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Applying the livelihood resilience framework in mountain agro-pastoral households: An indicator-based model with Latent Class Analysis

Lecegui, A.*[12], Olaizola, A.M.[34] Vidal, B.[1], López-i-Gelats, F. [5] Varela, E.[12]

1 Center for Agro-Food Economics and Development (CREDA-UPC-IRTA), Spain.

2 Institute of Agrifood Research and Technology (IRTA), Spain.

3 University of Zaragoza (UniZar), Spain.

4 Agrifood Institute of Aragon– IA2 - (UniZar-CITA), Spain.

5 University of Vic - Central University of Catalonia (UVic-UCC), Spain.

* Speaker and corresponding author: Antonio.lecegui@upc.edu.es

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1. Introduction

Farming communities with lifestyles linked to natural resources are particularly exposed to the effects of global change. These threats might come in the form of punctual shocks or long-term stressors and from diverse environmental, socio-economic and institutional nature. European livestock farming systems are mostly based on family farming whose household faces several challenges such as low profitability due to the gaps between input costs and output prices, the new demands of rural spaces and the coexistence with tourism, environmental and wildlife protection regulations, lack of generational turnover and the continuing risk of extreme events such as droughts, wildfires, pests and diseases. Nevertheless, many of them are actively responding to changing conditions through innovation and adaptive capacity to foster resilience that minimizes their risk exposure against uncertain changes.

The livelihood resilience framework applied at farm level (Speranza et al., 2014; Milestad and Darnhofer, 2003) has become a suitable approach for analysing the effects of global change stressors on-farm livelihood whose resilience depends on farm functions, farmer capacity and on the social, institutional and natural conditions. It is elaborated upon the sustainable livelihoods framework (Scoones, 1998) and the resilience thinking in socio-ecological systems (Holling, 1973). According to Tanner (2015), a livelihood is resilient when it encompasses capacities, assets and activities that allow households coping with and recovering from adverse conditions while maintaining or improving their livelihood opportunities and well-being. Despite the growing theoretical frameworks of resilience, few studies have operationalized the concept and less attention has been paid to the use of indicators to assess resilience (Carpenter et al., 2001). This study aims to identify the livelihood strategies adopted by Pyrenean farms households and to assess their coupled resilience dimensions using the three-step Latent Class Analysis (LCA).

2. Materials and Methods

The study was developed in two counties of the Spanish Eastern Pyrenees where small family farms of sheep, goats, cattle and, more recently, horses has been the main economic activity. The Pallars Sobirà county to the north is the most mountainous and touristic county, where 80% of its area is protected and dominated by forests, communal mountain pastures and private meadows. The Pallars Jussà county to the south is located in the lowland valley and it is characterized by less restrictive environmental conditions and a larger area of forage crops.

A survey through 103 face-to-face interviews (half in each county) with extensive livestock farming households was conducted between May and July 2018 following snowball sampling. Interviews consisted of a semi-structured questionnaire and information gathered addresses key technical, economic, productive, environmental and socio-economic issues of farms and households.

Following Milestad and Darnhofer (2003) and Speranza et al., (2014), farms' livelihood resilience was conceptualized in three core dimensions: 1) Activity variables that produce outcomes (livestock, land and labour and other income sources); 2) Asset variables or buffer capacity which represent the sources of capital (i.e. natural, physical-financial, human and social dimensions) and allow households the adoption of each livelihood strategy and 3) Resilience indicators for self-organisation, capacity for learning and diversity dimensions.

