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Authors	O'Flanagan, Patrick;Martinez, T. L;Abad, M. P. E
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UCC
University College Cork, Ireland
Coláiste na hOllscoile Corcaigh

SHEEP TRANSHUMANCE RESTORATION: AN EXAMPLE FROM THE EBRO BASIN (ARAGON, SPAIN)

Abstract

For centuries, sheep transhumance has been connecting the highlands with the lowlands in Spain, creating a livestock system with important social, economic, cultural and landscape effects. It started its decay in the nineteenth century until it practically disappeared in the 1970s and 1980s. It has been estimated that about five million sheep were involved in transhumant movements in the mid 1700s.

This article provides information on current numbers of transhumant sheep and flock origins and destinations. In the 1980s, transhumant sheep did not surpass 25,000 in the study area, while, at present, numbers are above 134,000. Traditional transhumance was descending, while, at present, both descending and ascending types are practiced. This paper also confirms that while once regarded as quaint and antiquated, transhumance's reputation has been enhanced by the ecosystem services it provides and by the cultural and heritage continuities that it renders.

Key words: CAP, livestock systems, sheep transhumance, Spain.

Introduction

Transhumance is the seasonal movement of livestock that follow the same routes every year. This farming system permits the exploitation of remote territories that reach their plant production peaks at different times throughout the year. Transhumance allows the avoidance of critical periods in each area and the exploitation of natural grazing land at its maximum productive potential (Grigg 1974). Herders practice transhumance especially on highlands and adjacent lowlands; livestock depend on mountain pastures in summer while in winter they graze on lowland pastures (Yasuda 1958).

The commodification of Europe's rural landscapes is undergoing a period of intense diversification. The foundation of Geoparks and roll-out of Special Areas of Conservation (EU Habitats Directive(s), 1997, 1998 and 2005), are simultaneously promoting and suppressing (by regulating and/or reducing human activities) the vitality of many rural areas. Place certification and the awarding of Protected Geographic Status are contributing to rural economic renewal as in the case of Antipodean wine and butter in Ireland (Overton and Heitgen, 2008). Elsewhere traditional agro-ecosystems are being revived to animate local economies by generating employment, strengthening identities and maintaining cultural landscapes (Fleskens, Duarte, Eicher, 2009). This paper contributes to this debate by examining the implications of the CAP supported revival of transhumance in Iberia. We can demonstrate that in the Ebro Valley, through the analysis of grant –data, that it has provided animation to many marginal zones. It has also facilitated the reutilization of common grazing zones, enhanced conditions for extensive stock raising, almost unwittingly helped to maintain rural population numbers and cultural landscapes via the recuperation of stock driveways (*cañadas*), and it has

encouraged conservation through the maintenance of biodiversity besides reducing the risk of range-fires. Its revival also has had critical pedagogical purchase, best seen in the appearance of Interpretive Centers at La Venta de Piqueras, La Rioja and Oncala, Soria.

In Spain, livestock movements date back to prehistoric times. As early as the reign of the Visigoths (fourth to seventh centuries) there were regulations to guarantee and support the exploitation of territories by transhumant flocks and herds, giving sheep farmers' privileges priority over tillage farmers. In Castile and Leon, the regulations culminated in the establishment of the charter of the *Mesta*. This institution endured from 1273 until 1836 and it had a remarkable influence on the social and economic organization of the Spanish people (García-Dory and Martínez 1988). In Aragón, the *Casas de Ganaderos* (Sheep Farmers Associations) expedited the functions of the *Honrado Concejo de la Mesta* (Honorable Council of the Mesta) and developed around the main cities (Fernández Otal 1993).

