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Mountain Family Farms in Galicia, Spain: Challenges and Strategies

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This article examines recent growth and diversification strategies of mountain farms in the northwest of Spain and the challenges that lie ahead. The data were obtained from a survey of production and household characteristics,

assessing the effect on strategies of the location and the characteristics of the farm and farmer. The small size of farms has influenced farmers' strategies for growth and diversification. Extensification has been pursued by a minority of farms because of their inability to reach viability with limited size. Diversification is low in agriculture and in other activities

linked to the farm, as it is driven by the constraints imposed by resources and age. Consequently, pluriactivity is the more common form of farm diversification despite the limitations of the local economy. Agriculture is in danger of deteriorating further in the medium term, as one third of farms are marginal and in transition to disappearance, and another half of farms are in a fragile situation due to their low income levels. The disappearance of 4 out of 5 farms and a third of agricultural land in the period 1982–2009 has drastically reduced traditional livestock activity.

Keywords: Mountain family farms; farm strategies; diversification; farm adjustment; northwest Spain.

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Introduction

Mountain agriculture today represents 16% of utilized agricultural area (UAA) in the 27 member European Union states (EU-27) and 34% in Spain (European Commission 2013). Mountain areas are defined by their unfavorable topography, typically described by elevation and/or slope, remoteness, and more extreme climate, but this can vary significantly between countries. In the mountains, agriculture faces several limitations, related to the existence of permanent natural handicaps, which reduce production alternatives and result in lower labor and land productivity. Mountain farms are smaller on average than those in lowland areas (Santini et al 2013), and population density is also lower than in lowlands or in the country as a whole (Nordregio 2004).

Difficulties in market integration have led to a severe structural adjustment in mountain agriculture, including a steep decrease in the number of farms, land abandonment, and extreme depopulation (Collantes and Pinilla 2004). Farmland abandonment in mountain areas affects the economic viability of these areas and has environmental impacts (MacDonald et al 2000; Haddaway et al 2013). Compensation policies have been established to offset these limitations, but agricultural incomes remain much lower in mountain areas than in lowlands (Bazin 1990).

This study investigated the adjustments made by mountain farmers in northwest Spain and compared

them with nearby nonmountain areas. Within this framework, we analyzed the growth and diversification strategies adopted by the farmers in recent years and the challenges that lie ahead, and we assessed the effect on strategies of the location and the characteristics of the farm and farmer.

Challenges facing mountain farms

The European Commission (2009) identified the main weaknesses of agriculture in mountain areas as permanent natural handicaps (slope, climate, and altitude), dependency on grazing, land abandonment in certain areas, pressure from urbanization and tourism in other areas, low accessibility and distance from markets, the digital divide, and climate change.

All these threats confront mountain areas and farms with land abandonment and marginalization (MacDonald et al 2000; Brouwer et al 2008) due to the limited agricultural activities that can be developed given natural conditions, the low-input/low-output nature of many agricultural systems, and a limited development of upstream and downstream sectors, restricting access to inputs and markets (European Commission 2009; García-Martínez et al 2009). These limitations result in mountain farms' lower performance potential, productivity, and capacity to accumulate capital (Bazin 1990; Manrique et al 1999), which decrease their income and possibilities for growth and development (Aubert and Perrier-Cornet

2009) and put them at higher risk of abandonment than lowland farms (Latruffe et al 2013).

Accordingly, a decrease in the number of farms and farmland abandonment are wide-ranging phenomena that have occurred throughout Europe in the last decades, even if there are differences between mountain regions (MacDonald et al 2000; Brouwer et al 2008). They occur when the land ceases to generate income and the opportunities for resource adjustment through changes in farming practices and structure are exhausted (Haddaway et al 2013).

Following the designation of areas by Article 18 of Regulation (EC) No 1257/99, the European Commission (2009) has shown that between 1995 and 2007, the structural evolution of mountains has followed the same patterns as in nondisadvantaged areas: an increase in farm size arising from a reduction of the number of holdings (−18% in mountain areas and −21% in non-less favored areas [LFAs]) was not accompanied by significant changes in the UAA (no change in mountain areas and a 7% reduction in non-LFAs). Nevertheless, in half of the EU member states, especially in southern states, the greater physical size of farms in mountainous areas compensates for their lower productivity per hectare.

Economic data more clearly show the risk of marginalization for mountain areas. Mountain farms amount to 17.8% of total EU-27 farms, but the economic average value of their production at the farm gate is considerably lower, at 11.5% (Santini et al 2013). In terms of farm net value added per agricultural working unit, the average mountain farm income is 27% below the average registered in nondisadvantaged areas (European Commission 2009). These differences are especially relevant in milk farms, where the average income in mountain areas is significantly lower than in other areas, due to both higher production costs and remoteness, which increases the cost of access to markets.

