CHAPTER SEVEN

Comparative Typology in Six European Low-Intensity Systems of Grassland Management

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European biodiversity significantly depends on large-scale livestock systems with low input levels. In most countries forms of grazing are organized in permanent or seasonal cooperations (land-owner/land-user agents) and covers different landscape such as alpine areas, forest, grasslands, mires, and even arable land. Today, the existence of these structures is threatened due to changes in agricultural land use practices and erratic governmental policies. The present chapter investigates six low-input livestock systems of grassland management with varying degrees of arrangements in different European countries and landscapes. These large-scale grazing systems (LSGS) are reindeer husbandry in Northern Sapmi (Fennoscandia), sheep grazing in the Polish Tatra mountains, cattle grazing in the Swiss and German Alps, cattle, sheep, and pig grazing in Baixo Alentejo, Southern Portugal, and sedentary sheep grazing in Central Spain. These systems showed very heterogeneous organizational patterns in their way of exploiting the pastoral resources. At the same time, these LSGS showed at least some of the following weaknesses such as poor economic performance, social fragility, and structural shortcomings for proper grazing management. Lack of proper mobility of herds/flocks or accession to specific grazing grounds can be a cause of environmental hazards. The surveyed LSGS are mostly dependent on public handouts for survival, but successive policy schemes have only showed mixed effects and, in particular study areas, clear inconsistencies in their aim to stop the general declining trend of LSGS. This research assumed that detailed system research may open the way for better-focused policy intervention, but policymakers need to take advantage of this period of support to push ahead for reforms. Recent European Union (EU) guidelines (2007–2013) on Rural Development Policy (RDP) and its operative scale of high nature value (HNV) farmland can easily fit the structure and functions of low-input grazing systems and LSGS.

1. Introduction

Large-scale extensive livestock systems in Europe represent large chunks of European land relative to the size of the business operations. As large-scale systems, they may represent links with nature values at the landscape level, and as extensive systems, they may represent low input and low value of production relative to the size of the business at the farming level. These large-scale grazing systems (LSGS) are mainly located in the most remote and less favored areas (LFAs) with harsh environmental and sometimes difficult social conditions. A small part of the rural population stands to make a living by maintaining traditional grazing practices, which, in turn, shaped the environment.

As being located in mostly developed countries, these systems have faced two main threats: intensification and abandonment (the most extreme form of extensification). In the first case, the harsh environments have limited the impact. In the second case, some studies have pointed out the risk of abandonment in the LFAs of the European Union (EU) (Baudry *et al.*, 1996; Caravelli, 2000; Garcia-Ruiz *et al.*, 1996; Muller, 1996; Zervas, 1998), but a pan-European coordinate socioeconomic research on the viability of LSGS is still lacking. Farming systems thought to satisfy ecological sustainability objectives must be economically attractive to farmers, if they are to be voluntarily adopted and continued (Dobbs, 2004). However, only 6 of the 22 studies on extensification of European livestock systems detailed in a review paper (Marriot *et al.*, 2004) collected data on animal performance and only two individual studies showed some indicators on economic performance. None of these studies was previously coordinated at the European level.

Maintenance of LSGS may thus be dependent on the fact that marginalization of agriculture, undermining viability of rural communities, does not go so far. In turn, LSGS may manage to fill in gaps created by a declining intensity of land use. In fact, the LFAs of the EU-12 represented some 56% of the EU's total surface area, and contained much of the high nature value (HNV) farmland (Brouwer *et al.*, 1997). Left to their own or under insensible schemes of policy support, the abandonment threat can be more prejudicial than the intensification threat (Atance *et al.*, 2000; Kristensen *et al.*, 2004; Vicente-Serrano *et al.*, 2004). Both threats, however, may derive similar effects: disappearance of potential economic, environmental, and social values (Angelstan *et al.*, 2003; Donald *et al.*, 2002; Krohmer and Deil, 2003; Loumou and Giourga, 2003; Tucker and Heath, 1994; Waldhardt *et al.*, 2004). It is common ground to highlight the importance of the agronomic and environmental services (pollinators, biological pest control, cultivated plants, and wild relatives, and so on) provided by these relatively undisturbed "natural ecosystems" (Hillel and Rosenzweig, 2005). It is less

common to change the arrow of causality and posing the question on how these truly LSGS are going to survive and continue to provide their potential assets.

European extensive systems of grassland management, notwithstanding their ample variation in environmental and structural components, face an encounter with modern farming or farming intensification. Can they survive with tactical concessions to modernity? Do they share some qualities that helped them to survive? Are they adept at anticipating or adapting to changes? Are their stakeholders shrewd managers of their assets? Are they good advertisers of their cultural, economic, or environmental utility? Are these systems able to integrate new values and functions to their products? These are some questions to which a typology of policy relevance may provide some answers. This research will argue that European policy intervention can be devised at the space scale of LSGS and HNV farmland. Structural and social constraints, as well as potential environmental assets, are linked to specific systems. Sensible policy schemes can only be devised after untangling these constraints.

In the following chapter, we sum up the results of a parametric analysis of six European study areas. This study was conducted within the EU-funded research project ''Landscape Development, Biodiversity and Cooperative Livestock System'' (Caballero and Fernández-Santos, 2004; LACOPE, 2002). These six study areas, and their respective LSGS, cover a wide range of different ecological, social, and economic conditions and exhibit different adaptations of the grazing system. The investigated large-scale extensive grazing systems are representative for some of the most widespread types of this kind of agricultural land use. One study focused on the reindeer grazing system of the boreal-alpine biogeographical region (Northern Sapmi); three LSGS represented different mountainous systems (Tatra Mountains in Poland, Bavarian Alps, and Swiss Alps). The remaining two covered outstanding Mediterranean systems: the open fields of Campo Branco and the surrounding *Montado* system in Portugal and the cereal–sheep system in Spain.

Extensification is the process of reducing fertilizer inputs, management intensity, and stocking rates at the farm level and is central to sustainable rural policies. However, typology research in the LFAs is fragmented and extensification studies should adopt an approach that will allow their results to be applied throughout Europe (Marriot *et al.*, 2004; Strijker, 2005). Successfully decoupling payments from production while maintaining HNV farming systems represent a severe challenge to the Common Agricultural Policy (CAP) of the EU. Studies are needed across a range of HNV areas in all of Europe's biogeographical zones (Beaufoy *et al.*, 2003). The main objective of this research was to assess whether some typology categories or common features can be drawn from the data of the six study areas or divergences between systems are perceptive for most headings and indicators.

2. Presentation of Study Areas

All study areas have in common that they represent pastoral systems under harsh environments. A significant part of the biodiversity depends on open land and the maintenance of particular pastures. To dismiss pastoralism as a backward pursuit, an embarrassment to notions of modernization, is to put aside a proven response to harsh environments. In most study areas, except Baixo Alentejo (Portugal) and to a lesser extent Entlebuch (Swiss Alps), pastoralists are not the owners of the land. This fact may represent problems of mobility of herds/flocks or access to pastureland. Full pastoral operations are carried out in the management unit (MU). This MU may encompass more than one farming unit of seasonal grazing use. Four of the investigated systems (Sámi reindeer management and the three alpine systems in central Europe) are still showing a pronounced seasonal migration pattern. The distance can easily exceed 200 km in Northern Sapmi, while it is rather short in the three alpine systems. The two Iberian systems are sedentary, albeit not devoid of mobility and access problems, especially in the cereal–sheep system of Castile-La Mancha (Spain). Key figures of the six study areas are shown in Table 1. Geographical location of the seven LACOPE study areas is depicted in Map 1. The study area of Connemara (west of Ireland) was not integrated in this report.

2.1. Northern Sapmi, Fennoscandia

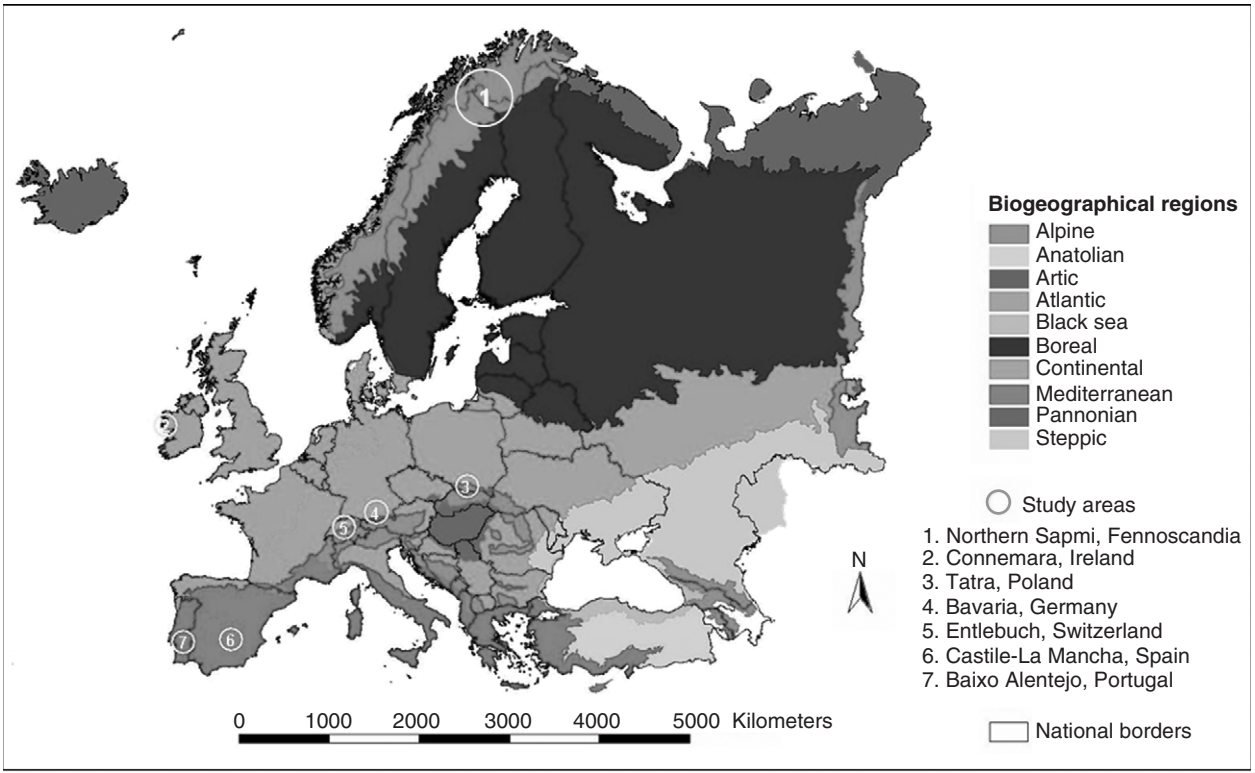
These LSGS take up a large tract of the northern part of the Scandinavian peninsula (Northern Fennoscandia), encompassing land of Norway, Sweden, and Finland. Reindeer management culture by Sámi herders is well entrenched in the area. National differences exist in historical background (Sandberg, 2006), herder production strategies (Riseth, 2000, 2003, 2006), as well as in the national legal and subsidy systems. In Sweden and Norway, reindeer management, with a couple of regional exceptions, is culturally and ethnically connected to Sámi people, while in Finland it is open to everyone and mainly a side industry to agriculture. Full seasonal migration, short-distance migration, and stationary patterns of reindeer herding can be envisaged, the first most common in Norway and Sweden and the latter in Finland.

In Norway, the husbandry unit is the base for most subsidies. Husbandry unit leaders, by cultural tradition, are usually concession holders. The concession model, dated from 1978, is the legal foundation for awarding subsidies. Within husbandry units, other right holders, apart from the leader, can be herders with subsidy allocation rights. In the western Finnmark area (24,290 km^2), to which the average Norwegian data are referred, 26 pasture

Table 1 Key figures of the regional agriculture

	Northern Sapmi[a]	Tatra Mountains[b]	Entlebuch[c]	Bavaria[d]	Baixo Alentejo[e]	Castile-La Mancha[f]
Total acreage of LSGS per study area (ha)[g]	42,000,000	2500[g]	7000[g]	61,000[g]	220,000	6,000,000
Grassland (t/ha dry matter)	1–1.5	2.5 (mountain), 4 (valley)	1.5 (mountain), 7.5 (valley)	7 (foothills)	0.8	2
Wheat grain (t/ha)	–	–	–	–	1	2.2
Orientation of the livestock production on the LSGS	Reindeer (meat-oriented)	Sheep (milk and meat-oriented)	Mainly heifers	Mainly heifers	Meat-oriented flocks (sheep, black pig, cattle)	Sheep (milk and meat-oriented)

[a] Søyland *et al.* (2002). Reindriftsforvaltningen, 2005.
[b] Statistical Yearbook (2002). Data only for Tatra National Park.
[c] Regional management Biosphärenreservat Entlebuch (2002).
[d] LBA (2002); Agrargebiet: Alpenvorland; meadows cut four to five times.
[e] INE (2001, 2002) and de Sequeira (1988) for the productivity figures.
[f] Caballero (2001).
[g] Total acreage of the grazing systems under collective form.



Map 1 Biogeographical regions of Europe and location (hot spots) of LACOPE study areas. *Source:* http://dataservice.eea.eu.int/dataservice/metadetalls.assp?table=Biogeo01&|=1.

districts, 241 husbandry units, 1279 reindeer owners, and 84,200 reindeers are in the area (year 2003–2004). The subsidies are bound to the concession holder who has to produce a certain minimum amount of meat to qualify. Reindeer herders with no concession are not qualified for subsidies and with little incentive to get into the reindeer industry. Reindeer families are represented for one husbandry leader.

The Swedish and Finish subsidy systems are not based on concession holders. In Sweden, the system is based on reindeer owners. Any owner with a minimum level of meat production counts in the official statistics. In Finland, the subsidy system requires husbandry masters to reach a minimum of 80 animals to qualify. Reindeer owners, with reindeer herding as their main source of living, receive a headage payment of 22 € per animal. In Sweden and Finland, one reindeer husbandry family may encompass several husbandry master or *doallu* (household). Regional data for Sweden (northern Norbotten läns) average 332 husbandry masters, 1249 reindeer owners, and 56,522 reindeer in the area. Regional data for Finland (Käsivarren paliskunta area) encompassed 128 husbandry masters, 168 reindeer owners, and 10,000 reindeer in the area (Paliskuntain, 2004).

2.2. Tatra mountains, Poland

The LSGS in the Polish Tatra mountain (Carpathian region) are strongly linked to milk sheep. These sheep stay from late autumn to mid-spring on the lowland farms and graze clearings in the mountain forests or areas above the timberline (*alps*) in the summer for roughly 160 days under care of a flock master (*baca*). Usually, one *baca*, which is a small sheep farmer, gathers the sheep of other small farmers (*gazdas*) and takes them together to the *alps*. One average *baca* flock (some 300–350 sheep) can be composed of the flocks of some 20 sheep of different owners. Sheep flocks under *baca*'s care are allocated to several clearings (around 12 clearings per *baca* of an average size of some 5 ha) in the alpine forests.

Some 75% of the clearings are privately owned and 25% is public (Tatra National Park) land. The clearings have several owners who claim property but do not have proper legal documents. Similarly, *bacas* cannot claim for subsidies in the *alps* as they do not have proper renting documents. As a whole result, devising and implementing proper policy schemes and incentives for moving sheep to the natural pastures in the alpine and subalpine zone (*alps*) cannot be properly established without an overhauling of the legal and institutional framework. Currently, farmers can only receive subsidies for land and sheep they own on the lowland farms.

Although sharing shepherding for the summer season is traditional, cooperation between different stakeholders (*bacas*, *gazdas*, and landowners) is difficult to manage, people are independent and difficult to be engaged for any form of cooperation. Some 20 years ago, sheep were moved to distant

clearings (up to 100–150 km). These clearings are currently underused due to difficulties in transportation and the low profitability. There is a need of keeping traditional ways of milk processing, but also to fulfill EU sanitary requirements. From mid-October to early May, individual sheep flocks are moved to lowland farms and fed indoor with hay produced in summer, while sheep flocks in the clearings.

2.3. UNESCO Biosphere Entlebuch, Switzerland

In the UNESCO Biosphere Entlebuch (canton Lucerne) there are 211 units of alpine pastures (Hofstetter *et al.*, 2006a) and 1015 (AfS, 2007) farm units in the valleys in the year 2005. Some 20% of the farm units of the valleys shared also one alpine unit, moving animals to the latter in the summer for some 110–130 grazing days, depending on the altitude, exposition, and grazing management (Hofstetter *et al.*, 2006b). Boarded (external) animals stay an average of 110 days with small variation. Owned animals stay a mean of 130 days with larger variations, depending on whether and how much the owner provides alpine pastures' hay to the herd.

Most summer pastures are located in the prealpine area (67% between 1200 and 1400 m) and a small part in the high alpine area (up to 2500 m). The dominant grazing lot is heifers from the lowland farms. Most alpine units (72%) have only one stable and 28% more than one when allocated pastures of different altitude.

Often, the area of the lowland farm unit in Entlebuch with an average of 14 ha (Hofstetter *et al.*, 2006a) is small compared with the area of the alpine unit (mean of 57 ha). As a consequence, private owners or tenants of alpine units cannot properly stock the alpine units only with their own animals, and thus external animals are added to the mixed herd. Owners of these external animals pay a grazing fee to the owner/tenant of the alpine unit (LBL, 2004a). These grazing fees, together with the subsidies, are the main sources of income of most alpine units over the summer season. In the alpine units of Entlebuch, most external animals are heifers and sheep from the canton of Lucerne (Office for Agriculture and Forest, 2004).

2.4. Bavaria, Germany

The Bavarian study area covers the German part of the Alps and the foothills in their vicinity. In the year 2005, ~50,000 cattle grazed on rough pastures in this area (Miller, 2006). Heifers are the dominant livestock species on these rough pastures, which are mainly alps, or less frequently grazed moorlands in the foothills. Over 40% of the area used by this grazing system is under some form of cooperative livestock management or cooperative livestock system (CLS). This makes the Bavarian study one of the remaining strongholds of CLS, which were fairly widespread in Germany until the

nineteenth century. For convenience, all CLS in the Bavarian study areas will be labeled *Allmende*. Typically, several lowland dairy farmers participate in the use of one *Allmende* on which they raise their replacement heifers during the vegetation period. Despite the awarded incentives, the intensity of land use declined within the last 20 years. The number of active members, the ones who send animals to the pastures of the *Allmende*, not only dropped from 27 to 17—or 2% per year—for the average *Allmende*, but also the number of animals using these pastures declined. The mean size of the upland *Allmende* units in the sample was some 400 ha. The average unit is more or less evenly divided between forest and grazing land. A shared characteristic of the Bavarian and Swiss systems is that they encompass a low-intensity farming unit of HNV, which is only an appendix to a more intensive form of land use (the lowland farm unit).

