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Abstract. We propose a grid of services at territory scale from livestock systems, combining the framework of the multifunctionality of agriculture and of the ecosystem services. The grid is divided in three concerns: social, environmental and food security. For the social concerns, three main services are provided: employment, alleviation of families' vulnerability, identity and social cohesion. For the environmental concerns, three services are also distinguished: first maintaining the domestic biodiversity, then through the sustainable use of grasslands and rangelands, the ecosystem services of those spaces may be mediated, such as water purification or carbon sequestration; finally livestock system mediated the cultural service of aesthetic value of landscape. This grid is tested on a local case study in a territory of Mediterranean mountain in South of France. From interviews with various actors of a territory, the roles of the livestock cited by stakeholders may be linked to the services enumerated in the grid. If some services are not required, a bundle of services is pointed, with the role "maintaining open lands" (linked to aesthetic value of landscape, prevention of forest fires, habitat for wildlife) coupled to the role "contribute to farm incomes" (linked to employment and local development. A discussion, based on the common attributes of the territories of Mediterranean and Mountain areas, and on the diversity of socio-economic contexts, illustrate others services in counterpoint of the case study.

Keywords. Livestock system – Territory – Multifunctionality – Services – Ecosystem.

Les multiples services rendus à l'échelle du territoire par les systèmes d'élevage méditerranéens et montagnards

Résumé. *Nous proposons une grille de lecture des services rendus par l'élevage à l'échelle du territoire, en combinant les cadres d'analyse de la multifonctionnalité et des services écosystémiques. La grille est divisée selon trois préoccupations : sociales, environnementales, sécurité alimentaire. Pour les préoccupations sociales, trois principaux services sont rendus : l'emploi, la réduction de la vulnérabilité des familles, l'identité territoriale et la cohésion sociale. Pour les préoccupations environnemtales, trois grands services sont aussi distingués : le maintien de la biodiversité domestique ; l'utilisation durable des prairies et des parcours permettant de moduler les services de support et de régulation de ces espaces, comme la filtration de l'eau ou la séquestration du carbone ; enfin l'élevage contribue à la valeur esthétique du paysage. Cette grille est testée sur une étude de cas, dans un territoire de montagnes méditerranéennes du Sud de la France. A partir d'interviews avec une variété d'acteurs du territoire, les rôles de l'élevage cités peuvent être reliés aux services identifiés dans la grille. Si certains services ne sont pas attendus, un bouquet de services est mis en avant, avec le rôle « Maintien de milieux ouverts » (lié aux services de valeur esthétique du paysage, de prévention des feux de forêt et de maintien d'habitats pour la biodiversité remarquable) couplé au rôle « Contribuer aux revenus des familles agricoles » (lié aux services d'emploi et de développement local). Une discussion, à partir d'attributs communs aux territoires de montagne et de la Méditerranée et de la diversité des contextes socio-économiques de ces territoires, permet d'illustrer d'autres services en contrepoint de l'étude de cas.*

Mots-clés. *Système d'élevage – Territoire – Multifonctionnalité – Services – Ecosystème.*

I – Introduction

Livestock is an important economic sector in Mountain and Mediterranean areas, generally since a long time. Beyond the delivery of animal commodities (meat, milk…), livestock farming systems are known for providing multiples services at territory scale. Manoli *et al.* (2011) distinguish two kinds of approaches in order to characterize the relationships between livestock and territories: i) analysing connection between livestock activities and the stakes about land use and natural resources and ii) understanding links between diversity of livestock systems and pathways to local development. Ryschawy *et al*. (2013) assess the multiple services provided by livestock at the scale of the French territory, with four categories of services (production, vitality, environmental quality, cultural identity and heritage), identified with research and extension services experts and with farmers. In this participatory approach, the services identified are linked to the French context. Two main scientific frameworks are the base of the various categorisations of services: the multifunctionality of agriculture (MFA) from economics (Madureira *et al.*, 2007), and ecosystem services (ES) from conservation biology (Virherrvara *et al.,* 2010).

The purpose of this communication is to propose a generic grid of services at territory scale from livestock systems. We build this proposition from the definitions of livestock systems and territory and the examination of the two frameworks (MFA and ES). We test the grid on a case study in a territory of Mediterranean mountain in South of France. We define then some common attributes of the territories in Mediterranean and Mountain areas and propose first elements of discussion about bundles of services in contrasted territories.

II – A grid of services at territory scale from livestock systems

1. Livestock system and territory: some definitions

A. Livestock Farming System as a multi-scale model

A livestock farming system is a conceptual model of the whole livestock farm. It represents a duality between the view of a farm as a human activity system, with a farm family seeking to satisfy specific objectives, and the view of a farm as a production process, with transformation of physical inputs to physical outputs (Gibon *et al*., 1999). The practices are a key component which links those two views of livestock farming systems. The practises are the result of the decision-making in farm family, through the perception of its context, and they drive the production process. We distinguish five categories of practices (fig. 1, from Moulin and Bocquier, 2005).