Between the eleventh and nineteenth centuries the number of transhumant sheep was high, reaching its peak in the thirteenth century, when about five million merino sheep used to travel routes of up to 700 km between the mountains in the north of Spain and the lowlands in the south (Zorita 1990). It is important to stress that the origin of transhumant flocks is the mountains in northern Spain (Cantabrian, Iberian and Pyrenean Mountain Systems). During the summer, for three or four months, they grazed the sub-alpine and alpine pastures, while the rest of the year, that is from October to May approximately, they grazed uncultivated or fallow land and *dehesas* (large silvo-pastoral holdings) in the south of Spain. That means shepherds

had to spend eight months a year away from their families and homes, which is exceptional in the transhumant systems in the world. It was more usual for flocks and shepherds to move for shorter periods. Stanislaw Berezowski (1971) categorizes Spanish transhumance as *descending* or *inverse* to distinguish it from the prevailing transhumance in the rest of Europe, which he calls *ascending* or *direct*.

For centuries, transhumant farming constituted one of Spain's principal economic foundations, thanks to wool exports to Ibero-America and most European countries (Klein 1920; Posthumus 1946; García Sanz 1978; Phillips and Phillips 1997). From an environmental viewpoint, the transhumant system left a heritage of a close net of stock driveways (*cañadas*), that totaled 125,000 kilometers in length and 400,000 hectares in width (Mangas, 1992). It also bequeathed different types of related pasture lands, whose optimum composition depended on the maintenance of high seasonal stocking densities (Gómez Sal and Lorente 2004; Herzog *et al.* 2005).

The decline of Spanish transhumance started in the nineteenth century, confirmed by the fact that, at the end of the eighteenth century, there were still 4.5 million transhumant sheep; while in 1865 the figure declined to 1.8 million. The suppression of transhumant farmers' privileges, decreases of wool exports, and increasing cultivation of pasture land contributed to a reduction in the number of transhumant flocks. During the twentieth century, other additional causes encouraged the abandonment of transhumant systems, such as new irrigation schemes for agricultural areas, urban expansion, increasing industrialization, and changes in shepherds' roles (Ruiz and Ruiz 1986). According to Julio Grande and José-María Elías-Pastor (1992), some

252,542 sheep moved in Spain in 1989: only 10,500 did so following stock driveways (*cañadas*), while trains transported 209,250 and lorries another 32,792.

The decline of transhumant sheep numbers has had important ecological implications, as *cañadas* and summer and winter pastures stopped being used. *Cañadas* tend to disappear, being occupied by crops, paved roads, or urban land uses (Ruiz and Ruiz 1986). Pasture lands go through a stage of plant succession: they turn into scrub and lose their grazing quality. That leads to an increasing fire risk, biodiversity loss, and landscape homogenization (Pain and Dunn 1996; Suárez Seoane *et al*. 2002; Vila *et al*. 2003; Benjamín *et al*. 2005; Pykäla *et al*. 2005; Rosen and Bakker 2005).

The Common Agricultural Policy (CAP) of the European Union favors extensive productive systems and sustains them with financial support. Since Spain joined the European Union in 1986, the Spanish transhumant system is revitalizing on a small scale, although it presents some modifications with respect to the traditional system.

CAP Measures Employed to Revitalize Extensive Livestock Farming

Early European Union measures to support sheep farming appeared in the Regulation 1837/80 (1980), within the Common Market Organization (CMO), in particular in the chapter relating to prices and markets of the CAP financed by the European Agricultural Guidance and Guarantee Fund. These measures came into effect for the first time in the 1980-1981 season. Their objective was to increase the number of sheep in order to supply the market, then in the

midst of a sheep production deficit that had promoted a rise of the Consumer Price Index. The strategy followed initially involved offering farmers an annual payment per head, Sheep Compensatory Premium (SCP), related to loss of income and to average meat production. The procedure did not take into account productivity or farm location in less favored areas. For our purposes, less favored areas are those experiencing severe depopulation and/or weak productive activity and they generally coincide with mountainous areas.

