Figure 22 - Strategic areas for wildfire risk management (AGP, in red) with wine production (PDO areas – yellow) in the Barcelona province. Real plantations of vines (in purple)

Figure 23 - Wine Designations of Origin in Catalonia

EMPORDÀ PDO:

Figure 24 - Photography of Empordà vineyard in Costa Brava at the beginning of 20th century

The Empordà region has been largely cultivated with vines in the past. The oral tradition refers to 30,000 hectares of vines, but following the *Phylloxera* crisis at the end of the 19th century and the rural abandonment of the 1950s, the vineyard extension decreased. With the emergence of wine tourism, a new generation of wineries appeared, taking advantage of the border with France and its synergies with the coastal tourism of Costa Brava. The PDO covers about 2,000 hectares. The Empordà wine-growing landscape is not continuous. It occupies territories with different characteristics with an unequal fire risk. Our visits concentrated in the cross-border area of the Albera and in the Cap de Creus NP which adjoins the tourist village of Cadaquès. Overall, it is a region known for the Tramontane wind which blows regularly and is feared in the event of a fire -e.g. the NPs of the region are grouped under the name of "Tramontane parks".

The Albera area is mountainous, partly covered by cork forests and includes Natura 2000 protected areas. However, a project of the DO Empordà has made it possible to enhance the cork farm for the local wine sector: "Taps de Finca" (2016). It is a quality product that cannot be used for low-end wines, but it helps to reinforce the message of identity and local landscape management for more premium wines, especially in the case of independent winemakers. Some wineries have less than 20% of their property planted with vines, the rest being forest, some of which is cork oak. It is not possible to produce corks from the woods of the property, the origin is the Empordà region. For example, on a property in 2020, from 4 tons of cork harvested, 400 kg were used to make high-quality corks (i.e. 20,000 corks at €4 each) and 3,600 kg were crushed for the production of chipboard stoppers. The activity now makes it possible to envisage the opening of new forest tracks.

Figure 25 - Cork production and surrounding of the vineyard in Albera mountains

Two fires are mentioned by the cellars visited: in 1986 (a childhood trauma for one of them) and in 2012. But there is a lack of awareness by the local population, even after being personally affected. Indeed, although in the first year there were donations to the local wildfire volunteers (ADF), the efforts ran out of steam in the 3rd year after the fire, to completely abandon the initiatives about 10 years after the fire.

One of the wineries produced a "smoked wine" (*Vi Fumat*) in 2012, a wine with a smoky taste, which is regularly cited as an example of the wineries' adaptation to fires. However, this production was minimal: a few hundred bottles and was entirely bought by a gastronomic restaurant in Girona for an event created following the fire. In no way is this action representative of the management of smoke-flavored grapes in the wine sector (national, European or international). Nevertheless, this fact questions the possibility of a positive valuation of the taste of smoke in the world of oenology and sommeliers.

The case of NP Cap de Creus is interesting: unlike the Albera, whose Natura 2000 are managed by private owners, and the agricultural and forest areas considered as parallel management areas, the NP offers a global understanding of landscape management. However, in 2022, the wildfire highlighted the effectiveness of vines in protecting the outer districts of the urban area of Cadaquès. The NP was established in 1998 and in the 2000-2001 seasons there were wildfires. In response, in 2002, the NP worked with all those who wanted to buy land by informing about a management model that included the risk of fire. In 2005, the 1st wildfire prevention plan was approved. A revision took place in 2009, then in 2022. The revisions make it possible to envisage bottlenecks. Cap de Creus was completely abandoned by farmers during a period, which created a homogeneous landscape. In this farmlands, the productive share rises up to a maximum of 25%. This means that the remaining 75% of the land represents a management cost without corresponding revenues. The Common Agricultural Policy aids often concern only the productive part of the holdings. The NP's aids can raise up to €60,000 but entail a process of around 3 months of drafting documents. For many farmers this means a complex process to get subsidies. To overcome these barriers, the park's technicians, who often have profiles as forestry or agricultural engineers, are largely dedicated to administrative management to ensure the development of landscape management strategies funded through these aids.

In concrete terms, in the management of the urban-forest or urban-agricultural interfaces, the municipality is the only channel of exchange with the agricultural producer, through its urban planning department. However, while the urban planning services recognise the role of wildfire protection of vines, requests for ploughing become invalid for 30 years after a wildfire due to the Spanish Forest law. These situations generate misunderstandings on the side of producers, who sometimes do not feel supported.

Figure 26 - Vineyard and pasture protected touristic areas in Portbou. Source: Diari de Girona (2023)

PENEDES PDO:

The Penedès wine region is the largest PDO in Catalonia. It brings together the largest wineries (including three international wine groups), a complex socio-economic reality encompassing large wine cellars, cava industry, cooperatives, winegrowers, independent winegrowers, "*garage wines*"... Its central production area is known as The Plain ("*La Plana*"), it includes negligible forest fragments and is directly endangered by the urban expansion of the Barcelona metropolitan area. Many urban settlements are directly in contact with the woodlands, with some housing estates built during the 70s and 80s more or less legally. These woodlands are generally young stands of *Pinus halepensis.*

Despite the density of producers in the region, wine growers regularly report a feeling of loneliness in the face of landscape management and climate risks, including the risk of wildfire. Here, too, farmers are reaching retirement age and winegrowers who are still active are regularly approached to take over the management of the vineyards. Concern is also expressed about the loss of the agriculture-forest matrix derived from monoculture.

Figure 27 – The Ancosa range covers cultivated areas amidst a forest continuity.

Nevertheless, at the end of the production area, the density of afforestation is high, particularly in mountainous areas. Thus, on the coastal part, the Olerdola, Garraf and Foix NPs include part of the vines, and on the north-west the mountain range of Ancosa (Figure 27) and Montmell are included in the Natura 2000 network. The latter do not have a specific management strategy, which is under the responsibility of private landowners. In the past, woods were utilised in connection with the needs of heating and charcoal production. The production of brandy, which was widely developed from the 18th century, implied a demand of this wood. Generally, a feeling of nostalgia is expressed about the loss of profitability of wood.

Figure 28 - View of Montserrat and Penedès plain from Subirats touristic vineyards

The Fire Wine Resilient Landscape approach is a priori of more interest to wineries that have developed a marketing and quality discourse in connection with the *terroir* and the landscape and thus capture added value from end consumers. However, a large part of the land under production belongs to winegrowers who specialize in the production of grapes as raw material. Few of them have a direct relationship with the end consumer. Few are involved in wine tourism initiatives and when they offer "rural tourism" they do not systematically promote the cellars and associated tourist products. Nevertheless, they are often grouped into associations or cooperatives that can be effective gears for territorial management. The PDO Penedes covers territories of various local administrations (provinces of Tarragona and Barcelona, 5 counties) with unequal technical and legal frameworks, which can be experienced as an obstacle for collective management, or as an opportunity when there is no history of wildfire risk management.

ORPI-MIRALLES range as Resilient Landscape

CTFC boosted the development of the Catalan Government initiative "Resilient Landscapes" within the Catalan Bioeconomy Strategy 2030. In particular, CTFC provides science-based support to model future ecosystem services, wildfire risk, according to climate scenarios and management itineraries. The development of resilient landscapes respond to different European strategies that are part of the EU Green Deal, which aims to achieve climate neutrality by 2050. Five pilot areas were chosen as test, including Orpí-Miralles, which is being developed in agreement with the local Forest Owners' Association. This area exhibits a high rate of agricultural abandonment and is adjacent to the PDO Penedès in its northern part.

The area is influenced by the proximity of Igualada city (41,000 hab.), only 63 km from Barcelona downtown. The agrarian sector has been mainly abandoned, with a few producers remaining in the lower lands, mainly to cultivate cereals and grapes. The housing is distributed between old villages and residential areas built in the 1960's-1990's. The residential areas host families that often do not participate in the local economy and society of the villages.

In this context, Fire Wine complements the general Resilient Landscape proposal of interventions or land uses that contribute to reinforce the landscape resilience, highlighting concrete productions and its socio-economic difficulties. Then, in the end of 2024 workshop highlighted the lack of active farmers and the fragility of production, which depends on grape and wine production companies from outside the territory and who feel little concerned by local issues. (cf. workshop in Orpí-Miralles – 2.2.2.)

As a result, the "Resilient landscape" project focuses on the need to renew the link between populations and their territory (pilot projects in agroforestry, forest and water resource management). This part of the Anoia is included in the recharge area of the Carme Capellades aquifer, one of the most important regional water reserves, and a spring has even been exploited commercially. Other management tools are being developed, such as a landscape charter, for example, or levers for valorization through the bioeconomy and the purchase of carbon credits.

Figure 29 - Vineyard in Miralles: power lines contribute to wildfire risk management

The workshop highlighted the small number of people involved and directly active in these projects compared to the size of the area concerned. Similarly, wine and cereal production is finally sold and sometimes directly managed by only two players that can be found further south in Penedès. Artisanal production is not valued and almost non-existent. Fire risk management can be a good reason to strengthen joint activities and initiate new dynamics thanks to the associated existing subsidies.

ALELLA PDO

Like Penedes, the PDO Alella has been closely linked to the urban expansion of Barcelona, which is Spain's 2nd largest city. In this case, the socio-economic structure of the wine sector was not strong enough to withstand urban sprawl. The vineyard is therefore a residual space surrounded by inhabited areas. Cultivated land is an intermediate area that is articulated with the NP Serralada Litoral. Although this NP is smaller than other NPs outside the metropolitan area, it is important for the services it offers in terms of quality of life, air quality and biodiversity. In this case, the vines are to be considered as semi-public spaces frequented by walkers (jogging, dog walking, teenagers' outings, etc.) and maintained by cellars. Vineyards represent a safe space regarding wildfire risk, which protects the NP.

Figure 30 - In such an urbanized area, the probabilities of human negligence are numerous and can have significant consequences. View from Alella vineyard towards Barcelona. Source: Soazig Darnay.

PLA DE BAGES PDO:

It is the PDO that brings together proportionally the most wineries that meet the criteria of Fire Wine: strategic isolated spaces in a continuous wooded mass, wineries with strong identities, and meaningful to preserve forested landscapes (which are largely included in the Natura 2000 network and in the UNESCO Geopark Catalunya Central) and cultural landscapes. Many dry-stone walls reappear during fires in the mountains, testifying the extent of rural abandonment in recent decades. A dry-stone heritage specific to the local wine culture is highlighted by the PDO: buildings dedicated to the pressing of the grapes and the first fermentation are particularly remarkable. The preservation of this heritage gives rise to projects to recover agricultural soils in areas that are not very productive of terraces, thanks to their impact on wine tourism. However, the Ley del Monte (43/2003 of 23rd of November), which prohibits the change of land use after a fire, prevents from any land use change, including those to recover the dry-stone elements as rediscovered heritage (cf workshop in Pla de Bages – 2.2.2).