The depopulation of recent decades has been accompanied by a reduction of livestock caused by the retirement of smaller farms and the abandonment of some traditional practices such as surveillance of grazing livestock (Zervas 1998; García-Martínez et al 2009). At the same time, the important adjustment process induced by establishment of milk quotas and territorial concentration of deliveries in the dairy chain affected production management, leading to a partial substitution of the final product of beef cattle from weaned to fatted calves kept indoors and fed intensively, and especially to a decrease in dairy production (Olaizola et al 1999).

The consequent undergrazing is another aspect of land abandonment, occurring inside the farm. It has resulted in degradation of pastures by allowing scrub and other unpalatable species to develop, reducing the grazing capacity of these areas (Zervas 1998). There may be inside-the-farm abandonment of marginal lands and simultaneous intensification in the use of higher-quality

or more accessible land as a way of rationalizing activities at the farm scale. Land abandonment also has environmental consequences for biodiversity, landscape, and soils, such as increasing the risk of soil erosion, landslides, and wildfires (MacDonald et al 2000).

In mountain areas, forest has great importance and can make up more than 90% of land use in some municipalities. Especially in southern Europe, forest fires are an increasing threat that accentuates the problem of marginalization (Brouwer et al 2008; European Commission 2009). Undergrazing and lack of management of former pastures contribute to the expansion of wildfires (Corbelle et al 2012). In contrast, mountain agriculture can play an important role in fire prevention, as the maintenance of extensive livestock systems reduces the spread of scrub and therefore the incidence of wildfires (European Commission 2009).

Finally, climate change has been recognized by the European Commission (2009) as a new threat for mountain areas. The risk of farmland abandonment in association with climate change is particularly sensitive in mountains because of increased exposure to natural hazards, low productivity, and reduced possibilities to adapt to new farming practices.

Farming adjustments

In order to overcome the challenges that mountain areas confront, mountain farms may undertake a process of adjustment. Agricultural adjustment may reduce the risk of land abandonment by maintaining the viability of farms (MacDonald et al 2000), but the structure of farming evolves continuously in response to changes in the conditions faced (Evans 2009). Drivers of these changes can be divided into 4 groups: economic environment, local and regional factors, farm and farmer characteristics, and public policies.

The economic environment includes factors directly related to agriculture, such as product prices, the relation of prices to inputs, and the relation between inputs such as labor to capital and technology (Breustedt and Glauen 2007). In general, the economic environment for mountain farms is less favorable than for others. The EU includes mountains in its definition of LFAs, representing 15% of UAA and 18% of agricultural holdings, but only 12% of the economic potential (European Commission 2009).

Local and regional factors include farm location, which determines production potential and access to inputs and output markets, as well as to local economic conditions such as opportunities for off-farm work (Smithers et al 2004; Roberts et al 2013). Almost all strengths that have been identified for mountain areas are related to local conditions (European Commission 2009): quality products; cultural landscapes; high ecosystem values (Baldock 1998), pluriactivity and farm

diversification; and innovation and local cooperation potential.

Farm characteristics such as size, orientation, productivity, and ownership or tenure of land influence adaptation patterns. Studies focusing on structural adjustment at an aggregate regional level have found higher rates of growth and survival in larger farms (Weiss 1999; Glauben et al 2006; Breustedt and Glauben 2007). However, the continued survival of small farms seems to be closely linked to economic strategies that allow them to compensate for their smaller amounts of land and capital by developing the value of work by family members (McKinnon et al 1991) and stabilizing their income. These strategies include developing higher-value products (by using organic farming techniques under quality-labeling frameworks), developing on-farm activities that are complementary to agricultural production, and off-farm employment (Bel et al 1993). Socioeconomic characteristics of farm operators and their families (age, education, managerial ability, and stage in life cycle) are major reasons for changes in farm structure over time (Bel et al 1993), and there is interaction between the factors relating to the farm economy, the farm business, and the household.

In the EU, establishing support for farming in LFAs in 1975 marked a major change in the nature of the Common Agricultural Policy (CAP) by introducing regional categories (Dax 2005) and addressing mountain areas specifically, taking account of the range of geographical differences in the production difficulties of EU agriculture. Since the reform of the Structural Funds in 1988, CAP commodity market support has gradually been decreased, while, on the other hand, the environmental implications of policy measures were increasingly emphasized. In the context of rural development programs since 1999, several measures were put in place searching for a bottom-up approach and for integration in the application of development policies in rural areas.

