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Abstract

Better aligning agriculture and environmental policies is an important issue for Mediterranean areas. Minimizing conflicts between the two sectors requires better understanding farmers' concerns. Using survey data among a sample of livestock farmers in the French Mediterranean Alps, we examine the main constraints they are confronted with. While France has adopted environmental policies aimed at the conservation of natural habitats and wildlife, which have contributed to a "rewilding" of mountains, farmers' responses suggest that the growing presence of wolves is a major concern, in addition to institutional and market-related constraints. Given that grassland changes, notably agricultural land abandonment in Mediterranean areas, is considered as problematic for its consequences on agriculture, biodiversity and landscape management, we examine whether the constraints perceived by farmers are related to land abandonment. Applying a probit regression to our survey data, we show that farmers' perception of the wolf's presence is positively associated with the level of abandonment of alpine grasslands. It is the only perceived constraint significantly associated with land abandonment. Our results have implications for the design of land use policies to support the permanence of mountain farming and to help livestock breeders confront their particular constraints.

Keywords: mountain farming, farmers' constraints; grasslands abandonment; wilderness; wolf.

1. Introduction

Land abandonment within Europe has been a contentious issue in the literature. Definition of relevant indicators and insufficient data for rigorous measurement of trends and drivers have underlain the academic debate (Terres et al., 2015). Yet, evidence from mountain and remote lowland areas suggests that mountain farming in Europe is at a high risk of abandonment over the next 20 to 30 years (Terres et al., 2013; European Commission, 2011; FAO, 2006; NORDREGIO, 2004). This would cause a major transformation of livestock farming systems and their landscapes (Querini and Bizzarri, 2009), with biodiversity and cultural losses (Beilin

et al., 2014; Roura-Pascual et al., 2005). In France's Mediterranean Alps, the 2010 agricultural census revealed a contraction of alpine agriculture by 30% over a 10-years period (Agreste, 2013a, 2013b). Biophysical conditions and the effect of remoteness are viewed as fundamental determinants of land abandonment (Brouwer et al., 1997; Strijker, 2005; Gellrich et al., 2007).

Over the last decades, economic globalization and regional integration have deeply transformed market conditions affecting farmers (Beilin et al., 2014; Meyfroidt et al., 2013). On one hand, agricultural policy incentives have positively influenced decisions to maintain mountain farming (Renwick et al., 2013). On the other hand, agricultural and nature preservation policies, particularly measures for which aid is relatively untargeted, have not been sufficient to prevent further decline in mountain agriculture and biodiversity (MacDonald et al., 2000). Mountain agriculture has been declared of capital importance by the European Union (EU) and governments of several countries with a long-standing tradition of protecting their agricultural sector. Multiple agricultural and environmental policies have been established to support economic activities in mountains and farmers' role in biodiversity conservation. However, the effects of some EU environmental policies may have been counterproductive in preventing, and perhaps redressing the trends of land and farm abandonment observed since the 1970s.

This could be the case with "rewilding" policy initiatives, which aim to foster large-scale land use change towards a wilder nature (Helmer et al., 2016). Well before "rewilding" became a policy, many factors facilitated the emergence of ecological and institutional conditions favourable to the recovery of wildlife and wilderness. Conservation of European wildlife and natural habitats was enhanced by national and European legislations like the Bern Convention of 1982 and the Habitats Directive of 1992 (EEC, 1981; Boitani and Linnell, 2016). The establishment of Nationally Designated Protected Areas, though not always created with the intention of conserving habitats and the species that inhabit them, have also favoured the protection of remote and low population density mountain regions (Navarro and Pereira, 2016). A mismatch between biodiversity conservation and the permanence of mountain agriculture, particularly traditional extensive farming, seems to persist in some places (Henle et al., 2008).