2.5. Baixo Alentejo, Portugal

Two types of landscape characterize the Baixo Alentejo study area: the open field on the flatland (Campo Branco) and, in the surrounding area with a slightly rougher morphology and/or shallower soils, the *Montado* system. In the open fields, farmers develop a more or less long rotation according with the soil type, based on rain-fed cereal and extensive grazing in fallow areas. This type of land habitat suited to steppe bird species and determined the classification of the area as a Special Conservation Area (ICN, 2006). The *Montado* system is an agrosilvopastoral system comprising an open formation of cork (*Quercus suber* L.) and/or holm (*Q. rotundifolia* Lamk.) oaks, combined with grazing activities (Coelho, 1997; Moreira and Coelho, 1997; Pinto-Correa, 2000; Pinto-Correa and Mascarenhas, 1999).

In the Portuguese case, a proper CLS does not exist, but rather a private-dominant property system with private grazing rights is dominant. Main actors are large landowners, either managers of their farm-holding or renters; medium-size farmers who frequently have to rent additional land in support of a mixed crop and livestock operation; and small farmers and landless pastoralists, the latter keeping their animals under renting agreements with landowners. Nevertheless, livestock production in this study area is predominantly assured by large landowners even if, in many cases, the wage granted to pastoralists includes the right to keep own animals jointly with the landowner flock.

A more complicated picture appears when land uses and livestock species are considered. In Baixo Alentejo three main land uses are dominant: the open areas of cereal cultivation, where operate a mix of cereal cropping with cattle and sheep grazing; the *Montado*, open forest of *Quercus* spp. (holm and cork oaks), where mixed farming of *Alentejano* pig, meat cattle and sheep may operate with cork extraction; the shrubby encroachment

areas under large fallow periods, where hunting appears as a strong competitor to grazing activities as well as EU-supported afforestation programs. Tourism operators may overlay in different land uses.

2.6. Castile-La Mancha, Spain

The southern Castilian plain forms most of the basin of the Tajo and Guadiana rivers. The whole region occupies an area of some 7.8×10^6 ha and is divided into five administrative provinces (Albacete, Ciudad Real, Cuenca, Guadalajara, and Toledo) and 916 municipalities. The central part of the region is properly called the La Mancha plain, where arable land is dominant (some 80% of total agricultural land, TAL).

In this Spanish study area, private landownership is dominant with some common grazing land in the mountains surrounding the plain. Mixed arable and sheep operations, where existing, are carried out of the same land units (grazing allotments or *polígonos de pastos*), under private ownership of arable land and public grazing rights, awarded to landless pastoralists (customary use-rights). Sheep farmers (both milk- and meat-oriented) take advantage of agricultural residues in arable land (mainly cereal stubble and fallow land).

3. Material and Methods

Field data were gathered in agreement with common headings and indicators, based on previous coordinate effort (Caballero and Fernández-Santos, 2004). Most teams except Northern Sapmi, which used public statistics for Norway, used questionnaires as field data collection tool and livestock farmers as individual recipients. In the case of Northern Sapmi, the reindeer district was used as sample unit and official records as source of information gathered at the level of the MU, in this case the husbandry unit within district. In case of the three alpine systems, the whole MU encompassed two farm units as livestock farmers moved animals from alpine private and commons grazing land over the summer season to farm holdings in the lowland over the rest of the year. In the two Mediterranean systems, the animals stayed over the year in the same MU, being private farm holdings in the *Montado* of Baixo Alentejo (Portugal) and grazing allotments (*polígonos de pastos*) composed of several farm holdings under public allocation of grazing rights in Castile-La Mancha (Spain).

Questionnaires were drafted based on main criteria as agreed on the matrix-heading: land uses, farm size and land ownership schemes, forage deficit (FD), grazing facilities, stocking, grazing management, economic performance, labor, and institutional factors. Productivity estimates were calculated on either by working unit (WU) or land unit.

3.1. Main criteria and indicators

Determining habitat and landscape features that lead to patterns of biodiversity is an important step for the assessment of the impact of extensification in agriculture. Local habitat factors for organisms are those influenced by management practices (Jeanneret *et al.*, 2003a) and seminatural biotopes (Zebisch *et al.*, 2004). The first authors stressed the influence of surrounding land use. There are no general models relating overall species diversity to landscape diversity, being the relationship depending on the organism examined. Land uses have been identified in our study areas as a requirement to assess biodiversity responses. These responses to landscape and habitat changes have to be identified by means of a multiindicator concept in different landscapes situations (Jeanneret *et al.*, 2003b).

In the six study areas very different kinds of pastoral resources are used, but grazing and nongrazing land uses were differentiated. Intensity of use of grazing resources was also stressed either by accounting the level of use of potential resources or the spatiotemporal distribution of grazing use.

In Northern Sapmi, winter and summer reindeer grounds are differentiated, partly within each country and partly across country borders, with Norway having excellent summer pastures in the suboceanic mountain ridge, and Sweden and Finland mostly winter pastures in the dry continental woods. Thus, the annual grazing cycle follows the directions of big river valleys, although borders' barriers have curtailed the traditional migrations of Sámi herders between countries (Riseth *et al.*, 2003).

In the three mountainous areas (Tatra, Entlebuch, and Bavaria), land uses are differentiated by farm units (highland summer pastures and lowland private farms). Grasslands are dominant in both farming units but the degree of use and intensity are different with higher intensity in the lowland farm, especially in Entlebuch and Bavaria, and some risk of abandonment of upland pastures (Grunig *et al.*, 2004). Nongrazing land uses corresponded mainly to alpine forest and some protected areas.

In the two Iberian countries, pastoral resources encompassed a mixture of arable land resources (stubble and fallow land) and natural pastures linked to open oaks' forest, the first being dominant in Castile-La Mancha and the latter in the Baixo Alentejo. Nongrazing land in these study areas are mainly more intensive cropped areas of vineyards, olives, and plots under irrigation, as well as some protected areas such as subsidized afforestation parcels or young tree plantations.

Farm size and land ownership schemes were defined either in private grazing land or in common grazing land. The latter dominates in the Northern Sapmi study area and in the highland pastures of Bavaria. Private landholdings dominate in Entlebuch, Tatra, in the two Iberian study areas, and in the lowland farms of the three alpine areas. The size of the MU varied largely among study areas, as well as the size of farming units

within study areas. Livestock farmers have legal grazing rights in the commons of Northern Sapmi and highland pastures of the alpine areas, private grazing rights in all study areas, and consuetudinary (customary) use-rights to arable pastoral resources in Castile-La Mancha. Grazing fees were applicable for allocation of grazing rights, either in commons or in private grazing land.

Modeling the FD was defined by a mass balance of available grazing days provided by complementary forage resources (CFR) as compared with structural nongrazing days (Caballero, 1993, 2003). These are days along the year where grazing is hampered by lack of vegetative growth, presence of snow, or humid soils. The only way to avoid an FD under grazing conditions is long- or short-distance migration patterns (*trashumancia* or *trasterminancia*). The first migration pattern represents long-distance and horizontal movements and the latter, shorter, and vertical movements. The FD represents the forage coverage of CFR on structural nongrazing season (SNGS).

Most areas of Northern Sapmi have operative long-distance migration patterns though present countries' borders and grazing restrictions based on international border conventions, to a considerable extent, have shortened or stopped traditional patterns for reindeer herding. Particularly in Finland, with relatively stationary grazing patterns, supplementary feeding covers the FD. Unfortunately, we have no sufficient data to evaluate the implications of this fact.

In the Tatra Mountains and in the two Alps' study areas, summer grazing days in the highland pastures assures 100–130 grazing days and the potential FD may occur in the lowland farms. In the two latter study areas, the potential FD can be more acute as only a proportion of the livestock units (LU) goes to the highland pastures. Productivity of CFR and proportion of TAL devoted to forage conserves are key issues. In the Iberian study areas, with stationary grazing patterns and climatic constraints, an FD may appear if forage conserves are not provided for coverage of the SNGS.

Across study areas and farm units within study areas, grazing facilities may differ greatly. Fences, barns, water points, milking or slaughtering facilities, haymaking or manure handling machinery, remoteness, accessibility paths, or herders' shelters are important indicators of less hardworking conditions, mobility, and homogeneous grazing use. Grazing facilities are of the outmost importance in highland pastures, remote areas, or grazing units where the pastoralists have limited resources or rights to improve grazing facilities such as in the Tatra Mountains or in Castile-La Mancha.

Stocking was defined as number of LU per hectare of available pastureland over grazing seasons or grazing units. In three of the six study areas, one grazing species is dominant: reindeer in Northern Sapmi, and sheep in the Tatra Mountains and the Castilian plain. In the other three study areas, different livestock species or type of animals are dominants in specific units. In the two alpine areas of Bavaria and Entlebuch, heifers are dominant in the alpine units

and dairy cattle in the lowland farms. In Baixo Alentejo, meat cattle is the dominant specie followed by meat sheep, except in the holm oak *Montado* where the *Alentejano* pig has its mostly demanded grazing territory. In these three areas with mixed grazing, units of different species and types of animals should be converted to LU by standard tables of equivalence to obtain the size of the herd by grazing unit. Similarly, on each land unit, nongrazing land should be detracted from TAL to obtain available pastureland.

In Northern Sapmi, different stocking and grazing distribution can be related to patterns of migration of reindeer herding. In the Tatra Mountains as well as in the Alps, differential stockings are related to lowland farm stocking, over most of the year, and summer stocking in the highland pastures. In Baixo Alentejo, cereal- or *Montado*-dominant areas may support differential stocking densities. In the southern Castilian plain, stocking can be related to land uses, either arable or nonarable land-linked resources.

By comparing stocking across study areas and grazing units some insight on grazing distribution can be obtained. The question, however, of whether study areas or specific grazing units are over- or underused remained unchecked. This assessment would require a comparison between potential stocking (base stocking or carrying capacity) and real stocking. Estimation of potential stocking would be based on availability, seasonal productivity, and quality of corresponding pastoral resources by study area or grazing unit. However, the FD mass-balance model, applied to most study areas except Northern Sami, may provide some insight on the adjustment of forage supply to animals' requirements. In Northern Sapmi, pasture surveys have been used regularly in the latest decades. Several studies indicate considerable overgrazing of lichen resources (particularly winter but to some extent also fall pastures) in Finland and in the Norwegian LACOPE area of western Finnmark as well as the adjacent Karasjok area of eastern Finnmark (Colpaert *et al.*, 2003; Johansen and Karlsen, 1998; Moen and Danell, 2003).

Under the heading of grazing management, mobility of livestock across grazing units was checked within study areas, as well as grazing days within the grazing units. Main schemes of seasonal reproduction (mating/calving-lambing/milking seasons) allowed relating the physiological status of main grazing species with seasonal grazing units. Grazing management also assessed the animal lots under grazing or indoor feeding by grazing season as well as main herding practices. The latter included whether herds/flocks were permanently conducted or only temporarily checked.

Main grazing species, animals' lots, animals' breed, production objectives, and main indicators of animals' performance were also recorded in this heading. Different production objectives were recorded across the six study areas and even within one specific study area.

Animals' performance indicators were required for estimating the value of production farming. For milking lots, marketed milk per dairy cow or per

breeding ewe and for meat production, the mean live weight (LW) of animals at selling or slaughter weight in the case of Northern Sapmi were recorded. Some other productivity indicators such as milk production per WU were also recorded. Distribution of milk production over the year or main processing-marketing channels of important livestock products were also recorded in most study areas.

Under this heading, some indicators of future trends in the grazing management of LSGS were also recorded. Current or predicted changes in LSGS management may have some ecological and economic effects. Changes in land uses that can promote better grazing practices and productivity, trends in grazing days, animals' lots under grazing, or trends in spatial distribution of grazing over the MU were some management indicators recorded. It was also important to assess the trends in the extensive grazing operations in the face of the European debate between extensification and intensification of LSGS (Caravelli, 2000; Marriot *et al.*, 2004; Pinto-Correa and Mascarenhas, 1999; von Boberfeld *et al.*, 2002).

Economic indicators were recorded with the aim of allowing a certain harmonization of reporting and comparison between study areas. Classical cost-benefit analysis was the main tool devised for analysis. The heading was divided in two main tiers: income structure and cost structure. The latter recorded external supply of feeding inputs, animal health expenditure and veterinary assistance, grazing fees, amortization and interests, labor (family or waged), and other costs such as transportation, animal acquisitions, or stock depreciation. Within the income tier, value of production farming, subsidies, and other income sources were recorded. Net profit or losses were calculated by detracting total cost from farming income, either with or without subsidies. Notwithstanding this common economic framework, we opted to maintain the traditional farm accounting of individual study areas instead of looking for a rather artificial harmonization. The main reason for this approach was that we were looking for a general picture of economic sustainability emerging from data of individual study areas rather than cross comparisons of individual study areas. These comparisons are still possible, taking into account particularities of farm accounting.

Taking into account the high degree of heterogeneity of the farm structure between and within study areas, the definition and selection of a meaningful economic indicator is not straightforward. In our study areas we have a gradient of increasing ratio of capital demand to running costs with corresponding increase of imputed costs. The remuneration of the production factors family labor, own capital, own land, and own assets induce imputed costs. One factor determining the relevance of imputed costs is the productive orientation. Dairy operations, such as in the lowland farms of Entlebuch and Bavaria, have higher imputed costs than the ones focusing on meat production. In these areas, the imputed costs can be in the some order of magnitude as the running expenses.

Most of the study areas depend greatly on family labor. Whether a farmer has to take into account this and other imputed costs depends on his/her attitude toward farming and his/her dependence on on-farm income. Only in Baixo Alentejo and Castile-La Mancha, family labor was valued due to the apparent trend of relying on waged labor. To correctly assess the economic sustainability of a given farm, one has to know the personal valuation of the farm-specific production factors. This would allow an adequate assessment of its imputed costs.

Having these problems with the correct assessment of the imputed costs, we selected the cash flow as the main indicator for the cross-country comparison of the economic sustainability. The cash flow has the advantage that it can be traced back to "real" monetary transactions, reducing the potential assessment bias. However, a cash flow of a given magnitude does not imply the same degree of economic sustainability across the study areas. In one system, the imputed costs might be negligible due to the low capital demand of the system and the use of waged labor implying that the cash flow is nearly equal to the profit. In another, the imputed costs might even exceed the running expenses. For the study areas where these considerations play a role, these aspects will be addressed and discussed in the respective paragraphs. In addition, peculiarities of some running or imputed costs in specific study areas are described in the text. With respect to public handouts, the data depict the situation in EU countries before the 2003 CAP reform.

Income and cost tiers were calculated for MU. In some study areas such as in Tatra, Entlebuch, and Bavaria, the whole MU is composed of two farm units: the highland pastures and the lowland farm, with different income, cost, and subsidy tiers attached to the respective unit. In Entlebuch, for example, grazing fees are a source of income instead of cost as owners of the external livestock, added to the alpine unit, pay a grazing fee to the owner/manager of the alpine unit. In those cases, separated records were available for each farm unit and results can be combined to get a picture of the whole MU. For harmonization of reporting and comparison between study areas, results were recorded for LU of the respective type of animals. In the case of Northern Sapmi, official records were used to assess the economic performance in Norway, while Sweden and Finland data are mainly based on herder interviews as statistics are incomplete.

Subsidies are an important tier in most extensive European livestock systems. A befuddled complex series of subsidy schemes are operative across study areas and even within one study area. Subsidies are awarded by EU, national and regional governments, or shared by both, and are allocated as direct payments, rural development schemes (agri-environment schemes, less-favored areas, and so on), specific grazing practices, and specific grazing units (a pool of public handouts). Notwithstanding this confusion, total subsidies were recorded by manager/owner of the MU and expressed as percentage of total value of production (OECD, 2001).

Under the labor heading, number of WU was recorded per MU on each study area. Labor was differentiated as familiar or waged and as full- or part-time employment. Labor productivity was rated as value of production farming per WU or number of LU/WU. The working hour (wh) annual standard was 1800 Awh. Working intensity was classified as High (H), Medium (M), and Low (L), regarding care intensity and migration/stationary models of herding.

Legal and institutional frameworks were important especially in those study areas where grazing rights are shared or regulated by some regulatory institution. Entitlement of property rights or renting contracts were also important for grazing regulation or subsidies' allocation in some areas such as the Tatra Mountain. Government regulations of grazing rights' and subsidies' allocation were especially important in study areas dominated by common lands (Northern Sapmi) or landless pastoralists (Castile-La Mancha). Farmers' opinions were recorded on the sustainability of the legal and institutional framework regulating the grazing operation, recent management trends, as well as the main destabilizing or limiting factors of the grazing systems.

3.2. Management units

The reindeer husbandry matrix was based on the average economic data from the LACOPE target areas in Northern Sapmi. For Finland, only one district or MU was included in LACOPE. Economic data for this district were available. For Sweden, however, only mean regional data of national target areas were available. These regions included several districts: Northern Norrbotten Mountain Sámi (nine districts). In Norway, most data were available on district level, here used for western Finnmark (26 pasture districts). LACOPE districts are within these regions with one exception in Sweden. The numbers provided in the data matrix are average for these regions, as individual districts (*siida* in Norway/Sámi village in Sweden) data were not available. In these latter two countries, the MU was the husbandry unit within reindeer districts, where economic data were gathered and most subsidies allocated. National models (three matrices) are based on regions corresponding to each country (Norway, Sweden, and Finland). The national differences were larger in the income tiers than in the cost tiers as a consequence of differences in herder production strategies (Riseth, 2000, 2003), differential prices of reindeer meat, as well as national subsidy systems. In this study area, data were available for the three national models of reindeer herding (Norway, not a member of the EU; Sweden and Finland members of the EU).