The most common instrument used in this context, but not the only one, was compensatory payments. Subsidies are essential for the maintenance of all mountain livestock systems (Benni and Finger 2013), but this is not enough to maintain population in rural areas (Bel et al 1993; Dax 2005). The economic viability of farms depends as much, if not more, on the competence of the operators, their technical choices, investment options, and family characteristics and values (Bel et al 1993; Chatellier and Delattre 2005). Agricultural subsidies may have slowed down structural change and limited the abandonment of farms (Breustedt and Glauben 2007). They increase farm profitability (favoring survival) and relax credit constraints (enabling expansion) (Latruffe et al 2013). Although this intervention may be detrimental to agricultural competitiveness, it may favorably affect rural areas' environmental conditions and socioeconomic

vitality in 2 ways: first, by helping to prevent land abandonment, and second, by helping farms in isolated areas survive, contributing to the maintenance of a critical population mass necessary for the provision of public services and maintenance of cultural traditions (Latruffe et al 2013).

However, other policy measures have had more influence on structural change in mountain areas (Bel et al 1993), such as price and modernization policies. Several policy instruments that directly or indirectly encourage farm diversification have been implemented in recent decades: agri-environmental programs, other rural development measures (investment and setting up of premiums), market premiums, and other systems of transfers to rural areas (Dax 2005). Although the implementation of such measures in the EU was not homogeneous among member states, there is a significant connection between implementation and the development of new activities by farms (European Commission 2008).