Several species, such as large carnivores, have benefited from restoration of their habitat (Keenleyside and Tucker, 2010). Biodiversity conservation policies have contributed to an increase by about 19% of the wolf population, mostly in the Mediterranean Alps and more recently in lowlands (Duchamp and Marboutin, 2016). In France, the wolf was seen again in 1992 as a result of animal migration from Italy, after having disappeared since 1930. Wolf hunting was banned until 2016 given the country commitment to European conventions for nature conservation. France signed the Convention on the Conservation of European Wildlife and Natural Habitats (known as the Berne Convention), where the wolf is included in Appendix II as a strictly protected species. It also adhered to the Council Directive 92/43 EEC on the conservation of natural habitats and wild flora and fauna (referred to as the Habitats Directive), where the wolf is listed in Annex II (species of community interest whose conservation requires the designation of special areas) and Annex IV (species in need of strict protection). France has also been proactive in establishing national and regional parks, which could have favoured indirectly the presence of carnivores in areas where extensive herding has traditionally taken place. The dispersal of wolves throughout the Mediterranean Alps has increased the risk of wolf attacks on livestock and therefore reduced the space for traditional pastoralism (Vincent, 2011; Meuret et al., 2002). A 2017 survey identified 360 wolf units, which represents a 23% increase compared to the 2016 registry of wolves (Garric, 2017). Protests by farmers whose herds suffered from wolf attacks led to compensation measures such as those enabled by the Life-loup programme (Duchamp et al., 2004). In 2017, a decree from the Ministry of Ecological and Solidary Transition has allowed for tightly controlled, targeted culls (a maximum of 40 units per year, only in self-defence).

According to actors from the farming sector, changes in land use and farm management induced by the presence of wolves have largely been ignored by policy.[1] Policies to address the wolf presence have mainly focused on managing *a posteriori* wolf-related damages on livestock. In France, for example, even though an average of 1940 wolf attacks per year (causing circa 7200 dead or wounded sheep) were compensated between 2010 and 2015 (costing an average of circa 2200 million euros per year) (MEEM, 2016), farmers are forced to change their livestock management practices to reduce the risk for about one million sheeps grazing on alpine pastures in summer. Concerns about the overall impact of rewilding the

[1] Personal communication in interviews with officials from the School of Shepherds at the Domaine du Merle at PACA and experts from INRA-Avignon (Interviews, 2014).

mountains on land abandonment and economic activity have therefore been raised (Garde and Meuret, 2017; Vincent, 2011).

The first objective of this paper is to understand farmers' perception of the main constraints to their activity in the French Mediterranean Alps. In particular, we explore the effects of agricultural policies (i.e., farmers' perceptions of constraints to productive activities) and environmental policies (i.e., farmers' perceptions of the rewilding of mountain landscapes) based on a survey of livestock farmers. The second objective is to examine whether the farmers' perceived constraints are associated with current trends in semi-natural grasslands area.

Potential tensions between biodiversity conservation and agricultural activities in landscapes dominated by 'high nature value farming systems',[2] such as those found in the Mediterranean Alps, need to be managed (Alard et al., 2003; Sancho Comins et al., 1993). Some of the impacts of agriculture on nature conservation are the fragmentation of landscapes, breaking formerly contiguous wild species populations and habitats, massive conversion of wetlands, and threats to biodiversity hotspots (Scherr and McNeely, 2008; Schuyt and Brander, 2004; Myers et al. 2002). High nature value farmlands are most prevalent in less productive areas, for example in southern Europe and mountainous regions (EEA, 2004). It has been argued that some of these areas would be suitable for wildering nature (Chapron et al., 2014).

So-called "marginal areas" hold biodiversity (Kelly et al., 2015) and play an important role in mountain conservation (Dengler et al., 2014). Previous studies have shown that land abandonment is less prevalent in high- compared to medium-altitude mountain areas (FAO 2006; Hinojosa et al., 2016a). Farming populations express a high attachment to their mountain environment despite its biophysical disadvantages (Garde and Lasseur, 2014; Hinojosa et al., 2016b). High nature value farming systems have become a focus for nature conservation and countryside management in Europe. Being dependent on a regular use, they are often associated with pastoralism and extensive livestock grazing (O'Rourke et al., 2016). Recognition of the interdependence of nature and society in these areas allows for overcoming

[2] According to EEA (2004), high nature value farming systems include: (i) farmland with a high proportion of semi-natural vegetation; (ii) farmland dominated by low intensity agriculture or a mosaic of semi-natural and cultivated land and small-scale features, and (iii) farmland supporting rare species or a high proportion of European or world populations.

the classic opposition between agricultural production and ecological richness (Plieninger and Bieling, 2013). Yet, many of the high nature value farming systems are facing the stark choice of either abandonment or intensification (O'Rourke et al., 2012).