Two farming units constitute the grazing system in the Tatra Mountains. The whole MU is thus composed of the lowland farm and the clearing alps. In order to gain a more profound insight in the system, a specific questionnaire was designed for each farming unit that took into account their

respective peculiarities. As a result of the breeding scheme (one lambing per year), the milking period corresponds to the summer season where traditional cheese making (*bundz* and *oscypek* cheeses) takes place. During the lowland farm period, marketed lambs and subsidies are the main sources of income.

In Entlebuch, the whole MU is composed of two farming units, one in the valley as a private farm and one in the alpine pastures (67% as a private unit, 26% as tenant, and 7% in some private or public cooperative agreements).

In Bavaria, the MU also encompassed two farming units. The lowland private farm, where animals stayed over the year. The land is in the ownership of the farmers or rented and is individually exploited. The second type of unit is the cooperative upland *Allmende*, where farmers sent their heifers for the summer grazing season. These units can be in the ownership of different bodies (private person, local authority, cooperative, and so on) and are jointly used and managed from the lowland private farmers. Although specific incentives are awarded for the use of upland pastures, only some 28% of lowland farmers send the totally of their heifers to the *Allmende* where they are raised under extensive grazing (Niemeyer and Rosenthal, 2003).

The study area of Baixo Alentejo is the only one where the MU coincides with individual farm holdings.

Individual holdings in Castile-La Mancha, mainly devoted to cereal cultivation, are grouped in large grazing allotments (*polígonos de pastos*) that encompass patches of diversity of resources such as cereal, annual legumes and sunflower stubble, shrubby-steppe vegetation (*eriales*), natural pastures, and fallow lands. The agricultural land of each municipality is divided, according to its size, into several *polígonos* and each small landowner, having a parcel within the *polígonos*, receive a per hectare grazing-fee paid by landless pastoralists who rented. More than 90% of sheep farmers rely on the *polígonos de pastos* and some of them add small parcels of owned or rented land outside the official system. As arable farming is the primary land use objective and crops are interspersed, the *polígonos* are unfenced, and sheep flocks should be permanently conducted with high working intensity. Individual *polígonos* corresponds to MU in this study area (Caballero, 2001).

3.3. Sampling process

The matrix of data in Northern Sapmi was based on different public and private sources, and encompassed data from national reindeer models in Norway, Sweden, and Finland. The Norwegian reindeer husbandry administration publishes an annual economic report based on numbers and accounts from the reindeer herders and their supervising organizations (Økonomisk Utvalg, 2004). In Sweden and Finland, there are no annual

economic publications. The Swedish data are based on a joint publication issued by the Swedish bureau of statistic and Swedish reindeer-herding organization (SSR, 1999). The Finnish data were received from nonpublished sources given by the Association of reindeer herding cooperatives for the year 2003.

Of a total population of 2751 farmers in the Tatra area, 40 lowland sheep farms were sampled. The results for the summer season corresponded to 17 flocks under the care of a main shepherd (*baca*-unit) and additional labor support by younger shepherds. Data gathered correspond to the year 2003.

A main heading-based questionnaire was sent to the 230 owners and/or managers of the alpine units in the Entlebuch Reserve and 107 completed questionnaires were gathered. Effective rate of response to the different tiers of the questionnaire varied from 75% to 100% of the filled questionnaires. Other sources of reported information were used and recorded in the corresponding heading. Most managers and owners of the alpine unit (some 90%) have a farm unit in the valley. Information on these farm units was mostly recorded from BfS (2004) and AfS (2004). Data for both farm units corresponded to the year 2003.

In the prealpine and alpine agrarian regions of Bavaria still exist around 1200 *alps*, in 155 thereof more than one farmer is involved in their exploitation (*Allmende*). For the purpose of this study, 56 farms participating in CLS and 34 *Allmende* were surveyed. Of the 56 farms, 38, 13, and 5 are located in the agricultural regions of the Alps, prealps, and prealpine moraine belt, respectively. Of those farms, 43 had entitlements to use the *Allmend*e: 33 of those are located in the Alps and 10 in the prealps. The left 13 farms did not posses any entitlement but board their animals on the CLS. Average farm size increased from 29 LU in the Alps to 62 in the prealps and 82 in the prealpine moraine belt.

In the same way, a number of 34 upland units were investigated. Most of them are located in the alpine region (25), 5 are situated in the prealpine area, 2 in the prealpine moraine belt, and 2 in the southern Bavarian foothills. Mean size of the upland *Allmende* unit is some 470 ha and ranges from 10 to 7400 ha. The average unit is more or less divided between forest and grazing land. Data for both units corresponded to the year 2003.

In the study area of Baixo Alentejo, 15 mixed-operating farm holdings were sampled. Data corresponded to the agricultural year 2003–2004.

Official records of sheep farmers in Castile-La Mancha, entitled of EU subsidies, amounted to some 8000. In the study area, 231 sheep farmers of the whole region were sampled with the criteria that the 5 provinces were to be represented by at least 5 farmers on each one of the 21 counties in the region. The survey tool was a questionnaire drafted according to main headings and totally 72 variables of quantitative and qualitative character. Surveyed sheep farmers were previously contacted for the local veterinary staff of the Animal Health Associations or *Agrupaciones de Defensa Sanitaria*

(*ADS*) in its Spanish acronym. The staff concerted working meetings with their corresponding affiliates to explain the objectives of the survey and content of the questionnaire. In this way, the rate of response was almost 100%. Data gathered in this study area corresponded to the year 2002.

4. Results

Typology of grazing systems with policy relevance can be addressed as a combination of analysis-related categories and systemic assessment of common features or trends. Even if a great deal of variation can be found for land use or grazing management indicators, both within or between systems, some common features may arise such as poor economic performance, scarce labor supply, abandonment, consolidation, legal or institutional drawbacks, and poorly devised subsidy schemes. From these main identified issues, policy actions can be derived although proper devising and implementation should be consistent with particularities of the individual systems. The interesting point in comparative typology of our six study areas is to untangle, if existing, these common features in the wide range of variation of most indicators. This report deals mainly with analysis of descriptive categories. In Section 5, however, we will try to uncover common features and trends to the six study areas. Between-system variability will be recorded in tables by indicating study areas' averages of main indicators, and within-system variability of some significant indicators will be recorded in the text. For those study areas with two farming units per MU (Tatra, Entlebuch, and Bavaria), indicators will be differentiated or weighed either in tables or in the text.

4.1. Land uses

Land uses were related by their potential contribution to the forage supply. In Northern Sapmi and the alpine study areas, nonarable land makes the most significant contribution to pastoral resources, mostly as natural grassland. In the two Iberian study areas, however, pastoral resources derived from arable land made a significant contribution to the feed supply (Table 2).

In the study area of Northern Sapmi, boreal forest/open tundra and natural alpine grassland dominate while cultivated agricultural lands are limited to valley and fjord areas, in North Norway about 1% of the total land area (Statistics Norway, 2004). Most of grasslands and large proportion of forest/tundra can be used as summer and winter grounds, respectively, for reindeer herding. Imagining a scale from continuous outfields via plots of outfields and managed pastures to plots of infields and indoor feeding, the Northern Sapmi system is still to a very high extent based on feeding from continuous unmanaged pastures.

Table 2 Land uses and pastoral significance in the six study areas (% TAL)

Indicator[a]	Northern Sapmi	Tatra	Entlebuch	Bavaria	Baixo Alentejo	Castile-La Mancha
Arable land	1	3	0.5	1	40	65
Non-arable Land	99	97	99.5	99	60	35
Pastureland	80	93	99.5	80	75.3	85

[a] Data corresponds to the lowland farm units in Tatra, Entlebuch, and Bavaria.

In the Tatra Mountains, land uses recorded in Table 2 corresponded to the lowland farm unit. In the alpine unit (sheep in *bacas*' care for the summer grazing season), arable land was underrepresented but pastureland (clearings in the forest) accounted for some 30% of TAL. The rest were alpine forest. In the study area, clearings and forest were in the proportion of 1:1 in hectare.

In Entlebuch, the data recorded corresponded to land in the lowland farm. In the alpine unit, unproductive land and forest take up some 40% of the land, the rest being pastureland of natural grasslands (51%), nature protected areas (5%), and grazing forest (4%).

Similarly, land uses for Bavaria corresponded to the lowland farm unit. In this case, 60% of the farm hectare was composed of intensively managed land (intensive pastures plus arable land) and 20% corresponded to the extensive managed land (litter meadows and alpine pastures). Some 20% of the land managed in the lowland farms were composed of forest.

Referring to the 1999 agricultural census the study area of Baixo Alentejo counted with more than 220,000 ha of TAL of which, 40% corresponded to arable land (temporary crops and fallow), 40% to area under permanent pastures and oak forests, and 20% of shrubland. Broadly, we can consider two different systems. The first, corresponded to cereal growing areas where residues (cereal stubble) are used by cattle and/or sheep and, the second, to the open-forest dominant areas (*Montado*) where cultivation was only occasional and where a mix of suckle cows, sheep, and *Alentejano* pigs were operating. Nongrazing land areas included shrubby invaders where only hunting may operate and some nongrazing cropland of vineyards, olives, and parcels under irrigation.

In the southern Castilian plain, arable land was dominant, especially in the central part of the region (La Mancha) where arable land takes up some 80% of TAL. Nonarable land was more significant in the foothill and mountain areas surrounding the plain. In this study area, pastureland included cereal, legumes, and sunflower stubble in the arable land, and natural pastures, *eriales* (shrub-steppe vegetation), and grazing Mediterranean forest in nonarable land. Nongrazing land uses included mainly

vineyards, olives, and irrigated parcels in the arable land part and dense Mediterranean forest in the nonarable part, encroached by shrubby invaders because of lack of grazing use.

In most study areas, the coefficient of variation (CV) of many land use variables exceeded 0.8 or even 1, indicating very skewed distributions. For instance, in the sample of lowland farms of the Tatra Mountains, nonarable land per farm was 15 ± 17 ha and area of natural grassland per farm was 13 ± 16 ha. In the sample of Baixo Alentejo, the mean total pastured area was 379 ± 322 ha, corresponding to 89% of the total area, while the proportion of arable land/TAL was 67 ± 72%. In the sample of Castile-La Mancha, proportion of arable land over TAL was 65 ± 28% (Table 2), and the proportion of natural pastures plus *eriales* over TAL was 17 ± 17%. These two and all other land use variables showed asymmetrical distribution (absence of normality) as rated by the *W*-test of normality (Shapiro and Wilk, 1965).

4.2. Size of farm-holding, land prices, and grazing fees

In Northern Sapmi, the farm-holding size was of less relevance as reindeer grazing is organized by pasture districts and husbandry units. In the western Finnmark area (Norway), with 24,290 km^2 and 241 husbandry units, the mean size was some 10,000 ha per husbandry unit (Table 3)

In the Tatra Mountains, the average renting price of pastureland (9 €/ha) and the grazing fee (4 €/ha) corresponded to the lowland farm unit (Table 3). In the alpine unit (sheep in *bacas*' care), mean grazing fees were 4.8 €/ha in public lands (Tatra National Park) and 36 €/ha in private lands. The mean size of the alpine unit was 46 ha/*baca* flock. The price of land is currently under adaptation to the free market rules but the number of land transactions in the study area of Tatry and Podhale are very limited. Attachment to the land is part of the cultural character and, most frequently, land is transferred within the family. Even land lease is not based on written contracts and even long periods of occupancy do not mean any right for the leaseholder. Land transfer prices are much lower when "within the family" (some 2300 €/ha) than for "outsiders" (some 4000 €/ha). In other Carpathian regions, such as Beskid Niski, prices are much cheaper (some 1000 €/ha), transactions are more frequent, and do not carry so deep emotions.

In Entlebuch, the mean size of the sampled lowland farm was 14 ha (Table 3) and the mean size of the alpine unit was 57 ha. Managers/owners of the lowland farms do not own enough animals to stock one unit of alpine pastures. They should rely on external animals to stock properly the alpine units. Owners of these external animals pay a grazing fee to alpine owners/managers (Wirz Handbuch, 2004). This side income represented the main income tier (59%), together with subsidies (41%), for the alpine unit operation. For this reason, luring external farmers to bring their animals

Table 3 Farm-holding structure, prices, and grazing fees in the study areas

Indicator	Northern Sapmi[a]	Tatra	Entlebuch	Bavaria	Baixo Alentejo[a]	Castile-La Mancha
Size of the farm holding (ha)	10,000	15	14	37	425	500
Size of herd/flock (LU)	48	12.7	15.6	40.7	141	82
Price of the lowland farm (€/ha)	NA	4000	32,000	25,000	3250	4900
Rent of the lowland farm (€/ha)	NA	9	500	143	50	50
Grazing fees (€/ha)	NA	4	286	22.5	17	3.2
MU using LSGS (%)[b]	100	90	20	28	NA	90

[a] In Northern Sapmi, mean size of the husbandry unit in western Finnmark (Norway). NA (not applicable). In Baixo Alentejo mean size based on the agriculture census was 65 ha. However, average LSGS involved larger farmers as it is represented in our sample (mean size 425 ha).

[b] Management units (MUs) using cooperative pastures or extensive grazing units (i.e., alpine units in Tatra, Entlebuch or Bavaria, rented pastures in Baixo Alentejo or *polígonos de pastos* in Castile-La Mancha). Approximately, the land price on the alpine unit of Entlebuch = 10,000 €/ha.

to the Alps for summer grazing was of paramount importance for the sustainability of the alpine system. In this case, the grazing fee stated in Table 3 was a mean estimation of external grazing fees and represented a source of income. Estimation[1] was based on grazing fee paid by the most represented lot (1- to 2-year-old heifers).

In Bavaria, the total hectare of the farms ranged from 3 to 124 ha with a mean size of 37 ha (Table 3). The cooperative upland *Allmende* ranged from 10 to 7400 ha with an average of 468 ha. The grazing fees in the *Allmende* were much lower as in the other alpine regions. Mean seasonal stocking (some 120 grazing days) on these units reached 0.9 LU/ha and mean grazing fee was 25 €/LU. Mean grazing fee in the alpine unit (*Allmende*) was thus some 22.5 €/ha (Table 3). However, it should be stressed that in a lot of cases (around 50% of the *Allmende*), no grazing fees were claimed. The other indicators represented in Table 3, for this study area, are mean sizes and prices in the lowland farms.

In the Baixo Alentejo sample, the mean size of farm holdings was 425 ± 256 ha, but only 72 ± 178 ha corresponded to permanent natural pastures. According with expert knowledge information in all the reference area (Alentejo), it is frequent the acquisitions of grazing rights on a year basis (or part of the year) with the grazing fees ranging from 10 to 20 €/ha per year according with the quality of the land. In the few cases of our sample where the acquisition of grazing rights was reported, the grazing fees attained 17.5 €/ha. Renting land (some 9% of TAL) on a yearly basis or for larger period showed a wide variation, 7 €/ha as a minimum to 63 €/ha as maximum. In Baixo Alentejo study area the price of agriculture land ranged from 1500 to 5000 €/ha according with the quality of land. Considering the whole area of the Baixo Alentejo, this range would be enlarged if good clay soils of the Beja area (land price ranging from 4000 to 7500 €/ha), or if land located inside the perimeter from the new Alqueva-dam irrigation system (10,000 to 15,000 €/ha) were taken into consideration.

In Castile-La Mancha, mean size of farm holdings (500 ha) corresponded to the MU (*polígonos de pastos*) where individual sheep flocks are maintained. These MUs are aggregation of individual farm holdings with mean regional size of some 30 ha. In some counties and municipalities, the *polígono* may encompass the landholdings of up to 80 landowner cultivators. Grazing fee corresponded to the sheep allotments under public allocation of grazing rights (*polígonos parcelarios*). Rented pastureland by private landowners was two to three times higher, although private landowners, who do not own a flock, rarely rent their land for sheep grazing.

[1] External grazing fee in Entlebuch = 0.9 LU/ha × 2.5 heifers/LU × 1.27 €/heifer per day × 100 days = 286 €/ha.

Within study area variation for indicators of this heading was also large. In the Tatra Mountains, for example, mean size of farm holdings was 15 ± 17 ha, and average area of *bacas*' flock was 49 ± 13 ha in the clearings of the *alps*. In Entlebuch, the altitude of 95 huts of sampled alpine units varied from 900 to 1600 m. Some huts were located in the high alpine area (up to 2500 m), with corresponding variation in size and land uses, land prices, and grazing fees, derived from differences in accessibility. In Bavaria, lowland farm size ranged from 3 to 124 ha in the sample and land price of agricultural land may reach a maximum of 32,000 €/ha (mean of 25,000 €/ha). Although mean size of the *Allmende* unit is some 470 ha, considering the nongrazing land (forest and wasteland) it may reach more than 7000 ha. In Castile-La Mancha, mean size of the *polígonos* was 499 ± 513 ha or a CV of more than 100% and mean grazing fees 3.21 ± 3.51 €/ha. Mean price of land for selling or renting showed less variation with values of 4900 ± 1325 €/ha and 50 ± 17 €/ha, respectively.

4.3. Institutional economics

The investigated LSGS were closely linked to specific property rights, especially the ones organized in a collective form (in the following mentioned as CLS). The CLS studied manifest a number of institutional features. First, to some extent, CLS have accommodated a certain welfare institution within their own institutional limits by providing livelihood security to people with very limited alternative possibilities. Second, CLS provided access equity and conflicts resolution for its participants as a functional necessity. Third, there are complex relations between the institutional system and the mode of production including embedded cultural features making the production system viable. Fourth, CLS by mostly being based on some form of rotational and limited use of pastures contributed to resource preservation and ecological sustainability. Concluding on institutional properties, CLS had much in common with common-pool resources (CPR). The users have to make collective agreements and have to decide how the resource use can be arranged in such a fashion so that the benefit of each user is proportional to the effort of that user. Moreover, CLS had in cases served as a vehicle for the social distribution of goods among the deprived segments of the population and thus had a potential to contribute as a buffer to take care of the destitute parts of a population.

A comparative analysis of the organization and structural form of the grazing systems presented the role different groups of actors play in these systems and their interrelationships (Gueydon *et al.*, 2004). We could distinguish four main groups of roles: the landowners, resource owners, livestock owners, and pastoralists. The role of the landowner was to provide a part or all of the pastoral resource. The role of the resource owner was to hold the right to exploit a part or all of the resource. The role of the

livestock owner was characterized by the fact that he/she owns some or all the animals grazing on the resource. Finally, the role of the pastoralist was to conduct on his own or together with others the herds on the resource.