Several new regulations and legal stipulations reflect the substantial changes rules have gone through since the first ordinances came into force (Silva 1996). Major changes relate to the amount received per animal eligible for subsidy payment. In this context, María Laguna (2006) includes yearly variations in less favored areas, showing fluctuations between 12.7 euros in 1987 and 22.4 euros in 1999. Regulations 3013/1989, 2069/1992, and 2525/2001 of the European Parliament are especially important because of their implications for territorial management. Regulation 3013/1989 included a bonus of 20 percent in the premium for sheep in less favored areas. This premium increased consecutively in subsequent years until it reached double the amount received in favored areas. Regulation 2069/1992 provided for the number of animals per farm eligible for subsidy, according to the stock in each farm in 1991, with a maximum of 1,000 head for less favored areas and 500 head for favored areas. This action intended to control the increasing number of animals. The EU-12 had an average of 76.6 million sheep in the period 1979-1981 and 100 million in 1990-1992 (Doménech and Barco 1994). Regulation 2529/2001 determines the amount received per sheep eligible for subsidy (the number of sheep recorded in each farm in 2001) from 2002

onwards, avoiding annual fluctuations. This measure did not encourage farmers to improve the technical efficiency of their farms nor were farmers able to obtain higher earnings from the market (López 2002). The amount given was 21 euros per sheep; a further 7 euros had to be added to if a farm was located in a less favored area and 7 additional euros if a farm practiced transhumance for at least ninety consecutive days a year. Also, farms in less favored areas might receive other forms of income support for extensification: these payments included Compensatory Payments for Mountain Areas and grants for local breeds, which, together, may double payments received in less favored areas.

Another CAP measure that has favored transhumance is land set-aside. Since 1988, the European Union subsidizes cropland set-aside in order to limit production. Farmers receive subsidies if they stop tilling a part of their farm. During the first five years of this policy (1989-1994), 182,374 hectares were set aside in Aragon. They were mainly concentrated in the wintering regions of the transhumant flocks (Meza and Albisu 1995). Since then, the pace of set-aside take-up has been constant.

Transhumance Revitalization in the Central Ebro Basin

Rise and Decline of Transhumance in the Pyrenees - Ebro Depression Gradient

Transhumant movements between the Pyrenees and the Ebro valley are among the most important on the Iberian Peninsula, due to the number of sheep relocated. The difference of altitude between the summits of the Pyrenees and

the Centre of the Ebro Depression exceeds 3,200 meters, involving the presence of bioclimatic stories where altitude determines the distribution of resources and the cycles of grazing. Above 1,500-1,600 meters, we find sub-alpine and alpine pastures that constitute the so called Pyrenean *puertos*. During the warmest three or four months, such *puertos* reach a high production ceiling in the Central Pyrenees, enough to feed 68,230 head of livestock (Ferrer 1988). These conditions favor the concentration of livestock on the *puertos* over a short time period. In the cold season, from the end of September on, cattle and sheep have to leave the *puertos* and even the mountain valleys, as farmers tilled lands earmarked for pasture until the middle of the twentieth century (Lasanta 1989). On the other hand, summer is the critical period for livestock on the lands around the River Ebro and the land is exhausted due to drought, while the rest of the year the supply of grazing land is more secure. Therefore, transhumance between both areas started as a result of the imbalance of food supply between summer and winter in both regions.

FIGURE 1

Domestic animals exploited Pyrenean summer pastures 7,000 years ago (Geddes 1983). Since the eleventh century, transhumance between the Pyrenees and the lowlands became very important. Juan Montserrat (1992) and also José María García-Ruiz and Blas Valero (1998) have been able to verify, through palynological studies, the presence of abundant ashes in lakes in the Central Pyrenees from the burning of the upper forest storey. The truth

is that the forest may attain a maximum altitude of 2,200 – 2,300 meters above sea level under natural conditions and human action lowered it down to 1,500 – 1,700 meters above sea level (García-Ruiz *et al*. 1990). The purpose of fires was to increase the land surface suitable for summer pastures and to extend the grazing period. Both changes were of great interest to Pyrenean farmers, as they enabled the enlargement of flock sizes and prolonged their presence on the upland pastures. From the eleventh century onwards, sheep numbers rose sharply reaching their peak during the fourteenth and fifteenth centuries, when wool production and trade became key supports of the Aragonese economy.