Figure 31 – Ancient dry-stone building that was discovered after the Pont de Vilomara fire in 2022, located in former vineyard terraces.

PRIORAT DOQ and MONTSANT PDO

The Priorat is a DOQ, the most prestigious PDO in Catalonia. PDO Montsant is also a high-quality wine appellation spread around the DOQ Priorat. It adjoins the NP Serra de Montsant, which is very popular with climbers and which signed the European Charter for Sustainable Tourism in 2016. A nomination to the UNESCO World Heritage List was then presented in 2017 for the entire Priorat county as a cultural landscape, representing the Mediterranean agroforestry mosaic but did not succeed. The PRIORITAT association promoted this candidacy and has since maintained the efforts of a common management of the landscape. One of the comments of the expert evaluators was the guarantee of wildfire risk management for the maintenance of the Universal Single Value.

In the DOQ limits landscape management is defined by a detailed map protecting certain afforestations, for reasons of aesthetic quality of the landscape and aromatic and environmental quality. The "protection and exclusion" map distinguishes between wooded areas to be conserved and an area forbidden to the planting of vines (protected natural area), but also a part of the territory where only terraced vines are allowed (levelling prohibited). This detailed document is an interesting basis for risk management as it sets the limits and informs the existing rural landscape management.

Figure 32 - Map of DOQ Priorat "Vilas", including protection & exclusion map (2nd map on the top left)

Figure 33 - Landscape Charter of Priorat (2012), designed with the Landscape Observatory of Catalonia. It is the basis for the work of landscape management and the UNESCO nomination

On the southern part of Montsant PDO, several members of the Capçanes wine cooperative and some winemakers are included in the Llaberia range. In this case, a consortium of municipalities develops a common management system that catalyses the governance to match biodiversity, agricultural and wildfire risk management. It is an emblematic territory for the management of fire-smart landscape.

Figure 34 - Mosaic landscape with fire smart management in Llaberia range.

PLA DE BAGES (Catalonia)

The viticultural heritage of Bages territory served as the starting point for studying the current role of vineyards in wildfire prevention. We supervised the research of Coline Pacton, PhD Student of Genova University (Italy), to the work of Fire Wine. Under our guidance, she conducted first an exploratory study in Pla de Bages, accompanied by a French student of landscape architecture, crossing the whole area walking and driving through the hills, to understand better its landscape challenges. Then we crossed her results to the conclusions of the workshop we organized in ARTIUM cooperative.

Figure 35 – Bages county map designed by Antonin Renard and Coline Pacton. The coloured parts represent the landscapes observed during the visits: the pine forest (dark green), linked to the mountains, is dominant. Few herds were detected.

Despite a significant decline, traces of the importance of viticulture can still be found throughout the county: along roads, near villages, but especially under trees where we still find dry stone terraces or vats, remnants of this past. The county had 25,000 ha of vineyards by late 19th century, what was drastically reduced to the current 500 ha due to the Phyloxera. Although abandoned vineyards became spontaneously afforested, certain recent events, such as the fire in Pont de Vilomara in 2022, have revived these once-cultivated landscapes. Today, viticulture is found scattered in the county, like islands within a vast Aleppo pine forest area, which is particularly vulnerable to fire risk.

The wine growers can be distinguished by their geographical position in the comarca, but also by their business structure: producers affiliated to the Artés cooperative, winemaker-oenologist within large estates, owners of family estates, new players in the process of setting up. Despite this diversity of contexts, there are several common themes and echoing difficulties: an interest in soil quality and water management, but also a constant need to adapt to increasingly unpredictable climatic events, as well as concerns about inheritance.

Figure 36 shows different contexts highlight various management initiatives, such as the water reservoir positioned between the vineyards and the forest and the wider path designed to mitigate root competition from pines. However, there is also a lack of management, exemplified by the overly dense forest along the boundaries and the inaccessible dry riverbeds.

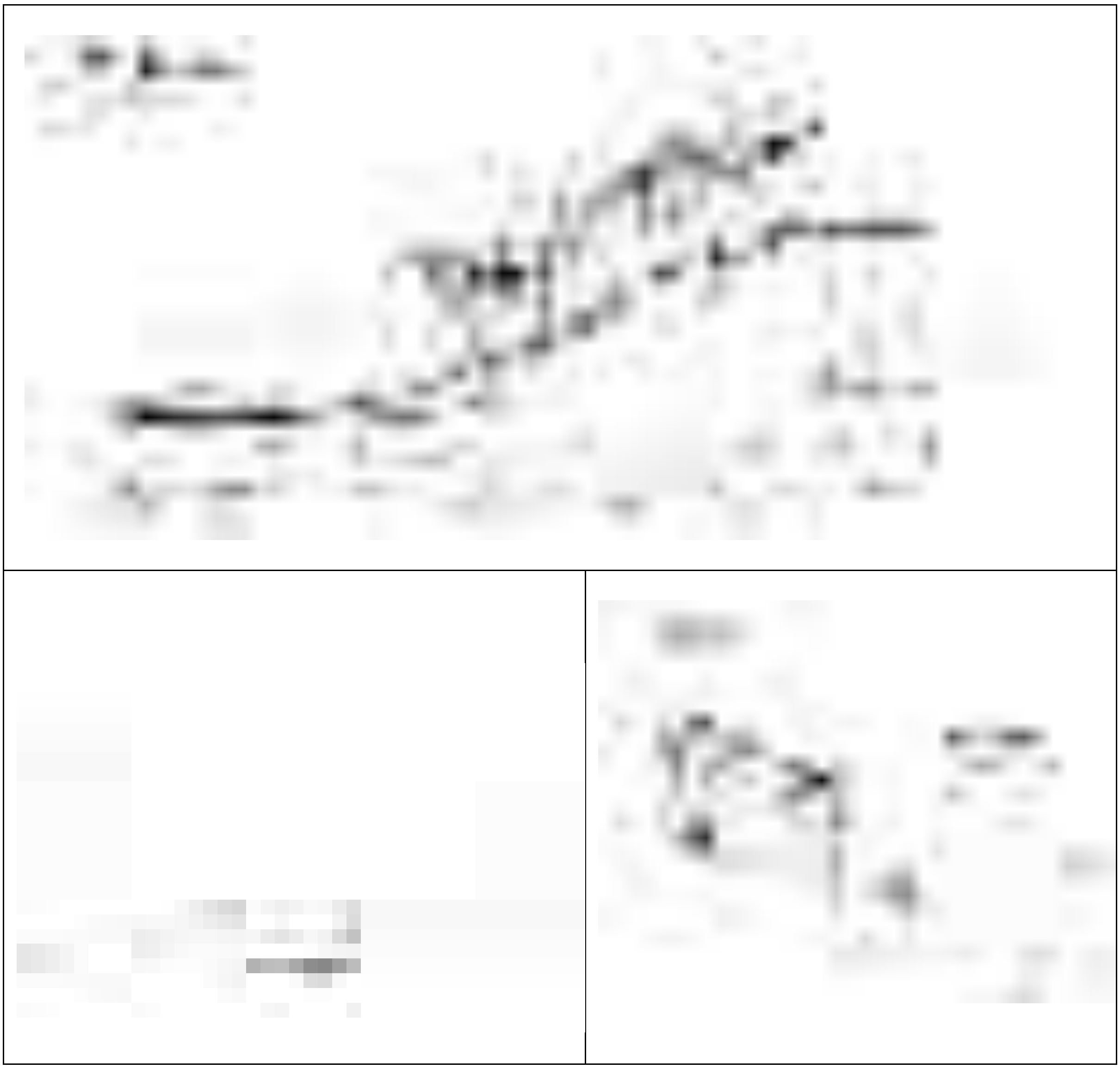

Figure 36 - Sketches of borders of the vineyards in Bages. Source: A. Renard, 2024.

However, difficulties in transferring vineyards are linked to production and profit issues, themselves linked to a combination of unfavourable climatic conditions and bureaucratic procedures that hinder the rapid adaptation to the pace of change. This dynamic often leads to abandonment. The concentration of active vineyards in certain areas of Bages, particularly in the large estates, reduces the presence of viticulture throughout the territory. Yet, for the Catalan firefighters, it is the presence of vines at forest interfaces, and their dispersal throughout the area, what helps mitigating the risk at a landscape level -as reminded during the workshop held in December 2024 at the Artium cooperative in Artés.

Many of these wine-growing islands are located close to or within forests and represent "pilot situations" for studying their interfaces with woodlands. In this sense, their specific geographical positions, confronted with different species, topography and soils, become a fertile source of information on ways of managing these mixed interfaces in other parts of the county, and even beyond. There is a need of a territorial approach that could link fire prevention to landscape management and agriculture production.

OTHER AREAS OF CATALONIA:

Apart from the most recognized PDOs where commercial approaches are more dynamic and help to identify wines and landscapes, individual or group initiatives are also to be noted.

The area of the Tremp valley, county of Pallars Jussà, represents the northern limit of the Catalan wine production. Prior to *phylloxera* the maximum vineyard area reached 7,000ha (19th century). A few small individual wineries are now operating and winegrowers sell some of their grapes outside the county, as far as the Penedès. The well-known wineries located further south have taken an interest in high-altitude production in response to climate change. The coolness of the night helps to maintain the acidity of the grapes. A local political will has pushed the reintroduction of vines.

Within the FIRE-RES project, IRTA has carried out additional work to study the viability of vines and apple production in the region (Casadó-Tortosa et al. 2024). In this case, wildfire risk is not experienced as an immediate risk, but in a projection of the announced future.

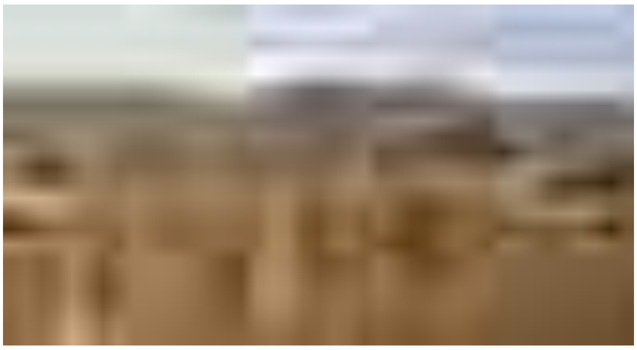

Figure 37 – Pallars' vineyards. Source: Armand Casado, IRTA.

Similarly, the county of Solsonès, is better known for its forest production than for its wines. As a result, the wineries are developing a local sales network, an interesting tool for Fire Wine to communicate with regard to risk. In the case of Roc Falcon, the production is less profitable than the main activity of selling young birds of prey to the Middle East clients. It is nevertheless an investment in the local future which, combined with rural tourism, can ensure an income in the event of international political tensions and which directly provides "fireproof" protection around the cages of breeding birds, from generations of selection. The vines were planted thanks to planting rights acquired from Penedès winegrowers who were retiring.