Reconciling agriculture with nature conservation requires approaches that integrate societal concerns about environment-development trade-offs (Sayer et al., 2013; McShane et al., 2011). These trade-offs require consideration of ecosystem services provided by agricultural mountain landscapes and ecosystem disservices associated with, for example, the repopulation of wolves, as an effect of environmental policy. In mountain areas, combining sustained agricultural activity and nature recovery is a challenge for policy-makers and demands stakeholders participation in both policy formulation and implementation. This points out to the evasive promise of win-win outcomes and the need for trade-off thinking (McShane et al. 2011). According to a mountain farmer in our survey (see Section 2), in the European Mediterranean Alps, "the politicians who [they have] elected, from the bottom to top levels have just discourses. By their actions, they show that they do not want us [farmers] anymore." Hence, understanding farmers' concerns is a crucial step to reconcile agricultural and environmental policies.

2. Study area and methods

Study area

The study area is located in the south of the French Alps, extending over four of the five counties that form the Mediterranean region Provence-Alps-Cote d'Azur (PACA). Summers are dry and hot and winters are drier compared to northern alpine zones. The area includes two main natural environments: i) the piedmont or *Préalp*es *du Sud*, a hilly zone that includes managed grazing areas and scrublands (called *garrigue* in French, an evergreen vegetation adapted to dry environments), and ii) the high mountain, which is less dry and is covered by extensive grasslands used by pastoralists in summer. Breeders from high mountain zones have developed a farming system relying on extensive grazing in summer and on dry-grass stock capacity and barns to keep the flocks in winter. Breeders from the piedmont mainly rely on seasonal transhumance to maximise their access to feedstock, i.e., grazing in summer in the high mountains and staying in the piedmont in winter. In the last agricultural census of 2010, 515000 sheep units were registered in the Southern Alps, making use of 187000 hectares of

grasslands (Agreste, 2015). Sheep farms are mainly small (between 300 and 1000 livestock). Household-managed, their gross margins are close to zero, with agricultural income significantly supported by public subsidies (Desriers et al., 2009). From the 24826 farms in PACA, 16.5% belong to farmers of less than 40 years-old and 31.6% to farmers 60+ years-old. In 2007, the average age of the household head was 51 for all categories of farms and 46.5 for the professional farms (i.e., farms for which the lead farmer has an agricultural diploma). 51.1% of farms were professional farms.

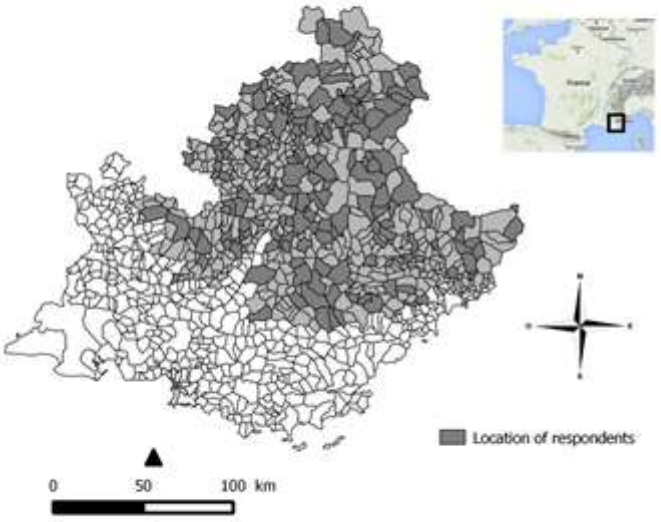

Figure 1. The study area: the French Mediterranean Alps in Provence-Alpes-Côte d'Azur. Units in light and dark grey are mountain municipalities. Respondents to the survey are from municipalities in dark grey.

Methods

A survey questionnaire was sent by postal mail in June 2015 to 1472 livestock farmers located in 167 municipalities of the French Mediterranean Alps (Figure 1), who constitute the whole population of mountain breeders in the Provence-Alpes-Cote d'Azur region (PACA). Before being sent, the questionnaire was discussed with several experts in pastoralism to improve its relevance and clarity. Prior to the construction of the survey instrument, a meeting with a group of farmers was held in the study area to explain the objectives of the study and explore the difficulties they are confronted with in their activity. This helped select the questions to be

included in the questionnaire. After three months, we received 310 responses (21%), which can be considered satisfactory for the targeted population. For multivariate regression analysis, our sample was reduced to 255, due to missing data on some of the dependent and independent variables.