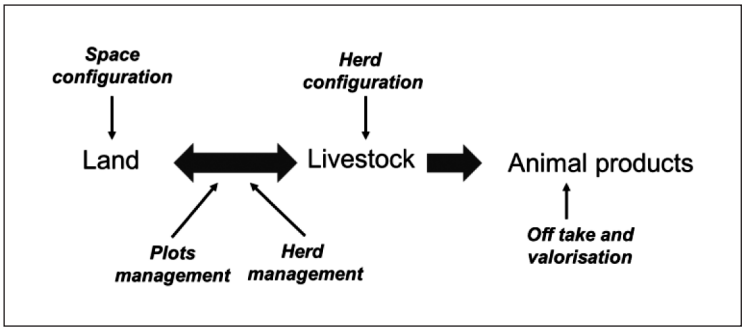

Fig. 1. Practises of livestock farm families.

First, along the years, the farm family configures the herd (choice of species and breeds, culling and replacement, etc.). It also configures the farmland: acquiring or relinquishing of land areas, creating equipment or buildings (fencing, trails, water point, shed,…) and rehabilitation of some plots (stone removal, bush clearance…). Then, throughout an annual cycle, the family farm operates the system. It links the herd and the farmland through rearing practises (breeding, feeding…) and land use practises (assigning a crop to a plot or a batch to a pen). It also collects the outputs of the herd, and markets animal products, eventually after processing.

The concept of livestock system may also be used at other spatial scales, from a plot where interact vegetation, flock and shepherd to a large area, with a geographic space, population of domestic animals, and a human society (Bourbouze, 1988). In that last case, the notion of farmland may be generalized to the notion of territory.

B. The territory as a system

Territory is usually taken to refer to a portion of geographic space that is claimed or occupied by a person or group of persons or by an institution. We chose to highlight the definition proposed by Moine (2006), in geography, because it is consistent with the above definition of livestock farming system. In his definition, the territory presents a dual nature: the material reality of the geographic space, in one hand, and a symbolic or ideational nature, in another hand, linked with the representation systems driving the human societies in the understanding of their environment. So, he defines the territory as a system, with three sub-systems: (i) the geographic space, claimed and planned by human beings, as the support of interacting components, such as ecosystems and institutions; (ii) the system of representation of the space, as filters influencing decision-making of actors and iii) the system of actors who act, conscientiously or non- conscientiously, upon the geographic space.

As a system, a territory is an intellectual construction, changing and fuzzy. In the same space, several territories may overlap or be nested. In relation with livestock activity, the geographic space used by a set of farms providing goods, in a contractual way, to a down-stream operator (cooperative or private) may be considered as a territory. The collecting basins of several operators of the animal commodity chains may overlap and a farmer may be part of several economic organisations for the selling of his different products (milk, meat). Those geographic spaces are also part of nested administrative and politic territories (rural community, program region, member state, European Union, for instance). Finally, they also may be part of the territories of environmental programs (Natura 2000) or institutions (National Park, nature reserve…).

So, the livestock services at territory scale would certainly be differently appreciated, according to the considered territory.

2. Multiple services: what about multifunctionality and service of the ecosystems?

A. The framework of multifunctionality of agriculture (MFA)

Multifunctionality refers to the fact that an economic activity may have multiple outputs and may contribute to several societal objectives at once. Multifunctionality is thus an activity-oriented concept that refers to specific properties of the production process and its multiple outputs. If the notion is not new, the term is. It appears in the European context in 1997 and has been used in the discussion of the negotiation agenda of the World Trade Organization (WTO) at Doha in 2001 (Guyomard, 2004). The primary production sector, such as livestock sector, is considered having a main function of production, and related joint production, including material and non-tangible goods. Multifunctionality of agriculture has been promoted through agricultural policies in some

region (Europe, Asia), supporting functions, beyond commodity production, for agricultural landscapes (Lovell *et al*., 2010). The list of the multiple non-marketed outputs and their classification are not stabilised, depending of each countries, in the international trade negotiations (Guyomard, 2004). Because they have distinct public characteristics, Vatn (2001) distinguishes (i) environmental aspects, with landscape, cultural heritage, pollution; (ii) food security, (iii) food safety and (iv) rural concerns (rural settlement, local economic activity). Guyomard (2004) refers to five functions of agriculture: (i) production of marketed goods, (ii) social function of maintenance of employment, (iii) territorial and social function of rural settlement, (iv) environmental function of resources preservation and (v) food security.