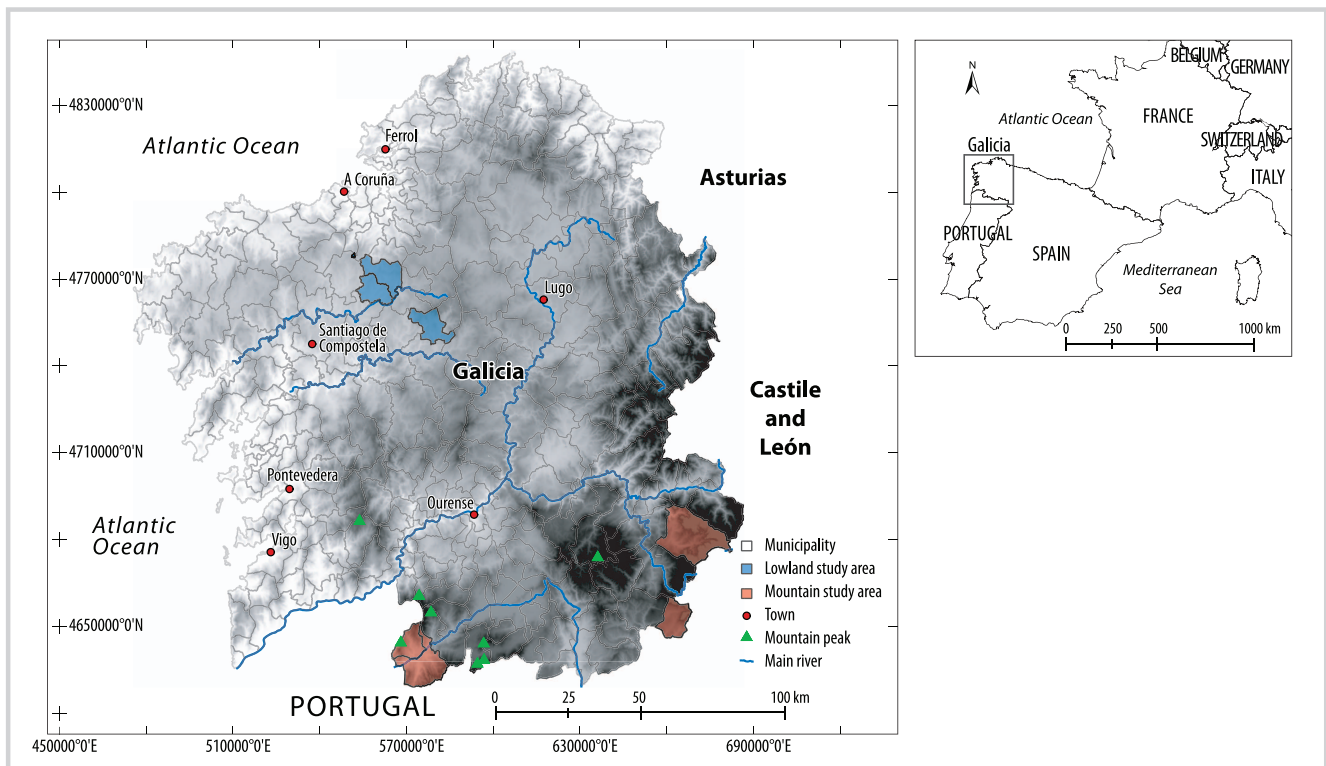
Methods

Data used in this article come from a survey conducted in the first half of 2008 of farms in 2 areas in the Galician region in northwest Spain, selected as representative of mountain and lowland areas. The sample was composed of 283 farms from a population of 1435, of which 23.7% were in the mountain area. The size of the sample was calculated by area (mountain and lowland) according to stratified random sampling with proportional affixation of the strata (herd size) and minimum variance (Neyman) (Pérez and Santini 2007), for a confidence level of 95% and a sampling error of 5%, utilizing the complex simple SPSS function (Siller and Tompkins 2006). All surveyed units can be considered family farms; most have single ownership (94.5%), and the rest are owned by partner societies composed of members of the same family, although in a few cases, family members live in different houses, constituting separate households.

A questionnaire was used to obtain information on the productive characteristics of farms, the farmers and their families, household revenue, decisions on strategy taken in the last 5 years and planned for the future, as well as participants' views on current trends in agriculture and on local factors that limit their activity. The strategies farmers reported were grouped into two categories: growth and diversification. These are discussed in more detail in the Results section.

A production typology was established using a hierarchical cluster analysis (the Ward method) to obtain a new factor with socioeconomic characteristics of the farms (Hair et al 1999). The general linear model with a complex sample function, used in the characterization of location (mountain or lowland), farm and farmer characteristics, and strategy, is a univariate analysis that

FIGURE 1 Study areas in the Autonomous Community of Galicia, northwestern Spain. (Map by Manuel Francisco Marey Perez)



determines the existence of significant differences in means. Finally, we studied the relationship between location and farm characteristics on the one hand, and farming strategies on the other, by means of a multivariate binary logistic regression analysis with a complex sample function. The reference categories for the independent variables were the lowlands for location and the marginal group for typology (Bender and Grouven 1998).

Study area

Galicia is a region with most of its territory (58%) classified as predominantly rural (European Commission 2013). Mountain and LFAs cover 54% of UAA in Galicia, which is higher than the Spanish and European averages (34% and 16%, respectively). They occupy a quarter of the territory but have only 2.4% of the population. After losing more than half of their inhabitants in the period 1981–2011, their average population density is about 10 inhabitants/km² (compared to 23 on average for Spanish rural areas). In Galicia, an intense structural adjustment led to the disappearance of two thirds of farms between 1982 and 2009. Of the total land released by the disappearance of farms, over half was abandoned or was put to nonagricultural uses (forestry or urban development), which resulted in a sharp decline in the

total area occupied by farms and has limited the increase in size of farms that remain active. This dynamic was similar in mountain areas, except for a greater decrease in cultivated land and a further increase in land devoted to pasture (López et al 2013).

The mountain area that was the subject of this study is made up of 4 municipalities, classified as mountain, located in the southern part of Galicia at the border with Portugal, at altitudes from 800 to 1400 m (Figure 1). The lowland area under study is made up of 3 municipalities classified as other LFAs, with altitudes from 300 to 500 m, located in the middle of a major livestock-raising area.

The mountain area has a low population density (8.8 inhabitants/km²), which is one fifth that of the lowland area. Migration to urban areas and a high number of elderly people have resulted in a loss of more than half of its 1981 population. The percentage of people with a professional occupation in the total population (28%) is about 10 points lower than that of the lowland area, but it is higher than Galician and Spanish predominantly rural areas as a whole (15% and 7%, respectively), of which 18% were devoted to agriculture in 2001. Local job opportunities outside agriculture are also lower than in the lowland areas, consisting mostly of self-employment; there are only 6 companies with employees per 1000 inhabitants, nearly one fourth of that the lowland area (CMR 2011; IGE 2012).

TABLE 1 Characteristics of farms by location (mountain and lowland).

Characteristics of the study areas	Mountain area ^{b)}	Lowland area
Total number of farms	341	1094
Livestock units ^{ns} (average units)	13.1	25.3
Dairy cows ^{***} (average units)	0.45	14.8
Utilized agricultural area ^{**} (average ha)	21.5	11.8
Number of family members ^{***} (average units)	2.6	3.6
Owner's age [*] (average years)	55.6	50.9
Revenues ^{***} (from 1 with < €6000 to 8 with > €120,000) ^{a)}	3.0	4.4
% of revenues from agriculture ^{***}	23.9	45.1
% of revenues from subsidies ^{ns}	9.5	6.6
% of revenues from pensions ^{***}	45.4	23.7
% of revenues from other gainful activities ^{ns}	21.2	24.6

^{a)}€ 1 = US\$ 1.26 on 2 October 2014.