Figure 38 - New terraces of vines amidst Solsonès mountains

MARGES DEL GAIA

On the borders of the DO Penedes and the DO Tarragona, scattered vineyards occupy the slopes of the Ancosa ranges and the plain further west. A viticulture technical support group established in 2022 is gradually articulating actions with other mountain wine groups. Various agricultural productions are spread in a dominant forest context, with micro-productions of wines and grape juice. The Gaia River meant the historical border between Catholic Catalonia and the Muslim world during several centuries. The Cistercian monastery of Santes Creus is part of this history and testifies to the existence of a cultural heritage of great value (Figure 39). All of these vines, which are a priori residual, therefore play an important role in the protection of this heritage.

Figure 39 - The monastery of Santes Creus (12th century) surrounded by woods.

SIERRA DE LLENA

The province of Lleida is known for its intensive fruit and wine production on mostly irrigated plots. The wines produced in this province do not therefore benefit from a remarkable qualitative image from the outset. Wines from the mountainous limits of the province are therefore doubly penalized, by image and by substantially lower productivity.

The Association of Private Forest Owners La Pobla de Cervoles Vilosell was created in 2022 in order to improve the forest management of the mountain where quality vines are concentrated. Its proximity to the Prades mountains, known for their natural heritage, gives them a special status. Within the association, mayors represent the two municipalities, jointly with 30 members. The largest areas belong to the cellars (3 cellars, 500ha) which each have their own individual forest management plan. There are 5,000 hectares in total to be managed, belonging to 2,000 owners, whose names are not always known.

One of the cellar owners testified: "*At the launch, there were 80 people in the audience, but they don't like to be checked and don't want to register. Some agree to help materially in cleaning the paths, for example, but do not want to be part of the association. The most difficult thing is to convince the population. Traditionally, the woods were only used for the production of charcoal, it is the place where garbage is thrown. We have to change our mentalities. In general, we need more sociability and socialization in the rural world*."


Figure 40 - Left: mixed productive landscape in Llena range. Right: wine landscape, both dominated by forest.

Living Lab Galicia

Figure 41 - Wine Designation of Origins of Galicia and Castile and Leon.

The main initiative of FIRE-RES in Galicia is the "*Model villages*"[10]. These are developed by a civil security team of the Galician Government and the initiative aims to prepare local people to the wildfire emergence and its prevention and preparedness.

It complements another initiative of Xunta de Galicia, the "*agroforest polygon*"[11] that Juana da Vega Foundation studied in the Monterrei municipality in 2022, and other land bank (2007) initiatives that have been experimented in small villages.

As the backcountry of Galicia hosts villages with traditional shape, the houses are concentrated in the urban nucleus and are surrounded by cultivated lands (vegetable gardens, corn, fruits trees and vines). This buffer area is efficient to protect the houses

[10] https://agader.xunta.gal/es/recuperacion-de-tierras/aldeas-modelo/
[11] https://agader.xunta.gal/es/recuperacion-de-tierras/poligonos-agroforestales

from most wildfires, as it has been demonstrated this last summer 2025 and in earlier occasions. The main limitation of the maintenance of these cultivated crowns is the minifundium structure of the plots. This is also the case beyond this WUI, further away in rural areas. Many parcels are too small to be an interesting farmland sale. The wineries that would like to extend their cultivation are facing this as a major difficulty that slows down their expansion process.

Figure 42 - New plantation of vineyard in community owned lands within the Monterrei PDO, in the municipality of Castrelo.

On the other hand, part of the mountains is managed by collective ownerships: "Forest communities", "neighbours' communities", *or 'Monte Veciñal en Man Común'* (MVMC), typically for grazing. These communal lands are non-divisible private ownership of the local inhabitants of parishes or villages (a smaller scale than the municipality). The Department for Rural Environment of the Government of Galicia gives support to these communities to manage their forests. It can be productive forest if well managed, but unproductive when it has been abandoned or burned too often. Then appears problematic situations because of invasive species (Acacia dealbata, Eucalyptus - mainly). Major wine producers can be interested to access to community-owned lands, which when not used for grazing have been often abandoned. For example, the Martin Codax cooperative (the largest of Galicia) planted a new vineyard in 2023 in Monterrei (area of Castrelo). In that case a 20-year contract was signed, as "agroforest polygon", for a total of 160 ha[12]. In fact, several "agroforest polygons" were developed in 2023 in Monterrei and Ribeiro areas, with the support of the Department of Rural Environment of the Galician government, for areas until 500 ha, which is remarkable in the global context of minifundium.

The management of the invasive species is a major challenge in the day to day of small and medium scale of wineries and grape growers: the abandoned lands are dispersed between productive lands in a context of minifundium. For example, *Acacia dealbata* has a very vigorous spreading root system which competes with cultivated vines and can

[12] https://www.campogalego.es/proyectan-nuevos-poligonos-agroforestales-para-vina-en-monterrei-y-ribeiro/

colonise the subsoil of the field (Figure 48). Moreover, adjacent parcels with Eucalyptus trees may project large shades that can interfere with agricultural crops.

Figure 43 - Acacia dealbata management of an abandoned neighbouring plot of vineyard and root competition in Monterrei PDO.

It should also be noted that the fire brigades, when analysing their mountainous landscape from a preparedness perspective, feel largely concerned about possibles wildfire jumps from one side of one valley to the other. In this case, they appreciate greatly the maintenance of vines and crops located in the vicinity of the forest areas to reduce secondary ignitions.

Living Lab Portugal

Figure 44 - Wine designations of Origin of northern Portugal

Land structure similarities can be found between Galicia and northern Portugal regarding the minifundium structure[13] and communal lands (“*baldios*”, “*aldeia comunitaria*”). FIRE-RES LL is bolstered by ForestWise in Vale de Sousa, and includes the famous winery “Quinta da Aveleda”, the largest productor and exporter of green wine (*vinho verde*). The winery owns 500 ha of vineyard scattered in different locations. In Vale de Sousa they accessed to 20 ha, with other 16 ha in the vicinity, which represented a great opportunity to extend their production in a context of minifundium. They signed a 30-year contract with the land community that owns the mountain. The viticulture manager commented that the clearing of the forest for replanting was profitable from 40 ha onwards, as it entails costly works to prepare the soil. They cut the forest and sold the timber, then uprooted the stumps that were sold locally for heating.

In the interior of Portugal, 3 main PDOS suffer regularly wildfires: PDO Dão, PDO Beira Interior, PDO Tras os Montes. The extreme fire of 2017 occurred in Dão wine region, and in summer 2025 multiple fires spread over Beira Interior area, near NP Serra da Estrela. Vineyards are mostly small, dispersed plots, in minifundium.

In the case of the municipality of Viseu, in the centre of the Terras do Dão wine-growing region, the cultivated land is essential to protect the forest area (Figure 47). However, the map does not reflect the abandonment of the agricultural plots. Vineyards were planted to protect the village (Figure 45). In some cases, cork oaks in the margins represent competence for vines, but these cannot be eliminated due to its protection status (Figure 46).


Figure 45 - Left: vineyard planted by the winery to protect the village. Right: the same village on the other side of the hill showing recent land abandonment, and Eucalyptus forest.

[13] https://www.agroportal.pt/a-procura-de-solucoes-para-a-gestao-no-minifundio/

Figure 46 - These cork oaks are protected but they cannot be productive because of the lack of enterprises of transformation of cork in northern Portugal.

Figure 47 - Viseu fuel map, the cultivated land (pale green) essential to protect the forest (dark green and yellow).

Figure 48 - Eucalyptus (in the back) and invasive Acacia (in the front) in vineyard, add difficulties to maintain the production.

Living Lab Aquitaine

The Aquitaine Living Lab is centred on the forest production area in the Landes district. It is largely included in the Regional Nature Park, which has a management and coordination team in the area, mainly dedicated to the preservation of natural environments, but also to risk management. In this part of Aquitaine, the cultivated areas are mainly used for maize production (linked to duck and foie gras production in south-western France) and vegetable production for the canned food companies (carrots, peas, beans, etc.). However, this is a relatively recent landscape (with plantations dating back to late 1800) and was designed from the outset to incorporate agricultural clearings within the forest massif for the purpose of fire risk management.

Indeed, after the disaster of the great fires of 1949, the security services became more professional and the monoculture of maritime pine, which had replaced the agro-pastoral system in the 19th century, was called into question. In the 1950s, the Landes region underwent the “agricultural colonization” process, focused on modernization and crop diversification, moving from the traditional agropastoral system to intensive agriculture focused on corn and other crops. This period was marked by the creation of organizations such as the CALG (*Compagnie d'Aménagement des Landes de Gascogne*) in 1956 to settle farmers, as well as by the arrival of refugees from the ex-colony of Algeria, contributing to a rapid transformation of agricultural landscapes and traditional practices. Land clearing operations transformed thousands of hectares of land for cultivation, and sharecropping was abandoned. An agricultural and firebreak belt was established, stretching from the Landes to the Gironde. But part of the model was abandoned starting in the 1980s. At the same time, forest operators gradually established firebreaks along the roads. There are also regulatory constraints on land clearing.

Agriculture is now industrialized, taking place on the wettest land that is least suitable for forestry. However, the water table is shallow and there are numerous pollution problems linked to the drainage network, which is up to 3 meters deep. The PNR ensures protection of lagoons that were established 10,000 years ago during the last glaciations. It is an environment similar to that found in Siberia, rare, which depends on the beating of the water table. Already 50% of them were lost following the drainage to develop intensive forestry and intensive agriculture since the 1960s. This is why the Landes PNR is in favour of the management of pastures for silvopastoralism rather than creating new agricultural openings using the existing model. A *cadrillage* is imagined, with lines of at least 25 m wide and a length of 5 km.

Figure 49 - Open space and agricultural island of 200 ha, amidst the forest of Les Landes.

At the north of the limits of the Living Lab begins the famous vineyard region of Bordeaux. The forest production spans until the seashore in parallel to some wine PDOs (Figure 51). Its southwestern border is directly connected to the forest. Most vineyards are extending in suburban areas because of urban sprawl, thus adopting an emerging role in wildfire risk mitigation.