To identify farmers' constraints, surveyed individuals were asked to indicate the three major difficulties they are confronted with in their activity, with an open answer format. All responses were used to build frequency tables of constraints. The reported constraints were then categorized *a posteriori* based on a content analysis. The full list of difficulties was analysed in terms of frequency and order of mention.

To examine the relationship between the reported constraints and land use trends affecting semi-natural grasslands in each municipality, we computed a continuous variable (*GRASSLANDS CHANGE*) based on the percentage change in semi-natural grasslands area (also called "marginal grasslands") at the municipality level over the 1990-2006 period.[3] This variable includes both grasslands abandonment (i.e., the rate of change is negative) and recovery (i.e., the rate of change is positive). The effect of the change in surface area of grasslands on the perception of each of the above-mentioned constraint category was examined using a probit regression (Greene, 2003), controlling for socio-demographic (age, education) and farm characteristics (livestock type, farm size, profitability, and whether someone is likely to take over the business after the farm's owner retires). These control variables were binary. For farm size, 1 was assigned to farms with a livestock herd size equal to or larger than the median size, and 0 otherwise. For profitability, 1 was assigned to farms considered as profitable and 0 otherwise.

We also included in our model three contextual variables likely to influence responses. First, farmers' responses are expected to differ according to whether the farm is located in a high or medium mountain area (*AREA*). In particular, the probability to report a bio-physical constraint is likely to increase for farmers operating in a high mountain area (Keenleyside and Tucker, 2010; Terres et al., 2013). Mountain municipalities were defined as having a minimum average altitude of 800m (in the Mediterranean area) or slopes larger than 20%.

[3] The authors thank Hinojosa et al. for making data available (for details of estimation see Hinojosa et al. 2016a). Grasslands included in calculation do not include cultivated plots or intensively used grasslands. Semi-natural grasslands refer to livestock-managed natural pastures located in high and medium altitude mountain areas.

High-mountain municipalities were defined as having a minimum altitude of 1200m for at least 50% of the municipal area. Secondly, the probability that farmers mention a given constraint is likely to decrease with the level of attachment to their place. Place attachment is associated with the individual's ability to effectively cope with constraints and develop resilience in her/his particular place (Lyon, 2014; Stedman, 2002). For example, recent studies on climate change show that common enabling factors and constraints for adaptation and mitigation responses are place-dependent and that capacity to respond to adverse effects strongly depend on the ties between individuals and their communities (IPCC, 2014). This effect is tested using the variable denoted *ATTACHMENT*, which corresponds to farmers' perception of their attachment to their place, ranging from 1 (if the respondent reports he/she is not attached at all) to 10 (if he/she reports to be strongly attached). Values were reclassified into a binary variable (1 for responses from 6 to 10, suggesting a strong attachment, and 0 otherwise). Thirdly, we hypothesize that farmers' perception of constraints differs according to their knowledge of, and value given to the biophysical attributes of their rural landscape. We estimated the perceived biodiversity richness of the municipality (*BIODIVERSITY*) (Franklin, 1993). Surveyed individuals were asked to indicate on a 5-point Likert scale whether they agree with the statement that biodiversity is rich in their municipality. Scores of responses for both were then reclassified into binary variables (1 for responses that strongly agree and agree with the statement, and 0 if they disagree and strongly disagree; neutral responses were excluded). Descriptive statistics for all variables are reported in Table 1.

Variables	Description	Whole sample (N=310)		
		N valid	Mean	SD
	Dependent variables (all binary, equal to 1 if yes, and 0 otherwise)			
BIO-PHY	The farmer perceives bio-physical, climatic and remoteness-related constraints.	310	0.16	0.37
INSTITUTIONAL	The farmer perceives institutional constraints.	310	0.54	0.50
MARKET	The farmer perceives market-related constraints.	310	0.28	0.45
F. MANAGE.	The farmer perceives farm-management constraints.	310	0.17	0.38
PERSONAL	The farmer perceives personal constraints and dissatisfaction.	310	0.30	0.46
WILDERNESS	The farmer perceives wilderness-related constraints.	310	0.39	0.49
	Explanatory covariate (continuous variable)			
GRASSLANDS CHANGE	The percentage change in semi-natural grasslands over the 1990-2006 period at municipality level.	298	80.43	1078.78
	Explanatory factors (all binary, equal to 1 if yes, and 0 otherwise)			
AGE	The farmer's age < 40 years.	300	0.23	0.42
EDUCATION	The farmer went to the University.	299	0.36	0.48
TYPE	The farm livestock orientation (=1 if a sheep farm, 0 otherwise).	300	0.66	0.47
SIZE	The livestock size measured in livestock units (=1 if LSU > median).	299	0.49	0.50
PROFITABILITY	The farm is profitable over the last five years (including subsidies) (=1 if profitable).	295	0.36	0.48
SUCCESSOR	The farmer thinks that someone else will take over his/her business after him/her.	287	0.58	0.49
AREA	The farmer's municipality is located in a high-mountain area.	300	0.35	0.48
ATTACHMENT	How the farmer is attached to his/her place. (=1 if strong attachment).	292	0.78	0.41
BIODIVERSITY	The farmer thinks that her/his municipality is biodiversity-rich.	276	0.88	0.33