^{b)}Significance values are general linear model significance (F Wald).

*10% ($P < 0.1$).

**5% ($P < 0.05$).

***1% ($P < 0.01$).

^{ns}Not significant.

The value of agricultural production in the mountain area, estimated by the total standard output (average value of production at the farm gate), is low, at €12,840/km² (1 euro = US\$ 1.26). This value is equivalent to 6% of that obtained in the lowland area, due to the smaller size and density of farms. Part of this difference is due to the current land use; in the mountain area, only one tenth of land is devoted to crops and meadows, and one third is devoted to forestry; the rest is underutilized, abandoned, or occupied by dams. In mountain municipalities, land held in common for grazing and forest production amounts to 56.7% of total area. This is a very important area, which is more and more underused due to the abandonment of farms and the decrease in number of cattle (INE 2012).

Livestock provides 95% of the value of production in both areas. However, in the last 3 decades, there has been a differentiated reduction in the number of livestock farms, falling at an annual rate of 6.5% in the mountain area, which is more than double the rate in the lowland area. This is the result of a sharp reduction in smaller farms and an increase in larger ones concentrated in the lowland area with less UAA per farm (Table 1).

Results

Farm differences by location

Mountain farms present significant differences in productive characteristics, not all of which can be explained by the unfavorable natural conditions. Size, measured by number of livestock units, is half that in the

lowland area, although UAA is almost twice as high. These differences are caused by lower land productivity, but some are due to a more extensive production system with a stocking rate of 0.6 livestock units per hectare. There are also differences in orientation to beef cattle and sheep, with only a minority of mountain farms having dairy cows, which is the main activity in the lowlands (Table 1).

Differences in family characteristics are also significant. Average family size is lower in mountain farms, while the owners are older. The level and composition of household revenues reflect these differences in productive and family characteristics. Revenues, and the percentage contributed by agriculture, are lower in mountain farms, which instead have a greater reliance on pensions. Differences in other gainful activities and in subsidies are not significant, although subsidies make up a greater proportion of agricultural revenues (39.7%) in the mountain area.

Farm characteristics

In order to separate the effect of location from the characteristics of the farm and family, a typology of farms was established (Table 2), based on variables related to production, family, and revenue, taking into account the existing interrelationships between farm and farmer characteristics. Cluster analysis distinguished 4 groups of farms: high, medium, low, and marginal. The first 2 groups were determined by their greater revenues and agricultural activity, especially in milk and to a lesser extent in beef cattle, which contributed 85% of revenue if

TABLE 2 Typology of farms.

Distribution of farms	Agricultural activity ^(c)			
	High	Medium	Low	Marginal
% of all farms	1.3	26.3	56.6	15.8
% of mountain farms	1.9	15.0	48.0	35.1
% of lowland farms	1.0	29.8	59.4	9.8
Farm characteristics				
Livestock units ^(a) (average units)	205.0 _d	47.0 _c	12.5 _b	2.5 _a
Dairy cows (average units)	88.4 _d	29.7 _c	4.4 _b	0.0 _a
Utilized agricultural area ^(a) (average hectares)	37.9 _c	25.3 _c	10.6 _b	5.9 _a
Number of family members (average units)	5.4 _c	3.9 _b	3.3 _{a,b}	2.7 _a
Owner's age ^(a) (average years)	47.7 _a	43.5 _a	53.2 _b	62.6 _c
Revenues (from 1 with < €6000 to 8 with > €120,000) ^(b)	7.8 _d	5.5 _c	3.7 _b	2.6 _a
% of revenues from agriculture ^(a)	85.3 _d	72.1 _c	32.9 _b	8.8 _a
% of revenues from subsidies	8.1 _{b,c}	12.2 _c	6.3 _b	3.0 _a
% of revenues from pensions ^(a)	3.8 _a	8.7 _b	22.3 _c	88.1 _d
% of revenues from other gainful activities	2.7 _b	6.9 _c	38.5 _d	0.0 _a

^(a)Cluster variables.

^(b)€1 = US\$1.26 on 2 October 2014.

^(c)Different subscript letters indicate belonging to a specific group that differs in average values from the other groups at 5% significance. For all items: general linear model significance (F Wald) is 1% ($P < 0.01$).

subsidies are included. The third group complemented reduced farming activity with off-farm work, which contributed nearly 40% of revenues. Thus, pluriactivity is related to smaller farms with low agricultural revenues, a situation which pushes people to complement incomes with other activities when possible. The fourth group of farms is defined by marginal economic status, because revenue depends on retirement pensions received by the owner or other family members.