Daniel Gómez Ibáñez (1975, 134) points out: "So important was this livestock husbandry based on transhumance that most other forms of rural economy were subordinated to it." These activities enjoyed a boom until the end of the eighteenth century (Fernández Otal 1993). It is unknown how many head of sheep moved between both areas. Severino Pallaruelo (1993) points out that the degree of involvement of Pyrenean sheep in transhumance was high, the Central Pyrenees being the area with the highest share of transhumant sheep in Spain. Some upland pastures exceeded 100,000 sheep, such as in the Valleys of Ansó and Tena (Villar and García-Ruiz 1976; Lasanta 1989).

TABLE I (POTENTIAL CAPACITY OF SUMMER PASTURES).

Vicente Pinilla's studies (1995) suggest that in 1836, about 700,000 sheep were still traveling from the Central Pyrenees to the Ebro Depression. Since the mid 1800s, transhumant sheep totals began to show a clear

downward trend, due to increasing difficulties in the wool trade. The leading causes of decline were: first, the competition of fine wools (initially from Prussia and later on from the British colonies and dominions) and second, Mendizábal and Madoz's provisions for land expropriation leading to the ploughing and cultivation of land and, as a result, decrease of grazing land supply (Pinilla, 1996). Around the mid 1900s, transhumance between the Pyrenees and the Ebro Valley underwent almost a terminal crisis. Contributing factors to this situation were new ploughing developments of untilled land associated with growing mechanization, irrigation of extensive areas and an increasing shortage of shepherds.

Luisa-María Frutos (1988) points out that in the wintering lands, farmers cleared 200,000 hectares of uncultivated and wood land to grow cereals and lucerne between 1962 and 1982, coinciding with two decades of increasing use of farming machinery. On the other hand, Teodoro Lasanta (2009) notes that during the 1900s, the irrigated lands in the Ebro basin increased from 380,000 hectares to 830,000 hectares, a large part taking place in wintering areas of transhumant flocks (about 300,000 hectares). Ploughing implied the decrease of natural pastures. Transformation of rain-fed into irrigated lands also contributed to the decrease of pasture areas, as farmers are able to harvest irrigated fields every year while rain-fed fields must lie fallow during alternating years. Irrigated areas present smaller plots, which hamper the tending of livestock and grazing management and, consequently, increase the cost of labor, as flocks have to be smaller and therefore more shepherds are needed. "Migrations have been curtailed not only by the rising cost of herding but also by the loss of lowland pastures, owing either to the conversion of arid

pastoral districts to irrigated arable land or to restrictions on grazing that have resulted from a more intensive use of lowland fields" (Gómez-Ibáñez 1977, 291).

FIGURE 2

In addition to the decreasing grazing areas and rising prices of pastures and labor, another major social factor deserves consideration. During the 1960s and 1970s, Spain went through an important industrialization and urbanization process which caused massive movements of population from rural to urban areas and nearby industrial estates (Caravaca and Méndez 1994). This was a major reason why few people wished to continue working as shepherds. It is a very hard job that requires working 365 days a year, and is especially hard if transhumance is practiced, when shepherds have to stay away from home for several months.

Pallaruelo (1993, 37) indicates that transhumance practically disappeared in the Central Pyrenees in the 1970s, because, at that time, "the most absolute contempt for everything associated to a past related to poverty, ignorance and isolation developed among the inhabitants of the Pyrenean villages." This disdain was largely encouraged by "the advice from some technicians who, following exclusively economic criteria," considered transhumance "an antiquated practice which should not exist in the twentieth century."

The truth is that, by the end of the 1960s, there were hardly any transhumant flocks left. García-Ruiz and Enrique Balcells (1978, 524) noted

that “transhumance lacks significance inside the province and it involves only a few farmers from Ansó and a few others much more scattered throughout the rest of the Central Pyrenees.” In 1985, field work verified that few flocks were transhumant, the total being less than 25,000 sheep (Lasanta 1989). García-Ruiz and Lasanta (1993) indicate that up to the 1970s, a remarkable share of the feeding system depended on transhumance (44 percent in the Valley of Aísa, 36 percent in the Valley of Hecho and 30 percent in the Valley of Tena).