Table 1: Variables used in estimations and their description.

3. Results

Farmers reported a total of 743 constraints to farming activity, which we classified into the following categories: (1) bio-physical, climatic and remoteness-related, (2) institutional, (3) market-related, (4) farm management, (5) personal, (6) wilderness, (7) generic constraints, and (8) none. Table 2 presents the percentage of respondents reporting the considered constraint for each category, with the more frequent (equal or above 10%) sub-categories highlighted in bold.

Category	% by	Sub-category	% by sub-	Examples of statements

	category		category	
1. Bio-physical, climatic and remoteness-related	7.6	Altitude	1.7	Sloped soils, mountain landform
		Climate	3.9	Dry soils
		Remoteness	2	Distance to markets and consumers, difficulties to reach the administration
2. Institutional	30.7	**Access to land**	**10**	Expensive rental prices, land segmentation, urbanisation
		CAP-related*	4.9	Bureaucracy, stress due to controls, loss of ICHN,** excessive regulation
		Red tape	**10.3**	Administrative fees, excessive bureaucracy to get support, constraints for innovation, need of justification upon a controller's requests
		Reduced partnership opportunities	0.4	Difficult to find a business partner
		Trust, networking and social cohesion	5.1	Bad relationships with villas, no respect from tourists
3. Market	14.5	Product prices	8.7	Low meat prices, price stagnation, low income
		Input prices	1.6	High price of agricultural inputs
		Commercialization channels	1.5	Transport costs, distance to the slaughterhouse
		Shortage of agricultural labour	2.7	Lack of serious workers, expensive labourers
4. Farm management	8.6	Farming infrastructure	4.1	Old buildings, high renovation costs, expensive new equipment, lack of irrigation
		Land abandonment	1.2	Reforestation, scrub

				encroachment,
		Livestock management	3.3	Livestock fertility, livestock mortality, sanitary problems
5. Personal constraints and dissatisfaction	15	Personal constraints and dissatisfaction	**15**	Permanent penuries, excessive workload, livestock farming does not allow time for holidays, limited possibilities to find a spouse, long winters, instability, isolation, stress
6. Wilderness	18.7	**Wolf predation**	**18.2**	The wolf, the wolf presence, predation of cattle by wolves
		Game	0.5	Land destroyed by wild
7. Generic	4.7	Generic	4.7	Profitability, productivity, charges, crisis, instability, penalties, water
8. None	0.2	None	0.2	

*CAP is the Common Agricultural Policy. ** ICHN is the compensation to rural territories with natural disadvantages.

Table 2: Percentage of all constraints identified by respondents, whatever the order in which they were mentioned, organized by categories.

The main result is the prevalence of institutional constraints in farmers' perception, as more than 30% of respondents reported this category of difficulty, with a particular focus on the regulatory framework established by agricultural policies at the European and national levels and the local procedures of implementation. A large proportion of individuals (18.7%) reported wilderness constraints. Farmers notably highlighted the impact of the wolf expansive presence on the availability of "safe grasslands" and the unexpected changes in farm management practices induced by the wolf presence – e.g., hiring shepherds to look after livestock, reducing the range of extensive grazing and building new infrastructure around farms. Personal and market-related constraints are also perceived to be important (15%). Other difficulties reported (access to land and farm-management practices) are less important than the above constraints. These findings hold when considering the order in which surveyed individuals reported their constraints. Institutional, wilderness, personal and market-related difficulties are most frequently reported in the first place (Table 3). Regardless of what

farmers reported in the first place, institutional factors are the most frequently reported second constraint, followed by wilderness (Table 4).

