

# Reborn from Ashes

## The Alvares Project



*Burnt forest surrounding young eucalyptus trees. © João Porfírio / Observador*

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## Introduction

Except for some glimpses of green, all one can see is the darkness of wood skeletons reduced to coal of what once were tall leafy eucalyptus and pine trees. In the beginning of November 2018, 80 km to the North of Alvares the first freezing temperatures of the year had covered Serra da Estrela in snow, the highest mountain in continental Portugal. Yet the national firefighting authorities were still in maximum alert, a reminder of what happened in the region the year before. Alvares is a small village situated between the mountains of the central of Portugal, 160 km northeast of Lisbon. It is said that Alvares got its name from the oaks that were once abundant in the region that used to be called *alvar* in Portuguese and nowadays go by the name of *alvarinho*. The alleged toponymy of this small village is an indicator of the singular importance of forest exploration as an economic activity in that territory.

In a peaceful afternoon of late spring, the inhabitants started to feel that the once fresh air was feeling heavier, and this was when they saw the tragic flames entering the village. The two contemporaneous and contiguous fires of Pedrógão Grande and Góis started at around the same time and destroyed a total area of 44,000 ha in June 2017. Fortunately, there were no recorded deaths nor seriously injured people in Alvares. That was not the case in the neighbour towns of Pedrógão Grande, Figueiró dos Vinhos and Castanheira de Pêra, where 66 people lost their lives and hundreds were injured in what the New York Times called "Portugal's worst forest fire in more than half a century"<sup>1</sup> (**Exhibits 1, 2**).

That year, the summer temperatures were extended until October, and the devastating wildfires in Central and Northern Portugal ended up killing a total 116 people and destroying almost 500,000 ha. The status quo of this region had changed forever, it was a wake-up call for people, from politicians to landowners, to realize the threat posed by the unsustainable management situation of the Portuguese forest. They came to the understanding that something ought to be done. A group of researchers and forestry experts received private funding to try to expose the causes of this phenomenon and propose several courses of action that promote structural changes to be implemented in preventing further losses of lives, natural resources and material goods<sup>2</sup>. Their study focused on the territory of Alvares since it is a good economic and demographic representative example of the Pinhal Interior region and, to some extent, of the larger region of Central and Northern Portugal. This case collects the testimony of key participants in the project. By gathering their vision and opinions about the different solutions to the problem, it pretends to provide relevant information that the readers should have in mind when collaborating in the effort to find solutions for this region.

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*João Vaz Patto, Rodrigo Ataíde, Renato Rosa and Milton de Sousa at the Nova School of Business and Economics prepared this teaching case.*

*This case is based on desk research. It was written to provide material for class discussion rather than to illustrate either effective or ineffective handling of a management situation.*