FIGURE 3 (LIVESTOCK FOOD SOURCES).

Meanwhile, at the beginning of the 1990s, each valley supplied 100 percent of the feed. There were no flocks involved in transhumance. Over the following years, however, the transhumant system had achieved slight revitalization.

Recent Revitalization of Transhumance in the Pyrenees – Ebro Depression Gradient

The authors recently conducted a census of transhumant sheep in the Pyrenees – Center of the Ebro Depression gradient. The census tabulated funds farmers receive for practicing transhumance. The regional government, which is the organization in charge of recording livestock numbers and their movements and controlling sheep farm subsidies, supplied numbers of transhumant sheep. Each farm fills in a card or a form, specifying the number of transhumant sheep and the origin and destination of the flocks. Field work confirmed this information. We visited 120 farms (64 percent of the total), while veterinarians

provided information for the remaining 36 percent. The regional government designates them to grant permits for livestock movements. We arranged phone interviews with every surveyed farmer. Conversations provided information about stock driveways, specific summer and winter grazing areas, number of years ranchers have practiced transhumance, past family involvement, whether they move on their own or with other flocks, summer and winter pastures rental prices and, finally, issues related to farm productivity and yield. The information collected is part of a wider study, still in its initial stages, comprising both conservation issues such as stock driveways, pastures, and transhumance-related infrastructures and productive issues including transhumant farms yields and possible use of stock driveways for eco and heritage tourism purposes. For this project, only information on the municipalities of transhumant flocks origin and destination and the stock driveways they use is utilized (Figs. 2 and 3).

The numbers of transhumant sheep amounted to 134,636 sheep, out of which 77,657 sheep (57.7 percent) participated in descending or inverse transhumance and 56,989 (42.3 percent) in ascending or direct transhumance, according to Berezowski's (1971) terminology. Out of the total number of sheep in the Aragonese Pyrenees (439,110 sheep), 17.7 percent participated in transhumance. This percentage concentrated in municipalities located in more upland areas, which have larger areas of sub-alpine and alpine summer pastures, locally known as *puertos* (García-Ruiz and Lasanta 1990). If we only take into account those municipalities with *puertos*, the figure is 101,873 sheep, out of which 76.2 percent correspond to transhumant sheep.

A fact worth underlining is that traditionally ascending transhumance had barely any importance, in opposition to descending transhumance, which clearly prevailed in the Ebro Depression and in the rest of Spain (Klein 1920). Nevertheless, it is becoming increasingly important, as confirmed by the fact that almost 57,000 sheep ascend the Pyrenean *puertos* in the warm season. On the other hand, field work permits the validation that reality goes beyond statistical figures**:** many of the flocks registered in the Pyrenean uplands should be registered in the lowlands. The reason for that is that farmers live in lowland villages but register their flocks in the uplands to benefit from the subsidies given to less favored areas. In some cases we are referring to farmers that had previously practiced transhumance and later on bought land and settled down in municipalities in the lowlands during the 1950s and 1960s. These farmers have recently started to practice transhumance again and so have registered themselves in their parents' and grandparents' villages to have access to pasture land and to gain access to more generous subsidies received in less favored areas. In other cases, lowland farmers associate with the inhabitants in the uplands to secure summer pasture and increase their income with CAP subsidies.