We propose a simplified classification with three items: social, environmental and food security concerns. We do not introduce a category of production of marketed goods, considering that this production of private goods is not a service at the territory scale. On the contrary, the delivery of services within the three concerns corresponds to public goods. Of course, the production and the selling of meat, milk, and so on, allow providing services, such as incomes and employment (social concerns) or food security. We chose the term of concern, following Vatn (2001), in order to avoid the confusion linked to the polysemy of the term function. In the framework of the multifunctionality of agriculture, the function is the role of agriculture in production of private or public goods. In the field of ecology, the notion of function relates to the structures and processes underpinning the potentiality for an ecosystem to deliver one service (Lamarque *et al*., 2011).

B. The framework of the ecosystems services (ES)

Firstly developed in the field of the nature conservation during the 1990s, the notion of ecosystem services (ES) is a new way of framing the relationships between biodiversity, ecosystems and human well-being. This framework spreads through several scientific disciplines (Virherrvara *et al*, 2010) then into policy and business circles (Lamarque *et al*., 2011).

The Millennium Ecosystem Assessment (2005) grouped the ecosystem services into four categories:

- Supporting services are necessary for the production of all other ecosystem services, such as primary production, nutrient cycling and soil formation
- Regulating services, such air quality maintenance, water purification, erosion control, climate regulation, regulation of human diseases,
- Provisioning services, such as food, fibre, fuel, fresh water and genetic resources

Cultural services are the nonmaterial benefits people obtain through reflection, recreation and aesthetic experiences.

In their study, Virherrvara *et al*., 2010 notice some discrepancies between this classification and those used in the scientific papers they reviewed. They stress in particular the fuzzy position of concepts such as biodiversity maintenance and habitat provisioning, difficult to assign to any particular ecosystem service category. Considering livestock activity, we will classify the domestic biodiversity as a supporting services as well the capacity of livestock to maintain particular habitats for wildlife.

As crop and rangelands covered a third of the Earth's land area, we have to consider the relationship between farming and ecosystem services (Zhang *et al*., 2007). In the context of integration of ecosystem services with farming, Bommarco *et al*. (2013) pointed the distinction between services as extracted goods and benefits (provisioning and cultural services, or final services), or as underpinning processes (supporting and regulation services, or intermediate services). In that way, agricultural ecosystems rely on a suite of intermediate services to provide food, fibre and fuel as well a range of non-marketed ecosystems services (Swinton *et al*., 2007). In that definition, we

find the function of production of marketed goods and the delivery of non-marketed outputs, as in the previous framework of multifunctionality. So it seems interesting to integrate those two frameworks, introducing in the MFA framework the concept of intermediate and final services.

Dale and Polasky (2007) stressed the relationship between agriculture and ecosystem services as the contribution of various agricultural practises to the range of ecosystem services. This last point seems very useful when speaking of the services of livestock systems. We propose to distinguish: i) services directly provided by livestock ecosystems, such as domestic biodiversity, and ii) the way of managing livestock through practises which mediate the delivery of ecosystem services. For example, the way of managing livestock in a territory contributes, with others processes, to the building of the landscape. According to the domestic animal species used and the grazing practices at several scales of time and space, the impacts on the landscape and his aesthetic value (cultural services from the ecosystems with domestic livestock) may be very different. When speaking of livestock services, then we have to consider the way of doing livestock farming.

4. Proposition of a grid of livestock services

We propose to integrate those two frameworks (MFA and ES), in a unique grid, and to specify the services of the livestock activity considered as embedded in an agro ecosystem with domestic animals. Livestock systems provides commodities**,** such like goods (food, fibre; manure…) and services (animal draught, for transport, cultivation or leisure). They correspond to the market function of the livestock activity (MFA) and to provision services of the ecosystem (ES). As they are private, we do not consider them as a service of livestock systems at territory scale. We organise the grid with three categories, corresponding to the delivery of non-marketed outputs or services, as defined through the MFA framework.

Considering the **social concerns**, ***employment*** is the first service of livestock systems, delivering livelihoods to rural families. Economic activities of those farm families allows the activities in other sectors (indirect employment), related to services up-stream and down-stream of livestock farms, but also in health, educative, or trading sectors. So livestock activity contributes to the ***local development*** and the ***maintenance of rural settlements*** in the territory. But husbandry do not only provides incomes. In countries where public institutions do not deliver sufficient social services to protect individuals (illness, unemployment, pension), the stock of animal is an important asset (Siegmund-Schultze *et al*., 2011) for the ***alleviation of the vulnerability of rural families*** and for the support of solidarities between families (Manoli *et al*., 2014). The livestock systems may also contribute to the ***cultural identities*** in a territory, reinforcing social relationships. Those identities may be supported by animals and their products, as a patrimony of the territory. Animals may be involved in religious or socio-cultural practices: ceremonies with ritual slaughter (Brisebarre, 1998) or games (Saumade, 1998). The animal products, with specification linked with local knowledge about processing, participate also to the identities of the territories. The local trade of those animal products, especially through direct selling from farmers to consumers; is also a way to participate to the ***social cohesion*** in the territory.

