

'Diagnosis of climate vulnerability in L'Alt Penedès'

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Coordinador

Socis



Context and methodology

This document has been written within the framework of the project LIFE5 CCA/ES/000102 Fostering resilience. Opportunities and challenges of the local economy and society to adapt to climate change to provide a response to the requirements anticipated in Action A1. It aims to analyse the effects of climate change in the Alt Penedès region, in terms of the aspects related to the diagnosis of risks, impacts and vulnerability.

The project is coordinated by Barcelona Provincial Council, and the Catalan Office for Climate Change (OCCC) is a beneficiary partner and responsible for Action A1.

The area of study for this diagnosis is the Alt Penedès region. The area focuses thematically on the economic areas in which LIFE Clinomics aims to take action: agriculture, livestock farming, forestry and tourism (although LIFE also includes fishing, in the Alt Penedès region it is considered negligible as an economic activity).

According to the LIFE Clinomics project, the work in Action A1 takes place in three phases, which also provide the structure for this document:

A1.1 Assessment of the studies carried out

Compiling of information on the territory and the economic sectors studied. The details of interest are organised in various files according to thematic blocks, and are followed by a summary that highlights the most significant specific aspects that make the Alt Penedès region vulnerable to climate change. It also includes the initiatives or projects under way that are working towards adaptation to climatic change in the various sectors studied.

A1.2 Vulnerability analysis

Identification of the main risks that affect each economic sector based on the information gathered in the first section and the participation of various agents. A matrix is produced that clearly shows the relationship between the impacts of climate change (rising temperatures and drought), the main risks arising from these impacts (such as changes in crops, increased risk of forest fire, etc.) and the relationship between those risks and the various economic sectors examined (agriculture, livestock farming, forestry and tourism). The opinions of stakeholders in the region are also included, for two purposes: to validate the matrix and to qualitatively and quantitatively assess their perception of vulnerability and the adaptive capacity of the various economic sectors.

Vulnerability indicators are calculated for the risks that are most closely related to each economic sector, for each municipality and for the region as a whole. The vulnerability associated with a risk is calculated based on the variables of exposure, sensitivity and adaptive capacity, according to the following formula:

$$\text{Vulnerability} = (\text{Exposure} \times \text{Sensitivity}) - \text{Adaptive capacity}$$

A1.3 Diagnosis of risks and vulnerability

Including the results obtained from the information balance sheet, the calculation of the vulnerability indicators and the participation of the stakeholders in the economic sectors studied.

Vulnerability analysis

Most of the vulnerability indicators have been calculated for each of the 27 municipalities in the Alt Penedès region. In cases where no data is available at the municipal level, the vulnerability indicators have been calculated directly at a regional level (CLINperbio and CLINrius), based on the simple average of the municipal values. The results of the indicators studied are classified in a range from 0 - green (not very vulnerable) to 10 - red (highly vulnerable).

Risk	Economic sector	Vulnerability indicator	Regional value	Colour
Changes in crop types	Agricultural	AGR03 = Changes in crops (AVM)	5.19	
Changes in the productivity of vineyards	Agricultural	CLINprod = Changes in the productivity of vineyards due to drought	4	
Changes in the distribution of cultivable areas	Agricultural	CLINredvi = Reduction of vine growing areas	4.26	
	Livestock farming	CLINpast = Reduction of pastureland areas	4.05	
Reduced water availability (increased evapotranspiration and increased recurrence of droughts)	Agricultural / Livestock	AGR01 = Increased irrigation needs in agriculture and livestock farming (AVM)	2.91	
	Forestry	FOR02 = Reduced availability of water for forestry (climate impact: rising temperatures)	2.23	
	Forestry	FOR03 = Reduced availability of water for forestry (climate impact: drought)	2.19	
Reduced flow levels in rivers and streams and longer duration of low	Agricultural	CLINrius = Reduced water flow in rivers	5.96	