Constraints	**First response**	**Second response**	**Third response**
Bio-physical, climatic and infrastructural	7.5	9.6	4.7
Institutional	25.4	38.8	28.3
Market	14.3	12.0	17.3
Farming management	6.8	8.0	11.5
Individuals' constraints and dissatisfaction	17.9	10.8	15.2
Wilderness	25.4	15.2	15.2
Generic	2.5	5.6	7.9
Total	100.0	100.0	100.0

Table 3: Frequencies of constraints classified by group and the order in which constraints were declared (percentages)

				Second constraint				
First constraint	Bio-Phy. &Climatic	Institutional	Market	Management	Personal	Wilderness	Generic	Total
Bio-Phy.&Climatic	15.8	47.4	15.8	0.0	5.3	15.8	0.0	100.0
Institutional	12.7	34.9	9.5	6.3	11.1	19.0	6.3	100.0
Market	8.1	32.4	13.5	8.1	8.1	27.0	2.7	100.0
Farm-Management	5.6	38.9	22.2	11.1	5.6	11.1	5.6	100.0
Personal	12.5	27.5	10.0	5.0	27.5	7.5	10.0	100.0
Wilderness	6.0	50.7	9.0	13.4	4.5	10.4	6.0	100.0
Generic	0.0	33.3	33.3	0.0	16.7	16.7	0.0	100.0
Total	9.6	38.8	12.0	8.0	10.8	15.2	5.6	100.0

Table 4: Frequencies of second constraint after identification of the first constraint (percentages)

We now examine the relation between each constraint category and the variables that can influence farmers' perception, particularly trends in semi-natural grasslands area in each municipality, based on a probit model (Table 5).

	Coefficients and significance					
Variables	**Bio-Phy.**	**Institutional**	**Market**	**F. Manage.**	**Personal**	**Wilderness**
Intercept	-0.144	-0.172	-0.474	-0.475	-0.598*	-1.093**
GRASSLANDS CHANGE	-2.007E-05	8.772E-05**	-0.001	-0.002	0.000	-0.002**
AGE	0.358*	-0.164	-0.027	-0.057	0.194	0.111
EDUCATION	0.255	0.156	0.409**	0.184	-0.095	-0.123
TYPE	-0.531	0.321*	-0.253	-0.057	-0.211	1.094***
SIZE	-0.190**	0.462**	0.197	-0.131	-0.055	0.364**
PROFITABILITY	0.057	-0.065	-0.547***	-0.062	0.027	0.124
SUCCESSOR	-0.009	-0.068	-0.337**	-0.065	-0.271	-0.227
AREA	-0.055	0.276	-0.130	-0.103	-0.135	-0.132
ATTACHMENT	-0.335	0.060	0.418*	-0.233	-0.228	0.050
BIODIVERSITY	-0.413	-0.193	-0.071	-0.143	0.664*	0.034
Scaled Deviance	0.80	1.30	1.08	0.92	1.17	1.14
L.R. Chi-Square	17.05*	15.68*	24.90**	5.20	11.14	49.33***`
Number of observations: 255						

***, ** and * refer to significance at the levels of 1%, 5% and 10%, respectively.

Table 5. Probit estimation results of farmers' perception of constraints to Alpine livestock farms

The main result is that bio-physical, market-related, farm management, and personal constraints are not associated with changes in grasslands area. For institutional constraints and wilderness, the parameters of the variable *GRASSLANDS CHANGE* are significant at the 5% level. The negative sign of the coefficient for the variable wilderness indicates that positive values of change in semi-natural grasslands area (i.e., less abandonment or grassland recovery) are associated with a perception that wilderness is less problematic, and vice versa. Thus the wolf presence is perceived by farmers as a constraint when semi-natural grasslands are increasingly abandoned in their municipality. Given that the variable *GRASSLANDS CHANGE* measures both negative and positive changes in surface area, within a range of -93.8% and +1076.6%, and that correlation does not imply causality, the negative relationship between wilderness and grasslands change indicates either that farmers' concern about the wolf increases in municipalities with grasslands abandonment, or that grasslands abandonment has facilitated the presence of wolves. Concerning the relationship between institutional constraints and changes in semi-natural grasslands area, the positive sign of the coefficient suggests that farmers located in municipalities with expanding grasslands perceive a greater burden in dealing with institutions, particularly land use regulations and the public administration's CAP-related procedures. The perception of market constraints is likely to be expressed by the more educated farmers and those with a higher level of attachment to their place. Conversely, farmers with less profitable farms and uncertain succession are less likely

to experience difficulties with agricultural markets, whether of products, labour or inputs. We also find that large farms and sheep breeders are more likely to report institutional constraints and experience difficulties with wilderness.