As shown in Table 4 the landowner can be a single entity for example the state such as in Northern Sapmi and Bavaria. It can be several individual persons acting independently like in the Tatra, in Baixo Alentejo, and also in some cases in Northern Sapmi and Bavaria. It can finally be a community of landowners like in Castile-La Mancha and sometimes in Bavaria or a formal legal entity like in Entlebuch and sometimes in Bavaria.

In Northern Sapmi, Castile-La Mancha, and Entlebuch, and in the more frequent setting of Bavaria, community of people (landowners or livestock owners) jointly owned the resources. In Baixo Alentejo and in the Tatra Mountains the landowners were likewise the owners of the resource. They rent the land or sell the resource for grazing activities under market conditions. The land and resource's ownership was separated in Northern Sapmi, Castile-La Mancha, and in some cases in Bavaria. The land belongs to individual landowners or the state but these entities do not have any statement to issue concerning the utilization or the distribution of the pastoral resource. In most cases the landowners received only limited revenues, if at all, for contributing their land to the system.

In all cases, livestock was individually owned, implying that profits from the exploitation of the resource by selling marketable products, receiving subsidies related to the number and kind of livestock or related to the way the grazing is performed, were not shared.

In most cases, except in Bavaria and Northern Sapmi, the direct utilization of the resource was under a single appropriator. Generally in cases of a single appropriator, the pastoralist was one of the livestock owners who may board animals of other livestock owners on his own account (Tatra and Entlebuch) or was being paid a fixed wage by livestock owners (alpine areas of Bavaria and sometimes in Entlebuch). In Baixo Alentejo, it was also frequent that the herdsmen combine a fix wage with the right to freely graze their own animals. In the prealpine region of Bavaria the livestock owners were also pastoralists as the work requirements for taking care of the livestock do not demand the employment of a herdsman. In Northern Sapmi, the pastoral-related work like herding and preparation of the herd for slaughtering was done cooperatively by the Sámi. In the Tatra Mountains, the pastoralist can be landowner and therefore also one of the resource owners and he frequently owns a significant part of the herded livestock himself.

The clarification of the different groups of actors and their role gave indication on the action which are collectively undertaken and consequently help to systemize the notion of "cooperative systems" within the different regions. Two different types of activities were carried out together; these were the collective provision of the land and the collective utilization

Table 4 Actors involved in the cooperative livestock systems (CLS)

Actors	Northern Sapmi	Tatra Mountains	Entlebuch	Bavaria	Baixo Alentejo	Castilla-La Mancha
Landowner (resource provider)	Individual landowners	Individual landowners	Community of landowners (formal)	Community of landowners (informal or formal)	Individual landowners	(Community of) small landowners
	State			State		
	Collective private body[a]			Individual landowner		
Resource owner	Joint ownership of Sámi (*siida*)[b] or reindeer pasture "district"	Individual landowner	Joint ownership of landowners	Joint ownership of landowners	Landowner	Joint ownership of sheep holders and landowners
				Joint ownership of livestock owners		
				Community of right holders		
Livestock owner			Individual livestock owner			
Pastoralist (resource user)	Jointly the members of *siida*	Individual pastoralist	Individual pastoralist	Same as "resource owner" (or herdsmen)	Individual pastoralists	Individual pastoralist

[a] Finnmark State and preliminary property during process of land reform (Sandberg, 2006), Norway; crown/state in Sweden/Finland but Sámi land claims.
[b] Norwegian expression. In Sweden it is the Sami village and in Finland *Paliskunta* (cooperative). But in essence it is the same form of organization among the three countries.

of the resources. Table 5 gives an overview of the presence of these actions in the different grazing systems. One major reason to opt for collective action was to realize economies of scale or to reduce transaction costs (Gueydon *et al.*, 2004).

The degree of governmental involvement varied significantly between the different study areas. In Northern Sapmi, Castile-La Mancha, and Entlebuch, the systems were strongly regulated by external rules and specific public laws. In contrast, the authorities in the Tatra Mountains, Baixo Alentejo, and Bavaria were not involved in the management of the systems apart from general regulations dealing with ''good agricultural practices.'' These rules applied to all farmers or in the case of Baixo Alentejo to the farmers benefiting from the Zonal Plan of Castro Verde, which is an EU agri-environmental measure aimed at the preservation of steppe birds such as the Great Bustard (*Otis tarda*). Moreover, the investigated systems ranged from ones with a relatively rigid internal structure and rule system, like in Entlebuch and Bavaria, to others with a high degree of governmental involvement, like in Castile-La Mancha and in Northern Sapmi.

Table 5 Organization forms and collective actions in european grazing systems

Study area	Organization forms	Collective provision of the land	Collective utilization of the resource
N. Fennoscandia	Sámi pasture ''district'' (formal) *Siida* (cultural origin)	No	Yes
Tatra Mountains	Private property of the alpine meadows	No	Yes
Entlebuch	Private property under private or cooperative law	No	(Yes)
Bavaria	*Allmende*	(Yes)	Yes
Baixo Alentejo	Private property of agroforestry area and rarely transhumance to rented cereal areas	No	No
Castile-La Mancha	*Polígonos parcelarios*	Yes	No

Source: Gueydon *et al.* (2004).

4.4. Institutional and legal frameworks

Present status of extensive grassland management systems is derived from land-use rules and institutions. Past traditional forms had to be adapted to the pressure of social changes and improved economic environment in most developed countries of our study areas. This may require new forms of production, sensible institutional and legal frameworks, and proper schemes of support in pursuit of economic, environmental, and social values. Whether these changes can be devised and implemented without losing the traditional values of these systems is a main challenge that can be addressed under a regeneration approach. The matrix headings compiled some farmers' opinions on these issues already addressed by experts' knowledge in previous work packages of LACOPE (Riseth *et al.*, 2003).

In Northern Sapmi, land-use policies and constraints regulating reindeer herding have been described by Riseth *et al.* (2003). In this area, land development had an impact on reindeer traditional pasturing areas. The UN report GLOBIO (UNEP, 2001) has researched the human impact and found that about 26% of the grazing areas in northern Norway have been lost in recent times and that there are serious impacts on about 50% of all grazing areas in Norway. The future prospects seem clearly negative and the situation is much similar in the whole Northern Sapmi.

In the Tatra Mountains, farm protectionism has changed since the liberalization on July 1, 1989. Since 1992, an assistance program for agriculture and farms has been developed. The local government, called *gminny*, provides some farms assistance but barely for mountain sheep farming. LSGS in the Tatra Mountains was plagued with structural and legal problems between the main social actors: sheep owners (*gazdas*), shepherds (with a main shepherd = *baca*), and landowners. Improvement of the legal and institutional framework was probably the most limiting factor that should be addressed before introducing instruments of the new CAP policy (structural rural development and direct payments). Written documents of ownership are lacking and some land ownership "runs in a family" with most people respecting but without legal documents to prove it. There is a need to maintain traditional grazing practices as part of a cultural background but also to fulfill EU sanitary requirements for milk processing. Technical support and measures to stress cooperative behavior are also required.

In Entlebuch, private property and private grazing rights were dominants (67%) in alpine units. One MU was usually composed of one farming unit in the lowland and one alpine unit. The livestock farmer managed both units during the summer grazing season driving down to the lowland valley farm for hay harvesting. Leasing of alpine units from private owners was also common in Entlebuch (26% of alpine units) while some farm cooperation by public or private law were less common in Entlebuch (some 7% of alpine

units). In these cases only members of the whole local community or members of private law cooperation had a share of grazing rights.

In Bavaria, the *Allmende* (CLS) system, in the sample, encompassed several cooperative forms depending on land property, legal form, and grazing rights. Land property comprised three categories: private (7% of whole surveyed hectare), public (71%), and cooperative (22%). In the surveyed study area, a short minority of *Allmende* (41% of the total number of sampled units) was organized as a collective organization with the land under the property of the cooperative. Also, frequent were types of public-owned land rented to livestock farmers (23% of units) and fractional ownership and management (23% of units). The most frequent legal form of the *Allmende* was a registered cooperative (42%) or registered association (9%). An important part of units (30%) did not present any registered legal form.

Regarding the level of use of grazing rights, only 32% of upland units managed a full use of grazing rights. However, in 34% of the *Allmende* less than 60% of grazing rights were used. In those CLS an underuse was apparent. Grazing fees were paid in only some 50% of CLS. In these units, grazing fees per LU varied from 0 up to 90 €/LU with average of 25 €/LU and 75% quartile of 30 €/LU per annum. Many units charged no or low grazing fee due to the decline in the number of animals that are sent to the alpine pastures. The *Allmende* therefore created an incentive for the owners of boarding animals. Members have also additional ancillary rights for hunting, mowing, or wood collection although sampled farmers indicated insignificant use of such rights. Users can be classified as active or passive members, depending on whether they send their animals to the alpine pastures. Some users were not members and do not have entitlements. They are, however, allowed to bring their animals to the units and have to pay a compensatory fee. The average proportion of passive members in the surveyed *Allmende* amounted to 34.5%. Half of the *Allmende*, showed a proportion of 25% of passive members. Otherwise, the average active members by units decreased from 27 to 16.6 (38%) in the last 20 years, confirming a general trend to underuse of alpine pastures.

Work overload, less family labor, and difficulties to organize the alpine labor were the main causes of abandonment of, especially, the less productive areas (e.g., calcareous mines) and the steep slopes of the *Allmende*, with subsequent forest encroachment. At the same time, an intensification trend was observed in the lowland private farms. First calving of highly productive breeds, mainly *Brown Swiss* and *Simmentaler*, was advanced to an earlier date and feeding conditions of heifers improved with the aim of improving milk performance. Under this trend, the significance of the *Allmende* for the lowland dairy farmers became partly redundant.

In Baixo Alentejo, the institutional and legal framework did not have the same impact and importance as it happens in Castile-La Mancha. In fact, since the relations between landowners and livestock owners are regulated

by the market and by the ordinary laws regulating all economic activities, livestock production shared the usual institutional and legal requirements of the other economic activities. Acquisitions, rental procedures, and grazing rights were subjected to the ordinary law, but many contracts were only informal, following gentlemen agreements between the landowners and the farmers or landless livestock owners. Other legal frameworks with incidence on the area resulted from the regulations involved on protected areas, as well as the voluntary adhesion to the Zonal Plan of Castro Verde.

In Castile-La Mancha, 86% of surveyed farmers indicated that a regulatory institution for the management of the grazing *polígonos* and allocation of grazing rights was required. Of those in favor of a regulatory institution, 45% of the sheep farmers indicated that the Local Grazing Commissions (LGC) should be under the umbrella of the local council and 46% indicated that LGC should be independent (private associations of arable and sheep farmers). Regarding of grazing rights, 49% of the surveyed farmers favored direct allocation by LGC and 47% indicated allocation by inner consensus within pastoralists. Only 4% of sheep farmers favored allocation by free auction.

4.5. Forage deficit

Availability of pastoral resources was seasonal in all study areas. Snowcapped land throughout winters in alpine areas and dry and hot summers, with soil-moisture deficit, in Mediterranean areas determine an SNGS, over the year. An FD may appear if available forage conserves do not meet the structural nongrazing days. The forage coverage model was based on a mass balance by comparing forage conserves availability with animals' requirements. In extensive systems of grassland management it can be assumed that at least the basal diet of animals is met by on-farm forage supply and thus a strategy of forage conserves has to be implemented to meet the SNGS. If not, animals should be supplemented with marketed forage or concentrates during the SNGS. A large FD may thus indicate an LSGS disconnected from land-based resources and progressively relying on external feed sources (Caballero, 1993). A summary of the forage coverage model in the different study areas is recorded in Table 6.

In Northern Sapmi, traditional migration patterns in the Sami area were hampered by between-countries border barrier and thus, FD was a serious concern for many of husbandry units practicing short migration or stationary patterns of reindeer herding. In Finland, CFR have become increasingly important from the 1980s onward (Kumpala, 2001). Coastal adaptation reindeer management in Norway also used some CFR under difficult winter conditions. The FD was of less relevance for reindeers herding under traditional full migration patterns. In this case, summer pasture grounds more nearer the coast and winter forest grounds in the interior

Table 6 Estimation of the forage coverage in the study areas

Indicator	Northern Sapmi[a]	Tatra	Entlebuch	Bavaria	Baixo Alentejo	Castile-La Mancha
SNGS (days)[b]	0–60	205	290	290	125	125
Productivity of CFR (kg hay/ha CFR)[c]	NA	5000	7500	7000	1440	4000
CFR/TAL (ratio)[d]	NA	0.5	0.65	0.65	0.15	0.0191
Stocking (LU/ha)[e]	<0.005	0.85	1.42	1.1	0.2	0.2
Days on CFR[f]	NA	245	286	345	90	32
Forage coverage (%)[g]	NA	111	99	115	90	74

[a] Maximum in Finland. NA, not applicable.
[b] SNGS, structural nongrazing season.
[c] CFR, complementary forage resources.
[d] TAL, total agricultural land.
[e] LU, livestock units.
[f] Days met by CFR.
[g] Forage coverage = [1 + (CFR-SNGS)/365] × 100 (100% would mean a balanced situation and thus absence of FD). Animals' requirements for maintenance stated as 12-kg hay/LU per day.

can as a rule meet the forage supply over the year. However, in Sweden, CFR to some extent are used on migration and during the calving period (Åhman, 2002; Åhman and Danell, 2001). Migratory reindeer herding in Finnmark Norway to some extent also used supplementary feeding in winter due to difficult grazing conditions with ice creation.

In the mountainous study areas such as Tatra, Entlebuch, and Bavaria, the whole animal lot (sheep) in Tatra or a proportion of specific lots (mainly heifers) in Entlebuch and Bavaria are moved to the alpine units during the summer season. In these cases, the FD may apply only to the lowland farm over the year. In Entlebuch, only 20% of the lowland farmers sent their animals to the alpine units representing 8% of total LU in the study area. In Bavaria, most forage supply was provided by green forage or forage conserves, while pasturing representing a small fraction, even during the grasslands' growing season. Under these conditions, a forage model has been developed by the Bavarian' team which assess the forage supply-animal consumption balance of energy over the year (Roeder and Gueydon, 2005). This tool may provide an estimation of the potential versus real

stocking of Bavaria lowland farms and an indication of level of stocking (under-, over-, or balanced supply of forage resources). In our estimation of the FD, grazing days was weighed by the proportion of LU (mainly heifers) that graze.

In the Tatra Mountains, the summer grazing season represented 160 grazing days. It was assumed that the lowland farm does not provide grazing days, the SNGS amounted to 205 days. While sheep are on the *alps* for the summer season, 50% of TAL (CFR/TAL = 0.5) can be mowed (one or two cuts) with mean productivity of 5000 kg of hay/ha CFR of available hay. Mean stocking in the lowland farm was some 5 ewes/ha or 0.85 LU/ha. Under this average scenario, days met by CFR would represent 245 days. As SNGS represented 205 days, an oversupply (111%) was apparent under average conditions and animals' basal requirements of 12-kg hay/LU per day. Under these conditions, the FD model indicated that a minimum of 0.42 CFR/TAL (42% of TAL) devoted to forage conserves was required to meet a SNGS of 205 days.[2] Similarly, if days provided by CFR equal the SNGS (null forage deficit), stocking could be increased to 1.01 LU/ha TAL without incurring in FD.[3]

Application of the FD model to Entlebuch and Bavaria lowland farms required some assumptions. In these cases, only a small part of the lowland farmers bring their animals to the alpine units. In these cases, we will consider a ''mode'' dairy farm situation on which farmers keep their animals in the lowland farm over the year, heifers being the only lot in the lowland pastures. In this case, grazing days should be weighed for the proportion of heifers-LU on the total lots. We assumed that heifers graze for 180 days and dairy cows are kept indoor. If heifers represented some 30% of total LU, the real number of grazing days was 60 or some 300 nongrazing days. An estimated ratio of CFR/TAL = 0.65 was considered for both study areas. Stocking in Entlebuch was rated at 1.42 LU/ha TAL on farms at mean altitude of 800 m (BfS, 2004). For Bavaria, the stocking level was set to 1.1 LU/ha of TAL, as the average farm keeps 41 LU and has 29 ha of TAL under private ownership and an additionally attributed share of 9 ha under cooperative management.

Mean yield of available CFR under medium-intensity farms was rated as 7500 kg/ha of hay-equivalent and 7000 kg/ha in Entlebuch and Bavaria, respectively. Some other estimations of hay yields for typical alpine regions are available (Gruber *et al.*, 1999). Under these assumptions, days met by CFR amounted to 286 and 345 days, respectively.[4] Maintenance requirements were

[2] CFR required to meeting the SNGS in Tatra as a ratio to TAL. CFR/TAL ratio = (205 × 0.85 × 12)/5000 = 0.42 or 42% of TAL. As actual CFR/TAL is 50%, a small oversupply was apparent.

[3] Increasing potential stocking in Tatra for a balanced situation. Stocking = (5000 × 0.5)/(205 × 12) = 1.01 LU/ha TAL, up from 0.85 LU/ha of current average stocking.

[4] The forage deficit model in Entlebuch and Upper Bavaria (days met by CFR): Entlebuch, (7500 × 0.65)/(1.42 × 12) = 286 days; Upper Bavaria, (7000 × 0.65)/(1.1 × 12) = 345 days.

estimated as 12-kg hay/LU per day. Given within-farms variability, it should be stressed that applicability makes sense for individual farms. In Bavaria, for example, the forage supply-energy demand forage model stated a trend of FD on larger farms (more than 2000 GJ of NE of forage demand) and a forage oversupply on small farms. Nevertheless, this exercise illustrated that the average lowland farm was almost balanced in Entlebuch (99%) with a light oversupply (115%) in Bavaria.

To estimate FD in Baixo Alentejo study area it was necessary to take into account the following assumptions. Even if the animals stay outside in the grazing plots all over the year relevant grazing days is far less than 365. Due to climatic conditions, we assumed that during two and half months in the winter period and from beginning of September to mid-October it was not possible to count on pasture to feed the animals. Therefore SNGS corresponded to 125 days. It was also assumed that, in average, we can count on 40% of the land as permanent grassland and the others 60% are involved in a 4-year rotation, meaning that CFR/TAL ratio is 0.15. Considering that the average of straw production is 2000 kg/ha, which is equivalent to 1440 kg/ha hay, and considering a stocking density of 0.2 LU/ha (Delgado, 2004), CFR corresponded to 90 days.[5] The forage coverage (deficit) would be 90% or an additional 5.8% of TAL devoted to forage conserves to reach 100%.