For the **environmental concerns**, we propose to refer to the ES framework. As a part of the ecosystem, livestock contribute to the nutrient cycling. Focusing on this component of the ecosystem, primary production and oxygen are the inputs. The outputs are food (living animal for meat, milk…), dejections (faeces and urine), and losses, especially gas (dioxide of carbon, methane....). Through the mobility of the livestock along the day and the season, and the transport by farmer of biomass (feed, manure…), various parts of several ecosystems are linked, such as rangelands of spontaneous vegetation and cultivated lands. Livestock activity provides directly ***domestic biodiversity*** at species and breeds levels. By the ***use of rangelands and grasslands***, part of natural or cultivated ecosystems for those last, livestock activity mediate the ***supporting and regulation services*** linked to those lands, such carbon sequestration (climate regulation)

(Sousanna *et al*., 2010) or water purification (MacLeod and Ferrier, 2011), habitat for wildlife (Havstad *et al*., 2007)… The presence of livestock is necessary for maintaining those types of lands. But, as mentioned above, this condition is not sufficient. The maintaining of grasslands will depends on feeding system and the balance between the use of grass (grazed or stored) and of annual forage crop, such like maize. The ecosystem services delivered by grasslands also depend on the couple "nitrogen fertilisation x stocking rate". A moderate intensification of the grassland may increase simultaneously the outputs of animal products and the supporting and regulation services of grasslands (Lemaire, 2013) The modality of use of rangelands will also be determinant for the renewal of the potential of grazed resources (Jouven *et al*., 2010) and maintaining the habitats for wildlife. Finally, livestock activity participates to the building of the aesthetic value of the ***landscape.*** The husbandry directly provides this ***cultural service*** because the livestock, pastoral equipment…, are constitutive of the landscape. It also mediates this ecosystem service, according to the mosaic of lands used and connected by livestock.

The **concerns about food security** (MFA framework) rely of course on the capacity of livestock systems to provide food (proteins) of good quality and safe, for urban consumers, but also to provide income to farm families in order to buy foods on markets. So livestock contributes to the availability of food (for all consumers, especially urban consumers) and to the accessibility to food (self-consumption and incomes to buy others foods, for rural families) (FAO, 2011). Livestock, through supporting and regulation services in mixed farming systems, also contribute to crop production and food security.

III – A case study in a territory of Mediterranean mountain

The case study takes place in the Languedoc-Roussillon program region in South of France. In this Mediterranean area, we focus on inner areas of mountains (*Cévennes*) and high calcareous plateaux (*Causses*).

1. Identifying the roles of livestock systems from interviews with actors

We conducted 21 interviews with territorial actors from various worlds (livestock commodity chains, agricultural sectors, other rural activities, local communities and natural parks). Then, we identified their perceptions about the changes of the livestock activities in the territory and the expectations about livestock systems, in, a form of items. We aggregate the items cited in a list of five roles expected from livestock activities. We choose the term of role because several services could be delivered by the way of a role. In the same time, a service could be provided by the mean of several roles. Thereby, the role of livestock systems is a mean, while the service is a goal. By the analysis of the contexts in which the roles are expressed in the interviews, we link (fig. 2) the roles and the services that we had listed in our theoretical grid (see above). Thus, those relationships are expressed from the points of view of the actors. We have an analysis in terms of the sub-system of representation of the space, as filters influencing decision-making of actors proposed by Moine (2006, see II.1.B).

The fig. 2 shows that the concern of food security is not a service expected by actors, even if the local livestock systems provides goods and incomes, participating to food security of rural and urban areas. It is not a stake for this territory. As well, alleviation of the vulnerability of families is not an expected service from livestock, because of the other mechanisms of social protection provided by institutions in France. Finally, even if some sheep breeds originated from this region (such the *Raïole* or the *Caussenarde*), the conservation of the domestic biodiversity has not been identified, in that sample of actors, as an expected service from livestock systems.