Latent Class Analysis is a segmentation technique to identify and describe differences between cases according to a set of characteristics in a heterogeneous population. It is based on a probabilistic model that assumes the incorporation of unobserved categorical variables (latent variable), able to explain the relationships among the indicator variables (Vermunt and Magidson, 2016). The three-step approach, used in this study, identifies the latent classes and relates class membership to external variables of interest (Vermunt, 2010). Thus, the model was based on 1) Building a latent profile (livelihood strategies) for a set of response variables or indicators (activity variables) where other exogenous independent variables (capital asset and context) predict the profile membership; 2) Assigning individuals to latent class based on posterior class membership probabilities; 3) Examining the associations between the assigned profile membership and external variables (resilience). Additionally, resilience was obtained as a latent variable through a Dfactor analysis. The model included both continuous and categorical (nominal and ordinal) variables. A total of eight response variables, five covariates and one dependent variable were used in the three-step. While the dependent variable was obtained from eight additional indicators.

3. Results and discussion

A five-profile model was the most parsimonious according to the Akaike's Information Criterion (AIC3) and conditional bootstrap tests. Indicators and covariables contributed significantly to discriminating among profiles based on the Wald test. The Dfactor Analysis for resilience with a single latent factor fitted the best with three levels. Furthermore, the independence assumption was verified by the bivariate residuals in both three-steps and Dfactor analysis. Activity variables' allocation and capital assess influence led to the identification of five livelihood profiles that had a different degree of resilience as an outcome:

Profile 1 comprises 28.5% of the sample adopting an off-farm labour diversification strategy. It is characterized by having a high proportion of off-farm family work and no external workforce. Besides, its territorial basis is composed mainly by meadows. Human capital, specifically holder education was highlighted in this group suggesting its importance for participation in non-agricultural activities. This strategy is also conditioned by the context as shown by the high altitude were these farms operated.

Profile 2 accounts for 22.7% following a multi-diversification strategy. Farm labour is mainly developed by external workers while households carry out non-farm activities. They held herds of large herbivores (cattle and horses) based on meadows. The external workforce and specialization in low requirements livestock might explain a greater availability of time for labour diversification in tourism-oriented activities by having a tourism house. Furthermore, the important role played by social capital in these farms seems to explain their capacity for income-diversification, being the livelihood profile that significantly presents the highest resilience.

Profile 3 encompasses 21.3% of the holders with an agricultural intensification strategy. Family labour in these farms is exclusively intended for livestock activity. They have the largest stocking rate and the territorial basis lies mainly in forage crops. Whereas the wide availability of machinery allows the intensification of production, the low natural capital and few family members might constrain the diversification of the activity. Thus, this livelihood profile has a lower than average resilience index.

Profile 4 spans 15.5% of farms with an added value strategy. These farms handle a flock of small ruminants (sheep or goats) and their territorial basis consists of forage crops. They are characterized by their involvement in value-added production through the specialization in organic farming, on-farm fattening (in addition to breeding) and on-farm product transformation. The capacity to increase the value of their products seems to compensate for the low stocking rate in these farms where agricultural labour is mainly done by hired workers while households perform non-agricultural activities. Storage of physical capital and the location in lower areas seems to determine the adoption of this strategy that showed the second higher values of resilience.

Profile 5 covers the remaining 11.8 % of the sample, encompassing farms where pensions and retired farmers are important sources of income and labour, respectively. The dependency on pensions and the low levels in physical capital shown both by the low levels of added value infrastructure and by the low machinery power might, indicate less chance of continuity of these farms. This is aligned with the lowest resilience value they presented.

4. Conclusion

This study shows the usefulness of the three-step LCA modelling tool for assessing the nexus between farms' livelihood and their coupled resilience. Farm context location and capital assets available to households significantly determine the adoption of each livelihood strategy and therefore their resilience towards global change.

Results suggest that livestock activity by itself is not enough to secure family income. Off-farm diversification activities are widespread in three of the livelihoods identified where household's part-time dedication might compete (profile 1), complement (profiles 2) or enhance (profile 4) livestock activity. Farm abandonment and intensification patterns arise from these livelihoods and they are significantly related to altitude, hence with the environmental, socio-economic, and the institutional factors that distinguish the two counties of the study. These findings could help the design of more effective policy measures in order to enhance and improve the resilience of mountain livelihoods.

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