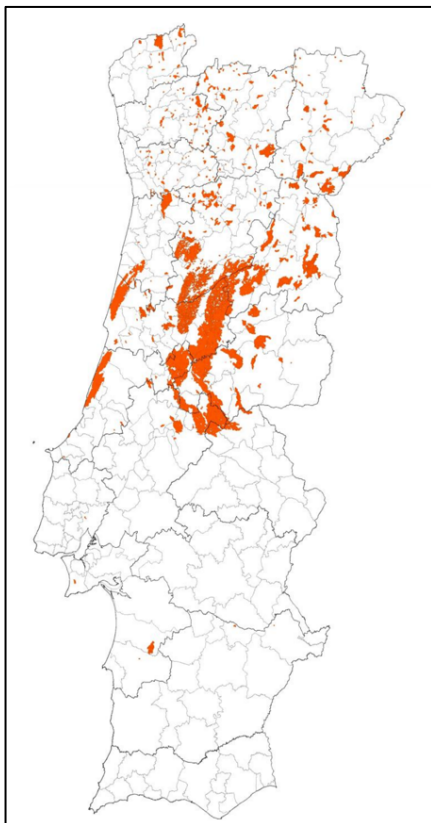


Exhibit 1: Total burnt area in continental Portugal in 2017. Source: ICNF

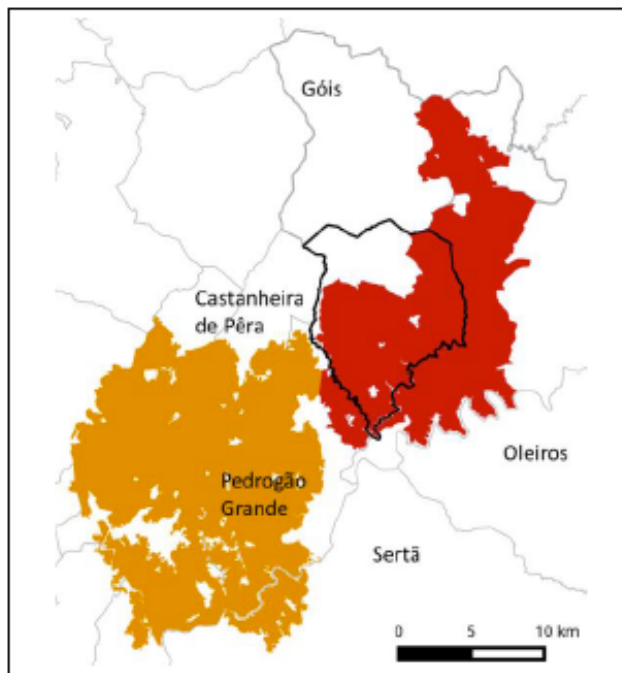


Exhibit 2: The fires of Pedrogão Grande (in orange) and Góis (in red). Source: "Alvares – um caso de resiliência ao fogo"

## The Portuguese Forest

The territorial characteristics of Alvares are representative of the entire Pinhal Interior region: an eminently productive woodland territory where its inhabitants have had the propensity to invest in forestry products for many generations. In what concerns timber production, the northern and central regions of Portugal, as well as the Spanish provinces in Galicia, are among the most productive areas in the European continent. Their climate and soil conditions allow vegetation growth in some productive areas to produce several times more per hectare per year than what the Nordics already consider to be productive forest land.

Similar to the Portuguese territory in general, nowadays more than 90% of forest land in Alvares is privately-held. The distributional characteristics of the Portuguese forest hardly have a parallel in the rest of the world where around 80% of total forest land is state-owned. Such an atypical allocation of land makes it very difficult to align the expectations of small landowners with the necessary long-term investments of forestry projects.

However, this was not always the case. João Pinho, a forestry specialist at the National Institute for Nature Conservation and Forests (ICNF), alludes to the history

of Portugal to justify the current situation. The Portuguese forest was once predominantly public when, in medieval times, the crown was the largest owner of land. For centuries, the Portuguese mainland had a deficient supply of timber to satiate the desires of an ambitious crown that sought to conquer new territories beyond its maritime borders. Fortuitously, the global expeditions of Portuguese explorers that started in the fifteenth century brought an unlimited source of timber to the country. As Portuguese ships arrived at the coast loaded with timber from the Atlantic islands (the archipelagos of Madeira and Azores), Brazil, the African colonies and India, the crown realized that it no longer needed to spend resources and workforce to keep its forest and successively bestowed its woodlands to private landowners. With the advent of new liberal economic policies in the nineteenth century in Portugal, changes in the distribution of land tenure were exacerbated. With the declining role of the government in forest exploitation and the abolition of the *majorat* (or in Portuguese, *morgadio*), forest property was consecutively privatized and fragmented into smaller plots, managed in an economic regime of self-sufficiency of rural families. In this agricultural society forest products played an important role: timber was fundamentally needed as a supply for construction and heating, and shrubs were necessary for cattle bedding which was subsequently used to fertilize cropland.