Risk	Economic sector	Vulnerability indicator	Regional value	Colour
water levels				
Decline in water quality	Agricultural	CLINquai = Decline in the quality of groundwater	4.44	
Increased risk of forest fire	Agricultural	AGR02 = Increased risk of fire in agriculture (AVM)	4.61	
	Forestry	FOR01 = Increased risk of fire in forestry (AVM)	4.31	
Loss of biodiversity	Agricultural	CLINvarvi = Decline in varieties of cultivated grapes	4.2	
	Forestry	CLINperbio = Risk of loss of biodiversity	3.11	
Loss of landscape quality	Tourism	CLINqual= Loss of landscape quality	4.83	
Variation in tourism demand	Tourism	CLINtur= Variation in tourism demand:	1.3	

Overall assessment of the results from the indicators and the perception of the stakeholders in the various economic sectors

Ten of the 31 stakeholders contacted to participate in the analysis of the vulnerability and the adaptive capacity of the various sectors sent back their quantitative and/or qualitative assessments.

The results of the calculation of indicators and the participants' perception coincide as regards the level of vulnerability and adaptive capacity obtained in the majority of the risks studied (approximately 67%). The reasons why the results diverge for some risks are discussed below:

- **Reduced water availability (increased evapotranspiration and increased recurrence of droughts):** on a scale of 1 to 10, the values obtained in the calculation of these vulnerability indicators are 2.23 (FOR02) and 2.19 (FOR03) are considered

medium/low vulnerability, while they are rated as high vulnerability in the assessment by the participants. This difference in the results is thought to be due to the fact that these indicators are not very sensitive for an analysis of the decline in the availability of water in the region, because in most of the region's municipalities, the majority of the forested area is covered by Aleppo pine trees (which have a very low sensitivity value for drought). The result of these two indicators does not adequately reflect the real vulnerability of the risk, which was highlighted by the participating stakeholders.

- **Increase of forest fire:** while the participants assess this risk as being high or very high, the value obtained from the vulnerability indicator (4.31 on a scale from 1 to 10) shows average vulnerability. This divergence is considered to be due to the low sensitivity of the indicator used (FOR01) to analyse this risk in the area. The average value for vulnerability is obtained as a result of the values for adaptive capacity (calculated based on the availability of municipal action measures in the event of fire and the presence of Forest Defence Units) and the sensitivity values (which combines the area of forest species with the level of their sensitivity to fires – average for Aleppo pine and low for holm oak).
- **Loss of biodiversity:** the vulnerability value obtained in the calculation of the FOR01 indicator is 3.1 (on a scale from 0 to 10), which is considered a medium/low level of vulnerability, while the participants rated its vulnerability as high. Although the participants made no comments regarding their assessment of this risk associated with the forestry sector, the differences in the results are considered to be due to the fact that this indicator, which is calculated for the region as a whole, uses the total area in the region's plan for spaces of natural interest (PEIN) and the total land area with Territorial Custody agreements (IGACC) as sub-indicators. Both of these

occupy much smaller areas than in other regions in Catalonia, which gives the indicator a total low vulnerability value for the region as a whole.

- **Variation in tourism demand:** the value obtained in the calculation shows low vulnerability (1.3 on a scale of 1 to 10) while the participants gave it very varied values, ranging from 1 to 4 (on a scale of 1 to 4), which therefore included low, medium and high vulnerabilities. The differences in the results are associated with different perspectives between the indicator and the participants in terms of assessing the tourism sector's vulnerability. The limited number of tourist accommodation facilities in the area with the greatest risk of forest fire and the highest adaptive capacity in the region (due to a very large number of visitors to the Enoturisme Penedès wine tourism routes) are factors that mean that the sector's final vulnerability for the region is very low. Meanwhile, the participants who rated the vulnerability of the tourism sector as high considered that a possible decline in vine production could affect the income and visitor numbers of the wine tourism routes.