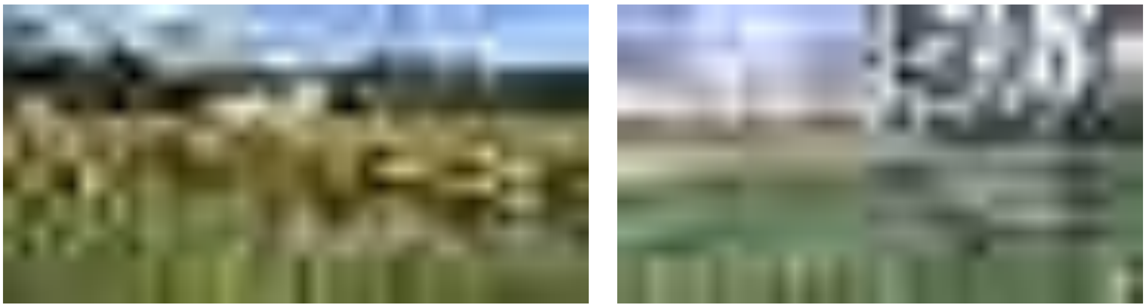

Figure 50 - Prestigious Sauternes (left: winery) and Pauillac (right: vineyard and honey) wine areas near Bordeaux.

Figure 51 - Designations of origine of Bordeaux.

Figure 52 - South of Graves wine area. Graves and Sauternes DO were directly affected by the Landiras fire in 2022.

During the fire in Cirsac en Médoc in July 2022, the ripening grapes were affected by smoke. However, the sector preferred not to communicate on this subject, and tensions arose in connection with the risk of considering the production as of poor quality, which would have affected all the Bordeaux appellations in commercial terms.

The Médoc PNR works together on landscape management with extensive livestock farms on the natural areas of the west coast, which reports as being easier than with cellars, and with the representatives of the concerned municipalities. The agricultural landscape management tool is the local Territorial Food Plan, which allows the valorization of meat from Blondes d'Aquitaine cows. In addition, some technicians miss a formal, institutional link between wildfire and landscape management.

Figure 53 - Landscape unit 1.5/1.4 of the PNR corresponds to the definition of Fire Smart Landscape and mainly concerns vineyards (estuary coast, east of the PNR).

Other EU regions

Bierzo (Spain)

The Bierzo PDO locates in the county in the most northwestern corner of Castile and Leon. Castile and Leon is a vast region in central Spain that includes some of the most prestigious wine appellations. However, Bierzo is historically and geographically very close to Galicia, with identical smallholdings and the same communal management of the mountains ("*Juntas Vecinales*"). The prestigious appellations are closer to the capital, Valladolid, under the influence of the Ribera del Duero PDO. Not only are investors of a different caliber, but the management of the territory is also very different. The risk of fire is also different because there is more farmland abandonment in Bierzo. This represents a dichotomy in terms of governmental support, as the measures do not always meet their specific challenges. Despite its proximity to Galicia, the regional administrative border precludes Bierzo vineyards to benefit from the initiatives tackling minifundium (agroforest polygon, model village). In terms of tourism, the Way of St. James passes through the Bierzo vineyards. It is not fully integrated into the region's wine tourism development, even though more than 200,000 pilgrims visit it each year. Yet, these vines represent a safety area for isolated walkers who are not always aware of wildfire risk.

Figure 54 - View of the eastern suburbs of Ponferrada from the abandoned vineyard

El Bierzo is essentially a large basin surrounding Ponferrada. This means that wildfire smoke often remains stagnant, and westerly winds can blow smoke from Portugal and Galicia fire, thus potentially affecting the taste of the wines.

Figure 55 - The Bierzo basin: the vineyard is maintained in the smooth hills and can be useful to manage fire risk considering the density of the vegetation of the mountains

In both Castiles and in Navarra, we recurrently met stakeholders who acknowledge the crucial role of vineyards in maintaining employment within a context of rural depopulation, the so-called “empty Spain”. This reflects the feeling of marginalisation of rural areas and of the agriculture sector.

During interviews in 2023, Bierzo wine producers expressed greater concern about windmill installations than about the risk of fire. They considered fire events as part of the mountains, far from their houses. Only a winegrower located higher up in the mountains referred to us to have planned a backfire once to protect his production, during a wildfire 2 months before the harvest. However, considering the fires of the summer of 2025, with more than 43,000 hectares burned in this county, it is likely their opinion may have changed.

The landscape features a large number of chestnut groves, as well as an associated processing industry (chestnuts in syrup, flour, etc.). The spokesperson of PDO explains that ‘*if the chestnut groves are maintained, there is no risk of fire*’. But these chestnut plantations are old, and their maintenance is called into question. The wine appellation's specifications highlight the identity of Bierzo in relation to its heritage of old vines, unique in the world for the quantity of aged plants. However, new investors are not interested in these old plantations, which combine several varieties, ripen at different times and their shorter planting distances prevent mechanization. This aspect highlights the fragility of the system under current market forces and underlines the particular attention that should be paid to when proposing new firebreak plantations. There is a marked trend towards abandoning vineyards on mountain slopes, and the visited wineries reported that they regularly receive offers to manage mountain parcels that otherwise will become abandoned. Forest expansion in abandoned parcels implies that some small, productive vines become trapped between woods and suffer from a lack of sunlight and root competition. This problem directly links to the reality of minifundium.

Moreover, the winegrowers reported increased wild fauna pressure on the vines following wildfires. They referred to wild boars mainly, but also young olive plantations become attacked by rabbits, which gnaw on the trunks despite protective measures. Some wonder whether the scrubland evolving on the abandoned vineyards provides these species with a favourable habitat.

Navarra (Spain)

We visited the village of St Martin de Unx, in the south-east of Navarra (Spain). This municipality is known for its efforts to combat rural depopulation, including through the VIVID project (2021), which has been taken over by the regional government. The village's economic development is heavily dependent on wine production thanks to the oldest wine cooperative in Navarre (1914), which is still active. It has 80 members and covers 525 hectares (the village has a total of around 600 hectares of vineyards).

The vineyard is divided between vines irrigated since the creation of the Navarra channel (2011) and traditional non-irrigated vines. The latter form a protective belt around the village, but are also the most fragile, as their yields are significantly lower in comparison to those of the neighboring irrigated vines. The surrounding landscape is not forested, although there are some wooded areas. Most of the natural areas consist of shrubby vegetation.

In 2022, the village experienced wildfire for which it was unprepared. There is no formal organization of volunteers to tackle the fire in Navarra. During the fire, a feeling of disorganization prevailed, and the professional fire brigades were unfamiliar with the area. Locals supported them by providing information such as access to water and the most sensitive areas. This event triggered a local collective reflection that they need to be prepared for any future fire event. This is particularly relevant due to the village isolation and aging population, which are comparable to most villages in the region. The community agreed to prepare a strategy in advance, clarifying everyone's roles and prioritizing security needs and existing risks. The wine cooperative representatives discussed with us the possibility of applying for the Fire Wine label, to highlight the role of farmers within a more prepared community model.

Figure 56 – Shrub vegetation in the San Martin de Unx landscape, including non-irrigated vines – protecting the village

Figure 57 - Contrast between non-irrigated and irrigated vineyard

Figure 58 - Vines along the road, a strategic location

Piedmont (Italy)

The Italian National Law 353-2000 states that each region is responsible for planning fire prevention and response measures. It also prohibits changes in land use after a fire. In Piedmont region, Law 15-2018 defines the framework after numerous previous laws (the first being 110-1994). It is structured in three parts:

- Organization at the regional level
- Forestry Corps (equivalent to the ONF)
- Volunteers

Firefighters are not trained in forest firefighting. Former foresters used to take on this role. The 2000 law has a very broad and open definition of forest fire, which addresses ideas of "heritage" and "quality of life." Law 155-2021 provides a definition of the urban-rural interface, which is interpreted according to regional urban laws. However, it does not define what an interface fire is.

The forests located in the foothills of the Alps are largely (70%) public forests, and mountain villages have a tradition of volunteer firefighters. This tradition has been highlighted in order to propose crisis management that integrates volunteer teams with civil security teams that are generally not specialized in forest fires. The volunteer teams have undergone training similar to that of professional teams and are trained to work together. The valleys are organized into *Squadra* to manage fires. In the 1950s and 1960s fires, there were many volunteers who supported the municipality: urban and village firefighters, the Alpine guild, lumberjacks, etc. In the 1990s there was a period of numerous fires: from 1989 to 1991, 40,000 hectares burned, there were deaths and injuries, and the Army was mobilized. Then, 2017 was a critical year with large-scale fires, for which the response system was not ready. Since then, the Piedmont region has become more professional, developing regional corps. Training, equipment, and procedures are the same for volunteers and professionals alike. The Italian regions operate differently: Sardinia, for example, renews agreements with volunteer associations every summer, what creates heterogeneity in organization and effort. The State provides Canadairs and civil protection according to forecasts and priorities. National law defines active firefighting.

The vineyards of Piedmont are world-renowned: the vineyards of Langhe-Roero and Monferrato were added to the UNESCO World Heritage List as cultural landscape in 2014. Nevertheless, being a rural area with intensive wine production, the risk of wildfire has not been taken into account in the global landscape management strategy. However, compared to other PDOs, Monferrato has a more varied landscape: small plots and fragmented properties have been abandoned since the 1970s, while Langhe and Roero have consolidated into larger properties. Since UNESCO recognition, tourism has been growing and Monferrato seems to have more sustained visitor numbers (particularly according to rural accommodation data – interview with IPLA), as there is undoubtedly more visitors' offer and the landscape is more diverse. The risk of fire in Monferrato is higher (and may even increase further) due to poorly maintained woodlands and a higher density of visitors. This could be a future challenge for the continuity of UNESCO landscape's Outstanding Universal Value (OUV).

Figure 59 - Wine Designations of Origin in Piedmont. Most are surrounding Asti city, but on the left of the map are smaller areas included in valleys.

Fire prevention is very recent: it has been institutionalised for about five years, in view of climate change. A PFIT territorially-oriented forestry plan is currently being developed, which will be a regional management plan, integrating "*wood and everything else*." Nowadays, there is a Wildfire Plan, which is a regional programming and guidance tool. There is also a PPR: a regional landscape plan, which covers landscape units according to a convention. The PPR is on a larger scale than the PFIT.

In 2001, a regional knowledge tool was created, bringing together land use, forest maps, land cover types, fuel, etc. Its current revision is being used as an opportunity to introduce a development strategy (particularly in mountain areas). In total, there are 1 million hectares of forest with little forest management. There is a need to renovate the woods and assess carbon capture. Compared to the PFIT, the PPTB is more specific to fires, introducing risk analysis and the location of prevention measures. It provides support for creating areas for investment and preventing large fires, which here correspond to fires covering more than 30 hectares, or around 10% of current fires. Interventions can be carried out in forestry and fuel reduction. According to statistics, most fires occur in the urban-forest interface. Overall, the civil protection service focuses on forest fire risk. It should be possible to demonstrate the benefits of recovering agricultural areas in those areas.

