

‘Diagnosis of climatic vulnerability in Les Terres de l'Ebre’

Executive Summary

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Coordinador

Socis



Introduction

As part of the LIFE Climate Change Adaptation programme, Barcelona Provincial Council is coordinating a project entitled 'Fostering resilience. Opportunities and challenges of the local economy and society to adapt to climate change' (LIFE15 CCA/ES/000102 LIFE CLINOMICS). The institutions involved in this project include the Catalan Office for Climate Change (OCCC) of the Government of Catalonia, and the Terres de l'Ebre Environmental Policies Consortium (COPATE). The objective of this project is to increase the resilience of Mediterranean local institutions by means of an intervention in three regions in Catalonia: L'Alt Penedès, the Montseny Biosphere Reserve and Les Terres de l'Ebre.

The initiatives to be implemented as part of the project include the preparation of a diagnosis of the vulnerability of the Terres de l'Ebre region to climate change (Action 1), with special emphasis on the following sectors: agriculture and livestock farming; forestry; fishing and aquaculture; and tourism. Les Terres de l'Ebre is the largest territory of the three covered by the project, and it includes the four southernmost regions of Catalonia: Baix Ebre, Montsià, Ribera d'Ebre and Terra Alta.

The Catalan Office for Climate Change is a beneficiary partner of this project and is responsible for Action 1, which is being carried out in three phases: an analysis of the territorial and sectoral situation (A1.1), a vulnerability analysis (A1.2) and a diagnosis of risks and vulnerabilities (A1.3).

A1.1 Assessment of the studies carried out

This section summarises the information available on the territory and the economic sectors studied. The information, structured in dossiers according to the various thematic sections, is presented in the appendix to the study. The following conclusions can be drawn from the information gathered:

The area devoted to crops exceeds 40%. Olives are the main crop. The largest concentration is on the Baix Ebre - Montsià plain and on the Baix Ebre coast. Citrus fruits are mostly grown in the southern areas, along the course of the Ebro River. Vineyards predominate in La Terra Alta, as well as non-citrus dry farmed fruits (almond trees). The main crops in La Ribera d'Ebre are olive groves and irrigated non-citrus fruit trees (sweet fruit). Rice is grown in the Ebro Delta. The total number of farms has declined considerably in the last 30 years, while their average area has increased.

The number of livestock farms in Les Terres de l'Ebre has fallen very significantly since 1982 (-86%). Poultry and pigs account for the vast majority of livestock units. There has been a considerable rate of growth in pig farming in the last 25 years.

Forests occupy almost 50% of the area of Les Terres de l'Ebre, with a predominance of Aleppo pine forests and scrubland. More than 80% of the publicly owned forests have approved forest management projects and instruments (forests for public use). However, privately owned forests predominate in Les Terres de l'Ebre and, in this case, only 7,396 hectares have a Technical Forest Management Plan (TFMP).

The boats in the five fishing ports in Les Terres de l'Ebre account for a quarter of the Catalan fishing fleet, and a fifth of its catches. Aquaculture facilities are mostly concentrated on the coast of Sant Carles de la Ràpita and Montsià, as well as around the Punta del Fangar. Mussels are cultivated in the bays created by the Punta del Fangar and the Punta de la Banyà. *Long-line* aquaculture follows the northern coastline of the Ebro Delta and around Alcanar.

The sun and sand tourism model plays a major role in Les Terres de l'Ebre and much of the accommodation is therefore concentrated in the coastal towns. The number of

overnight stays has declined over the last ten years. They peaked in 2007 (at 1.75 million) and have stabilised since 2013 (at 1.35 million).

A1.2. Vulnerability analysis

The vulnerability of each sector to a given risk depends on three variables defined as follows, according to the Catalan Strategy for Adapting to Climate Change (OCCC, 2012).

- **Exposure:** the presence of people, means of subsistence, environmental goods and services, infrastructure, and economic, social and cultural assets in places that could be negatively affected by the impacts of climate change.
- **Sensitivity:** the extent to which a system or sector is affected, whether adversely or beneficially, by climate-related stimuli.
- **Adaptive capacity:** a system's or socio-economic sector's inherent capacity to adapt to the impacts of climate change, control the potential damage, take advantage of its opportunities and cope with its consequences. Building adaptive capacity means developing the institutional capacity to respond to climate change effectively.

Vulnerability = (Exposure x Sensitivity) - Adaptive capacity

The greater the exposure and sensitivity to a given risk, the higher the vulnerability.

The greater the adaptive capacity, the less vulnerability.