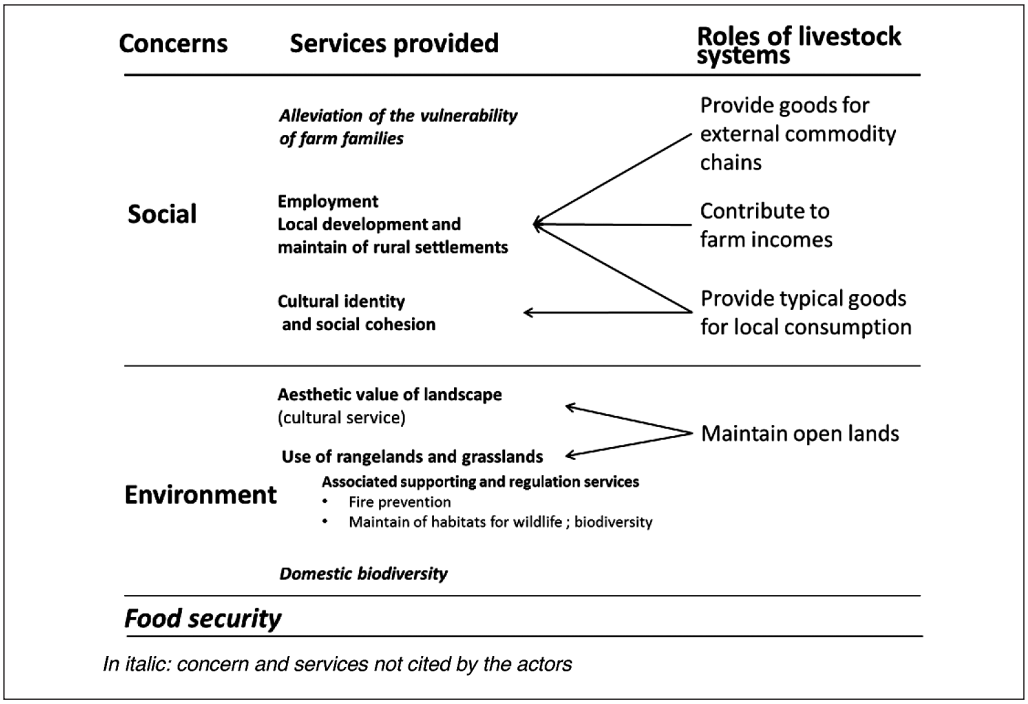

Fig. 2. Grid of the services provided by livestock systems and the roles cited by 21 actors of the territory *Causses and Cévennes* (Languedoc-Rousillon, France, year 2012).

2. The roles and the services from livestock systems in the territory of *Causses and Cévennes*

A. The roles and the services in the field of environmental concerns

The table 1 show that the role "*Maintain of open lands*" is the most cited (67p.100 of the actors of the sample). This role is clearly linked with the cultural service of aesthetic value of landscapes, delivered by the various ecosystems in the territory. The grazing of rangelands in order to maintain open landscape is clearly a stake for the actors. Ruminant grazing mediates, with others processes, this aesthetic value. We could notice that livestock in itself, and the presence of patrimonial building linked to agropastoral activities are not cited. The focus is made on the maintenance of open landscape.

Of course, the role "*Maintain of open lands*" is also linked with the expected services of use of grasslands and rangeland and the associated ecosystem services. For instance, in the *Cévennes*, rangelands (non-included forests which are grazed) and grasslands represented 80% of the utilised agricultural lands in 2010. Two associated services are pointed. The first is the prevention of fire, which is an important risk for Mediterranean forests. The grazing under forests prevents the accumulation of herbaceous dry matters in summer, risk factor of spreading of a start of fire. The maintenance of firebreaks by the livestock grazing is also expected. The maintenance of open lands is also a mean to preserve specific habitats for wildlife and conservation of natural biodiversity. This service is expected by actors of the preservation of the nature (parks for instance) but also by hunting federations, attached to little games linked to open lands. The other

intermediates services of grasslands and rangelands, such carbon sequestration (and mitigation of climate change); soil formation and regulation (erosion), water purification, are not cited by actors. It seems that there is no stakes perceived by the actors of this territory, about the resources (air, water, soil, and climate), in relation with livestock. Climate change is rather expressed as a factor impacting the livestock systems (dry years of the 2000'). The role of ruminants in GHG emission and the role of rangelands and grasslands in carbon sequestration, corresponding to a global stake, are not expressed (even if public policies incite to a reflexion, such as "climate plan" for the Regional Natural Park).

Table 1. The roles of the livestock systems cited by 21 actors of the territory *Causses and Cévennes* (Languedoc-Rousillon, France, year 2012)

	CC	Ag	RA	LC	Total	p. 100
Number of interviews	*6*	*7*	*4*	*4*	*21*	*100*
Provide goods for external commodity chains	3				3	14
Contribute to farm incomes	1	2		2	5	24
Provide typical goods for local consumption	2	2	1		5	24
Maintain open lands	1	6	3	4	13	67

CC : Commodity Chains operators and advisors

Ag : Agricultural services and professional representatives of agricultural sectors

RA : Services and representatives of others Rural Activities (forestry, hunting, tourism)

LC : political representatives of Local Communities and services of natural parks

TThe role of "*Maintenance of open lands*", and the multiples services linked, is expressed by the majority of the actors (87 p.100) of the categories "Agriculture" (Ag), "other Rural Activities" (RA) or "Local communities and Parks". The livestock farmer representatives express also this point of view. This could be explained by the fact that in the territory, a large amount of the incomes came from the Common Agriculture Policy subsidies: 50% to 70% for various ruminants systems, with a large amount –45% to 60%– linked to the second pillar and Territorial Agro-Environmental measures contracted by farmers.