The results of the calculation of indicators and the participants' perception coincide in the level of vulnerability and adaptive capacity obtained in the majority of the risks studied

Diagnosis of risks and vulnerability

Diagnosis of risks

The risks evaluated may have a negative effect (red), where the risk has negative consequences for the specific economic sector; a positive effect (green), considered as a potentiality or opportunity for the sector to improve its adaptive capacity; and finally an ambivalent effect, (green/red), where the effects may be both positive and negative.

Risks in the agricultural sector	
●	Changes in crop types
●/●	Changes in the productivity of vineyards
●	Changes in the distribution of cultivable areas
●/●	Reduced water availability (increased evapotranspiration and increased recurrence of droughts)
●	Decline in water quality
●	Increased risk of forest fire
●/●	Loss of biodiversity

Risks in the livestock sector	
●	Reduction of pastureland areas

Risks in the forestry sector	
●/●	Reduced water availability (increased evapotranspiration and increased recurrence of droughts)
●	Reduced flow levels in rivers and streams and longer duration of low water levels

Risks in the forestry sector	
	Increased risk of forest fire in forest systems
	Loss of biodiversity

Risks in the tourism industry	
	Loss of landscape quality
	Variation in tourism demand

Diagnosis of vulnerability

A diagnosis of the overall vulnerability of each economic sector is presented below, taking all the risks identified into account, as well as the results of the indicators and the assessment of the participants, and the other information gathered during this study.

Agricultural sector:

The overall vulnerability of the Alt Penedès agricultural sector is average. The sector has high vulnerability in terms of the quality of water and the decline in the number of vineyards in L'Alt Penedès, which together with the figures for the increase in the average area of the properties gives some idea of the process of concentration of land ownership that has gradually taken place in the region. However, the overall vulnerability is not considered high, since the adaptive capacity of the sector is good, especially in terms of the results obtained for indicators such as changes in the productivity of vineyards. These results are consistent with the information gathered on existing agronomic and wine-producing techniques that may alleviate the effects

on the production and quality of wine due to drought, and plans to reintroduce old varieties and promote new varieties that are better adapted to warm climates.

The livestock sector:

The vulnerability of the livestock sector is considered low due to the limited presence of this activity in the region, especially in comparison to the agricultural sector. It is also considered low due to the sector's adaptive capacity, which could increase with the recovery of livestock practices linked to forestry (clearing of undergrowth and prevention of fires using herds of goats). Adaptive capacities include breeding of the Penedesenca Negra Millorada, known as the Black Penedès Rooster, which after obtaining the European PGI (Protected Geographical Indication) label, has become consolidated as quality livestock farm product in the region.

The forestry sector:

The forestry sector is considered the most vulnerable of the four sectors analysed in this study. The vulnerability is considered medium-high, mainly due to the risk of fire and the reduction of the flow rates of rivers and streams and the longer duration of low water, linked to the availability of water, and the loss of biodiversity to a lesser extent. In addition, the possible decline in income for the sector due to limited forestry and the low economic value of the predominant forest species in the region contribute to increasing the sector's vulnerability. There is therefore a need to manage forest areas based on a long-term perspective in order to facilitate the regeneration of forests and prevent the recurrence of fires. With good Management Plans and government grants, management of the region on a landscape level can improve the yields of small private operations, and reduce the vulnerability of forest areas to fires and drought.

Meanwhile, there is potential in forestry's use of biomass, combining forest products and vine shoots. Apart from reducing the risk of forest fire by clearing the undergrowth, it would also contribute to mitigating climate change by generating heat from a renewable source. Plans for the use of Aleppo pine forests should be made 30 years in advance, in order to obtain structural wood for construction and simultaneously use wood chip by-products as a biomass. However, this would require a more in-depth study of this potential in a region like L'Alt Penedès.

The tourism industry:

The vulnerability of the tourism industry is considered low, due mainly to the sector's very good adaptive capacity, thanks to the possible change in the seasonal nature of visits, the region's proximity to Barcelona and Tarragona, the presence of tourism products in the region promoting the area's sustainability, the fact that it is highly valued socially, and the large number of annual visits to the Penedès wine tourism routes (which tops the rankings of visits in Spain every year).