Owners are younger and below 50 for the first and second groups and older in the other 2 groups; family size is also smaller in the latter groups. Only 17% of mountain farms depend on agricultural activity, while nearly half are small farms with other gainful activities, and the remaining 35% are marginal. By contrast, in the lowland area, there are twice as many farms classified as dependent on agricultural activity.

Farm strategies

We divided strategies followed in recent years into 2 categories: growth and diversification. In the growth category (Table 3), 4 strategies were identified: intensification, extensification, reduction of agricultural activity, and no strategy. Farms that followed an

intensification strategy have a significantly greater productive dimension and income level, as well as younger owners, while those that have not had a defined strategy and especially those that have reduced their activity are smaller in size and revenues and depend more on pensions.

Almost 60% of mountain farms have not had a defined growth strategy in recent years; another 17% have had a strategy of reduction. The remainder of farm strategies are distributed between intensification and extensification, with a strikingly low percentage choosing the latter. In the lowland area, there are more defined strategies; 40% of farms have intensified and 20% have extensified their production, in part induced by policy requirements for receiving grants or seeking a reduction in work.

Logistic regression analysis showed a significant effect of location on the intensification and no-strategy types, with a lower likelihood of intensification and a higher one of no strategy in the mountain farms. Farms with no strategy are more dependent on subsidies, which make up around 31% of agricultural income. The 3 groups with high, medium, and low activity have a higher likelihood of pursuing an intensification strategy and a lower

TABLE 3 Characteristics of farms by growth strategy.

Distribution of farms	Past growth strategy ^{b), c)}			
	Intensification	Extensification	Reduction	No strategy
% all farms	33.9	17.8	20.6	27.6
% mountain farms	13.8	10.6	16.8	58.7
% lowland farms	40.3	20.0	21.8	17.9
% high activity	81.2	0.0	0.0	18.8
% medium activity	63.8	11.2	9.5	15.5
% low activity	28.2	25.8	20.1	25.9
% marginal	1.1	1.3	42.8	54.8
Farm characteristics				
Livestock units ^{***} (average units)	42.7 _c	19.3 _b	5.7 _a	11.9 _b
Dairy cows ^{***} (average units)	25.5 _b	7.9 _a	1.6 _a	3.7 _a
Utilized agricultural area ^{***} (average hectares)	20.5 _b	15.3 _b	6.9 _a	10.7 _b
Number of family members ^{***} (average units)	4.1 _b	3.4 _{a,b}	2.7 _a	2.9 _a
Owner's age ^{***} (average years)	44.1 _a	53.7 _b	62.1 _c	52.8 _b
Revenues ^{***} (from 1 with < €6000 to 8 with > €120,000) ^{a)}	5.4 _c	3.9 _b	3.0 _a	3.2 _a
% of revenues from agriculture ^{***}	55.0 _b	41.7 _a	28.3 _a	29.3 _a
% of revenues from subsidies ^{***}	8.6 _b	5.9 _a	4.3 _a	9.2 _b
% of revenues from pensions ^{***}	10.1 _a	19.1 _a	42.5 _b	48.0 _b
% of revenues from other gainful activities ^{ns}	26.3 _a	33.2 _a	24.8 _a	13.4 _a

^{a)}€1 = US\$1.26 on 2 October 2014.

^{b)}Significance values are general linear model significance (F Wald).

^{c)}Different subscript letters indicate belonging to a specific group that differs in average values from the other groups at 5% significance.

*10% ($P < 0.1$).

**5% ($P < 0.05$).

***1% ($P < 0.01$).

^{ns}Not significant.

likelihood of reduction than the marginal farms. The likelihood of extensification is higher in medium- and low-activity farms (Table 4).

For the second category, diversification, 4 strategies were identified (Ilbery and Bowler 1998): agricultural, for farms practicing either an agricultural activity or a nonagricultural one using farm resources; pluriactivity, for off-farm work by the holder of the farm or the holder's spouse; both; and neither.

The level of diversification was low, with only a fifth of mountain farms practicing an agricultural diversification strategy and another 25% carrying out off-farm work. In lowland farms, there was more pluriactivity but less agricultural diversification. These trends were confirmed by logistic regression analysis, which detected a significant effect of location, with mountain farms having a lower

probability of pluriactivity and greater likelihood of agricultural diversification (Table 4).