During the last half of the 19th century and the first decades of the following one, the maritime pine (*Pinus pinaster*) started occupying an increasingly larger part of the territory. An expansion that continued until 1970, occurred mainly in previously fallow lands and that made maritime pine the dominant tree species in the country. The pine promised higher returns in timber and allowed for extra returns in resin, a forest secondary-product that soon became a preeminent industry and, despite the subsequent decline, still has a surviving factory in Alvares. Then, in the last decades of the 20th century, the first plantations of eucalyptus (*Eucalyptus globulus*) appeared. Encouraged by the amplified importance of Portugal in the global production of paper products, this species imported from Australia started to propagate as land-holders perceived the superior economic value of its output, which allows for higher returns in shorter cycles of usually 10/12 years and is therefore also better suited to face a high-frequency forest fire regime. Fires, in fact, may have in addition favoured the expansion of this species, as maritime-pine forest landowners typically replanted their lands with eucalyptus after a fire event.

Things went well until the collapse of the socioeconomic system that sustained that rural society. As João Pinho puts it, "large forest fires started when the community that explored forest resources in this way ceased to exist". New materials started replacing timber in construction, families started using gas for heating and cooking, and shrubs were no longer needed as chemical fertilizers substituted cattle manure. Since rural families departed to large cities in search for better life conditions, the countryside started to decay in a cycle of continuous abandonment. With the paradigm shift, the productive advantage of Portugal soon became a calamitous drawback: the rapid vegetative growth that is virtuous for timber production also means that the land is an exceptional producer of biomass, the most significant contributor to the spreading and intensification of forest fires. What the forest produces will always have an end. If it is not economically exploited, it will burn



sooner or later.

## Alvares

Thirty-six little settlements scattered throughout the hills and valleys compose the territory of Alvares. In the three villages of Alvares, Chã and Cortes live the majority of the population, the remaining settlements are virtually forsaken and populated by only a few. Currently, the community sums to only 800 people in a place that 70 years ago used to be populated by over 4,500, a testimony of the abandonment of what was once a vivacious land where family farming took a significant part of the local economy.

Census data about the population living in the parish reflects the reality of the Portuguese countryside. In the last years, the population of Alvares is declining at a rate of around 20% every ten years, a decline that has nefarious socioeconomic effects and is reflected in the ageing of the community. Some of these consequences are the closure of public services such as the post office and health care facilities or even the burden of having to pay to have an ATM in the village. After leaving Alvares on their teenage years, younger generations discover a world of opportunities that they will hardly forego for the fresh air of their parent's village.

Apart from forestry production, there is little to no economy in the region. The ageing population earns a living by receiving transfers from the central government, either through retirement pensions or other social subsidies. In addition to the government, another crucial source of income comes from the people that migrated into the large cities of Portugal and abroad, who spend an important share of their income in Alvares. When migrants come back to their motherland in the summer, they consume the local products and services, invest in their houses and, in some cases, in their forest land. The return of the migrated alvarenses and their families is a decisive phenomenon for the local dynamics.

In 2016, forest land was about 90% of the total ten thousand hectares that compose the parish of Alvares and eucalyptus and pine plantations occupied more than 80% of the total (90% of forest land). One of the most preoccupying characteristics of Alvares is the distribution of forest property. Just as the North and Centre of Portugal, minimal holdings are the common land structure. More precisely, in Alvares alone there are over 3.000 forest owners and the average plot of land measures only a meagre 0.6 ha. Needless to say, that, in such a context, forest owners have low scale and low capacity to carry out fuel management and maintenance work, an indispensable effort to prevent and control the intensity of forest fires. The exceptions to this scenario are the woodlands under the management of the Navigator Company and Altri. Both companies together manage around 16% of the eucalyptus forest in Alvares and a large extent of forest in the rest of the country, a large scale that allows them to adopt sustainable practices and to take advantage of the productivity of this land for paper pulp production and other by-products. The area that these two companies congregate tends to be on the most productive sites and is managed by them either by renting others' land or by owning the land themselves. Finally, notwithstanding the fact they amount to less

than 3.5% of the total parish area, two distinct forest areas are worth mentioning: the Perímetro Florestal de Góis and the Mata da Oitava. These are managed by ICNF and the District Council of Góis and are a harbour to the larger diversity of tree species in the region.