Obviously, only one of the 6 actors of the animal commodity chains cite the role of maintain of open lands, the main service they expected from the livestock systems being the delivering of animal goods.

B. The roles and the services in the field of social concerns

The role "*Provide typical goods*" (goat and ewe cheeses, beef meat from heifers…, with distinctions of origin and process), is a way to build the local identity. Those typical goods are often linked with a regional consumption of livestock products; with short trade chains (direct selling from farmers to consumers, or short chain with traditional butchery) is also a mean to reinforce social cohesion and local development. Indeed, those typical products participate to the attraction of the territory for rural tourism and hence they support local development.

The livestock systems "*contribute to the farm family incomes*", through the marketed goods but also subsidies from PAC (see above). Thus, livestock systems maintain direct agricultural employment, and support indirect employment in upstream and downstream of farms (slaughterhouses for instance, in the territory, allowing the short trade chains in meat industry) and general trade and services in rural area.

Finally, the livestock systems "*provide goods for external commodity chains*". Indeed, some operators of the sheep industry, located in neighboured regions (mainly Midi-Pyrénées) are looking for lambs in the territory for providing the national French market (111,000 lambs, a third of the regional production, are sold to operators outside the Languedoc-Roussillon region, Nozières *et al*., 2013). This market is characterized by a decreasing delivery of French lambs (less than 50% of national consumption) and the operators of MP collect lambs in a large basin, in order to keep their positions on the national market and preserve theirs activities (fattening lots, slaughterhouse…). This role of the sheep farming systems of the territory is a way to maintain employment in other territories, expressed by neighbouring operators, part of the actors' system of *Causses* and *Cévennes*. This is a good illustration of the nested territories mentioned above (II.1.B).

C. Livestock multifunctionality in the Causses *and* Cévennes *territory?*

At the scale of the actor system described through this sample, the multifunctionality of livestock industry is a reality, even if all the potential services are not expected by the actors, or at least not expressed at the time of this case study. Nevertheless, if we examine the roles cited by each actor, we have another vision: 15 actors (upon 21) cite only one role. For 9 of these actors, they only mention the role of "*Maintain open lands*" (Ag, RA or LC actors). When they mention other roles (such as "*provide goods*"), there is an evident relation with the sector they represent. When 2 roles are expressed by an actor, the main couple is "*Maintain open lands*" x "*Contribute to farms income*", for 4 actors (2 Ag and 2 LC). The last two actors coupled "*Maintain open lands*" with "*Provide typical goods for local consumption*" or "*Contribute to farms income*" with "*Provides goods for external commodity chain*".

Some recent studies point the importance to consider the relationships between services, in terms of bundles of services (Raudsepp-Herne *et al*., 2010). We have to stress the relationship between the environmental role "*Maintain open lands*" and the services in the field of social concerns. This bundle of environmental and social services is expressed by actors from different worlds: from agricultural sector, local communities and natural parks representatives. Those two roles are here viewed as synergic, in a context of extensive pastoral livestock systems, with a low global stocking rate (0.07 UGB / ha of total space, from RGA, 2010), where livestock industry is perceived as the last agricultural activity before the wilderness, with spreading of forests.

Nevertheless, if we could notice a large consensus upon this expected role of "*Maintain of open lands"*, there are some divergences, between actors, about the capacity of livestock systems to achieve this role. The economic viability of farms is a first issue, allowing maintain of a sufficient global stocking rate in the territory. But a second issue is about the feeding practices, especially the place and the modalities of grazing: balance between stored forage and grazing, shepherding or free grazing in pens… We point here the difference between a general expectation for the livestock systems and the husbandry practices, which mediate the capacity of the livestock systems to deliver those services. Some actors, who support environmental stakes, cite negatively the spread of arable lands, to the detriment of lands with spontaneous vegetation. Those new arable lands are dedicated to cultivated grasslands for securing storage of forage increasing the feeding autonomy of farms: + 569 ha of new arable lands from 2000 to 2010, for instance in *Cévennes*, with an increase of 807 ha of cultivated grasslands, *i.e.* 25% in ten years). Nevertheless the cultivated grasslands still represent a small part (8%) of the grasslands and rangelands (RGA, 2010). Another example of divergence may be stressed, about the expected models of farms. If some actors (CC, Ag, and LC) cite the interest of a diversity of livestock systems, others defend a unique model of farm, with small size, organic farming, direct selling and less dependency from the CAP subsidies.