The total number of farms involved in transhumance is 184; 116 practice inverse (descending) and 68 direct (ascending) transhumance. The average sizes of flocks are 669 and 838 sheep, respectively, although flock sizes range from 15 to 4,306 head. Descending transhumance is conducted in thirty-seven municipalities. The largest numbers of sheep are in those municipalities at higher altitudes and, therefore, with more extensive grazing surface areas (Fig. 4)**.** More than 3,000 sheep are involved in transhumance in

Ansó, Sallent de Gállego, Fanlo, Puértolas, Gistaín, Benasque, Montanuy, Pont de Suert, and La Vall de Boí. Flocks move preferably to irrigated areas in Monegros, Bajo Cinca, and Bardenas. García-Ruiz *et al*. (2003) indicate the close relationship between newly irrigated areas and sheep concentration. Diversity of land uses in irrigated areas and exploitation of untilled land provide a more bountiful supply of grazing resources and their balanced distribution over most of the year, in opposition to the seasonal deficits in rain-fed cereal systems.

As for ascending transhumance, flocks depart from thirty-two municipalities, plus five additional ones that practice horizontal transhumance, that is, displacements to municipalities located within a similar range of altitude (Fig. 5). This represents another form of transhumance. Areas of stock origins are quite scattered, although a higher concentration are evident in irrigated municipalities in Monegros (Lanaja, Lalueza, Grañén, Sariñena, Poleñino, Sena, and Huerto), Cinco Villas (especially in villages in Bardenas), and the mid-Gállego (Almudévar and Gurrea de Gállego). Flocks move preferably to the western valleys of the study area (Ansó, Hecho, Aragüés, and Canfranc), upper Gállego (Panticosa, Sallent, and Biescas), upper Sobrarbe (Broto, Fiscal, Fanlo, and Puértolas), and upper Ribagorza (Montanuy, Alt de Aneu, and La Vall de Boí). Finally, it is worth noting that a small number of flocks move to the Iberian Mountain System (Used and Brea de Aragón) from the Ebro Valley (Sariñena and Lanaja).

FIGURE 4 (DESCENDING TRANSHUMANCE)

FIGURE 5 (ASCENDING TRANSHUMANCE)

It should be stressed that food for transhumant livestock is cheap, as in summer and winter they graze mainly on common lands. In summer flocks use alpine and sub-alpine pastures rented through auction at low prices (between one and two dollars per sheep), since the supply of mountain pastures is greater than the demand. Carlos Ferrer and others (2008) estimated that only 55 percent of the grazing resources in the *puertos* is grazed. Pastures are normally free for farmers registered in the municipalities in the highlands. Commonage is also used in the lowlands, where some isolated tree species prevail such as Aleppo pines (*Pinus halepensis*), holm oaks (*Quercus ilex*), Spanish junipers (*Juniperus thuriphera*) and white (*Populus alba*) and black poplars (*Populus nigra*) beside rivers. Shrubs including Mediterranean saltwort (*Salsola vermiculata*), Mediterranean saltbush (*Atriplex halimus*), kermes oaks (*Quercus coccifera*), and rosemary (*Rosmarinus officinalis*). Herbaceous species of the genus *Stipa* and other annual species that sheep farm. Farmers supplement this fodder with stubble from cereal, lucerne and fallow fields.

Lands set aside as a consequence of the CAP are important grazing areas. María Paz Errea and Lasanta (2000) examined the potential of set-aside lands for feeding sheep. They estimated that these lands can feed between 0.3 and 1.1 sheep/ha/year in rain-fed areas and between 1.1 and 2 sheep/ha/year in irrigated areas. Variability of livestock carrying capacity depends much on set-aside years and on management after being set aside. The rental costs of wintering pastures are low, since they are common lands and fields with crop residues; prices ranged between 2 and 4 dollars/sheep in recent years.

Compare this average with the cost of feeding in the absence of transhumance estimated at 18.31 dollars/sheep, since each sheep has an average intake of 30 kg of cereal, 20 kg of lucerne and 50 kg of cereal straw, besides any grazing intake (Lasanta and Arnáez 2009).

In ascending and descending movements, flocks use stock driveways as shown on figures 2 and 3. They spend between six and twelve days on a single journey, depending on the distance between the summer and the winter pastures. During the journey, they graze on untilled fields and on residues of crops close to the stock driveways, which are totally free.