However, the risk is known in the narrow valleys of the Alpine foothills. Indeed, the rate of land abandonment (of traditional fruit production, vineyards, livestock farming) is high and spontaneous afforestation is progressing. Average rainfall rates generate dense vegetation. Laws prohibit clearing of woods without authorization, and the land is highly fragmented.

Italian wine appellations can be established on areas of 3 hectares or more, which explains their multiplicity. This is an asset for these small villages, which can benefit from this visibility. Pomaretto in particular is a village whose local administration supports the preservation of wine culture and wine tourism. This is an attractive proposition for Turin's foodies, who are increasingly shunning the overcrowded UNESCO vineyards where prices are skyrocketing. The current climate is therefore favorable for the development of more family-run vineyards. Vineyards locate in strategic sites because the valleys gather many villages and their corridor effect can be particularly dangerous in the event of a forest fire -to evacuate, for the fire spread behaviour. Some vineyards can be truly strategic in firefighting, preventing the spread of fire from one valley to another by breaking the horizontal fuel continuity. They complement extensive livestock farming, which maintains open pastures and ancient chestnut groves if they are well maintained. However, chestnut groves are traditionally cleared using fire, and climate change, which promotes drought, creates new risks during this management process. There is therefore a need to train farmers in these valleys so that their activities contribute to effective preventive management.

Nevertheless, pressure from wildlife is strongly felt, especially from deer. Few fences are installed because of their high cost. They prefer to manage the height of the grass to limit the passage of animals, as these avoid open spaces. Producers would like to be able to clear brushes 20 meters beyond their plots without having to request permits, which are very complex procedures. They also call for rebuilding forest roads, some of which are currently hardly accessible. In addition, minifundium generates significant notary fees. Even though there is no legal obligation, in practice it is necessary to use notaries even for sales of 95 m^2 plots, which adds to the difficulty of assembling suitable plot sizes for production.

Figure 60 - Vines and fruit trees in Colina de Saluzzi. Planting apple trees is more expensive than planting vines.

Figure 61 - Valsusa vineyard (11 producers). Restaurant and rural tourism promoting farm products.

Figure 62 - Vines and solar panels on the terraces of Pomaretto (9 producers). The vines are planted on south-facing slopes, where the risk of fire is highest.

PACA Region (France)

The south of France, with its Mediterranean climate, regularly suffers from forest fires. As early as the 19th century, the Massif des Maures in Provence was studied in order to limit the effects of fires on the landscape. Indeed, Provence coast, already a very touristic destination, was then a holiday resort for the noble families and the European upper bourgeoisie. The landscape of the Massif des Maures is divided between cork oak forests, vineyards, olive groves and extensive pasture areas. A PNR project is underway, which would be a continuation of the PNR de la Ste Baume and the NP des Calanques in the eastern part of the agglomeration of Marseille (2nd largest city in France) in the Bouches du Rhône department. The Toulon agglomeration is the economic centre of the Var. The urban and tourist density of the coastline and the hinterland between Marseille and Toulon makes it a particularly sensitive area to the risk of fire.

Figure 63 - Natural parks of the Provence region and location of the projected PNR Maures Estérel Tanneron, that would cover the Maures mountains.

Figure 64 - Between Bouche du Rhône and Var districts, the Sainte Victoire mountain, famous for the paintings of Cézanne.

In addition to the various entities for the management of natural areas, the Grand Site de France de la Montagne Sainte Victoire offers a specific territorial management tool, in contact with the Aix-Marseille metropolis. The mountain painted by Cézanne at the end of the 19th century (Figure 65) reappeared identically after the fire of 1989 (5,000 hectares burned). Fire was then the trigger for specific landscape management, which integrates the use of fire and aims to maintain agriculture lively enough and to allow for grazing.


Figure 65 - Cezanne painting of Provence (left) and landscape sensitive map of Grand Site Concors Sainte Victoire (right), both expressing the risk of land artificialization

All these protected landscapes are concerned by the production of Provence wines. The cellars of Provence produce rosé wine on a massive scale. Its wine sales structure does not add much value through territorial identification: 55% is sold in bulk, nearly 50% of the surface area in production belongs to cooperatives. In addition, 27% of vineyard land was irrigated in 2020 (Figure 67), i.e. an increase of 370% in the area in 10 years, placing wine production in 4th place among irrigated crops after rice, pome fruits and meadows. In 2019, the consumption of rosé wines peaked and since then has experienced a slower decline than other types of wines. In 2022, there was a 53% increase in rosé consumption in 15 years in France, which made it an interesting investment.

The real estate market is also particularly valued in this region compared to the rest of France. Urban and agricultural pressure is therefore strong on natural areas, particularly on the foothills, which can lead to the use of the concept of firebreak vines for financial reasons.

Figure 66 - Wine PDOs in Provence (France), surrounding the densely populated areas of Marseille and Toulon.

Figure 67 - Irrigation network in Provence

The region has launched an Agricultural Recovery Plan (2018-2026) with the ambition of recovering 10,000 ha by 2030 in the Var district, "*to support the economic development of the sectors and facilitate the installation of new farmers*". The objectives are:

- Developing agricultural production potential,
- Reconciling agricultural conquest and reconquest projects with environmental issues,

- Environmental issues
- Promoting agriculture in its multifunctionality
- Mobilizing agriculture as a firefighting tool – for which a specific manual has been recently released (Chambre d’Agriculture du Var 2025)

The desire is "*to accentuate territorial approaches to fight against fallow land and to deploy a global strategy for the reconquest of wooded land with agricultural potential*" by integrating this management into urban planning documents. A map is available, taking into account the different fruit production (vines, chestnut trees, olive trees, etc.), market gardening, silvopastoralism and truffle farming (Figure 68). The harmonization of all the DFCI plans of the metropolis of Marseille is also underway, the DFCI responsibility being that of the metropolis since its creation in 2016.

A local researcher testifies about the local forest: *"The forest has no silvicultural production, apart from a marginal production of paper pulp. There is an acceleration of the differences in economic interest since the forest is no longer worth anything and the vine has increased in value. The forest is therefore the target of wine-growing extension projects here (...) The production of cork is marginal. There is a bit of harvesting. The population has not been renewed, we have not planted for 50 years. The best trees are on the side of the road. The economy is not enough to counterbalance the vine".* In addition, agricultural technicians confirm the loss of momentum in investment for the planting of stone fruit or chestnut trees. There is therefore some doubt about the diversity of potential agricultural establishments.

Figure 68 – The Agricultural Reconquest Plan[14], examples of the St Tropez (up) peninsula and of Plan D'Aubs (PNR) Ste Baume (below). In both cases, the potential for silvopastoralism is dominant (pale brown), but many vineyards would be available (yellow in IGP and blue-green in AOP Côtes de Provence), andoccasionally land for aromatic plants.

However, both in Grand Site Ste Victoire and in PNR Ste Baume, the technicians are concerned about the lack of breeders and the lack of generational succession. In particular, they report conflicts of use with metropolitan walkers, linked to the herding dogs. They also denounce the low awareness of the neo-rural population to the fire risk.

Figure 69 - Vineyard in Grand Site Ste Victoire. Left: mosaic of natural vegetation and vines. Right: olive tree and vines, burned hill on the back.

In the town of Saint Tropez, vines are partly kept in the enclosures of bourgeois villas by winegrowers who have become "gardeners". The cooperative is in charge of 180 ha of vines, i.e. 500 plots belonging to more than 120 owners, but with only 6 service providers. The fire issue is present but does not seem to be integrated as an emergency.

Overall, there is an argument in favour of fire-resistant vines in the foothills and not in the centre of the massif, because it is less profitable. However, these vines would be more interesting with regard to landscape management issues -being wildfire prevention linked

[14] https://www.pleinchamp.com/actualite/la-vigne-un-pare-feu-qui-reclame-aussi-sa-part-d-eau

to fuel management, and improvement of biodiversity. A researcher declared: *"The vines isolated in the forest are marginal, the environment closes in, drawing two massive continuities: forest in the mountains and vines in the foothills. The chestnut groves still cover 100 to 300 ha with an average harvest, only a few dozen hectares are really maintained* (...) *Because of the wild boars, kilometres of roads are fenced off. The plots in the heart of the massif are from 1 to 15 ha, everything is fenced. This is an old phenomenon. In addition, these cellars do not have access to irrigation. The young people who settle down are a marginal phenomenon: remoteness, no irrigation, complicated terrain, pressure from wild boars. This is not the area where the vineyard is extended".*

Figure 70 - Vineyard in St Tropez municipality. Left: vineyard and recently burned hills. Right : garden vineyard surrounding the villas.

But another difficulty exists, linked to urban and land pressure. The phenomenon of "*cabanisation*", which is the establishment without authorisation of constructions or various installations occupied episodically or permanently, in areas that cannot be built, agricultural or natural, and most often in areas at risk of flooding or forest fires, is multiplying. The territory of Provence, but also the Garrigues to the north of Montpellier are particularly sensitive areas. This is why the DDTM (Direction Départementale des Territoires et de la Mer) is against the creation of new agricultural islands within forest areas. However, there is also no support initiatives or recognition for disadvantaged producers in the centre of Massif, who have good practices, to maintain them.

Overall, the PACA region's agricultural recovery plan proposal fits well with the fire-smart landscape concept, but the financial stakes here are particularly tense and confronts the danger of disrupting the landscape balance between diversified agriculture, natural areas and urban sprawl.

HERAULT DISTRICT (France)

The Grand Pic Saint Loup Community of Municipalities is an example of transversal wildfire risk, environmental, and vineyard management. Indeed, an employee is in charge of animation by connecting the various institutional and private actors, and the territory bases its discourse on the management of its landscape. This person enables the application for different funding sources for the rural area in order to combine them in the best possible way. Thus, at the limit of the mandatory OLDs on the contours of the municipalities, herds are subsidized to maintain low vegetation near departmental roads, while aid for hunting associations allows the creation and maintenance of groves.

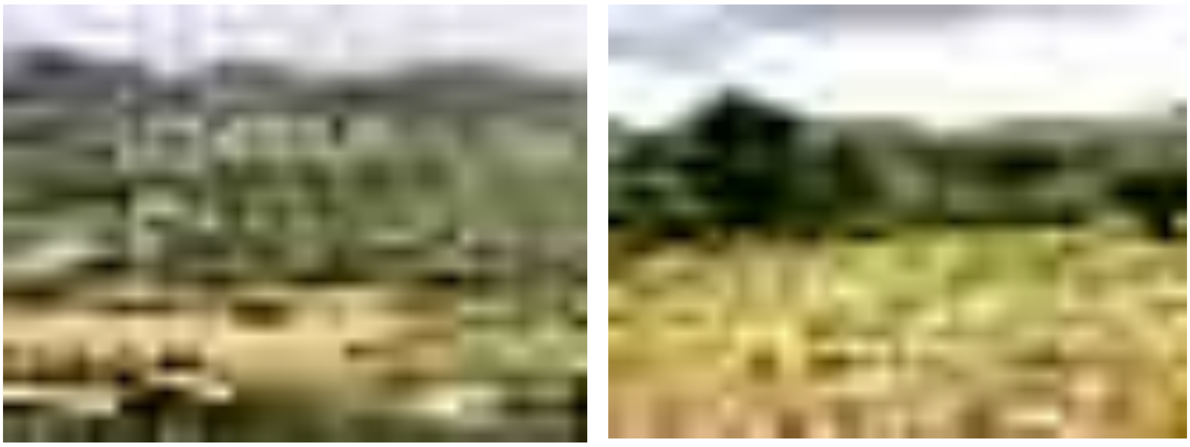

Figure 71 - Pic Saint Loup landscapes. Left: combined management of cereal fields, hunting area and fuel cut-off. Right: Vineyard and pasture area in between the «garrigues» vegetation.