IV – Illustration of bundles of services for territories in Mediterranean and Mountain areas

We are now going to have a more general view of the services at territory scale of livestock systems, as counterpoint of the previous case study. Facing the diversity of the territories in Mediterranean and Mountain areas, we propose to start from some main common attributes of those territories, and to illustrate some services at territory and their relationships. Then, we take in account the various socio-economic contexts of the considered territories.

1. Rangelands and grasslands: a common attribute, but contrasted situations

The huge space of spontaneous vegetation is a common attribute of the territories from Mediterranean and Mountain areas. This space is shared between forest ecosystems and rangelands. Of course, cultivated lands also exist, in some favourable parts of the territories (Mediterranean plains, valley bottoms in mountain areas). We find here the classic distinction of space in the Mediterranean agrarian system with the *ager*, the *saltus* and the *sylva*. Livestock mobility for grazing is a requirement for the use of those rangelands, with the classic figure of the shepherd.

Biophysical conditions are contrasted along the year, with periods of null growth of the vegetation (winter in mountains and summer in Mediterranean plains). Livestock sector has to invest in shed and storage of feed for long winter (Mountain) or to develop irrigation, especially in Mediterranean plains, in order to grow green forage for summer, like alfalfa or maize. Livestock mobility to long distance, the altitudinal transhumance, is also a classic manner to feed the livestock within complementary spaces in terms of seasonality of primary production.

The presence of rangelands, disappeared in other territories, such temperate plains, is linked to the climatic and geomorphological conditions and the long tradition of livestock activities in those regions. Indeed, those spaces present interesting resources for livestock, especially alpine grasslands in high mountains, above the forest, or crop residues from pluvial cultivated lands and annual forage from irrigated lands in Mediterranean plain.

Concerning the environmental concerns, the use of rangelands and grasslands is one of the main expected services from livestock systems. In mountains areas of developed countries, agriculture is no longer the main economic activity in the territory. Livestock activities have decreased since mid-twentieth century, with the spread of forests. Cocca *et al.* (2012), demonstrate that, in a mountain area of the eastern Italian Alps, the loss of agricultural areas in 69 municipalities was primarily counterbalanced by the maintenance of livestock farming, especially extensive systems. They concluded that efforts are needed to maintain a territorial network of traditional extensive farms to avoid further landscape deterioration in Alpine areas. On the contrary, Navarro and Pereira (2012) argue that current policies to maintain extensive farming landscapes underestimate the human labour needed to sustain these landscapes. They examine the potential benefits for ecosystems and people from rewilding. In the remote areas of developed countries, with an issue of abandonment of farmlands, maintaining the use of meadows and pastures by extensive livestock systems may be controversial. Nevertheless, examining this issue, it is a necessity to consider all the services, in addition of those delivered by grasslands and rangelands, i.e. cultural services (landscape) and social services (identity).

In other territories, like the steppe areas in Maghreb, the situation of the rangelands is completely different. Farming is a strategic livelihood for most of the rural families. A frequent overstocking on the steppe is described (Nasr *et al*., 2000); Several drivers explain a shift from pastoral to agropastoral systems, relying on concentrate rather than grass, the increasing of the number of animals and the degradation of rangelands (Bourbouze, 2000). The stake is here to maintain live-

stock as livelihoods (social and food security concerns) and a sustainable land use, in a fragile environment (with balance between cultivated land –and new strategies of animal feeding– and space with spontaneous vegetation).

2. Mediterranean and Mountain territories: an old cultural heritage

The Mediterranean basin and some Mountains in the world are very old areas of human settlement (with often a function of refuge area for mountains, even if livelihoods are not so easy). Those territories have been the birthplace of some civilisations, with important cultural heritage (Inca Empire in the Andean mountains, Antique Greek civilisation…).

The domestication of livestock is one of the heritance from those ancient human settlements. In the Fertile Crescent, farmers domesticated various species like cattle, sheep, goat, pig that have spread worldwide. Some mountain areas are also the birthplace of domestic animal species, specialised to the mountain conditions (Andean camelids, Yak). Those domesticated species evolved in numbers of breeds. Conservation of this domestic biodiversity could be difficult, facing the spreading of a little number of improved breeds. Livestock activities relying on those breeds are a manner to keep this domestic biodiversity.