In Castile-La Mancha, the proportion of TAL devoted to forage conserves was much lower than in the alpine study areas, but also stocking on the MU (*polígonos*) was much lower. CFR takes up land devoted to annual forage legumes (mainly vetches) and green cereals, both harvested as hay. But as landowner cultivators are not owners of the sheep flocks, they have little incentive in forage conserves, as these crops were not subsidized. Otherwise, landless pastoralists, who may have an incentive to increase the feed supply, were, for the most part, not owners of the land. However, a minority of them may own or rent some parcels for forage conserves cultivation.

In the sample of 231 sheep farmers, CFR represented 1.91% of TAL (CFR/TAL ratio was 0.0191) and mean stocking was 1.17 ewes/ha TAL or 0.2 LU/ha TAL (1 ewe = 0.17 LU). Mean number of grazing days stated by sheep farmers was 240 days or SNGS = 125. With these data and mean productivity of available CFR of 4000-kg hay/ha, the estimated number of days provided by CFR amounted to 32 days[5] and the CFR would only cover 26% of SNGS. Under these average conditions the CFR/TAL to cover the actual FD (93 days) would require an additional 5.6% of TAL devoted to forage conserves. This can be done by a trade-off to forage

[5] The FD model in Baixo Alentejo and Castile-La Mancha (days met by CFR): Baixo Alentejo, $(1440 \times 0.15)/(0.2 \times 12) = 90$ days; Castile-La Mancha, $(4000 \times 0.0191)/(0.2 \times 12) = 32$ days.

legumes and green cereals from plenty of available fallow land (some 20% of TAL). This average exercise conceals a great variation within farmers. For example, statistical measures of distribution for CFR/TAL and stocking showed values of 1.9 ± 5.1% of TAL and 1.2 ± 0.9 breeding ewes/ha of TAL, respectively. With these variations, it was clear that the model should be applied to individual farms. Nevertheless, the average model exercise illustrated that, in this study area, the forage coverage was only 74% and the FD situation was more common than in others.

Tatra and Bavaria managed an oversupply of forage resources. One study area (Entlebuch) presented an almost balanced situation and in the two Iberian study areas (Baixo Alentejo and Castile-La Mancha) an FD was apparent, to a largest extent in Castile-La Mancha (Table 6).

4.6. Grazing infrastructure

Extensive grazing management is usually a hardworking labor-intensive operation. In developed countries, where most of our study areas are located, availability of labor for these operations is in short supply and it is expensive. One of the main causes for the unsustainable state of the extensive grazing operations is that young European farmers are barely enthused toward the LSGS operation as they may find alternative labor opportunities in other sectors. This problem can be aggravated if grazing units lack minimum grazing infrastructures or, as it is some times the case, the land ownership structure or legal and institutional framework do not favor proper implementation of grazing facilities. In our six study areas, a wide range of situations were found. First of all, the systems can be differentiated between those requiring permanent or semipermanent herding, such as in Northern Sapmi (Norway), Tatra, and Castile-La Mancha, and those requiring only occasional care, such as in Baixo Alentejo and alpine units of Entlebuch and Bavaria. In the lowland units of the two latter study areas, even no herding of animals at all was needed as most lots were under indoor-feeding conditions. A scaled account of availability of main grazing infrastructures in the six study areas is shown in Table 7.

In Northern Sapmi, permanent reindeer herding was dominant in Norway with high working intensity and less time for husbandry units' leaders to be engaged in alternative sources of income (waged labor). Up to the late 1950s the migrating reindeer herders used to be full pastoralists moving the whole family with the herd year around. The sedentary process was promoted by obligatory schooling, making the families to settle in standard housing, often in fall areas, or on the border between fall and winter areas. The adult men follow the herd and live in huts and travel back to the family, by snowmobile in winter and by car in summer, as the collectivity of herding work often open for taking turns. In summer areas families often have second homes. In Northern Sapmi, fences are used for

Table 7 Available grazing infrastructure in the six study areas

Indicator[a]	Northern Sapmi	Tatra	Entlebuch	Bavaria	Baixo Alentejo	Castile-La Mancha
Working intensity	L/M/H	H	L/M	L/M	L/M	H
Fencing	A	NA	A	A	A	NA
Water points	A	NA	A	A	A	NA
Barns and shelters	A	A	A	A	A	A
Milking facilities	NR	NA	A	A	NR	NA/A
Accessibility	L	L/M	M/H	M	M/H	L
Pattern of herding	P	P	O	O	O	P

[a] L/M/H, Low, Medium, High; A, available; NA, not available; NA/A, not available dominant; NR, not relevant; P, permanent; O, occasional.

longitudinal divisions between districts and to some extent also between different season pastures and also as leading fences to corrals for herd round-ups (for calf marking, herd divisions, slaughter, and so on). Low and medium working intensity were most common in Finland and Sweden, respectively, and related to stationary and short-distance migration patterns of reindeer herding.

In the alpine units of the Tatra Mountains, fencing was not required as clearings have forest borders. However, almost permanent care of sheep was required, as shepherds have to move animals daily for milking, occasionally between rented clearings, and permanently because of predator problems mainly with bears and wolves. Although sheepfolds were available, most shepherds' hut lacked electricity supply and milking facilities. There was a need of keeping traditional ways of milk processing, but fulfilling with EU sanitary requirements, which means some new equipment. Idle far-reaching clearings have problems of mobility. With increasing interest in summer grazing, these alpine pastures may be used only if transportation problems are solved. Most of lowland farm units were provided with electricity supply, but most dwellings, shelters, and barns were in most need of overhauling and repair.

In the alpine units of Entlebuch, the lowland farmers, managing an alpine unit, go up with their animals (mostly heifers) for summer grazing and live in huts located in the alpine units. Temporarily, they may come down to the farm for hay supply. Most huts were located at a good accessible place. Some farmers (28%) owned more than one hut if they are managing alpine pastures located at different altitudes or they are managing heifers and dairy cattle. Most of alpine units (90%) had energy supply facilities, public

electricity (60%) being the most common source of energy. Generators and solar panels were other sources. Many alpine units with public electricity also had solar panels for lighting and use wood and gas for cooking. According to Swiss standards, 45% of huts were in very good or good condition and 35% were in need of improvement in the medium term. Regarding the equipment of the stables, the situation was more or less the same, with more than 30% of the stables in need of renovation in the medium term. Although a minority of alpine managers operated with dairy cattle (some 22% of total LU in alpine pastures), a big majority of them had milking facilities. Of those alpine units included in the Entlebuch sample, some 88% had direct move by road and only 6% had move by paths. Incidentally, one alpine unit had access by a small cable car, but only for materials. In the lowland farms of Entlebuch, most dwellings and stables were in good condition as farmers may combine husbandry and tourism activities, and they received subsidies and free of interest loans for repairing and overhauling.

In the alpine units of Bavaria, mobility to some areas of the *Allmende* was difficult and demands special equipment such as four-wheel drive vehicles. Other areas of difficult access such as steep slopes or less favored land areas such as calcareous mires tend to be less and less used. As a whole, mean time by car from the lowland farm to the *Allmende* units was some 15 min by road. alpine units were fenced and most dwellings were in good state of repair.

In Baixo Alentejo, most private farms were fenced along large plots (mean size of 21 ha) with at least some infrastructure aimed to provide feed and water to the animals. The most modernized have automatic devices while the other only can count on more rustic facilities. Mobility does not pose any particular problem, unless when grazing parcels are far from the stables and other grazing areas. Daily movements varied according to the species: while suckle cows frequently do not return to the stables on a daily basis, sheep usually come to the stable or at least to a sheepfold near to the headquarters, the same pattern to the pigs. Manure was not a problem in these operations due to the low concentration of animals that only during the night achieve levels that could cause concern. Furthermore the traditional practice of rotating the location of the enclosures, determining also the rotation of the family orchards that took advantage of the fertilization provided by the animals, contributed to avoid excess manure. What caused concerns was what happens to the soil of the enclosures where the pigs are kept where not only almost all vegetations disappear but also where the soil structure is negatively affected due to the normal animal behavior when in circumscribed areas.

In Castile-La Mancha, the grazing infrastructures and the location of the allocated *polígono* had an incidence on grazing use and spatial distribution of grazing. Usually, grazing use decreased as the distance between the center of the *polígono* and the village nucleus increased. On an average size municipality (some 8000 ha and 16 *polígonos*), the mean distance can be 4 km.

Theoretically, access to the *polígonos* by shepherds conducting their flocks is mandatory and regulated in the Local Grazing Management Plans (*Ordenanzas Locales de Pastos* in Spanish). In practice, in many municipalities the *Ordenanzas* are not up-to-date and many drove paths have fallen to the plough by increasing intensity of cultivation. Most arable farmers abide by the law allowing access of flock to grazing parcels. However, they do not show cooperative behavior claiming that sheep flocks interrupt land practices or harm land infrastructure or crops. Additionally, grazing (cereal, legumes and sunflower's stubble, fallow lands, *eriales*, and natural pastures) and nongrazing parcels (irrigation, vineyards, and olive orchards) are interspersed within the *polígonos*, hampering movement to specific parcels. Some 56% of sheep farmers had their sheepfold located in the *polígonos* and the rest (44%) in the villages or their surroundings. This last group of sheep farmers, when operating a milking flock, has to move the flock on grazing days from the sheepfold to the *polígonos* and back for sheltering, milking, and water supply. Under these grazing practices, sheep flocks should be permanently conducted and a trend toward less grazing days and heterogeneous distribution of grazing use (far-reaching parcels less used than those near the village) was apparent. Most sheepfolds either in the village or in the *polígonos* had water supply (85%) and feed storing facilities (89%), but only 10% of them had proper manure disposal facilities, and 45% of sheep farmers arranged machinery for handling manure. Milk- and meat-oriented sheep flock were more or less evenly distributed in the region and in the sample. Of those milk-oriented in the sample, 55% had milking facilities and 45% milked by hand. The question of manure disposal was of great environmental significance. Those sheep farmers with the sheepfold near the village may accumulate heaps of manure near the villages until disposal by interested cropping farmers, with sanitary risks and hazards of leaching to aquifers or runoff to surface waters.

4.7. Labor

The extensive systems of grassland management in Europe can still be considered a family-business operation. Most of these systems represent a hardworking operation carried out in remote and LFAs within a much more favorable general economic environment. The labor constraint is thus, at present, one important limitation for the sustainability of extensive systems of grassland management in Europe.

In some study areas, such as Northern Sapmi, reindeer herding was a source of social cohesion for the Sámi families and households and the general social rating of the reindeer farmers is high. In this area, most laboring was family job, although some farmers may have an extra source of income with occasional wage labor. Sámi lifestyle was centered on reindeer herding and their annual cycle of work tasks were organized in

accordance to the pasture cycle. Within the Sámi society, being a herdsman (*badjeolmmus*) has a high societal status reinforced by the revival of Sámi language and culture (Riseth, 2006).

In the Tatra Mountains, family labor was dominant in the lowland farm, but 7 out of the 40 sampled farms had waged labor. For the summer grazing season, sheep of several lowland owners are gathered in large flocks and conducted by the *baca* shepherd. The supporting labor of the *baca* shepherd is paid in cash. The *baca* shepherd net income was the difference between income from cheese production and costs from grazing maintenance and additional supporting labor. Usually, it is counted as 100 sheep per shepherd and they owned some 1250 € per grazing season (some 4 months in the mountains) plus food and accommodation. Grazing management was harsh work by lack of grazing infrastructures and technical improvements, but in this less-developed study area, young farmers have few options to alternative jobs.

In Entlebuch, family was also the main source of labor in the lowland farm, but waged labor support was required for managing alpine grazing units. In this case, external animals in the alpine unit required permanent (dairy cows) or occasional caring and waged labor was required. Farming job was standardized by WU (*Arbeistkrafteinheit*, AK) depending on animal species and on sloping land. Most alpine units (63%) had between one and three WU and 23% less than one. Caring of dairy cows (less dominant in alpine pastures) was permanent while caring of heifers (dominant livestock) was occasional, lowland farmers managing an alpine unit need help during summer from family labor or employees and labor was usually the main tier of costs. The decreasing interest of young people to work as farmers was mostly caused by high labor inputs, isolation on the Alps, hard work, and poor economic perspectives. However, stabilizing factors in this area such as off-farming income from tourism, intact family life, regard by the regional community, and good social integration were incentives for social sustainability.

In Bavaria also, most farming job in the lowland farm was carried out by the family, while most job in the alpine unit (*Allmende*) was waged (some 80% of working hours). Part-time job dominated in smaller farms of the Alps agrarian region with some 50% of the farm in this region ($n = 38$) having less than 50% of the household income derived from farming. The profit estimates were based on labor reimbursement of 10 €/h for labor on the *Allmende*. Mean labor demand on the *Almende*, which were mainly grazed by heifers, sums up 9 h per grazing season and LU.

Although most of the farms in Baixo Alentejo were family farms, hired labor was more relevant in larger farms, which use most of the area. Nevertheless, the declining trend of the wage labor was evident from the observation of the census. Herdsmen jobs are nonattractive from a sociocultural point of view. In these extensive farming systems, it has been

possible to increase the substitution of labor for capital (fences, automatic feeding and drinking devices, machinery, and so on), making labor easier and less constraining.

In our sample ($n = 15$), the mean WU per farm was 3.4 ± 1.7. Family and wage work corresponded to $(60.4 \pm 26.4)\%$ and $(39.6 \pm 26.4)\%$, respectively, of labor demand. In this sample, two cases only used family labor, five used essentially family labor, four used more permanent wage work than family labor, and four used wage work but only part time. In the cost structure of surveyed farms, family job was accounted for by the real wages of the region.

In Castile-La Mancha, family labor was dominant in smaller flocks while a combination family and waged labor support was dominant in larger flocks. In this case, most waged labor was carried out from immigrant population. With mean regional flock size of 485 ± 396 breeding ewes, mean provincial numbers of WU per flock were 1.55 ± 0.75 ($n = 51$); 1.28 ± 0.58 ($n = 41$); 1.83 ± 1.08 ($n = 49$); 1.56 ± 0.88 ($n = 39$); 1.52 ± 0.78 ($n = 51$) for the provinces of Albacete, Ciudad Real, Cuenca, Guadalajara, and Toledo, respectively. The mode for all sheep flocks was 1 WU per sheep flock. Proportions of the only waged or both family waged flocks have increased in the last years with decreasing number of flocks and increasing flock size. Some 30 years ago more than 90% of sheep flocks were operated with family labor only. Immigrant implication is filling the void of barely enthused young Castilian farmers toward the sheep operation. In this study area, the social rating of the shepherd job was low even within their own farming communities although, paradoxically, the production of the *Manchego* cheese was promoted as a seal of regional identity. Grazing infrastructure and management should be improved and higher professional rating of the shepherd job enhanced to achieve higher social integration. Higher labor productivity in the two Iberian study areas was mostly the result of larger herd/flock size (Table 3).

4.8. Productivity estimates

Extensive systems of grazing management are characterized by low output related to the farmed area. In the EU, most of these systems also are located in areas with physical environmental constraints such as poor and dry soils or steep slopes in mountain areas. In our six study areas, the most contrasting biogeographical European regions were represented from the alpine-boreal zone in Northern Sapmi to the Mediterranean zone in Baixo Alentejo and Castile-La Mancha. But within specific study areas, some contrasting trends of intensification were also represented. In Northern Sapmi, for example, different patterns of reindeer migration can be found. In Norway, a full migration-extensive pattern was more common with full-time reindeer husbandry and subsidies allocated to husbandry leaders. In Sweden and

Finland, the subsidies were allocated to reindeer owners who are paid by meat production. They had an incentive for part-time job and more intensive forms of production (short migration or stationary patterns of herding). Productivity estimates were required to assess economic performance.

In Entlebuch and Bavaria, two farming units (alpine and lowland pastures) were integrated in the whole MU with very different levels of intensification. A common feature of these two systems is a combination of one unit with regulated stocking and a function of nature conservation (alpine unit) with an intensive use in the lowland farm unit with high use of farm machinery (indoor feeding of grassland conserves dominant). In the Tatra Mountains, however, although the system was based on the use of the same two units (alpine and lowland units), more extensive forms of production were dominant. In Baixo Alentejo and Castile-La Mancha, climatic and soil constraints limit the intensification and productive outputs. In fact, these two latter systems can be considered as modified forms of past traditional systems dating from before the introduction of farm machinery in the early 1960s. The crop subsystems have evolved in response to new technologies (crop varieties, mineral fertilizers, and farm machinery) as requirement for cutting costs and less labor demanding operations. The livestock subsystems, however, had changed less and can still be considered as open grazing and extensive operations.

In Northern Sapmi, productivity was estimated for the Norwegian part based on public statistics (Økonomisk Utvalg, 2004; Reindriftsforvaltningen, 2005) and the numbers in Table 8 are regional average numbers for western Finnmark (Norway). The numbers are based on 1.8 WU per husbandry unit (mainly family labor), 8.33 reindeer per LU, and 350 reindeer per husbandry unit. Accordingly, the average labor productivity was 23.3 LU/WU. Compared to the other study areas land productivity was extremely low (Table 8). The main reason was very low-intensive land use (3.5 animals per km^2). Labor productivity was at a low medium level both in livestock and in income.[6]

In the Tatra Mountains, labor productivity was estimated as a weighed mean (9 LU/WU) of those in the lowland farm (3 LU/WU) and sheep in the alpine unit (17 LU/WU). Productivity of labor[7] was weighed for days in the lowland farm (205) and days in the alpine unit (160). Land productivity was valued by estimating a weighed stocking (5.88 ewes/ha) and value added by ewe resulting of the addition of lamb selling in the lowland farm (19 €/ewe) and processed milk in the alpine unit (47 liters/ewe and 24 €/ewe). Total value was 43 €/ewe and land productivity was 253 €/ha. Lambs are marketed at mean LW of 11.6 kg and, the number of sold lambs by breeding ewes was 0.6. If labor productivity is estimated as €/WU, the

[6] For internal comparison, the best performing region of Sámi reindeer husbandry (South Trondelag/Hedmark) had these indicators outcome: €/ha = 2.7; LU/WU = 41.5; €/WU = 33667.