For example, in St Mathieu de Tréviers, there are 17 hectares of 100 m wide fuel cut made in 2020 along the departmental road. The Community of municipalities has created an alliance and shares its maintenance with local pastoralism.

The Grand Pic Saint-Loup is defined in part by its wine-growing terroir, which represents 4,530 hectares, or 8% of the total surface area of the territory and 36% of the agricultural area. It has 96 private cellars and 2 cooperative cellars.

Figure 72 - Map of the vines in the PDO (AOP) Pic Saint Loup on the Grand Pic St Loup zone, the other vines being shared between PDO Languedoc, Grès de Montpellier and Terrasses du Larzac.

Livestock farming is also present in the area with about fifty very diversified farms. As the official website refer. the pastoral practices implemented offer, *"beyond a strict agricultural and food issue, a primary interest in the quality of the landscapes, the* *preservation of biodiversity, and fire prevention*". The combination of both agriculture and grazing permits to cover an important part of the management.

Figure 73 - The Fontevraud wine-growing landscape charter was the driving force behind the recognition of landscape units in 2014 and played a major role in defining the territory of the Grand Pic St Loup.

The global landscape management provides tools and support to the management of the wildfire risk. A new tool, "the Landscape Plan", can focus on risk and develop strategies with the populations. Several are underway in the Occitanie region.

Figure 74 - Existing agricultural values, according to the SCOT (Territorial Coherence Scheme). SCOTS conditions urbanistic documents of the municipalities, where agricultural areas carry values and diversity that contribute to the quality, balanced functioning and identity of the territory.

Cross-cutting themes

The challenges of pastoralism

Pastoralism is often reintroduced into wine-growing parcels because it is a complementary agrarian activity that reduces the costs and carbon footprint related to the maintenance of the vine. The main maintenance refers to the weed control, and the rising trends towards decreasing the use of weed killers implies an increase in mechanical work -which can be substituted by grazing. Commercial and financial issues influence the maintenance of extensive grazing. The presence of a slaughterhouse nearby means an asset, as is the existence of a favourable consumption area (metropolitan area, markets, local processors, food tourism, etc.) or a Territorial Food Plan in France, for example. Silvopastoralism can be popular for the management of public spaces and protected areas, in view to preventing fire risk, enhancing biodiversity or simply grass management. In this case, calls for tenders are most often launched after an assessment of the feeding potential of the area concerned. Many shepherds do not have the means to buy large pieces of land, so they depend on these contracts, especially in the case of young farmers.

However, in the case of wildfire prevention, herds have problems accessing water, especially in the mountains, and access to water pools intended for firefighting is generally not allowed. Dual water management may therefore be considered, which can be problematic in certain areas or in certain periods of drought. In Provence, in the case of fire preventive silvopastoralism, shepherds can apply for access to water from CERPAM PACA because they have MAE DFCI aid, which is not the case in all territories. In addition, during droughts, the feed will probably not be of sufficient quality for the herd or will be non-existent. In this case, how can a sufficient number of animals be maintained from one year to the next? Lamb meat, for example, is more tender if the food is rich and abundant. The shepherd also needs storage and a resting area outside the area to be managed, which implies another subsidy application. In the case of dairy farming, the presence of a milking parlour is also necessary, which implies greater public investment and stricter health standards. Silvopastoralism is therefore often carried out by meat farms or by herds of animals subsidized solely for shearing or clearing (horses, donkeys, bison, etc.).

A representative of the SDIS of the Hérault district testifies: "*In Villeveyrac there were 2,000 ewes who maintained a 100 m x 3 km cut until 2015 thanks to the MAE. That's the total of what we do all year round. But the aid has been cancelled. The region had revised the rural development plan. However, it is this document that defines the distribution of aid*".

Silvopastoralism is popular to widen the fuel discontinuities created by roads, which is an important part of DFCI plans in France. However, management can be problematic for the safety of the herd: a fence must keep them 3 m from the road. There is often a lack of information (DFCI plan, site map) from the town hall in charge of setting up the contract with the shepherd, it is most of the time due to a lack of coordination between the SDIS and the District.

About wildlife management

In all the visited territories, a recurring problem is the conflicts with the expanding wild fauna. Indeed, roe deer and deer graze on the young shoots, sometimes condemning the harvest of an entire plot for one or two years, wild boars consume the grapes when ripe, and rabbits gnaw on the trunks.

The isolated vines in the mountains or in natural areas are the most affected. Nevertheless, overall, the most affected winegrowers seem to be in regions where rainfall is less frequent and probably food and water are lacking -and thus animals find them in farmlands. The 2021-2024 drought that affected north-eastern Spain and southern France was a particularly difficult time in this sense. The consequent reactions are shared: as soon as the finances allow it, the vines are barricaded. The simple electric wire is now replaced by 2 m high proof barriers to prevent the deer from jumping over them. Iron meshes were also chosen to reinforce the concrete. Fortunately, these barriers can be still accessible for the fire responders. Yet, if they become too numerous, the fire services will see their progress excessively slowed down.

A testimony of an independent winemaker from Languedoc: "*The concern about wild boars is much stronger than fires. We are talking about €40,000 of expenditure necessary for the fences against wild boars for small farms*". An independent Italian winemaker adds: "*Our workforce is extra hours, but the investment in equipment is money*". Indeed, financial expenses related to the protection of the production tool are increasing while incomes are decreasing, leading the economic model into a negative dynamic.

Wild fauna also acts as vector for diseases transmission to cattle, and wild herbivores imply competition for grazing pastures. Wild carnivores may entail defensive costs for cattle breeders.

This aspect of management highlights that a fire smart landscape includes the balance between the forest and the agricultural areas in a holistic logic. It also highlights the particular difficulties of agrarian production on the edge of the forests.

Weed and herbaceous management

An ongoing debate regards the grassing of vines, which would "*no longer be considered as firebreaks*". These remarks have been heard repeatedly in the Languedoc Roussillon (Aude, Hérault and Pyrénées Orientales districts in particular) from stakeholders in the forestry and agricultural sectors and firefighters. At the same time, media in the USA and Australia have highlighted the increase in significant wildfire damage to vineyards.

Several notions are implied in these different declarations. Firstly, agroecological management in the context of wine production is questioned because it is accompanied by the maintenance of herbaceus cover in the inter-row and the edges of the fields. However, pesticide and herbicide use in viticulture have been regularly reported for soil pollution and for the associated health risks by the neighbourhood. Being a wood crop, the recurrence of these treatments entails accumulative effects during the several decades of that land use. vineyards are also susceptible to fungal diseases in wet conditions and monoculture promotes epidemics (insects, diseases, etc.), which leads to recurrent treatments. In France, for example, in 2016, it was reported that vines, occupying 3% of agricultural land, used 20% of phytosanitary products. In 2025, the PestiRiv study demonstrated the impregnation of inhabitants of the neighbourhood with many phytosanitary products (source: ANSES). Regulatory safety distances between treated areas and inhabited buildings were introduced for the first time in France by the decree of 4 May 2017. Taking vines into account in the preventive management of fire risk needs to find a balance with parallel policies towards reduction of polluting treatments or distances with houses.

The vines allow firefighting actions because the fire drops in intensity suddenly. But *"a firebreak vine must be a plot with a minimum of grass, a 'clean' strip of brush*" according to the SDIS 34. "*Cutting off the fuel does not guarantee that the fire will stop, it depends on the prevailing wind. The fire jumps are often 200m, up to 800m"*. The vineyard plots do not guarantee to "turn off the fire" either, contrary to the expressions used, whether they are grassed or not. But their distribution can allow strategic spaces to ensure the safety of the fighting teams, of the housing, and their fuel reduction at the landscape level hinder the sufficient energy for becoming extreme fire.

In France, the "*positive grass strip*" is financed with the Payment for Environmental Services aids for farmers, linked to good environmental practices. This payment is distributed by the Community of Municipalities, is funded by the Ministry of the Environment and the Water Agencies, and aims to contribute to the agroecological transition of farms. This aid was defined as part of the Biodiversity Plan presented by the

Prime Minister on 4 July 2018. They are often used to ensure the quality of municipal drinking water resources. But these grassy areas should also be considered as increasing the exposure of the nearby assets (being houses, vineyards, etc). A winegrower from the Languedoc declared: "*In 2018 we suffered a fire. It was concomitant with the fire in Montpellier which mobilized all the teams. It was on September 15, after the harvest. The dry grass was trampled on. The vines in the first line were burned, because the hedge was the vector of fire. The rest survived. The fire spread through the dry torrents. It bypassed the vineyards to progress towards the village*."

At the same time, the winegrowers acknowledge that managing the grass cover around the plot is complicated without phytosanitary products because it involves too many hours of tractors (cost of diesel and labour, which exponential increase in sloping areas). There is therefore a question about this management, to be analised. It should be considered on a case-by-case basis or locally. About grass management, a wine cooperative member in France also stated existing misunderstandings: "*The administration has blocked all steps in favour of the reconquest of wine-growing areas from forest areas with the 2014 framework law*[15]*. My problem is to make politicians aware that clearing land in a reasoned way allows the preservation of populations and housing in the event of a fire. 1 hectare of vines represents 5 jobs. However, there is no understanding of what is at stake. We are not allowed to intervene in streams or intermittent torrents according to the DDTM*".

But we should not consider that the problem of grass cover in vines is systematically linked to measures in favour of biodiversity and agroecology. The people interviewed insist on the presence of speculative wasteland, including vineyards but also chestnut groves and olive groves, which are added to the wasteland resulting from the abandonment of crops. For example, a member of the ONF specified: "*There is an agricultural area, a part of speculative barren, and a part of wasteland due to abandonment due to lack of water. However, the whole thing was considered to be a fuel cut! We need to revise the department's plan and base ourselves on where there is agriculture, while ensuring that it is as little combustible as possible”.*

Then, secondly, these statements about grass management warn of the change in the regime of fires, which are visibly faster, more violent and have greater consequences on exposed crops. Thus, the fires of 2025 in the Corbières massif (France), according to the firefighting service report, presented the beginnings of a pyrocumulonimbus. More than 11,000 ha burned, with an abnormal acceleration of fires in the first phase of the fire. Extreme fires can burn nearby vineyards and other farmlands due to the strong energy released.