Touristic attractiveness of the territories relies on several assets. The first assets are indeed the landscapes and the cultural patrimony. Livestock contribute to those landscapes and to a part of the rural built patrimony. For instance, the cultural landscape of the agropastoralism of *Causses* and *Cévennes* has been recently recognized as a world patrimony by the UNESCO. The landscape and its multiple attributes (categories of rangelands, trails for transhumance, sheep bridge, cheese cellars…) are an asset for rural tourism (Rafqi, 2013). This cultural landscape may evolve. It is not a fixed conception of patrimony. But maintaining this patrimony alive relies on the capacity of livestock systems to keep on building an agropastoral landscape. Another important asset for tourism activity is the snow and the development of winter tourism in mountains and sea and the seaside tourism of the Mediterranean basin. Livestock activities could take advantage of touristic frequentation, but they also contribute to the identity of the territory and reinforce its touristic attractiveness. The relationship between typical animal products and local breeds, through specifications like those of some protected designation of origin (PDO) in Europe, may be a synergic process for this reinforcement (Lambert-Derkimba *et al.*, 2011).

So, the way the livestock mediates the aesthetic value of landscape, a cultural services from ecosystem, is in a strong relationship with social concerns, through the identity of the territory. The sustainable use of rangelands and grasslands is also linked with supporting and regulation services delivered by those lands. The way of grazing and store forage is the unique level that linked those services. We have here a bundle of services, with various balances depending on the socio-economic contexts (remote areas of developed countries *versus* rural areas of North Africa for instance).

3. A wide range of socio-economic contexts

In fact, beyond some common attributes, territories are very diverse, according to the socio-economic context of the countries. The history of the human settlement led to a wide range of population densities between mountains in the world: 5 people / km² in mountain in Norway *versus* 378 for Central High Plateau in Vietnam, for instance (Pasca and Rouby, 2012 ; Gubry, 2000). Inside the Mediterranean basin, there is also a great diversity between littoral plains, with urbanisation and arable lands and potentiality for irrigation, and inner areas of dry mountains or deserts. So, the expected services from livestock systems are necessarily different between contrasted territories.

According to Huddleston and Ataman (2003), 631 millions of human beings live in mountain areas (above 1,000 meters) in Asia, Pacific, Latin America and Caribbean islands, Africa, and Near-

East (against only 56 millions of mountaineers in developed countries). 70% of this population relies on solely livestock or on mixed farming systems. Food security is thus an important stake for those families. Social concerns, with incomes, alleviation of family vulnerability are also components of the bundles of expected services from livestock. The stake is to ensure livelihoods for rural populations in their territories, and limit the urban population growth by immigration. But livestock products from a given territory also participate, through markets, to the national food security. The comparative analysis between the countries of Maghreb is there very illustrative of the various policies and the role assigned to domestic production for food security. Algeria relied on the export of petrol and gas to import dairy products from international market, in complement of a "modern sector" of intensive dairy production in state farms (Djermoun and Chehat, 2012). The service of food security was not expected from the local livestock systems and these have been neglected (Bourbouze *et al*., 1989). The relationships between Agriculture and Food have been the focus of a social debate in the 80'. The dependency from international market was regarded has a scandal by the consumers and the financial experts (Chaulet, 1991). The level of self-sufficiency was indeed very low for milk (30% in 1981-1985), but the level of consumption pretty high (140 l/year/capita for the same period, Djermoun and Chehat, 2012). In the same times, with different assets, Morocco chose another way. A national dairy plan has been implemented, with taxation of imported milk powder, importation of dairy heifers, development of various dairy livestock systems and dairy industries. Livestock industry has to ensure food security. But the price of milk was rather high for the consumers, and the consumption stay at low level, with 38 liters/year/capita in 2000 (Sraïri *et al*., 2007).

V – Conclusions

The test on a local case study shows the consistence of the proposed grid. Its generic nature allows separating potential services from livestock at territory scale and the expected services for the local stakeholders. The identification of the system of actors is an important issue. It is not evident, because of the nested nature of territories and overlapping of territories according the stakeholders. The analysis of the case study thus pointed the potential services that are not today included in the system of representation of the actors (such as the regulating services of carbon sequestration by rangelands). The distinction between "role" of livestock, related to expression from the discourse of actors, and services identified from scientific framework seems useful. It is a way to identify the lever by which husbandry practices and results of livestock activities provide various services. Finally, the consideration on the way of operating livestock systems is also an important issue, when identifying the expected services of livestock. If final services such as food delivery depends on the presence of livestock farms in the territory, the services related to social, environmental and food security concerns relies on the balance of the various livestock systems and their distribution in the geographic space of the territory.

The bundles of services from livestock closely depend on the context of the territories. For instance, the services of alleviation of the rural families vulnerability is not a stake for livestock systems in developed countries, while they are crucial in others countries. So, it is difficult to have a general view of bundles of services for Mediterranean and Mountain livestock systems. A comparative approach of several study cases would be a pertinent perspective, in order to identify bundles of services and their relationships with local context.

Finally, the research has to assess those bundles of services provided by livestock from an exhaustive point of view (with no limitation to the services expected by the system of actors). It is a way to evolve the local system of representations, the filters by which actors make their decision. The definition of indicators for quantifying those services is there another important issue for research.

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