[7] Productivity of labor in Tatra = (17 × 0.44) + (3 × 0.56) = 9 LU/WU.

Table 8 Main productivity indicators in the six study areas

Indicator[a]	Northern Sapmi	Tatra	Entlebuch	Bavaria	Baixo Alentejo	Castile-La Mancha
Land productivity (€/ha)	3.3	253	1570	1500	188	162
Labor productivity (LU/WU)	23.3	9	17.9	31.5	43	41
Labor productivity (€/WU)	15,912	2276	28,016	31,500	22,914	39,073

[a] In Northern Sapmi data represented only Norway (western Finnmark). In Tatra, Entlebuch, and Bavaria data represented the combined alpine and lowland units. Productivity related to only farming income.

estimation[8] would be 2276 €/WU. While sheep are on the *alps*, it was estimated one shepherd per 100 sheep (17 LU). For our mean sample of 340 sheep per *baca* flock corresponded to 3.4 shepherds.

In Entlebuch, the mean altitude of the lowland farm was 800 m (range 600–1000 m) and the mean altitude of alpine pastures was 1300 m. Mean growth rate of younger cattle in the lowland farm was 0.62 kg LW/day. However, in some alpine pastures located between 1700–2600 m growth rate may decrease at 0.1 kg LW/day. For a grazing season of 100 days this difference represented some 50-kg LW. Similarly, milk productivity of dairy cattle in the lowland farm was 6000 liters/cow per year, but for the small number of dairy cattle in the alpine pastures, productivity may decrease to an equivalent of 15 liters/cow per day (100 days on summer pastures). Usually, the small number of dairy cattle in the alpine pastures used the best quality pastures, although of the 230 farming units of alpine pastures in Entlebuch (2003), only 17 maintained dairy cattle and only 7 produced alpine cheese. Productivity data recorded in Table 8 corresponded to an average MU (LBL, 2004b). Other productivity estimators for upland Swiss pastures are available (Mayer *et al.*, 2003).

Roughly, a mode MU consists of a lowland farm and the *alp*, on the 18 LU use 14.6 ha while on the *alp* 34.2 ha of rough pasture are used by the equivalent of 12.5 LU. Production income[9] per MU, including 7366 € of grazing fees, was nearly 48,000 € of which over 70% are derived from milk sales. Based on this mode MU, the standardized productivity equals 993 €/ha, 1570 €/LU, or 28,016 €/WU (Table 8).

[8] Productivity of labor in Tatra = (43 €/ewe/0.17 LU/ewe) × 9 LU/WU = 2276 €/WU.

[9] Production income per lowland farm in Entlebuch: (6000 × 12.5 × 0.464) = €34800 for milk sales plus (420 × 5 × 3.25) = €6825 for meat sales or a total of €41625 per farm or 2312 €/LU.

For Bavaria, the calculations of the revenues are based on the information on the production amounts of each farm and the average Bavarian prizes in autumn 2004. Dairy farms represent 79% of the farms by production objective and 91% of LU in the sample. The average farm realizes market revenues of 42,500 €. In case of an average farm 75% of these revenues can be attributed to milk and 25% to meat sales. This corresponds to roughly 1500 €/ha, 1000 €/LU, 31,500 €/WU, and 13 €/Awh.

In the Baixo Alentejo, sample the average total pastureland was 379 ± 322 ha and mean of 141 ± 96 LU/farm or 0.44 ± 0.30 LU/ha corresponding to a total income of 1289 ± 1040 €/LU with costs of 943 ± 662 €/LU. The system was strongly dependent on subsidies that represented, in average, 588 ± 294 €/LU or 196 ± 159 €/ha. The weighed average labor productivity was 43 ± 21 LU/WU or 22,914 ± 17,403 €/WU without subsidies. Finally, land productivity was 188 ± 148 €/ha without subsidies.

In Castile-La Mancha, a mean *polígono* of 500 ha (mean of 82% pastureland) stocked at a rate of 1.17 animals/ha (1 breeding ewe per ha). Animals' productivity was some 100 liters of marketed milk per breeding ewe per year, which was sold at mean price of 0.9 €/liter. Similarly, milking oriented flocks sold 1.4 lambs per ewe at a mean LW of 13.2 kg/lamb and mean price of 3.9 €/kg LW. Total sales per breeding ewe were 90 €/ewe for milk and 72 €/ewe for meat or a total of 162 €/ewe and roughly the same 162 €/ha. Mean labor productivity was different for milk-oriented sheep flocks (242 ewes/WU) or meat-oriented sheep flocks (367 ewes/WU). In milk-oriented flock the labor productivity was equivalent to some 41 LU/WU (0.17 LU/ewe). Taking into account this equivalence, the value added by ewe (162 €/ewe) was equivalent to 953 €/LU and productivity by WU can be estimated at 39,073 €/WU.

Averaging productivity indicators by study area illustrated differences between study areas but concealed a great deal of variation within study areas. In Entlebuch, for example, farm size ranged from 0 to 1 ha (2% of farms) to more than 30 ha (4% of lowland farms) with farms between 10 and 20 ha representing some 48% of total lowland farms. Size of farms may affect productivity indicators as well as lowland farms using or not an alpine unit (20% of lowland farmers using). Of those using an alpine unit, some 16% bring dairy cattle to the alpine unit and only seven out of 230 alpine units in Entlebuch produced alpine cheese. Similarly, mean LU per lowland farm was only 16 but the mean alpine farming units allotted 27 LU of which 52% were heifers, 23% dairy cattle, 9% sheep and 7% suckle cows. The workload also varied depending on whether the lowland farmers also operated an alpine unit. In this case, WU in the lowland farm should be supplemented with full-time family or waged labor, if the manager brings dairy cattle to the Alps, or part-time family waged labor for heifers, suckle cows, and sheep. Similarly, land productivity showed a decreasing gradient with increasing

altitude. In the lowland farms at mean altitude of 800 m (range of 600–1000 m), mean stocking was 1.42 LU/ha (97% of TAL was grassland) and mean grassland productivity was 7500-kg hay/ha. In the alpine unit at mean altitude of 1300 m stocking was 0.5 LU/ha TAL (only 60% of TAL is pastureland) and mean land productivity was 3000-kg hay/ha. At higher altitudes of 1800–2000 m productivity decreased to some 1500-kg hay/ha.

In Bavaria, differences in productivity between lowland and alpine units are also acute. Year-round stocking in the lowland farms was some 1.4 LU/ha TAL (if just privately managed TAL is considered), but only 0.4 LU/ha in the *Allmende*. Within the farmers' sample differences in productivity were related to farm location. Sampling units are located in three agrarian regions with increasing levels of land productivity—Alps (*Alpen*), prealps (*Alpenvorland*), and prealpine moraine belt (*Voralpines Hügelland*). The intensively managed grassland and arable land represented more than 80% of land uses in the two latter areas. In contrast, it represented only 50% of land use for the farms located in the Alps. Increasing land intensity and mineral nitrogen application were also related, with 13%, 46%, and 60% of farms located in the Alps, prealps, and prealpine moraine belt using mineral nitrogen, respectively. These differences in land structure and intensity had an impact on land productivity. While similar in overall average farm size, including forests, farms in the three areas stocked a mean of 29, 62, and 82 LU per farm, respectively. Mean productivity of grasslands in the whole sample was 41 MJ NE for lactation per hectare but values ranged from a minimum of 14 to a maximum of 78 MJ of NE for lactation per hectare.

In Baixo Alentejo, large variation of productivity was observed. The results from our small sample showed high figures for standard deviations suggesting that larger samples will provide even large variation, and this happens either on animal, work, or land productivity.

In Castile-La Mancha, mean values of animals' productivity concealed a large variation. Ewes' yield of marketed milk presented a CV of 58% (98 ± 57 liters per ewe per year). Data presented in Table 8 represented means of milk-oriented sheep flocks ($n = 112$ in a whole sample of $n = 230$) for harmonization of reporting. Production objective, however, was a main cause of variation within this study area. Flock size in milk- or meat-oriented sheep flocks presented values of 428 ± 430 ($n = 112$) and 540 ± 354 ($n = 118$) breeding ewes per flock, respectively. LW of lambs at selling had values of 13.1 ± 4 and 20.0 ± 4.4 kg LW, respectively, and corresponding labor productivity showed values of 249 ± 99 ewes/WU and 367 ± 150 ewes/WU, respectively.

Despite the fact that all systems are regarded as marginal, within the national and regional context, big differences in the market revenues per hectare indicated large differences in the productivity of the systems. The market revenues per WU, however, showed less difference for the study areas located in the EU-15. Only for Tatra it was significantly lower.

4.9. Economic performance

Two main assumptions supporting EU policy toward extensive systems of grassland management are that these systems are not economically sustainable but, as they may deliver some social and environmental functions not properly factored in farm prices, they should be awarded some public handouts. Neither of both assumptions has been properly tested. In this section, we will address the first part of the assumption (economic sustainability) by applying a classical cost-benefit analysis to the economic data gathered in our six study areas. Given the wide variations in production objectives, farming practices, and general economic environment between the six study areas, economic sustainability should be addressed within each study area. After this, a general picture of sustainability may or may not appear. The data gathering process was agreed on within LACOPE (Caballero and Fernández-Santos, 2004). This previous coordination effort facilitated comparisons and harmonization of reporting. Profit or losses of the farming operations were estimated either with or without subsidies, and main data were related to the same unit (€/LU) for comparisons. The implication of public handouts was valued as the ratio of total subsidies to value of production farming (Table 9).

In three study areas (Tatra, Entlebuch, and Bavaria), the MU or operating unit was composed of two farming units (the alpine unit and the lowland unit), each one with their own structure, practices, and subsidies. Field economic data were recorded for each farming unit but an economic appraisal was also performed for the whole operating unit. One of the main problems for proper economic appraisal was recording of subsidies. Many policy schemes were operating in the six study areas. Subsidies can be awarded by the EU or by national and regional governments, and being allocated as production subsidies, environmental schemes or direct headage payments (by head of animals). All were accounted as public handouts. In our income accounting (Table 9), we will refer only to farming-derived sources of income (value of production farming). In some areas other sources of income such as tourism will be reported in the text. Data recorded correspond to the year 2004 in Tatra and Baixo Alentejo; to 2003 in Northern Sapmi, Entlebuch, and Bavaria; and to 2002 in Castile-La Mancha.

In Northern Sapmi, data reported in Table 9 are divided into specific columns for each of the three countries due to the diversity of economic structure. The Norwegian part corresponds to the region of western Finnmark and represented the average of 241 husbandry units, 84,200 reindeer in the area, and 1279 reindeer owners. These data represented means of 350 reindeer per husbandry unit, 66 reindeer per owner, and 5 owners per husbandry unit (Reindriftsforvaltningen, 2005). For Sweden and Finland, the main data are herder interviews material from one district in each country. In the north of Sweden (province), reindeer husbandry master

Table 9 Main economic results of operating units in the six study areas

Indicator	Northern Sapmi			[a]Tatra	[a]Entlebuch	[a]Bavaria	Baixo Alentejo	[b]Castile-La Mancha
	Norway[c]	Sweden[d]	Finland[d]					
				(€/LU)				
Farming income (A)	790	120	419	253	1606	1291	701	953
[e]Total costs	443	169	196	509	650	820	943	865
Total subsidies (B)	656	33	167	176	784	270	588	141
Net cash flow without subsidies	347	−49	223	−256	956	471	−242	88
Net cash flow with subsidies	1003	−16	390	−80	1740	741	346	229
Ratio (B)/(A) (%)	83	27	40	70	49	21	84	15
Total subsidies (€/ha)	3	0.1	0.4	105	491	380	196	140
Year of records	2003	2003	2003	2004	2003	2004	2003	2002

[a] In the case of Tatra, Entlebuch, and Bavaria a combined MU is considered (lowland farms plus alpine pastures). Lowland farms only in Entlebuch had farming income of 2312 €/LU and total subsidies of 1060 €/LU.

[b] This profit conceals a great of variation within individual samples with 35% of milk-oriented sheep flocks having losses without subsidies. Subsidies in €/ha correspond to the cultivator, not to the landless pastoralists.

[c] Based on public statistics (Økonomisk utvalg, 2004; Reindriftsforvaltningen, 2005).

[d] Based on herder interviews in one MU each country. In Finland, cost of supplementary feeding is not included.

[e] Family labor not included in Northern Sapmi, Tatra, Entlebuch, and Bavaria.

(unit or household) was 332 husbandry masters and 56,522 reindeers. Reindeer owners numbered 1249 and each husbandry master had in average 170 reindeers. In Finland Käsavarren paliskunta (district) reindeer husbandry *dollu* (unit or household), 128 husbandry *dollu* and 10,000 reindeer were in the area. Reindeer owners numbered 168.

The EU agricultural subsidy programs do not involve the reindeer industry in Sweden. The argument is that the Swedish's reindeer husbandry operation is an exclusive right for the Sámi people and thereby not open to all European citizens (Jernsletten and Klokov, 2002; Ulvevadet and Klokov, 2004).

We noted that both income and cost tiers were clearly higher in Norway than in Sweden and Finland, which limits the differences in the level of profit without subsidies. In Sweden and Finland, animal stock increases are not included in the income tier due to uncertainty of data. Particularly in Sweden this probably means an underestimation of farming income. In Finland, an additional uncertain factor is the cost of supplementary feeding, which is not included in the calculation due to the uncertainty of extent, cost, and its coverage. Strikingly, the subsidy level is very high in Norway and intermediate in Sweden and Finland. Compared to other study areas, two national operations in Northern Sapmi (Norway and Finland) turn a profit without subsidies. With subsidies, the profit is high in Norway, Finland operates at an intermediate level and Sweden showed a loss. While data for Norway are confirmed, we have indications that farming income is underestimated for Sweden and costs for Finland. Notwithstanding these uncertainties, we have preferred to show the trends in the three countries. The low to very low level of subsidies per area in the three countries is a good indication of very low intensity per area of the reindeer production.

In the Tatra Mountains, main source of income came from processed milk (marketed cheese) during the summer grazing season, while sheep on the *alps* (24 €/ewe). Marketed lambs on the lowland farm represented some 19 €/ewe to a total income from production of some 43 €/breeding ewe. Total costs included 70 €/ewe in the lowland farm and 10 €/ewe on the *alps* or a total of some 80 €/ewe. Subsidies were only allocated to sheep in the lowland farm and amounted to some 30 €/breeding ewe. In this case, the sheep business was unprofitable even if accounting subsidies in total farm income. Only by adding nonfarming income sources such as tourism services (equivalent to some 23 €/breeding ewe) can the farming enterprise turn profitable. It should be noted that the summer period of sheep on the *alps* was profitable even without subsidies due to the fact that the milking period occurred during this season and sheep gathered in large flocks accounted for higher labor productivity than in the winter period in the lowland farm.

In the farms of Entlebuch, farming income and cost tiers were derived from the lowland and the alpine farming units, providing that the livestock

farmers bring their animals to the Alps. If this is the case, we considered an average lowland unit of 14.6 ha and 18 LU with total sales of 41,625 € per lowland farm (see productivity tier) plus 7366 € per alpine unit in grazing fees. Total farming income in the whole operating MU of 48,991 or 1606 €/LU for a standard MU stocking 30.5 LU (Table 9).

A main cost tier not included in Table 9 is the remuneration of family labor. Taken a full cost approach, labor represent some 50% of total costs (Höltschi, 2006), if one takes the standard rate of 15.7 €/wh. For an average MU with 30.5 LU, the remuneration of family labor would imply additional costs of 1583 €/LU.

Subsidies in the alpine units of Entlebuch represented 80 €/LU as sheep and 200 €/LU as heifers. For a standard unit stocked with 80% heifers and 20% sheep, represented 176 €/LU. For stocking of 0.8 LU/ha and an alpine unit with 34.2 ha of pastureland, subsidies valued 141 €/ha and total of 4822 € per alpine unit.

According to government allocation, subsidies for the average lowland farm in Entlebuch comprised general area-payment subsidies, compensation for harsh production conditions, and contribution to environmental performance, for a total of 19,087 € per farm (14.6 ha) or 1307 €/ha. Subsidies in the lowland farm were more than 10 times higher than in the alpine units. Weighed mean for an average MU in Entlebuch[10] with 34.2 ha (70%) of pastureland in the alpine unit and 14 ha (30%) lowland farm would receive 491 €/ha and 784 €/LU (Table 9).

For an average situation in the Swiss alpine region,[11] the average lowland farm was 18.6 ha and received 31,098 or 1672 €/ha (Swiss Federal Office for Agriculture, 2004). If combined with an alpine unit of 37 ha of pastureland (receiving 141 €/ha), the weighed average would be 646 €/ha.

In Bavaria, the 56 farms surveyed in the sample participated in 17 different *Allmende*. Of those farms, 43 had CLS locally inherited entitlements and 13 were boarding farms, paying a grazing fee. In this case, however, livestock farmers were less lured to send their heifers to the Alps than in the study area of Entlebuch, and contribution of grazing fees by external animals was of much less significance. In most CLS, most of the required labor was waged. For the *Allmende*, the main source of revenues was public handouts. For this study area, data showed in Table 9 corresponded to economic performance of the mean lowland farm, without taking into account only the labor and fodder saving of using the alpine pastures.

For the average farm, the total amount of public handouts amounted to 400 €/ha but only 8.800 € per farm since the larger farms received lower

[10] Weighed average farm support in Entlebuch (30% lowland unit and 70% alpine unit) = (1307 × 0.3) + (141 × 0.70) = 491 €/ha.

[11] Weighed average farm support in the whole Swiss alpine region (33% lowland farm and 67% alpine unit) = (1672 × 0.33) + (141 × 0.67) = 646 €/ha.

public handouts per hectare. Farming revenues for lowland farm summed up to 50.800 €, not including side income by agrotourism and forestry. Total costs, excluding family labor but including capital cost and depreciation, amounted to 51.400 € per farm. Of these total costs roughly a third are depreciation for buildings and machinery. The depreciation was calculated based on standard costs, which might underestimate the maximum useful life of these facilities especially for the very small farms, which are very frequent in the sample. The figures presented in Table 9 deviate to some extent from the data just presented. This is for two reasons. First of all, no depreciation is included in the stated costs. Second, larger farm, measured in LU, are more profitable than smaller ones, therefore if the economic indicators are related to LU the farm they show has a slightly more positive picture.