FIGURE 6

The CAP and Transhumance's Rehabilitation

One explanation for transhumance's rehabilitation has been its enhanced social appreciation and recent studies have stressed its remarkable role in forage preservation, biodiversity diversification, and improvement of landscape quality and structure (Ruiz and Ruiz 1986). Also, the advocacy efforts of some groups such as the *Asociación Concejo de la Mesta* and the *Asociación Trashumancia y Naturaleza* have helped reinvent transhumance. Some naturalists and scientists such as Jesús Garzón (Cáceres, 2006) and various associations that have organized congresses on stock driveways (Mangas, 2005) have put special emphasis on their rehabilitation to facilitate the movements of livestock.

Not underestimating the role played by scientists and pro-transhumance groups, the main incentive for revitalization was undoubtedly the implementation of the CAP. We must bear in mind that economic support provided by the CAP is essential for the economic viability of farms. When Ahmed Ammar (2006) examined the economy of sheep farms in *Sierra de Guara* (Central Pyrenees), he noted that an average of 29.6 percent of non-transhumant farm income comes from CAP funds. It is possible to assume that the figure will be higher for farms involved in transhumance, as the amount of subsidies is also higher. On the other hand, Emilio Manrique and others (1999) consider that 38 percent of farms in the Pyrenees, especially those involved in transhumance, would not be profitable without the CAP subsidies.

Additionally, the allocation system of ewe subsidies (regardless of productivity) favors the growth of sheep numbers and flock sizes. Farms have followed the strategy of improving labor productivity by increasing the number of ewes in the flock rather than by increasing the number of lambs born from each ewe. The first is a safer option since it relates to a subsidy system linked to ewes, independently from their productivity. The second choice, however, encounters biological constraints (fertility increase is limited) and requires more labor for shepherding, feeding, and health care (Lasanta and Laguna 2006). The fact is that average flock size in Aragon increased from about 200 head at the beginning of 1980s to 363 in 2002 (Sierra 2002). Farms practicing transhumance account for a large share of that increase. The average size of farm enterprises involved in descending transhumance is 625 sheep and 865 sheep for those conducting ascending transhumance, thus much bigger than the average flock in Aragon.

Nevertheless, table II shows a high variation of transhumant farm sizes. It is common for the smaller farms to join the bigger ones when practicing transhumance, forming flocks of over 1,000 sheep.

TABLE II (FARM COMPOSITION BY SIZE)

Despite farm numbers having decreased considerably, farm size enlargement involved an increase of sheep numbers. Laguna and Lasanta (2007) have shown that livestock numbers went from 324,130 sheep in 1982 to 439,110 in 1999 in the Central Pyrenees. This represents a 35.4 percent increase, while the number of farms decreased 44.2 percent.

Transhumance practice has also been supported by two facts. On one hand, the fact that many farms maintained their holdings divided between the highlands and the lowlands. We are referring to those families, with their roots in the Pyrenees, who settled in the lowlands during the 1960s and 1970s, but maintained their homes, their fields and, especially, their entitlements to mountain pastures. This fact has also helped ascending transhumance to play a more important role than it had traditionally enjoyed. Entitlement implies that when the stockholder maintains his/her residence and lands or appears in the census as a resident of a mountain village, his/her stock has the right to graze on the common lands.

On the other hand, livestock movements are relatively short (150-200 kilometers), compared to those conducted between the Cantabrian and Iberian Mountain Systems and Extremadura and Castile-La Mancha. This fact has contributed to the use of ancient stock driveways (*cañadas*). In the other

Spanish regions however, where transhumance has also been revitalized, part of the journey is now covered by train. Approximately 20 percent move by train involving a cost of 2.4 dollars/sheep per trip. The annual train transport cost is 4.8 dollars/sheep, taking into account both descending and ascending movements.

Conclusions

In the Ebro basin, as in many other regions in Spain, we find a system of bio-climatic stories organized according to altitude. Altitude determines distribution, quality, and cycle of grazing resources. On an annual basis, each altitudinal layer has a period of maximum pasture production and another period with a severe deficit. The logical farming strategy to exploit the land involves the use of techniques that mitigate seasonal irregularities and variation of grazing resources, by adjusting resources and livestock requirements. The transhumant system, that is, the movement of livestock according to the optimum availability of pasture provided the traditional adjustment.

