultures avec bovins laitier	
		832	Exploitations mixtes combinant bovins laitiers avec grandes cultures	
		833	Exploitations mixtes combinant grandes cultures avec herbivores non laitiers	
		834	Exploitations mixtes combinant herbivores non laitiers avec grandes cultures	
84	Exploitations mixtes avec diverses combinaisons cultures-élevage	841	Exploitations mixtes combinant grandes cultures et granivores	
		842	Exploitations mixtes avec cultures permanentes et herbivores	
		843	Exploitations apicoles	
		844	Exploitations avec diverses cultures et élevages mixtes	

ANNEX IV

Interview guidelines for key informants

B. Enquêtes aux éleveurs

1. L'âge de l'éleveur : 25-40 ans □ 41-65 ans □ > 65 ans □

Caractérisation de l'exploitation et gestion pastoral

2. Localisation de l'exploitation (département/commune)

Aveyron	Gard	Hérault	Lozère

3. Date d'installation:	**4. Main-d'œuvre (nombre personnes) :**

5. Superficie agricole utilisée (SAU) de l'exploitation (ha)	**6. Type d'aires utilisées - transhumance**
_____Total _____Cultures permanentes (vergers, vignes, etc) _____Cultures annuelles (céréales, etc) _____Prairies cultivées (<6ans) _____Prairies cultivées (>6ans) _____Parcours – pelouse _____Parcours – bois _____Parcours – landes	□ Cultures permanentes (vergers, vignes, etc) □ Cultures annuelles (céréales, etc) □ Prairies cultivées (<6ans) □ Prairies cultivées (>6ans) □ Parcours – pelouse □ Parcours – bois □ Parcours – landes

7. Troupeau (type et nombre) :			**8. Transhumance** :
Brebis	Vaches	Chèvres	Type : individuelle □ collective □
			Lieu de séjour en été :
9. Production principal :			Durée du séjour en estive (jours) :
Lait □ Viande □ Fromage □			Nombre d'animaux :

10. Calendrier d'alimentation

(%) utilisée par mois *Total (100%/saison)*	**Printemps**	**Été**	**Automne**	**Hiver**
Concentré				
Foin				
Pâturage sur parcours				
Prairies cultivées pâturées				

11. Le foin utilisé dans l'année (tonne):		**12. Concentré acheté dans l'année (tonne) :**
acheté :	Produit :	

Les changements depuis l'installation de la ferme (ou dans les 20 dernières années)

13. Nombre d'animaux:	**16. Aire de Cultures et prairies:**	Diminué	Mainten u	Augment é
augmenté □ maintenu □ diminué □	Prairies cultivées foin:			
14. Type d'animaux :	Prairies cultivées pâturées:			
maintenu □ modifié □ (type:_____)	Parcours :			
	Cultures:			

Nouvelles options de gestion
15. Si vous augmentez le nombre d'animaux, ce qui devra changer dans votre ferme :
□ Augmenter l'achat de fourrages et de concentrés
□ Produire des céréales sur l'exploitation pour l'alimentation des animaux de l'exploitation (conversion de parcours ou de prairies permanentes vers la culture de céréales)
□ Produire plus de foin sur l'exploitation
□ Augmenter la surface des parcours (conversion des cultures permanentes, des terres arables ou des forêts en parcours)
□ Utiliser parcours externes à l'exploitation (transhumance)
□ Augmenter la taille des exploitations
□ Rien (ne devra changer dans l'exploitation agricole)

Questionnaire for land managers

A. Entretien aux informateurs
dans le Bien du paysage culturel des Causses and des Cévennes, selon les données statistiques du Recensement Agricole (1988-2010): - *le nombre d'exploitations a diminué* - *la surface toujours en herbe a diminué* - *la surface de terres labourable a augmenté* - *le nombre d'animaux a augmenté*
1. Qu'est-ce qui a changé dans la gestion des exploitations agricoles au cours de cette période?
2. Comment font les éleveurs pour alimenter des troupeaux plus importants ? quelles sont les ressources utilisées ?
3. Pensez-vous que les surfaces de parcours dans les exploitations ont été transformées en terres labourables ?
4. Pensez-vous que le nombre d'éleveurs qui ayant leur exploitation hors de l'aire « Causses et Cévennes » utilisent des parcours dans cette aire a augmenté ?
5. Quel type de surfaces est utilisé pendant la période estivale ? Quelles surfaces et où sont-elles localisées ?
6. Si ces tendances se maintiennent (augmentation du cheptel, diminution des surfaces de parcours), ce qui devra changer dans les exploitations agricoles :
□ Augmenter l'achat de fourrages et de concentrés
□ Produire des céréales sur l'exploitation pour l'alimentation des animaux de l'exploitation (conversion de parcours ou de prairies permanentes vers la culture de céréales)
□ Produire plus de foin sur l'exploitation
□ Augmenter la surface des parcours (conversion des cultures permanentes, des terres arables ou des forêts en parcours)
□ Utiliser parcours externes à l'exploitation (transhumance)
□ Augmenter la taille des exploitations
□ Rien (ne devra changer dans l'exploitation agricole)