During the same summer in Catalonia (Spain), a vegetation fire (mainly cereal) in the Segarra county also surprised the authorities with the formation of a pyrocumulonimbus cloud and an acceleration of the fires with winds of 125 km/h, burning more than 5,000 hectares. Cereal fields accumulate large amounts of fine fuel (this is, the easier to burn)

[15] French Law No. 2014-773 of 7 July 2014 on orientation and programming relating to the development and international solidarity policy

at the beginning of the fire season. If these are not harvested soon, they may entail an important horizontal continuity across plots. And if the cereal is largely continuous in the landscape, the energy contained that is liberated when burn violently may create extreme conditions. However, cereal farmers are currently subject to market timings in order to make decisions on their harvesting, which are disentangled from the wildfire risk mitigation.

2.2.3. Survey findings and scientific article on vineyard managers and wildfires

The article "Bridging wine and forestry sectors to reduce wildfires: Wine actors' perceptions, their role in risk reduction and externality labelling " shares the conclusions of the survey made in 2022-2023. It was published in the journal *Trees, Forests and people* (Figure 75). In the next subsections the relevant portions of the article are presented. The database with the survey data were also uploaded into a public repository, with reference: Górriz-Mifsud et al. (2024).

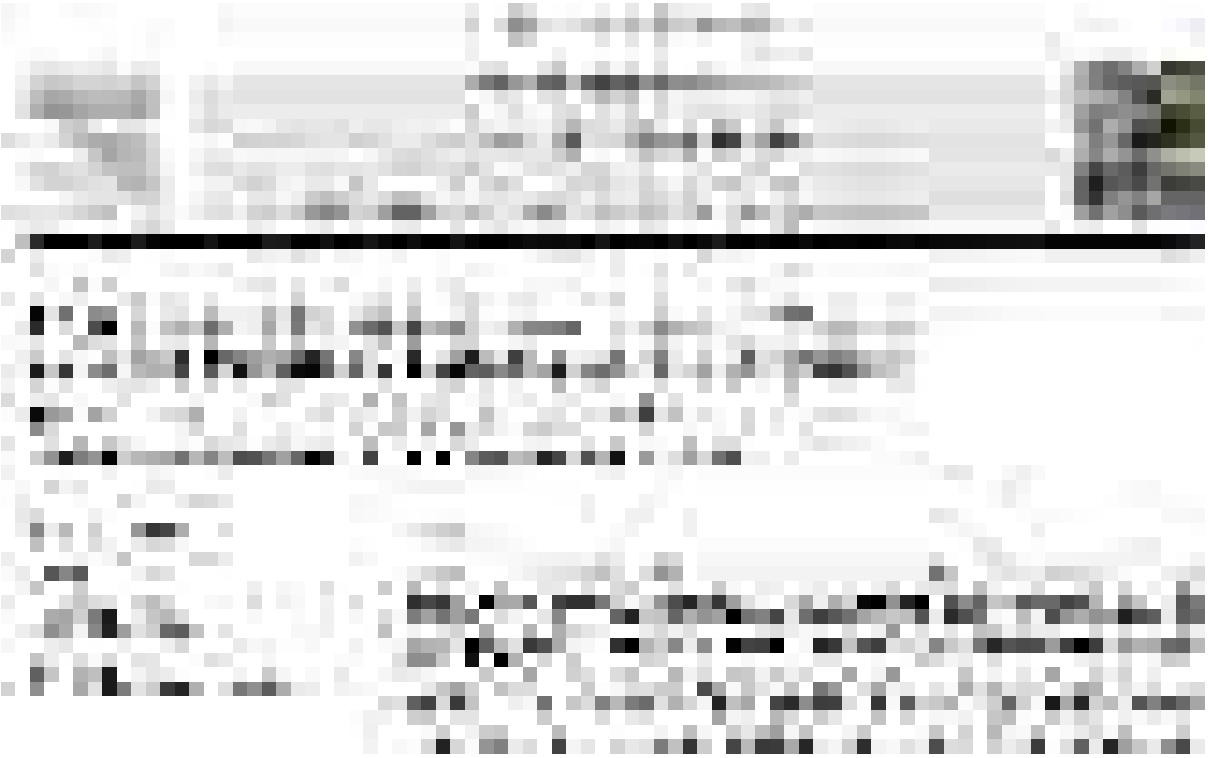

Figure 75 – View of the published article.

Conceptual framework

After the initial field work across LL, we developed a conceptual framework to explain farmers' decision-making factors to landscape configuration and its consequent wildfire risk (Figure 76). On that basis we developed a survey to compile quantitative data that confirms (or refutes) that framework.

Figure 76 - Conceptual framework of farmers as providers of fire risk mitigation. Source: Górriz-Mifsud et al (2025).

Demographic profiles and role within the wine sector

We launched a voluntary online survey. The sample consisted of mainly men (63%), between 46 and 65 years old (53%), followed by the group between 26 and 45 years old (35%). France showed larger ratio of women (42%), with Italy in the opposite trend (25%). No statistically significant evidence has been found between gender and other variables -i.a. holding size, fire experience, wildfire concern, preventive measures, or preferences for externality recognition.

As per their role, 48% self-identified as wine producers, 33% as wine growers, 18% as representatives of wineries, 8% as representatives of Designations of Origin, and 23% as wine experts -each respondent able to have more than one role.

Farmers' productive factors

Three quarters (N=125) of our respondents reported managing some piece of rustic/non-urban land (the specific legal term differs across countries), either through ownership (69%), ownership and rental (27%), or uniquely rental (7%) –with larger ratios of land ownership in Portugal (75% own the land, N=3), followed by Spain (69%, N=55), Italy (67%, N=8) and France (62%, N=18). Supplementary Material #3 shows the detailed country-level data.

The average land holding size reported has been of 88.4 hectares (median: 24 ha). The largest holdings corresponded to Spain (average: 98.9 ha, median: 25 ha, N=80) -skewed due to the large Catalonian respondents, whose average is 121.1 ha, N=62). France follows (average: 59.3 ha, median: 23ha, N=29), with Italy showing smaller holdings (average: 17.3 ha, median: 10 ha, N=12). Portuguese replies contained extreme situations: one respondent of 1000 ha and another of 1 ha, N=4; thus, being the average an inadequate indicator.

A large portion of the respondents declared counting with wine tourism as a side-activity: this is larger for France (53% respondents, N=16) than in Spain (45%, N=36). The findings for Portugal (50%, N=2) and Italy (75%, N=9) are to be considered carefully owing to the limited number of responses.

Relation between vineyard managers and surrounding forests

Vineyard holdings were reported to consist of mainly vineyards (61% of their extension on average), 64% respondents count also with other crops (covering 21% of their property area) and 65% encompass also forests (for whom those occupy 28% of their area). The rest of the property was composed by constructions, winery, infrastructure for visitors, or fallow land -when applicable. Regional differences could be observed within Spain, where Catalonia displayed larger rates of forest land within the property (33% holding area, N=45) vs rest of Spanish respondents -where on average only 16% (N=15) of the area of the holding corresponds to forests. France and non-Catalonian Spain showed larger specialisation of vineyard holdings, with >70% property area dedicated to vineyards.

The most frequently reported surrounding dominant forest tree species are, by far, “pines” (26%, respondents could not detail further), followed by those able to distinguish *Pinus halepensis* (17%), next by *Quercus ilex* (13%) and *Castanea sativa* (6%) -consistent with the Mediterranean area composition. Twenty-two percent recognised not knowing the tree species.

Among those land managers who also own a piece of forest (64%, N=80), only 24.7% report counting with a forest management plan -less frequent for French respondents in comparison with the rest. Few land managers report having benefited from the forest wood: 68% have not sold wood in the last 20 years, and among those who have traded, only 3.8% (N=3) declare having obtained positive gains -13.8% declared that “sales covered the costs”, thus neutral gains, and 15% declared a net loss owing to harvest expenditures exceeding the sales. These trends are consistent across countries.

Forest Owners’ Associations typically facilitate wood mobilisation-or at least related membership can be considered as a proxy of social capital towards forest management. Amongst simultaneous vineyard and forest managers (N=80), only 11% are engaged in foresters’ associations. This proportion is, however, biased due to the sensible higher percentage of Catalan respondents who are members of a Forest Owner Association (16%, N=7), whereas French, Italian and Portuguese respondents show negligible ratios. In addition, 26% Catalan respondents are members of a Forest Defence Group -which are associations of fire volunteers (Rodríguez Fernández-Blanco et al. 2022), this question was posed only to that subsample as per its regional specificity.

Fire-concerned vineyard managers

Part of our survey respondents declared concern about wildfires. Within a scale from 0 (not worried at all) to 10 (maximum concern), the average land manager reported 7.5 -in contrast to the 8.06 of non-farmers (winery or PDO representatives). Most Spanish land managers report a high concern (8.44, N=80), followed by far by Portuguese (6.5, N=4), whereas French respondents (6.07, N=12), and Italians (5.08/10, N=12) perceived lower risk in their areas – these differences being significant (KW H: 21.4296, p-value: 0.00002, N=121 as insufficient responses from Portuguese land managers do not permit to include them in this analysis). Suppl. Material #4 illustrates State-level details.

We found a significant positive -yet weak- correlation between the part (%) of the holding dedicated to forests and the degree of wildfire concern (Pearson r: 0.2494, p-value: 0.005034) -Suppl. Material #7. No significant correlation was found between those producers involved in wine tourism and wildfire concern (Pearson r: -0.0575, p-value: 0.472635). Yet, this result differed when zooming into the countries (Supplementary material #5) with land managers from Spain showing an average larger concern if engaged in wine tourism (8.694, N=36) than those without wine tourism (8.227, N=44) - without significant differences observed (Pearson r: 0.0877, p-value: 0.439191). Land managers from other countries did not show such trend -even the contrary.

Twenty-six percent of wine growers reported having experienced a wildfire "on their own holding", and 32% "in their municipality, valley or massif" (in contrast with 61% of non-farmer respondents). Therefore, over half of our sample had some exposure to the wildfire risk. We cannot assess whether there was self-selection bias among respondents -which is plausible. No statistically significant differences were found across land manager respondents from Spain, France and Italy (Kruskall-Wallis H statistic is 5.9494, n-1: 2, N = 121, p-value: 0.05106) -Portuguese replies were too few for running this test.