Pluriactive farms tended to have a somewhat lower productive dimension, and subsidies played a smaller role in their income; there were no consistent differences between diversified and other groups in the farm characteristics. Subsidies represented around 13% of diversified farms' incomes (Table 5).

Discussion and conclusions

The study area has common characteristics with other mountain areas, especially in southern and eastern Europe (Buchenrieder and Möllers 2009), where livestock production systems are based on beef cattle and to a lesser extent on sheep. In all of them, there has been a

TABLE 4 Relationships between growth and diversification strategies.

Factor ^{a)}	Category	Exp β for growth strategy ^{b)}			
		Intensification	Extensification	Reduction	No strategy
Zone	Mountain	0.32***	ns	ns	5.3**
Activity level	High	435.7***	0.00***	0.00***	ns
	Medium	125.3***	8,4**	0.09**	ns
	Low	28.4***	23.8***	0.24**	0.44*

Factor ^{a)}	Category	Exp β for diversification strategy ^{b)}			
		Agricultural diversification	Pluriactivity	Both	Neither
Zone	Mountain	2.5*	0.60*	ns	ns
Activity level	High	16.9**	ns	ns	0.06**
	Medium	ns	3 × 108*	ns	0.10**
	Low	4.6*	1 × 109**	ns	0.02***

^{a)}Different categories of zones and activity levels are compared with the lowland zone and the marginal activity level, respectively.

^{b)}Multivariate binary logistic regression significance (F Wald).

*10% ($P < 0.1$).

**5% ($P < 0.05$).

***1% ($P < 0.01$).

^{ns}Not significant.

sharp decline in farming and abandonment of land in recent decades, with reduced biodiversity and increased vulnerability to fire (Collantes and Pinilla 2004; López et al 2013). However, the severity of these changes was higher in our study area, with a little development of other activities such as tourism, which plays an important role in the local economy of the Pyrenees and Alps (Brouwer et al 2008). This suggests that demand for tourism may not always be available.

Mountain farms are more likely to maintain a no-growth strategy and less likely to pursue intensification. They are also more likely to show agricultural diversification and less likely to be pluriactive. The greater age of farmers, the smaller size of mountain farms and families, and a reduced reliance on agricultural income are all factors related to a mature stage of the life cycle, which explain the lack of a defined strategy (Inwood and Sharp 2012).

The small size of mountain farms also explains the lack of significant difference from lowland farms in terms of extensification, as the limited land resources and the land's lower productivity are insufficient to achieve farm viability by this route in the prevailing systems of production with beef cattle and sheep (Manrique et al 1999; García-Martínez et al 2009). Although agricultural diversification is higher than in lowland farms, its level is low, as less than a fifth of mountain farms are involved. Possible causes of this include small farms' limited capital for structural diversification and the greater age of farm

owners, which make them less likely to make changes in agricultural production (Meert et al 2005; European Commission 2008). The lower pluriactivity on mountain farms may be related to existing limitations in the local economy, with fewer employment opportunities due to the small number of local companies and the greater difficulties in accessing jobs outside the area (Smithers et al 2004; Roberts et al 2013). Thus, pluriactivity and other forms of diversification are not a major supplement to the agricultural income of mountain farms, in contrast to the findings of other studies (Kinsella et al 2000; Meert et al 2005). In our case, a major supplement is provided by the retirement pensions received by members of households; 42% are over 65 years old.

Farm characteristics also help explain recent farming strategies. Farms with high agricultural activity are more likely to intensify, and marginal farms are more likely to follow a reduction strategy, while extensification tends to be higher at both low- and medium-activity farms. The intensification path of growth, followed by the minority of mountain farms with high agricultural activity, seems to be associated with the general trend of intensification practiced by the dairy farms that make up this group. The higher probability of extensification on the part of the low-activity group relative to the medium-activity group can be seen as a lesser commitment by these farms to agriculture, substituted by other activities. Diversification strategies are also affected by farm characteristics; the medium- and low-activity groups have a greater

TABLE 5 Characteristics of farms by diversification strategy.