Taking into account these assumptions, the average farm made a loss even before remunerating family labor. These mean results for the average farm in the sample ($n = 56$) of Bavaria conceals a great deal of variability between larger and small farms and between agrarian regions. Only 26 of the 56 farms in total had profits. Especially, 24 of the 38 farms in the Alps showed losses. However most farms had a positive cash flow, and only four small farms showed negative calculated cash flow per hectare. These negative cash flows can be largely attributed to the conservative assessment of the revenues. Especially direct marketing was more common in the small farms in the Alps. Further, it should be kept in mind that these farms continued farming for noneconomic reasons. As a further general pattern it can be seen that the cash flow increased with increasing farm size. This holds especially for the farms outside the Alps. The farms in the Alps often compensated small herd sizes with the large quantities of land, which are eligible for nature conservancy or compensatory payments and which can be managed at low costs. As stated before, some of the economic agricultural activities of especially small farms were omitted in the calculation. Therefore, the real cash flow and profits of these farms per hectare could be a few hundred higher than stated. The profits per hectare as well as the cash flow per hectare showed the same general patterns in relation to land use intensity. Farms with a higher average stocking rate per hectare had a higher profit as well as cash flows. Since the cash flow was positive for most farms at least short term sustainability seems to be assured. The cash flow as well as the profits showed that farming was most profitable in the prealpine moraine belt and least in the Alps.

The processed costs in the farm were very high if they are compared with other study areas. Some authors have related these high costs with intensive use of farm machinery and low incentives to raise suckle cows and heifers under grazing conditions (von Boberfeld *et al.*, 2002).

Economic results from the Baixo Alentejo sample showed a clearly divergent situation before and after subsidies. Only three farms in the sample

showed positive results before subsidies and, interestingly, all of them produced *Alentejano* pig. Furthermore, the only producer specialized in *Alentejano* pig was the most successful before and after subsidies. Results of the sample ($n = 15$) without subsidies ranged from 810 €/LU to −841 €/LU, the mean was −242 ± 436. Considering the situation with subsidies the panorama was much better, but three farmers still presented losses. The results ranged from 1659 €/LU to −254 €/LU with a mean 346 ± 489 €/LU. The ratio of subsidies to total income (including subsidies) was 46 ± 21% and the ratio of subsidies to value of production (without subsidies) was 84 ± 55%.

The great variation observed in this small sample suggests that, at least, identical variability could be found in larger samples. The number of observations was too low to try to extract statistical evidence correlating the results with any kind of variable, namely productive orientation.

In Castile-La Mancha, farm economic results were mostly dependent on the production objective (milk- or meat-oriented sheep flocks), and the size of the flocks. Data gathered in Table 9 corresponded to an average of milk-oriented sheep flock ($n = 112$). In this case, farm market revenues were coming from milk sales to *Manchego* cheese-making facilities and meat sales of early-weaned lambs. Total farm revenues represented 162 €/breeding ewe (953 €/LU). Total costs represented 147 €/breeding ewe (865 €/LU) of which the two main tiers were labor (45%) and supplementary feeding (39%). The average milk-oriented sheep flock would make a small profit of 16 €/breeding ewe. However, data recorded for meat-oriented sheep flocks ($n = 118$ in the sample) showed a net loss without subsidies of −12 €/breeding ewe. Subsidies awarded to the sheep operation included direct headage payment plus a top-up payment to LFAs, amounting to 24.04 €/ewe for milk-oriented flocks and 30.05 €/ewe for meat-oriented flocks. When subsidies were included, the average farm turns a small profit.

These data, however, concealed a great deal of variation within the sample. Farm profit of milk-oriented sheep flock ($n = 112$) showed mean values of 16 ± 41 €/breeding ewe with 35% of milk-oriented sheep flock showing losses without subsidies. When subsidies were included, mean farm profit showed values of 40 ± 41 € per ewe and even 17% of individual farms showing a loss. Similarly, in meat-oriented sheep flocks, mean profit without subsidies showed values of −12 ± 38 €/breeding ewe with 58% of farm showing losses. When subsidies were included net results were 18 ± 39 €/ewe with yet 24% of meat-oriented flocks with losses.

As expected, the economic results among the six study areas varied greatly in the total income (farming revenues plus subsidies), as well as in the total costs and proportion of public handouts on farming revenues. Farming income varied from 1606 €/LU in the MU of Entlebuch to 253 €/LU in the whole MU of Tatra. In this latter study area, total costs were much higher than farming income, although farmers may have side-income from tourism

services. If in Entlebuch one would only take the figures for the lowland farm, farming income would account to 2312 €/LU, the highest of all study areas. The proportion of subsidies to value of production farming also varied greatly from 15% in Castile-La Mancha to around 85% in Norway and Baixo Alentejo. It was illustrating how in those study areas (Tatra and Entlebuch), where the low-input units were included in the analysis, showed the poorest economic performance if family job were included. In the case of Tatra, the alpine unit was unsupported. In the case of Entlebuch, the alpine unit had much less agricultural output (only external grazing fees) and agricultural support than the lowland farm unit and all jobs (family or waged) were rated at standard rate. The combined operation was unprofitable mainly because families accept a lower wage rate for working in the Alps. This idealism, however, may have a limit.

4.10. Grazing management and trends

Within this tier, main trends in grazing management were recorded by study area regarding specially the following subjects—animals' lots under grazing, trends in spatial distribution of grazing and trends in grazing days. Some others study-area related indicators were also recorded. Grazing management trends were recorded by comparing the present situation with available data of some 20–30 years ago.

Long displacements of herds (*trashumancia*) across grazing units and seasons were operative only in Northern Sapmi, but only under full migration patterns. Short displacements (*trasterminancia*) of some animals' lots between lowland farms and highland pastures were operative in the Tatra Mountains and the two Alps study areas. In Baixo Alentejo and Castile-La Mancha, grazing patterns were mostly stationary across the year with herds/flocks displacements between seasonal resources within one specific MU. In Castile-La Mancha, a small proportion of sheep flocks (some 2%) in the sample still practiced the old *trashumancia* across the *cañadas* from summer pastures in the north of the region to winter pastures in the south. Currently, lorries or trains displace sheep. Also in Baixo Alentejo, a very small proportion of cattle and sheep herds still practice the *trashumancia* to cereal stubble fields over the summer season unless occasional sanitary rules restrict displacements.

Indigenous livestock breeds were dominant in most study areas except in Entlebuch and Bavaria where more productive breeds are dominant, indicating an increasing level of intensification, specially in the lowland farms. In Tatra, indigenous sheep breed (*Polska owca górska*) is dominant for the production of regional cheeses. In Entlebuch, *Original Brown* and *Simmentaler Fleckvieh* dairy breeds are indigenous, but more productive breeds are increasing (*Brown Swiss* and *Red Holstein*). In Bavaria, highly productive breeds such as *Brown Swiss* and *Simmentaler* are dominant. In Baixo Alentejo,

indigenous sheep (*Merino*) and pig (*Alentejano*) are dominant, but cattle crossing with foreign breeds is frequent and the same in Castile-La Mancha (indigenous *Manchego* sheep). The importance of autochthonous livestock breeds for the sustainability of extensive livestock systems has been stressed (Blanc *et al.*, 2004). Herd-conducting patterns were very different across the study areas depending on availability of grazing infrastructures, type and distribution of grazing resources, labor availability and cost, and grazing behavior of the specie.

In Northern Sapmi, the reindeer husbandry has changed in the last 20–30 years from a subsistence pastoralism to a motorized and market-oriented industry. With the motorized vehicles, the Sámi could keep much bigger herds and, in recent years, the number of animals has increased considerably in several of the regions (Kautokenio, Karasjok, and Finnish Lapland) of Northern Sapmi. The implications included decreasing animal weights, reduced offspring rates, increasing predators, emergent dependence on artificial feeding, increasing socioeconomic stress, and avoiding traditional long-migration patterns. The level of support and policy schemes varied between the three countries but headage payments and direct price support played a great role. Reindeer herders have an incentive to increase stocking density with these systems of support and overgrazing may result on specific areas. At the same time, and as a consequence of access restrictions across borders, traditional migration patterns were hampered and some pasture areas are unused or underused due to grazing prohibition. Dissolution of national borders between Norway, Sweden, and Finland is required and new area-payment schemes of subsidies devised and implemented in favor of long-term pattern of seasonal land use and pasture adaptation.

In the Tatra Mountain area, the number of sheep has decreased from some 300,000 to 60,000 in the last 30 years, especially in the downturn of change since the liberalization of the Polish economy in 1989 and lower demand and prices for meat, milk, and wool. This lower size of regional sheep flocks is having an influence on stocking of alpine pastures over the summer grazing season. Far-reaching grazing meadows in the clearings of the forest are becoming less used or abandoned on mobility problems. The alpine pasture lack of a proper system of subsidy support mainly because property and grazing rights are not clearly defined. A rehearsal of the grazing system should start with a proper legal and institutional framework with appropriate claim of property and grazing rights. Currently, mean number of owners claiming property on private clearings (mean size of some 5 ha) was 32. Some indicators to assess the degree of intensification/extensification in the Carpathian region are available (Fereniec, 1999; Krajcovic, 1990; Krynski, 1976; Manteuffel, 1981; Statistical Yearbook, 2003).

In Entlebuch, the same trend toward abandonment of the far-reaching alpine units was observed. Here, however, only 12% of alpine units did not have road but, care of animals in far-reaching alpine units represented a

harsh working and expensive operation due to high standard wage-labored cost of Switzerland. Animal care was restricted by labor cost and thus, dairy cows, requiring permanent herding and care, was the least present lot in the alpine units. Generally, heifers' care was at least once a week, but nearly one third was cared for twice a day. Care intensity depends on weather conditions. The care of suckle cows and sheep was more occasional. Stocking density in alpine pastures is law-regulated (*Sömmerungsverordung*). Organic fertilizers, as dung and liquid manure, are allowed only if produced in the stable of alpine units and spread during dry weather. Only Phosphor and Kali are allowed as chemical fertilizers and use of other chemicals require an especial permission. N-fertilizers are not allowed since 1970s, when common use of N-fertilizers promoted the spread of weeds in alpine pastures. Currently, most alpine units (95%) used dung and a big majority (78%) used liquid manure usually close-by the alpine huts. Underuse is a regular trend in alpine pastures with shrub and forest encroachment. These areas have to be cleaned by hardworking and costly operations.

In the sampled lowland farms of Bavaria, most (80%) were dairy-oriented. Only one farm in the sample was not keeping any cattle at all. The farm's productive orientation influenced the number of animals kept. Usually dairy farms were the largest. The dominant cattle breeds were *Simmental* (53% of farms) and *Brown Swiss* (dominant in 29% of farms), with old regional breeds present in 15% of the farms (mainly part-time farms). Regional breeds were usually maintained in small herds of some 16 LU by part-time farmers. Heifers on the *Allmende* were mostly from dominant breeds. Of the 56 sampled farms, only 14 applied N-mineral fertilizers to grassland, and the rest were under the K34 Bavarian agri-environmental scheme that does not allow the application of N-mineral fertilizers. Seven farms complied with organic farm standards. Complying with organic standards was easier for small than for larger farms but the first have less comparative advantages. Organic farming implied a surplus income of 5%.

Winter-spring calving was the most frequent calving season. This breeding scheme allowed to meeting the higher energy demands for milk production with spring flushing meadows. Three to four harvests per plot were common with a high percentage (some 65%) of land uses devoted to conservation as hay or silage. Plots under grazing were usually used by heifers or suckle cows. Outside the Alps, dairy cattle barely grazed at all.

In Baixo Alentejo, livestock production knew important shifts in the last 20 years but showing an oscillating pattern according to the variations of the determinants of change that is socioeconomic factors such as subsidies and availability of wage labor. The first movement corresponded to the increase of meat sheep production compared to the others species. This was followed by a declining trend of the sheep production that was being substituted for meat cattle during the last 10–15 years. This shift was essentially provoked

by a more attractive animal premium. In this last period, it was also observed an important increase of extensive *Alentejano* pig production, mainly in oak-holm *Montados*, where the acorn allows premium prices to these animals. Differently from other livestock, pig production determinants were essentially market driven.

In Castile-La Mancha, 46% of the milk-oriented flocks kept the milking lot under indoor feeding for some 4–5 months, with only maintenance and gestating ewes (four first months) under grazing. In meat-oriented sheep flocks, ewes are kept indoor usually 1 month before and 1 month after lambing. Sheep farmers used all kind of available resources but a trend was observed for less grazing days and heterogeneity of spatial distribution of grazing. A large majority of sheep farmers (77%) indicated less outdoor grazing feeding than 20 years ago and only 3% more grazing days. The main reason given by farmers was lack of grazing resources in the *polígonos* due to increasing intensity of cultivation in fallow and stubble-land. Lack of grazing resources, hardworking conditions and daily drove of flocks from near-the-village sheepfolds to the *polígonos* are promoting less use or abandonment of far-reaching *polígonos* or parcels and some overuse of plots near the villages. A consolidation trend was apparent in the regional flock. In the last 20 years the numbers of flocks decreased at a rate of some 3% per year, but the number of sheep remained almost the same at the regional level. Average flock size increased from some 200-breeding ewes in the 1970s to more than 400 at present.

4.11. Main limiting factors

Livestock farmers were questioned on main factors that may hinder present use of land-based resources on LSGS or may favor stabilization of the grazing systems.

For Northern Sapmi, we based our assessment of limiting factors on our total material. Generally, the different adaptations (migration types) within Sámi reindeer management face various concrete problems. Tables 8 and 9 showed that Sámi reindeer management is a low-profit industry and a low-intensive land-user. We noted that the industry was subsidized not only from public budgets, but also from other income (Karlstad *et al.*, 2002; Labba and Riseth, 2007). The low-profit situation does not seem to be limiting as the cultural valuation of staying in business seems to be very important (Ciuryk and Niemeyer, 2003; Labba and Riseth, 2007; Riseth *et al.*, 2005; Riseth, 2006). However, on a general basis much of the problems could be traced much back to: (1) an encroachment/disturbance problem and (2) a seasonal pasture balance problem. If these problems were reduced, clear overgrazing problems also might be scaled down/brought under better control. Both problems have external reasons as (1) depends on the property rights situation and the general development of society's

technical infrastructure while (2) in addition to nature conditions depends on national borders, border closures, and bilateral conventions (Riseth *et al.*, 2004).

In the Tatra Mountains, the small size of the plots in the lowland farms and large number of owners of clearings in alpine units makes difficult the implementation of efficient grazing systems. Surveyed farmers also indicated a lack of cooperation between stakeholders but specially sheep owners and shepherds (*gazdas* and *bacas*) and, some time, landowners. Long-term renting contracts would contribute to stability and much easier management. Technical assistance was also cited as a main limiting factor especially required for milk processing facilities and animal transportation to far-reaching alpine units, presently underused. Finally, the most cited limiting factor was a lack of proper legal and institutional framework. Without proper allocation of property rights and grazing rights it was difficult to devise and much less to implement grazing rights contracts or even a sensible scheme of policy support for the alpine pastures.

In Entlebuch, a majority of surveyed farmers (78%) rated as good or medium the future of the alpine unit operation. When questioned about the main conditions for increasing stability, the most cited responses were the luring of external farmers to bring animals to the Alps (32%) and increasing subsidies for alpine pastures (32%). Other less cited responses included nature contract, cooperation with tourist facilities or improving marketing of products. It seems that luring lowland and external farmers to bring their animals to the Alps was a main condition for long-term stability of the system. Notwithstanding this response, 9.9% of farmers abandoned the operation between 1985 and 1996 and 12% of farms gave up between 1997 and 2003.

In Bavaria present incentives for luring farmers to bring their animals to the *Allmende* (CLS) are higher for small farms located in the Alps agricultural area. Most farmers derived less than 10% of the forage supply and less than 5% of the revenues from the CLS. Present scheme of subsidies do not incentive the use of CLS. Nevertheless, for the average surveyed farm, the granted amount of public handouts per ha dropped from 380 €/ha of agricultural land to 340 €/ha, if corresponding share of the CLS was included. This situation is changing in the course of the implementation of 2003 CAP reform. Until 2004, direct payments played a minor role and the lowland dairy farmers have little incentive to comply with stocking limits. Under new cross-compliance rules for direct payments, dairy farmers may have an incentive to comply with stocking limits by outsourcing heifers to the *Allmende*.

In Baixo Alentejo, the most frequently referred limitations to livestock farming were the market price of meat products, the scarcity of labor, the soil and climatic constraints of the region, and the lack of land to buy or rent. Therefore, farmers adjust by favoring livestock species with better

market prices, more favorable public handouts, and less labor demand. The rejection of the herdsmen profession forces an adaptation of the workload through new forms of management and better infrastructure and machinery that allow them to bypass the need of permanent care of the animals (Vicente *et al.*, 2005).

Other constraints, besides the ones that result from the soil and climatic conditions, result from the lack of cooperation between farmers. If there are some signs of cooperation concerning marketing and livestock sanitary-medical help that was enforced by the government and primarily funded by the EU. All the other dimensions of cooperation are totally absent or only represent incipient attempts.

In Castile-La Mancha, main limiting factors cited by sheep farmers included cooperation with landowners–cultivators, improving grazing infrastructures for less hardworking conditions and overhauling the legal and institutional framework. These conditions had no clear arrow of causality. Landless pastoralists may expect better cooperation by landowners but landowners-cultivators do not have proper economic incentives to facilitate the grazing use of their lands, although most of them abide by the law. Hardworking conditions are to some extent inherent to the structure of land-based resources (unfenced *polígonos*), but also stressed by lack of grazing infrastructure. As a result, young Castilian farmers are barely enthused toward the sheep grazing operation. The rehearsal of grazing law (JCCM, 2000) has not derived a general social consensus.

4.12. Interface to biodiversity

On this research, the current socioeconomic status, limiting factors, and main trends of the surveyed LSGS were to be addressed. However, this research had also the subsequent objective of paving the way for further interdisciplinary research between the socioeconomic and ecology groups within the LACOPE project. For this reason, some grazing management indicators of ecological significance are stressed on this heading.