While it is settled that the small size of the plots is a concern, the magnitude of this problem grows as time goes by, as land ownership is further fragmented through heritage. Adding to that there is no reliable registry of the size, location and ownership of each plot (**Exhibits 3, 4, 5**).



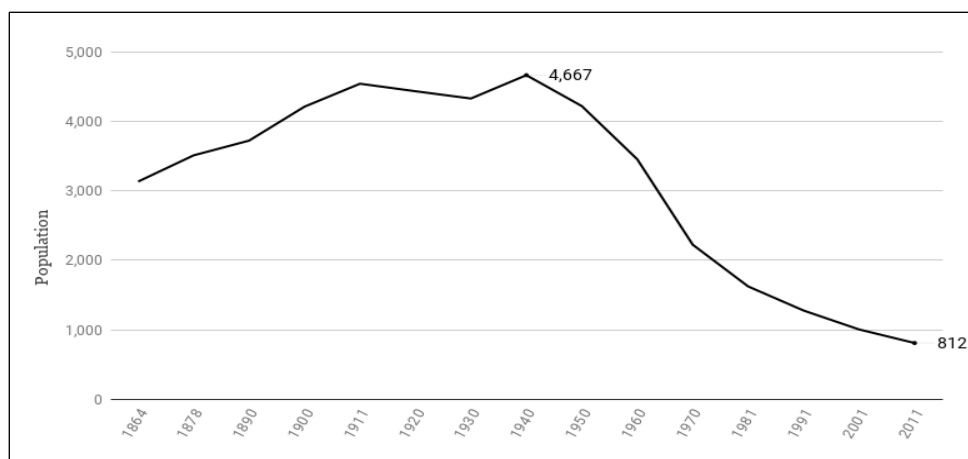
*Exhibit 3: The village before the fire.  
Source: Junta de Freguesia de Alvares*



*Exhibit 4: The village after the fire.  
Source: "Alvares, um caso de resiliência ao fogo."*

## The Fire of 2017

At the early afternoon of the 17<sup>th</sup> of June 2017, two wildfires started at the neighbour parishes of Alvares and Pedrógão Grande. The fire spread across the hills and valleys in a shattering speed, boosted by the extreme heat and the voracious wind, to be ultimately extinguished five days later. The consequences of the Alvares fire were dramatic to the local economy in general and to the forest in particular. In this fire alone, two-thirds of the total area of Alvares were destroyed, leaving the locals to feel the effects of the successive abandonment. Fortunately, human losses were avoided in Alvares. Nevertheless, material losses were significant. Many people lost their their animals, their personal belongings, their farms, their cars, their agricultural equipment and, eventually, their investment in forest.



*Exhibit 5: The population of Alvares. Source: INE*

Since 1975, 42 wildfires occurred in Alvares and cumulatively burnt about 20 thousand hectares, the equivalent to twice its total area, meaning that some areas have burned several times in the past 40 years. This cycle of fire is incompatible with any forest production. If fires occur with a periodicity of roughly a decade, no species can grow sufficiently enough to have an acceptable economic return in a shorter period. In this way, species with longer revolution entail increased risks for the average land-owner. (Exhibits 6, 7).