The vulnerability analysis has been produced based on obtaining the vulnerability indicators for the significant risks previously identified for each economic sector, and the results for the risks as perceived by 19 territorial stakeholders from 13 institutions belonging to the various economic sectors studied. The results of the

indicators studied are classified in a range from 0 - green (not very vulnerable) to 10 - red (highly vulnerable). They are as follows:

Agriculture and livestock farming sector risks	Indicators	Value
Changes of crop types Changes in plant productivity Reduced water availability	AGR01 = Increased irrigation needs in agriculture	7
Increased risk of forest fire	AGR02 = Increased risk of fire in agriculture	5
Changes of crop types Reduced water availability	AGR03 = Changes in crops	5
Changes of crop types Changes in plant productivity Reduced water availability	CLINsec = Impact on dry farming	8
Changes of crop types Changes in plant productivity Reduced water availability	CLINsec1 = Nuts in Les Terres de l'Ebre	2
	CLINsec1 = Nuts in Terra Alta	7
	CLINsec1 = Vines in Terra Alta/Ribera d'Ebre	2
	CLINsec1 = Vines in Terra Alta	7
	CLINsec1 = Olives in Les Terres de l'Ebre	7
Reduced water availability	CLINquai = Decline in the quality of groundwater	6
Changes in livestock farms	CLINram = Changes in types of livestock farms	10
Changes in the distribution of crop areas Reduced water availability	CLINpast = Reduction of pastureland areas	3
Coastal morphological changes	CLINmar = Rising sea level (Ebro Delta and coastal area)	10
Changes in plant productivity Risk of increases in invasive and/or troublesome species	CLINexo = Risk of invasive and/or troublesome species (agriculture)	8

Forestry sector risks	Indicators	Value
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Increased risk of forest fire	FOR01 = Increased risk of fire in forestry	6
Reduced water availability	FOR02 = Reduced water availability in forestry (climate impact: rising temperatures)	4
Reduced water availability	FOR03 = Reduced water availability in forestry (climate impact: drought)	2
Loss of biodiversity	CLINbio = Risk of loss of biodiversity	6
Changes in the distribution of forest species	CLINbosc = Changes in the distribution of species of interest for forestry	2

Fishing/aquaculture sector risks	Indicators	Colour
Changes in fishing and aquaculture	CLINmar1 = Effect of rising sea level on port infrastructure	2
Changes in fishing and aquaculture Risk of increases in invasive and/or troublesome species	CLINexo = Risk of invasive and/or troublesome species	8

Tourism industry risk	Indicators	Colour
Changes in the pattern of tourism demand Reduced water availability	AIG01 = Changes in the pattern of tourism demand in water management	5
Changes in the pattern of tourism demand	TUR01 = Changes in the pattern of tourism demand	4
Loss of landscape quality	CLINqual= Loss of landscape quality	6
Coastal morphological changes	CLINmar = Rising sea level (Ebro Delta and coastal zone)	10
Coastal morphological changes	CLINplat = Risk of loss of beaches	7
Loss of biodiversity	CLINbio = Risk of loss of biodiversity	6
Risk of increases in invasive and/or troublesome species	CLINexo = Risk of invasive and/or troublesome species (tourism)	5

Health risks	Indicators	Colour
Risk of increases in invasive and/or troublesome species	CLINexo = Risk of invasive and/or troublesome species	5
Health	SAL01 = Increase in mortality associated with heat	7
Health	SAL02 = Worsening of climate comfort (accentuation of the heat island phenomenon) effect on health	3
Health	CLINsal = impact on health (heatwaves)	7

Taking into account the risks analysed, the vulnerability analysis for each sector gives results indicating high vulnerability for the agricultural and livestock farming sector; low vulnerability for the forestry sector; and moderate vulnerability for both the fishing industry(5) and the tourism industry (6). The vulnerability for health is also moderate (6). However, it should be taken into account that the number of indicators used for this calculation varies greatly from one sector to another. Furthermore, in some cases, such as the fishing industry, it was impossible to calculate all the indicators that would have been necessary for an overall assessment of their vulnerability to the risks associated with climate change.

The results of the indicators and the assessment made by the stakeholders in the territory are consistent with each other (very high vulnerability) in regard to the rise in sea level (agriculture and tourism), the impact on livestock farms, changes in plant productivity (dry farming crops), reduced water availability in agriculture, and the risk of invasive and/or troublesome species (agriculture and aquaculture).

There is some divergence of opinion regarding the risks which the stakeholders in the territory perceive as involving maximum vulnerability (increase in the need for

irrigation, loss of biodiversity and impact on health of heatwaves), while the indicators give high values (7 out of 10).

Finally, there are significant differences for the other risks, especially in the forestry sector. The vulnerability indicators give moderate or low values, and the perception of vulnerability by the stakeholders in the territory is very high. This is largely due to the sensitivity and adaptive capacity sub-indicators that comprise the respective indicators.