Distribution of farms	Diversification strategy ^{b), c)}			
	Agricultural diversification	Pluriactivity	Both	Neither
% all farms	8.9	30.2	5.1	55.8
% mountain farms	14.1	19.0	6.4	60.5
% lowland farms	7.2	33.7	4.7	54.4
% high activity	34.8	0.0	5.2	60.0
% medium activity	5.0	16.2	5.2	73.6
% low activity	11.5	45.8	6.4	36.3
% marginal	3.8	0.0	0.0	96.2
Farm characteristics				
Livestock units ^{ns} (average units)	27.1 _{a,b}	17.3 _a	32.5 _b	23.5 _{a,b}
Dairy cows* (average units)	11.4 _{a,b}	7.0 _a	12.9 _{a,b}	13.7 _b
Utilized agricultural area ^{ns} (average hectares)	18.5 _a	11.3 _a	22.4 _a	14.1 _a
Number of family members** (average units)	3.2 _a	3.5 _{a,b}	4.1 _b	3.2 _a
Owner's age*** (average years)	45.1 _a	49.1 _{a,b}	44.9 _a	55.4 _b
Revenues** (from 1 with < €6000 to 8 with > €120,000) ^{a)}	3.6 _a	4.1 _a	5.3 _b	3.9 _a
% of revenues from agriculture***	36.4 _{a,b}	31.0 _a	37.4 _{a,b}	45.7 _b
% of revenues from subsidies***	12.7 _c	5.1 _a	6.6 _{a,b}	7.9 _b
% of revenues from pensions***	42.5 _b	11.3 _a	7.3 _a	38.2 _b
% of revenues from other gainful activities***	8.3 _a	52.6 _b	48.7 _b	8.15 _a

^{a)}€1 = US\$1.26 on 2 October 2014.

^{b)}Significance values are general linear model significance (F Wald).

*10% ($P < 0.1$).

**5% ($P < 0.05$).

***1% ($P < 0.01$).

^{ns}Not significant.

^{c)}Different subscript letters indicate belonging to a specific group that differs in average values from the other groups at 5% significance.

likelihood of pluriactivity, while agricultural diversification tends to be more likely in the upper- and lower-activity groups. The greater pluriactivity of small farms is related to their greater need to supplement household income (European Commission 2008; Aubert and Perrier-Cornet 2009). Agricultural diversification activities have different origins in the 2 groups; in the low-activity group, they are a response to agricultural policies (agri-environment programs and aids to cattle breeds in danger of extinction), while in the high-activity group, they represent initiatives taken by farmers.

The existence of a minimum density of farm population, farmers' integration in off-farm labor markets, diversification, and agricultural and regional policy aid have been the determining factors for

achieving regional objectives of long-term sustainability in isolated regions such as mountain areas in Europe (Aubert and Perrier-Cornet 2009; Shucksmith and Ronningen 2011; Benni and Finger 2013; Latruffe et al 2013). None of these factors appears to be well developed in the mountain area that was the focus of this study. The level of support for policies is low compared to those found in other studies (Perret et al 1999; Chatellier and Delattre 2005; Santini et al 2013). Subsidies amount to about €1220 per farm, which is a fifth of that obtained by lowland farms, due to the greater weight of direct payments (the first pillar of the CAP).

Limited rural development measures have been established both at the farm level and the county level by leader program initiatives. Agri-environmental schemes

are limited in the studied area to endangered breeds of beef cows that help extensive systems to survive. In fact, diversified farms have a significant amount of subsidies in their income, but so do those with no strategy. This shows the difficulty in these LFAs of elaborating a development strategy, as the local economy lacks other productive activities and services, is affected by severe depopulation and aging, and offers few employment opportunities. The lack of a labor force puts at risk the land management of extended communal areas, counteracting productive initiatives (López et al 2013).

The mountain study area is on the periphery of the periphery. In such cases, overcoming economic and environmental limitations due to isolation is the major challenge. The weak agricultural structure of this mountain area, characterized by a low density of small farms and aged farm owners, is in danger of deteriorating further in the medium term given past farming strategies.

One third of farms classified as marginal are in a state of transition to disappearance due to the advanced age of farm household members. Half of the farms in the low-agricultural-activity group are in a fragile situation, due to their low level of income. Members of this group should add value to their products, diversify into other activities, or pursue pluriactivity. This leaves a third group composed mostly of farms with a medium level of

agricultural activity and with limited land resources. Their priority is to increase their size, primarily by increasing the land available for livestock production based on their own resources and becoming less dependent on purchased feed. The increase in farmland should come from abandoned farms and from the land held in common but currently not used in farming.

This study suggests that a clear strategy for farms in mountain areas, which takes advantage of the area's identified strengths, is unlikely to emerge. This may be attributed to the aging of the population, the macroeconomic environment, and a lack of effective policy instruments.

Policy instruments should help farms to find new ways of using their resources and overcoming isolation. It has been said that farm strategies to valorize these areas' cultural and natural resources must be supported by collective and policy action in order to overcome demographic exodus by attracting economic activities and retaining population. In regions with such low population densities, the challenge is attracting population or at least maintaining economic activities that preserve high natural values (HNV) for the whole population. Agriculture and forestry are still the most important activities that could generate incomes and contribute to sustainable development of such isolated areas.

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