A significant difference in wildfire concern for land managers was found depending on their prior wildfire experience (Kruskal-Wallis H statistic: 21.5341, n-1: 2, N = 125, p-value: 0.00002). By crossing the previous two questions we found an expectable higher concern (average: 9.3) of farmers reporting a fire within their holding, than those reporting a fire in the vicinity (average: 8.15) and those without any close exposure to wildfires (average: 6.05) – a trend that is shared across the analysed countries (Figure 77 below).

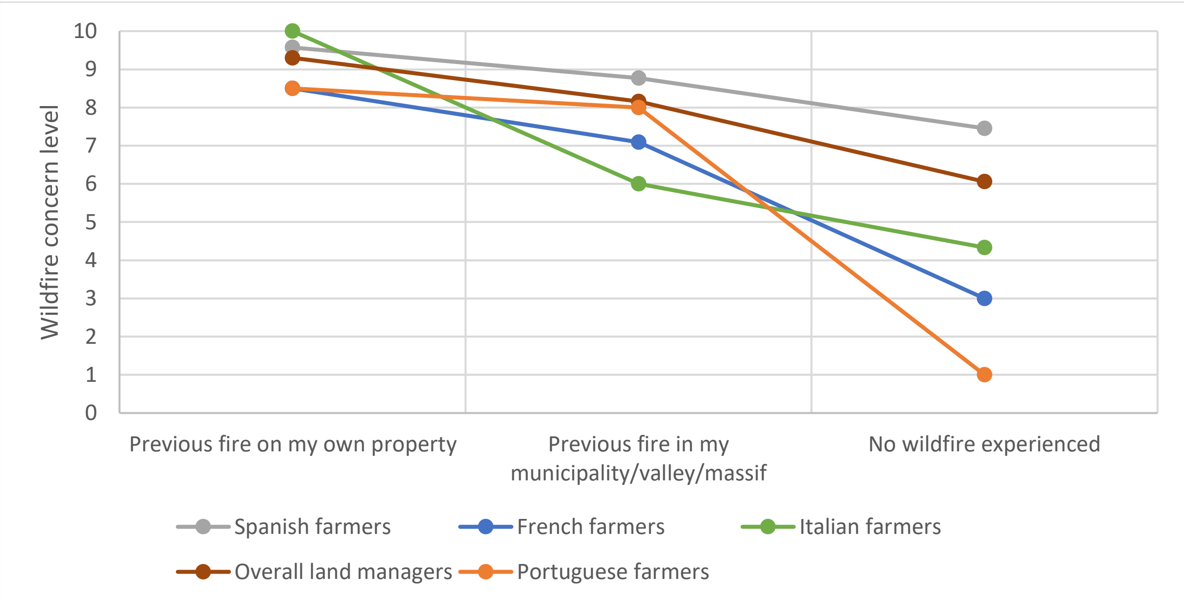

Figure 77 - Wildfire risk concern and previous fire experience of land managers

Indeed, 66% respondents perceived that their property could be affected by a fire, because is located close to a forest or bush area. As this question pretended to capture the landscape configuration, the ratio varies across countries, with Portuguese, Italian and Spanish respondents showing between 70% and 75%, several points over the French (52%) replies -38% reported having their fields further away from forests. As exposed elements to potentially be burnt, 85% report the farmlands, followed by far productive infrastructure (33%), and inhabited houses (27%). The exposed assets depend on the complexity and particularity of each property, so only some respondents report potential damages to animals (11%), cultural heritage (22%), and humans (15%). Respondents acknowledge a high (30%) or very high (12%) risk that these assets will burn in the event of a wildfire reaching their property.

Yet only 20.2% report counted with an insurance for the agricultural losses in the event of a wildfire (just 1.6% stated the equivalent for the forestry part), and 20% for damages in houses. 30% declared that their insurance covers other type of calamities, and 38% acknowledged not counting with any insurance. No correlation was found (p-value > 0.05) with the perception of wildfire risk -thus the insurance adoption depending on other factors.

The workshop revealed three main reasons for wildfire concern among wine sector representatives:

i. potential losses in their yields (burnt grapevines) or in the organoleptic characteristics of the grape due to the smoke taint,

ii. potential reduction of their scenic beauty linked to their wine tourism and marketing,

iii. general awareness and attachment to their territory.

Among land managers with a forest management plan, 70% (N=24) indicated that such plan includes wildfire prevention measures. Despite the limited size of this subsample, some trends can be found. First, all those reporting awareness of fire prevention measures hold a preoccupation level over 5 -meaning that those who are less worried (<5) do not even know about preventive measures affecting their plots. Seventy-five percent of them report having the measures implemented, with two indicating they did not have time because these were too recently planned, another was in the process, and finally other argued that their cost is excessive. Respondents from Spain (80%, N=12) and France (71%, N=5) are those executing at least part of the planned fire risk mitigation measures.

From a wildfire risk reduction perspective (Table 3), it can be observed that most frequently reported measures fall in self-protection of assets and the so-called "pre-suppression" strategy -which primarily facilitates the response. These were the establishment a security buffer without biomass around buildings and infrastructure, and road maintenance for the firefighters' access (59.3% both). Other pre-suppression actions were water pools for firefighters (33.3%), and only in a few cases the establishment of firebreaks (11.1%). As "prevention" (strictly speaking this is avoiding the ignitions), it is relevant that one third of the subsample were careful with the potential sparks stemming from their running activity -i.e. machinery. As "preparedness" measures which modify fuel distribution, 44% reduced biomass within the forest as thinning or shrub cleaning, or applied prescribed burning (30%); with near one third reducing the rests of pruning activities (33%) and some also acting in farmlands by establishing new crops in abandoned plots or strategic areas (22.2%). Use of extensive livestock was only punctual (7.4%). Table 3 shows that respondents from Spain contemplate more fuel reduction while in France security perimeter and firefighters' roads dominate. Prescribed burning is only reported by a few French and Spanish managers, and controlled grazing and recovery of abandoned land is captured in Spanish replies. Most respondents from Italy and Portugal are unaware of any planned wildfire measures within their property.

In some countries/regions, wildfire prevention measures are not mandatory, but there is higher-level wildfire prevention plan. Requested about the awareness of such higher planning that would encompass their property, only 20% indicated the existence of such plan, 52% stated that there is no plan covering their land, while 28% recognised not knowing about it. 60% of Spanish respondents and 58% of Italian ones think there is no such supra-property prevention plan, in contrast with 31% of French managers. Instead, 24% of French managers, 19% of Spanish wine growers, and 8% of the Italian ones are aware of such plans.

When asking about their acquaintance with financial management to facilitate forest management, only 11.3% (N=9) confirmed having benefited from them, 15% knew of these aids exist but had never used them, 19% were unsure about their existence, and 55% were not aware of such aids. Spanish respondents show larger awareness of such aids (35%), and indeed larger ratio of usage (15.4%). Unawareness of such aids is more acute for Italian (90%), French and Portuguese forest owners (67% both).

Table 3 - Frequency of the wildfire measures included within the rustic property where the vineyard is located according to their role within the wildfire risk management phase (multiple answers possible). % within land managers with wildfire prevention plan

Wildfire risk phase	What measures does your property's prevention plan include?	Overall		Spain		France		Italy		Portugal	
		N = 27	%	N = 15	%	N = 7	%	N = 1	%	N = 4	%
Pre-suppression	Security perimeter without vegetation around buildings and facilities	16	59.3 %	9	60.0 %	6	85.7 %	0	0.0 %	1	3.7 %
	Maintenance of roads for firefighters access	15	55.6 %	9	60.0 %	5	71.4 %	0	0.0 %	1	25 %
	Water points/reservoir for firefighters	9	33.3 %	6	40.0 %	3	42.9 %	0	0.0 %	0	0.0 %
	Firewall	3	11.1 %	2	13.3 %	1	14.3 %	0	0.0 %	0	0.0 %
Prevention	Watch out for machinery that can cause sparks on days of high fire risk	9	33.3 %	7	46.7 %	1	14.3 %	0	0.0 %	1	25 %
Preparedness	Reduction of branches, bushes or tree density	12	44.4 %	10	66.7 %	1	14.3 %	0	0.0 %	1	25 %
	Shredded pruning waste	9	33.3 %	8	53.3 %	1	14.3 %	0	0.0 %	0	0.0 %
	Prescribed burnings	8	29.6 %	5	33.3 %	3	42.9 %	0	0.0 %	0	0.0 %
	Activation of abandoned agricultural plots or in forest areas in strategic areas to stop or slow down the spread of fire	6	22.2 %	6	40.0 %	0	0.0 %	0	0.0 %	0	0.0 %
	Extensive livestock farming to reduce bushes (controlled grazing)	2	7.4 %	2	13.3 %	0	0.0 %	0	0.0 %	0	0.0 %
	I don't know	5	18.5 %	0	0.0 %	0	0.0 %	1	100 %	4	100 %

Interest in wildfire risk reduction support and in a fire-smart produce label

Requested for their interest in receiving a specific support for implementing wildfire risk reduction measures, on average 46% respondents declare interest in financial support, followed by technical support (41%) -see Figure 78. Spanish respondents shape the sample trends in this regard, as they are more numerous and tend to demand more support (especially financial). French respondents are more inclined towards no requesting support and are particularly less interested in networking for knowledge and concern sharing. On the opposite, Italian respondents pointed their largest interest towards the networking. A positive but weak correlation is found between concern on wildfire occurrence and aggregated demand for support (of any type): Pearson r: 0.4065, p-value < 0.00001.

Figure 78 - Wine growers' interest in receiving support for fire prevention - per respondent country.

Next, the survey explored the current experience with labels, to move afterwards to the new proposal. Thus, it inquired the typology of labels that producers were already employing. Respondents indicated mainly the Protected Origin Designation (73%), followed by organic agriculture (48.6%). PDO is predominant among French respondents (85%), followed by Spanish (72%) and Italians (50%). Organic farming prevails among Spanish wine growers (63%), with France and Italians respondents showing significantly lower rates -22% and 12.5% respectively. Other less frequent labels have been biodynamic agriculture (16.2%), sustainable tourism (9.9%), sustainable forest management (7.2%, which concentrates in Spain), ISO (6.3%) or EMAS (Eco-Management and Audit Scheme) (1.8%). Eleven percent declared not counting with any label. Italian respondents exhibit the largest ratio of biodynamic labelling (25%), followed by France (18.5%) and only incipiently in Spain (16%).

Producers engage in these labels mainly to reinforce their product (70%), and to boost their visibility (49%). Other reasons seem to be more secondary or case-specific: to have access to subsidies (28%), to get recognition from the administration (20%), to raise sales (19%), to increment their product price (23%), or to increase visitors (11%). Such overall trend is followed by Spanish and French respondents, whereas Italians give the largest prominence to the greater visibility (71%, N=5) and Portuguese expect a larger price (67%, N=2).