A.1.3. Diagnosis of risks and vulnerabilities

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 agriculture and livestock sector	
	Changes in crop types
	Changes in plant productivity
	Increased irrigation needs
	Changes in the distribution of crop areas
	Reduced water availability (increased evapotranspiration and increased recurrence of droughts)
	Changes in livestock farms
	Coastal morphological changes (especially in the Ebro Delta)
	Increase in invasive and/or troublesome species

Risks in the forestry sector	
●	Changes in the distribution of forest species
●	Increased risk of forest fire
●/●	Reduced water availability (increased evapotranspiration and increased recurrence of droughts)
●	Loss of biodiversity

Risks in the fishing and aquaculture sector	
●	Changes in fishing and aquaculture

Risks in the tourism industry	
●	Coastal morphological changes (especially in the Ebro Delta)
●/●	Loss of landscape quality
●	Reduced water availability (increased evapotranspiration and increased recurrence of droughts)
●/●	Changes in the pattern of tourism demand
●	Loss of biodiversity
●	Risk of increases in invasive and/or troublesome species
●	Impacts on people's health

Diagnosis of vulnerabilities

a) Agricultural and livestock sector

The overall vulnerability of the agriculture and livestock sector in Les Terres de l'Ebre is high. The sector's vulnerability is very high in terms of the impact of climate

change on dry farming crops, the reduction of water available for irrigated crops and the implementation of new irrigation support systems. The crops that are most vulnerable to the effects of climate change are those located in the Ebro Delta, due to the retreat of the delta area as a result of rising sea levels and the subsidence of the Delta, which is aggravated by the lack of sediment deposits. The dry land crops located in the Terra Alta region (vines and almond trees) are highly vulnerable due to the decline in precipitation and its irregular distribution. The adaptive capacity based on implementing more efficient irrigation techniques and introducing species and varieties for cultivation that are better adapted to the new conditions may contribute to reducing the general vulnerability of crops. However, in the case of crops located in the Ebro Delta, the vulnerability of the agricultural sector will continue to be high due to the fact that its adaptive capacity does not depend only on the sector itself, but rather on society as a whole, and whether measures are taken against rising sea levels and subsidence with greater sediment deposits.

The vulnerability of the **extensive livestock farming sector is low**, despite the impact of climate change on changing precipitation levels linked to pastureland. This is because it is an activity that is not excessively important in the area, and pastureland is not abundant. Increasing extensive livestock farming may contribute to improving the territory's capacity for adaptation to the risk of forest fire. However, **the vulnerability of intensive livestock farming is very high**, since an increase in mortality, miscarriages and stress due to increased temperatures has been identified. This requires increased investment and expenditure on cooling systems and water needs. Constructing or adapting farms to become increasingly efficient in the use of energy and water can contribute to reducing vulnerability.

b) The forestry sector

In overall terms, the vulnerability of the forestry sector is low. This is above all because this activity is of little importance in Les Terres de l'Ebre. Its vulnerability is considered **medium-high for the increased risk of forest fires and the loss of biodiversity**, especially of the species that are most sensitive to rising temperatures and the reduction and irregular distribution of precipitation. This includes Scots pine, Austrian pine, beech and holm oak forests, and riverside vegetation. Improved management of the habitats of the most vulnerable species and a more extensive implementation of the technical forest management and improvement plans could help to reduce their vulnerability.

However, because forestry is not an important activity, its vulnerability is rated as low in terms of risk of changes in the distribution of species, since should the sector undergo significant development, it will have good adaptive capacity for forest management. Furthermore, forestry has potential for the use of biomass as an energy resource. If this becomes widespread it would reduce the risk of forest fires, contribute to the improvement of forest management, and to the mitigation of climate change by generating heat from a renewable source.

c) The fishing and aquaculture sector

This is a sector with very high overall vulnerability, especially in the case of the aquaculture located in the bays of the Ebro Delta. Aquaculture in the bays is basically affected by the morphological changes in the Delta. Some of these are natural and others are caused by climate change, and lead to the bays closing up. This closure makes the water temperature rise above the optimum levels for breeding the various species, and also leads to eutrophication of the water. Taken together, these phenomena lead to high mortality rates or product sizes that are unsuitable for sale.

The adaptive capacity of the aquaculture sector in isolation will barely reduce the this activity's vulnerability, since the measures that need to be taken involve society as a whole and not only the sector by itself.

Fishing on the open sea **has a medium-low vulnerability level**, since it has a greater adaptation capacity to the effects of climate change, and because climate change is not the only impact on this activity, since it is also affected by pollution and overfishing.

d) The tourism industry

In overall terms, this industry's vulnerability is average, mainly due to its good adaptive capacity. This is due to the possible change in the seasonal nature of visits, improved efficiency in water use, the sector's adaptability by promoting environmental certificates for tourist companies and regions (ECST, EMAS, ISO 14001, etc.), and the redefinition of tourism products and changes in promotion strategy and target market.

Sun and sea tourism has a medium-high vulnerability level. This is primarily due to the rising sea level that alters its main asset, i.e. its beaches, and the increase in heatwaves which may make it difficult for tourists, and especially those who are most vulnerable, to remain outdoors. The current adaptation measures are mainly palliative, and either involve sporadically regenerating beaches after storms, or investing in cooling systems for tourist establishments.

Meanwhile, **the vulnerability is very high for tourism in the Ebro Delta**, due to the dynamics involved in the reduction of its area as a result of the combined effect of the rising sea level and the subsidence of the Delta itself. In this area, the adaptive capacity goes beyond the boundaries of the sector, and the measures implemented

to reduce this risk need to be the result of a major regional or even a national agreement.

The increase in troublesome species such as mosquitoes or black flies may have a negative impact on tourists' experiences. Continuing or increasing preventive checks may contribute to reducing the sector's vulnerability to this risk.