The expected relationships between constraints and the other explanatory variables are, in general, not supported by our data. Farmers' perceived difficulties other than those related to markets are not associated with profitability. Profitability is only associated with market constraints, including all agricultural markets (products, labour and/or inputs). Location in high or medium mountain areas was not significantly associated with farmers' constraints. There is no association between biodiversity and wilderness (Pearson coefficient of 0.03, $p<.05$), suggesting that the perception of biodiversity richness is independent from the perception of wild fauna. Similarly, place attachment is not related to most of the constraints farmers are confronted with.

4. Discussion and conclusion

In the first part of this study, we investigated the constraints livestock farmers in the French Mediterranean Alps are confronted with in their activity. The survey results show that their major difficulties relate to institutions, wilderness, personal dissatisfaction, and agricultural markets. In the second part, we examined the relation between the reported constraints and changes in grasslands area, particularly abandonment, which is a major concern in the region. Our findings suggest that only institutional and wilderness constraints are related to land abandonment. In the former case, an increase in grasslands area is associated with higher administrative burdens. In the latter case, concerns about the impact of wild fauna are more prevalent in municipalities experiencing grasslands abandonment. These issues are thus central to the persistence of farming activity in mountain regions.

Profitability is viewed as an important factor for staying in livestock farming. By definition, less profitable farms experience market difficulties (Santini et al., 2013). Yet, our results confirm that profitability is not the only factor that influences the permanence of farmers in mountain areas (Hinojosa et al., 2016b; Dumont et al., 2016). Our results show that farmers are also concerned about wilderness, independently from economic profitability. As suggested elsewhere, this may be explained by the role that subsidies, compensation policies and possibly non-farm activities play in counteracting economic difficulties associated with the

marginal mountain environment and financial losses due to wolf attacks (Silhol et al., 2007; Grandmougin et al, 2010; Dumont et al., 2016). Policy initiatives to counteract negative market effects and other factors that originate in the wider rural economy are important for high value nature areas where pastoralism is in decline (Keenleyside and Tucker, 2010). Galanopoulos et al. (2011) and Raggi et al. (2013) reached similar conclusions for, respectively, mountain farmers in Greece and other EU countries. The environmental public goods provided by mountain grasslands may justify such policies.

Various policies, notably the EU's Common Agricultural Policy, has historically aimed at ensuring a fair standard of living for agricultural communities (Hill, 2012). Financial aid for farmers facing natural or other constraints is meant to encourage the continued use of agricultural land and to maintain Mediterranean mountain landscapes, promoting high nature value farming systems (KMC, 2014). However, farming profitability is not the only or most important determinant of decisions to maintain agriculture in mountain areas or to abandon land (Terres et al., 2013; Hinojosa et al., 2016b). As suggested by Celio et al. (2014) and Lorent et al. (2008), broader rural development programmes offer an opportunity for adapting land use policies to the context of mountain livelihoods. The CAP recognizes the natural handicaps of mountain areas and their association with depopulation and land abandonment through its structural support to 'Less-Favoured Areas' (Regulation 950/97). In addition to financial support for agriculture, other forms of support facilitate diversification into non-farm activities by developing non-agricultural small and medium enterprises in rural areas. There is also support for developing economically viable small farms.

Our results show that bio-physical and climatic constraints score low among farmers' concerns. This contrasts with previous studies, which highlighted the prominent role of these factors in land and farming abandonment decisions (NORDREGIO, 2004; IEEP, 2006; Beilin et al. 2014). Other studies suggest that the mountain environment produces place attachment and enhances the resilience of communities, and therefore bio-physical conditions typical of mountains are not necessarily driving land abandonment (Hinojosa et al., 2016a, 2016b; Herman, 2015; Garde, 2014; Barthod, 2010).