In Northern Sapmi, three questions connected to border restrictions are at stake from an interdisciplinary point of view: (1) The relatively stationary coastal reindeer herding in Norway have very limited winter pastures and would gain much of increased access to winter pastures in continental Sweden and Finland. (2) The stationary adaptation in continental Finland leads to trampling of lichen resources and increased dependence of supplementary feeding. Change to cross-boundary migrations would increase support the double herd size without supplementary feeding and increase productivity by one third due to access to cool mountains in summer. (3) Migratory reindeer herding in northern Sweden have limited access to summer pastures in Norway and have their summer pastures in areas better suited for fall pasturing (Riseth *et al.*, 2004). Eliminating these restrictions would increase reindeer

summer pasturing in the Scandinavian mountain ridge and thereby promote grazing at biodiversity hot-spots of arctic-alpine plant rarities dependent of disturbance by grazing (Fuelling *et al.*, 2004; Olofsson and Oksanen, 2005).

In the Tatra Mountains, the summer grazing season with sheep in *bacas*' care in the alpine units (clearings) was of the outmost importance for economic results of the whole MU as well as for cultural assets and indigenous product (cheese processing in the *alps*). The ecological effects of abandonment of the summer grazing operation in the clearings are at the stake.

In the Swiss Entlebuch UNESCO Biosphere Reserve, the use of the lowland farm seems not to be at stake, as is sustained by generous handouts. However, not all the managers/owners of lowland farms take their animals to the alpine units. In this case, we have assessed the economic effect of the MU with or without operating an alpine unit or the economic effect of MU operating alpine units but with or without external grazing fees. The question of abandonment of the alpine unit, with much lesser support, is more acute in this study area, with corresponding lower grazing use in the upland pastures.

In Bavaria, the number of entitled farmers sending their animals on the *Allmende* tends to decline. The alternative of valuing the economic status of the lowland farms with or without using alpine pastures seems sensible and feasible with present economic data. The question of abandonment of far-reaching and low-productive grazing grounds in upland pastures may have ecological significance.

In Baixo Alentejo, one controversial question was the foundation of subsidies granted to cereal production on the grounds of environmental schemes. On the one hand, this practice is easily understandable in the restricted area of the Zonal Plan of Castro Verde where the cereal-fallow rotation is of importance as habitat for steppe birds. Differently is subsidizing wheat in other areas that looks more as a way to substitute coupled subsidies that no longer can be granted. Another question was the existence of contradictory policy measures with impact on the competition for the land use, which have great impact on grazing and in biodiversity. In fact, subsidies to afforestation of agricultural and pasture land are not only contradictory with the needed open spaces for target birds, such as Great Bustard, but also reduces the area devoted to grazing and increases the risks of fire. These practices may contribute to decreasing biodiversity levels.

In the southern Castilian plain the mixed cereal and sheep operation is hindered by scarcity or poor mobility to grazing resources, lack of grazing infrastructures, and harsh-working operations. Cultivators–pastoralists relationships were not cooperative and current scheme of subsidies promoted a divergence of interests between the two social groups. The grazing operation based on the use of agricultural residues in arable land can be considered as a secondary option of land use and thus the landless shepherding operation based on the use of the *polígonos* (MU) is under risk. Under the present

decoupling scheme for direct payments, rated as 75% for cereal and 50% for sheep in the Mid-Term Review of the CAP, 2003, cereal farming' consolidation can be expected with corresponding increase of tilling intensity and less available resources for the sheep operation. Under this scenario, it would be sensible to assess the interdisciplinary effects of mixing cereal and sheep versus growing cereal as the only operation or the effects of crop rotations with declining tilling intensity (unploughed fallow land) and increasing hectare of annual legumes. These latter cropping and management alternatives, apart from their effects on soil quality and cereal yields (Lacasta and Meco, 2006), may have an incidence on the habitat suitability of target steppe birds such as Great Bustard. Some 50% of the world population of this specie is concentrated in the Spanish cereal regions (Alonso *et al.*, 2003).

One common ground for most study areas, except Baixo Alentejo, was the presence of problems of mobility of herds/flocks and/or problems of access to specific grazing grounds. The first were more apparent in Tatra (transport to far-reaching clearings in the Alps), and to some extent in Entlebuch and Bavaria and the second in Northern Sapmi (country borders barriers). Castile-La Mancha was a case study of both mobility and access problems. Landless pastoralists drove animals on grazing days from sheepfolds near the villages to the grazing allotments (*polígonos*), and back for sheltering, watering or milking. Accessibility, even to far-reaching *polígonos*, was allowed, but mobility was hampered of lack of drove paths and interspersion of nongrazing parcels. On the other side, accession was only allowed to particularly allocated *polígonos*, and access to nongrazing grounds (growing cereals, vineyards, olive orchards, and irrigation parcels) was mandatory prohibited. For all study areas and from an ecological point of view, occasional overgrazing in specific parcels can be hazardous, but a lesser magnitude than heterogeneity in spatiotemporal distribution of grazing-use.

5. Discussion

One of the main findings of this comparative typology was to assess that the intensification and abandonment threats were not totally unrelated. Strong attachment to traditional forms of production may bear these systems more prone to be abandoned. Our real goal is to devise management plans for these systems without losing their main assets.

The six analyzed systems encompassed a wide range of variation in environmental and structural conditions within corresponding categories on the main headings-indicators analyzed. However, within this ample variation, some common trends aroused.

Regarding land use, overstocking was more occasional than usual, being inconsistent with a frequent concern stressed in the policy schemes and agri-environmental measures (Oñate *et al.*, 1998; Primdahl *et al.*, 2003). Land-based grazing resources were not usually in short supply, but we have found heterogeneous distribution of grazing lots over the available resources with widespread abandonment of the far-reaching or less-quality grazing grounds. This trend may have consequences on the succession vegetation changes and environmental assets of these LFAs. This general trend was coupled, in some study areas, such as Entlebuch, Bavaria, and Castile-La Mancha, with high-nutrients-demanding lots, such as milking animals, unlinked to land-based resources. This again, may have consequences for the maintenance of autochthonous breeds and indigenous quality of regional products.

All areas faced also climatic constraints limiting the duration of the grazing season. Strategies of forage conserves or CFR were devised to meet the corresponding FD. In the cases of Northern Sapmi, Tatra, Entlebuch, and Bavaria, the main strategy was to move some lots of animals to different grazing units to remove grazing pressure in the lowland farms over the summer season. This was coupled with a supply of forage conserves in the lowland farms, which help to meet the structural FD. In the Iberian systems, however, animals stayed over the year in the same grazing units. In this case, the only strategy was to devise a supply of forage conserves for the SNGS. Our results showed that, especially in Castile-La Mancha, such a strategy was not fully in operation, with correspondent regional FD. The same occurred in Baixo Alentejo where farmers deal largely by buying external feed supplies.

Another common ground of these systems was their poor economic performance and the need to support the systems with public handouts. This research, however, has not addressed the issue of whether this poor performance is structural or there could be some management alternatives that may improve the economic results without affecting their main environmental assets. This is of importance as the two main assumptions in support of public handouts to these systems are the structural unprofitability, and the one that presumes that these systems may deliver environmental assets not factored in farm prices. The first assumption relates to the content of this report. Our results showed that, under current land use and grazing management practices, the repeal of subsidies would render these systems economically unsustainable. To test the hypothesis of structural unprofitability, the individual farming data collected on each study area should be of use for further modeling on management alternatives. What this research revealed is that subsidies make the difference between gain and loss for many farmers in the study areas and thus, under present schemes, farmers do not have any incentive to look for alternatives that are not yet devised and much less implemented. Further results will show that these alternatives may exist

and that current policy schemes would need to be adjusted for the new practices being implemented (Roeder *et al.*, 2005).

Notwithstanding these common grounds, large differences between study areas were found regarding the policy schemes in practice and the total amounts of handouts diverted to the systems. Although it is common knowledge on the largesse of the EU, our results revealed that the two non-EU countries (Norway and Switzerland) supported our two study areas with larger handouts. In the case of the Tatra Mountains (Poland), the situation regarding public handouts is at an impasse. Current policy schemes of support were devised after liberalization of agricultural markets in Poland, but new schemes, under the EU umbrella, are in the process of being devised and implemented. In this study area, subsidies represented a large amount when stated in relative terms, but this was mostly the effect of a low value of production farming in the Tatra Mountains.

Our results showed the limitation of comparing public handouts in relative terms (OECD, 2001), both between or within study areas. Tatra and Entlebuch, for example, had similar ratio of total subsidies to value of production farming. However, the MU in Entlebuch can be supported as seven times higher when valued in €/ha. In this latter study area, the lowland farm unit and the alpine unit presented similar ratio (around 50%). However, the lowland farm was supported at 10 times higher per area when, paradoxically, it is the alpine unit that concentrates most natural values. Even value of production farming can be artificially inflated by higher prices (an indirect subsidy or handout), as it is the case of milk price in Entlebuch (60% higher than in Bavaria). In this case, an indirect support can be rated as value of production, deflating the ratio.

The main issue regarding public handouts is the lack of a methodological approach at the European level to test how these schemes should be devised, implemented, and controlled. This is a big issue as large amounts of taxpayers money is at stake and farmers' decisions on land use and practices are mostly driven by policy schemes, with corresponding environmental and social consequences. Farming practices within specific systems are restricted by physical constraints such as climate and soil factors, but policy schemes cannot have the same category. We may find sensible alternative farming practices, with economic, environmental, or social assets that cannot be implemented because they are not favored by proper policy schemes. In short, policy schemes should be devised only after proper knowledge of structural, social, and environmental constraints of extensive grazing systems. Our report can be a good example of this approach. Although we have found a common ground of economic unsustainability, the specific schemes for overhauling should be regionally tailored and adapted to specific conditions of our study areas.

We also found differential grounds regarding social inclusiveness and cooperation between the surveyed grazing systems that are usually related to

money poured into the systems. In Northern Sapmi, Entlebuch, and, to a lesser extent, Bavaria, the main functions of the systems were supported and entrenched by the whole population. In other systems, in addition to poor economic performance, we have found a social fragility with institutional and legal frameworks that do not accomplish their functions (Castile-La Mancha) or were almost nonexistent (Tatra Mountains). This makes a point for this sustainability tier to be taken into account when devising policy frameworks (RDP, 2005). Faltering institutions and legal systems should be rebuilt and economic infrastructure improved on these fragile systems.

Farmers' attitudes toward their grazing operations were not monolithic across our study areas. European young farmers are barely enthused about extensive livestock operations, but family turnover was more assured in those study areas such as Northern Sapmi (Norway) and Entlebuch which poured more money into their systems and operated with better grazing infrastructures. In the case of Northern Sapmi, a further cause of stability is the isolation of the area and the cultural ties to the livelihood. Alternative jobs, if available, are often used as supplements (Labba and Riseth, 2007; Nordin, 2006; Riseth, 2006). Just the opposite was occurring in Castile-La Mancha, where the vicinity of Madrid lures many young farmers to alternative jobs in the Spanish capital. Our results showed that, let to their own, these systems may be swept away by the market forces operating under a surrounding environment of better economic and social conditions. This finding supports the EU approach of pouring handouts, but does not support the current policy framework in its functions of integrating these systems in the mainstream economic of developed countries, and stabilizing the rural population in the LFAs of the EU.

Other more market-oriented experts and institutions (Anderson, 2004) support the view of repealing handouts and trade barriers altogether. Our results, however, showed that our main objective should not be simply to eliminate the supply of subsidies but rather to undermine the demand for it. Subsidies should be redirected to the extensive livestock systems and their HNV farmland under Rural Development Policy (RDP) guidelines, and in support of sensible management alternatives that may render these systems more sustainable in the future (Moreira, 2004).

Of the two main threats facing European livestock systems, intensification and abandonment, the latter was more apparent in our study areas. In some study areas, such as Entlebuch and Bavaria, we have found an intensification trend in the lowland farm units coupled with a related abandonment of the low-input and extensive alpine units. In any case, in Europe, there is a common knowledge and corresponding extensive literature on the negative impact of intensification on nature values (Benton *et al.*, 2002; Chamberlain *et al.*, 2000; Donald *et al.*, 2002; Newton, 2004; Ormerod and Watkinson, 2000; Watkinson and Ormerod, 2001). Important policy schemes, such as agri-environmental measures, have been devised and

implemented to mitigate this impact (Oglethorpe and Sanderson, 1999; Oñate *et al.*, 1998; Primdahl *et al.*, 2003), although with mixed effects (Critchley *et al.*, 2004; Kleijn *et al.*, 2006). But what our results showed is that abandonment is the first concerning risk in our less favored study areas. In this case, agri-environment schemes are less suited and rural development plans should be devised with the aims of improving economic profitability and social cohesion for these LFAs. Paradoxically, these areas concentrate a great deal of European HNV farmland (Baldock *et al.*, 1996) and receive much less support than agricultural intensive areas, as shown by our results.

Our results thus showed that the LFAs of the MU were less supported than more intensively used grounds. In Entlebuch, the alpine unit was much less supported than the lowland farms. In Bavaria, premium by area was higher in the lowland farms than in the *Allmende*, although support by wh or LU was not so different In the Tatra Mountains, sheep farmers received handouts for their lowland operation but any incentive for using the clearings of the alpine unit. In Castile-La Mancha, cultivators and pastoralists were paid separately, although they use the same land unit. As being the sheep operation in most danger of abandonment, pastoralists are supported to a much lesser extent than arable farmers. These and many other inconsistencies plagued the EU current schemes of support, mainly because these schemes are horizontal in scale, sector-oriented, and have not being devised taking into account specific structure as well as values and constraints of particular grazing systems.

Rather than seeking to improve a simple rigid general model of policy support, we should be encouraging a more diverse range of economic practices and respecting the different values that they reflect. However, for communication to be transparent, we must all be speaking a common language of economic, environmental, and social assets. From our results, several management goals emerged in support of the main framework:

1. To improve mobility, accessibility, and grazing infrastructures. The main goals of this management scheme would be to facilitate grazing management, relieve pressure on harsh-working conditions, improve spatial distribution of grazing, and fulfill with EU rules on animal management and sanitary rules of slaughters and milk-processing. Our results illustrated that most of our study areas showed constraints regarding these goals, although to a different level. The questions of mobility, accessibility, and poor spatial distribution of grazing were shared at a higher level than the constraints on grazing infrastructure or poor sanitary conditions in milk processing.
2. Promoting proper legal and institutional frameworks. In this case, we found different level of social fragility in our grazing systems, from Northern Sapmi, where social inclusiveness, cooperation, and support attitudes were apparent, to the Tatra Mountains, where even land

property rights or grazing rights were not properly documented or assured. The latter situation was also present in Castile-La Mancha where, although a management institution (LGC) was legally in charge, its operation was failing by lack of managerial and technical support. Our results showed different categories in our study areas regarding natural assets and product values, but also divergences in social values. In this latter case, categories were not an asset but one hazard.

3. Encouraging professional labor supply. Structural harsh environments, on most of our analyzed systems, and failings in grazing infrastructures rendered these extensive systems hardworking. Family-labor and family-business turnover was not assured. Progressively, these systems are more and more relying on external waged labor. Professionalism of present and newcomers should be upgraded to improve the social rating of the herders/shepherds jobs and assure labor supply. This scheme may include the implementation of grazing schools within study areas (Agricultural Education and Extension Center LBBZ Schüpfheim, mountain School Hondrich, and Plantahof GR in Switzerland are good examples).
4. A management plan in support of regional products. Up to now, pouring taxpayers' money to these systems has been justified on the basis of environmental and social assets. However, the perception of these values by the society is somewhat blurred. The general high social rating of these systems could be exploited for marketing of premium products. For this aim to be reached, quality assurance practices should be devised and implemented on maintenance of autochthonous breeds, extensive production methods and fulfillment of EU sanitary, and welfare rules for animals and processing products. Regulatory Councils can be established in pursuits of these practices and promotion of grazing systems and regional products of potential links with nature conservation. Good examples of this development plan are the productions of reindeer meat in Northern Sapmi, alpine cheeses in Entlebuch and *Berner Alpkäse* AOC in Switzerland (cows' milk), Tatra cheeses (ewes' milk), *Alentejano* pigs products and cattle and sheep meat in Baixo Alentejo, and *Manchego* cheese (ewes' milk) in Castile-La Mancha.

But the strong dependence on this pillar of income is very risky since the economic viability of the systems greatly depends on external decisions. A fine example of the low predictability of the political decisions in this sector is the recent development of the EU's rural development policies. Within the framework of the 2003 CAP reform the council intended to strengthen the funding for rural development, but not even 2 years later in fall of 2005 the EU funds for rural development in the EU-15 were greatly reduced (CEU, 2005).

Current state of development for these regional products was far from the objectives devised in this plan. In the Tatra Mountains processing of

alpine ewes' milk did not comply with EU sanitary rules. In Entlebuch, only 7% of alpine units processed cows' milk, and in Castile-La Mancha, although a regulatory council was functioning, attachment to production rules (indigenous breeds and linking to land-based resources) were not assured. Of these two main pillars for indigenous products' assurance, the latter is more at risk. Our results showed a progressive detachment of production methods from land-based grazing resources, as consequence of harsh working conditions on grazing units and higher costs of changing to wage from family labor conditions. The cost of bringing animals to grazing grounds, including waged labor and grazing fees should be lower than income, including value of production and subsidies.

5. An assessment tool that allow, on the basis of available geographic data (CORINE data, biotope mapping, digital terrain models), save upper and lower bounds for acceptable stocking levels for each MU. This would allow to emphasizing the linkage between public payments and the provision of environmental services. In many mountain areas the productivity of pastures varied significantly and to establish a minimum stocking (0.5 LU/ha) makes little sense.

Large-scale extensive systems in developed countries can be categorized as losers within a hyper-competitive economic environment. In dealing with losers, we may assess whether these systems are ''born losers'' (structural or chronic) or there are some alternatives to improve their economic and social performance. Our results supported the view that, although these systems are plagued with structural and physical constraints (harsh climatic conditions, poor soils, mobility, accessibility, steep slopes), much can be done to correct many other nonstructural constraints (insensible policy schemes is probably the most important) in support of alternative management plans.

Most pundits would agree on the requirement to overhaul and modernizing the extensive livestock systems in Europe to refrain the abandonment trend. The question is what path should be chosen to that end. If we remain strongly attached to traditional production rules, more farmers may detach. But if loose rules are devised modernizing would mean increasing number of farmers at the expense of lack of fidelity to extensive principles. At the end, both paths can take place, but customers and taxpayers should be aware of the differences with proper discriminating rules and information channels. It is in this latter task where the modernizing path cannot be questioned.

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