A series of social and economic factors were the prime causes for transhumance decline since the nineteenth century until it almost disappeared in the 1960s and 1970s. However, CAP support for extensive livestock farming together with other circumstances have helped it to regain vitality. Those measures have contributed in a certain extent to maintaining the ecological and economic benefits that were provided by the transhumant system over centuries, such as pasture conservation, reduction of forest fires, landscape diversity and greater biodiversity (Manrique *et al*. 1996; Gutman *et*

al. 1999; Torrano and Valderrábano 2004; Bernués *et al*. 2005; Riedel *et al*. 2007).

The CAP has contributed to revitalizing transhumance by improving farm incomes and increasing average farm size. Around 250,000 sheep were moving in Spain in the 1980s in comparison to roughly one million at the end of the 1990s and about 800,000 between 2004 and 2009 (UPA 2009); mirroring similar processes in other European regions (Serrano *et al*. 2004; Veysset *et al*. 2005). The figures for the Ebro basin on the same dates increased from 25,000 sheep to more than 134,000. We must bear in mind that transhumant systems are tightly linked to large flocks and big farmers. Livestock relocation and rental of pastures require expenditures that become profitable only with a big number of head per flock and, consequently, a reduction in the price of labor (Olaizola *et al*. 1998).

On the other hand, both in the Pyrenees and in the Ebro Valley, farmers increased their flock sizes after Spain joined the European Union and thanks to the CAP subsidies; however, they came across the problem of having to feed livestock during the period of shortage. For small flocks, food had been guaranteed by the available resources: hay meadows in the Pyrenees and crop residues in the Ebro Valley. However, by increasing the number of heads, many stockholders had to buy feed. Under such circumstances (large flocks and purchase of feed), transhumance turns out a more profitable system, as it is supported by a premium per transhumant sheep. In fact, various studies show that viability of sheep farms depends on flock sizes and on subsidies (Manrique *et al*. 2007; Pardos *et al.* 2007).

The third CAP measure that contributed to revitalize transhumance is land set-aside policy. It increased substantially the grazing area in the lowlands, so that transhumant flocks can graze on commonage, untilled land, set-aside land and crop residues simultaneously and at a very low cost.

Transhumance restoration is due, to a large extent, to flocks moving from the centre of the Ebro Valley to the Pyrenees (ascending or direct transhumance). Farmers participating consider the advantages offered by mountain areas: exploitation of free or cheap summer pastures and collection of substantial subsidies. This fact represents an important change in relation to the traditional transhumant system, by which flocks from the Pyrenees moved to exploit uncultivated lands and stubble in the centre of the Ebro Valley (descending or inverse transhumance).

In a more general context, it is worth mentioning that the CAP has helped to increase sheep numbers and restore transhumance. This has obvious positive economic and environmental effects. Among the latter we can include the reclamation of many stock driveways, a public good that was degrading and that is now being restored and rehabilitated for livestock movements and as "green roads" for tourism (Antón-Burgos 2007). On the other hand, transhumance contributes to the preservation of a varied landscape and of its aesthetic quality, which represents a major resource for tourism in the rural areas, especially in the Pyrenees (Vaccaro and Beltrán 2009).

The CAP, however, has favored a farming system increasingly based on subsidies and less on ewe productivity and exploitation of natural pastures. Production objectives declined and, to a large extent, farmers' gains were based on maximizing premiums (Veysset et al. 2005; García-Martínez et al.

2008). This fact implies that farms increasingly depend on external factors. Their continuity depends greatly on maintenance and size of subsidies and less on internal resources (pastures). That shows a great capacity of the current management to adapt to new income sources. It also shows its high degree of future risk by detaching itself from pastures, which constitute an essential resource for the development of extensive farming, in so far as they are mainly a public free resource.

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