The multiple constraints to be overcome to make mountain agriculture a resilient and striving activity are still a matter of academic discussion. The policy debate focuses on the type and level of intervention to support farming and reduce conflicts with other uses of the rural space

(Sandker et al., 2012). Can mountain landscapes be multifunctional? How to reconcile the dual goals of ensuring the permanence of agriculture and environmental conservation (Sayer et al., 2013)? Our results provide evidence on perceived externalities of environmental policies aimed at biodiversity conservation and rewilding. Pan-European initiatives such as Rewilding Europe (Sylven et al., 2010) and the Large Carnivore Initiative for Europe (Species Survival Commission of the International Union for the Conservation of Nature [IUCN]) aim at restoring species such as the wolf. Changes leading to rewilding the European landscapes started in the mid-2000s supported by a growing network of protected areas, better designed to suit multi-use criteria, and by better legislation and enforcement (Helmer et al., 2016). Formally implemented since 2011 thanks to a favourable policy environment (e.g., Wilderness Resolution and the new EU Biodiversity Strategy), the Rewilding Europe initiative has made progress both in terms of policy agenda and number of restored species. Restoration has been possible even outside protected areas set aside for wildlife conservation thanks to improved public opinion and protective legislation (Chapron et al., 2014). However, human coexistence with large carnivores like the wolf is highly controversial in part because of a deeply rooted hostility toward this species in human history and culture (Treves and Karanth, 2003). The extent to which this perception influences farmers' land and husbandry management practices should be taken into account in the design of policies to deter land abandonment (Stanchi et al., 2012).

Our result that the reduction of semi-natural grasslands areas and concerns about the wolf are positively associated supports the suggestion that coexistence of large carnivores and farming activity requires particular conditions of land use zoning, compensation measures, and tolerance and adaptation (Garde and Meuret, 2017; PASTUM, 2015; Vincent, 2011). Involvement of local communities in the rural policy process related to such a sensitive issue has great importance (Breitenmoser, 1998; Sillero-Zubiri and Laurenson, 2001). Previous research has suggested that large carnivores can coexist with people (Carter et al., 2012), knowing that wolves do not threaten humans directly (McNay, 2002). Coexistence can take place through land-sharing models, which have proved to be successful on a continental scale (Chapron et al., 2014). Garde (2015) showed that the cohabitation of sheep farming with fully protected wolves, which was forced by environmental policy, does not just imply the reintroduction of farming practices and land management organisation from the 19th century. Large carnivores do not permanently reside in high human population density areas but rather recolonize areas with moderate human densities. These include human-dominated landscapes

near urban areas (Chapron et al., 2014; López-Bao et al., 2013; Basille et al., 2009), and highly fragmented landscapes consisting of forest-farmland mosaics. Appeals for tolerance and adaptation need to be accompanied by policy support for changes in herd management practices – e.g., using mountain dogs, electrified fences, and night-time surveillance of herds.

Our results do not show any significant relationship between the perception of farm management constraints and land abandonment or other factors at the farm scale. However, they suggest that constraints associated with the institutional framework of agriculture (i.e., regulation and administrative burdens) matters, in particular for large farms and those located in high mountains. Research on the role of the regulatory framework, both at the EU and national levels (Schermer et al., 2016), suggests that institutions can influence the maintenance of nature-friendly farming practices in mountain areas.

In a new agro-environmental context that includes a focus on rewilding landscapes, not all mountain areas may be suitable for agricultural activity (Terres et al., 2015; Navarro and Pereira, 2012). Further, some level of land abandonment may not be detrimental to the provision of ecosystem services. A spatial targeting of support for agricultural activities and for a broader rural policy (including non-farm activities) could decrease conflicts between agriculture and nature conservation with a rewilding of landscapes. For example, land abandonment in locations characterized by fragmented landscapes that are economically marginal and characterized by low land use intensity could contribute to the restoration of important non-agricultural habitats (Keenleyside and Tucker, 2010).

Trade-offs between agriculture and environmental conservation need to be more strategically addressed by both agricultural and environmental policies. As problems associated with wilderness can trigger agricultural abandonment in most vulnerable areas, conservation of high nature value areas becomes a significant socio-ecological challenge. The future CAP 2020 is expected to address this issue by incentivizing grasslands maintenance and better integrating agri-environment measures with rewilding of European landscapes. Increasing targeted subsidies for extensive farming in vulnerable areas, such as the high mountains, is one approach. Another approach is through specific measures for rural development, as proposed to the European Commission by the French National Assembly for the post-2020 CAP (Assemblée Nationale, 2017) concerning agricultural holdings with high ecological impacts, particularly on biodiversity.

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