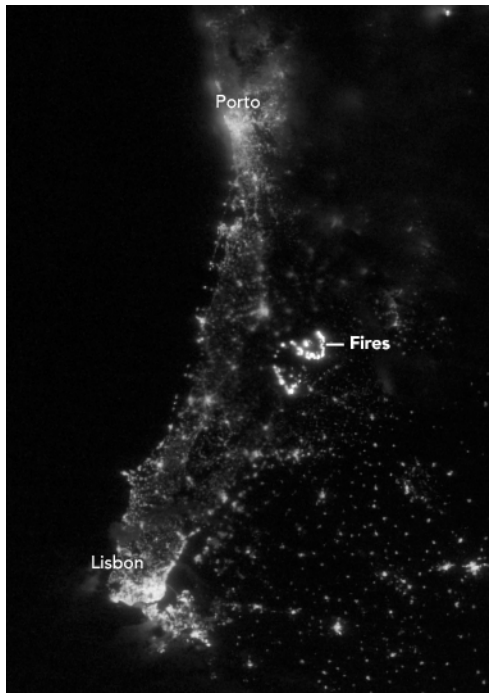


Exhibit 6: A satellite image of Portugal during the night of 19 of June 2017. The blaze burned so brightly that its light was visible from space. Source: NASA

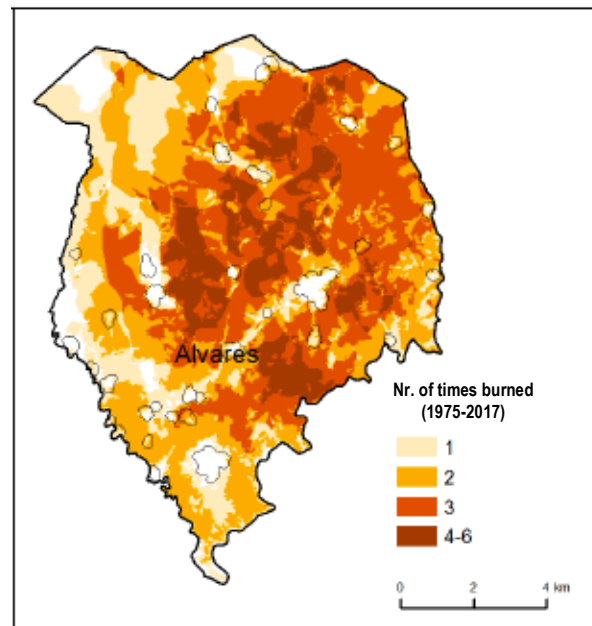


Exhibit 7: Fire frequency in Alvares since 1975. Some areas (in dark orange) were burnt more than 4 times. Source: "Alvares – um caso de resiliência ao fogo"

After the fire, the causes of the phenomenon were extensively discussed in the national media, and public opinion was divided in pointing out different culprits. Some said it was a failure of the State in its obligation to protect people's lives and goods, others blamed climate change, others accused arsonists, but the mainstream opinion turned towards a common scapegoat – the uncontrolled invasion of a highly inflammable foreign tree, the eucalyptus.

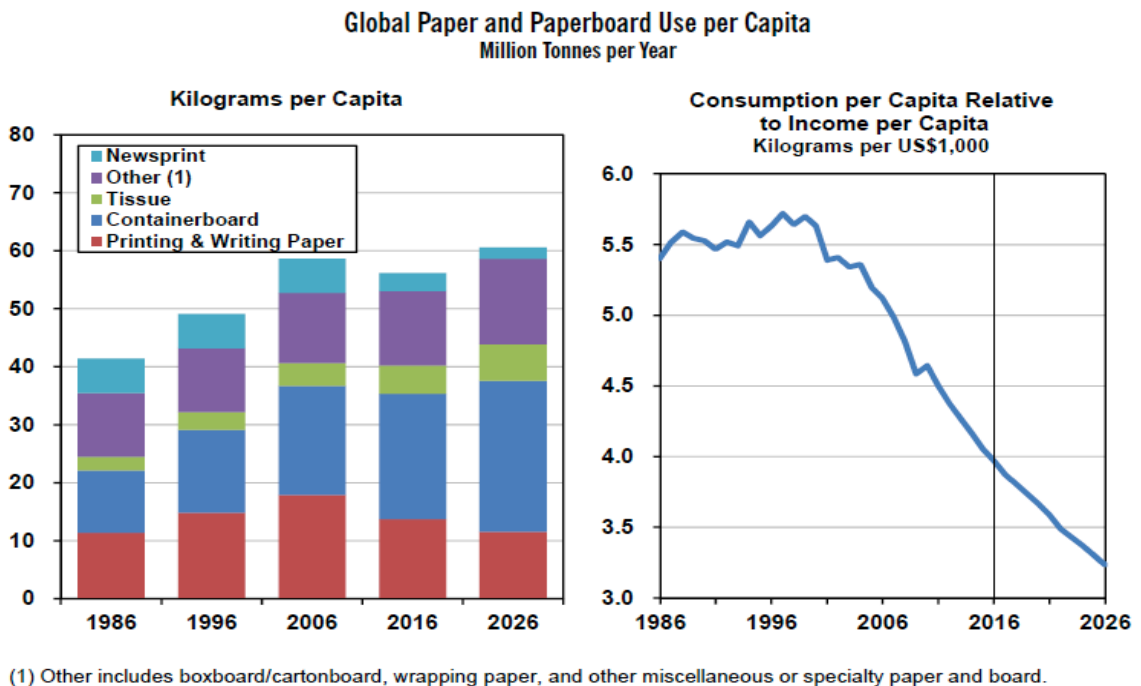
## Altri and Navigator

Altri is a producer of Portuguese Bleached Eucalyptus Kraft Pulp (BEKP). Last year their production amounted to 900 tons of BEKP. The Navigator Company, in addition to producing pulp also produces the end-product – paper, having sold 1,6 million tons of office paper last year. This number puts them as a leading company in the paper industry worldwide. From its activity of producing pulp, Navigator can generate 2,5 TWh/year (electric power) which corresponds to roughly 50% of the

energy produced in Portugal from biomass and 5% of the electric energy generated in the country. To have an idea of the dimension of this company one can refer to its contribution to the Portuguese GDP – 1% (**Exhibit 8**).

Being their raw material pulpwood, in order to avoid volatility on wood prices and to preserve control over a critical asset to their operations, these companies either have their own forest land or they manage land from local owners. Additionally, they may also buy some wood from other producers to assure their plants keep working at full capacity. In Alvares, they do a little of both. Regardless of owning or managing others' land, this region is essential for them since it combines high growth rates with high fibre quality. This means that it would be burdensome to abandon the area, despite the future challenges it brings.

From that, it can be inferred that they are also an important stakeholder. Also, the risk of fire resulting from poorly or unmanaged neighboring forests is crucial to their investments: forests managed according to state of the art techniques are still vulnerable to the occurrence of large forest fires. Another reason why it is crucial to mitigate the risk is related to the nature of forestry – long term returns. From a financial perspective, it is of utmost importance to mitigate risk so one can discount future cash flows at lower discount rates, thus enhancing the net present value of their investments.



*Exhibit 8: Projections suggest that printing paper will keep its global importance in the near future.*  
Source: RISI Report



## The Few Entrepreneurs

Two of the main problems in forest management in the region are the lack of entrepreneurial capacity and the lack of coordination. The fire left the vast majority of small land owners totally bewildered, without knowing what to do next. But the lack of dynamism already existed before the fire due to a variety of reasons, among them the advanced age of landowners, the low level of education and low economic resources.

Small forest owners can be divided into two main representative subgroups: those that still reside in Alvares and those that live outside but still have their properties in the region. The first group of landowners is mainly composed of retired people with low levels of education and modest socioeconomic conditions. In their favor, they know the territory better than anyone else but the attachment to the land they inherited may induce them to ask for larger selling prices of their land. The other group is characterized by a higher education level and greater investment capacity. However, the fact that they moved to outside of Alvares makes them less aware of the characteristics of that land. In several cases, the connection to Alvares goes back to more than two generations and many current owners do not even know the exact location and limits of their properties.

After the fire, a group of dynamic forest owners decided, for the second time, to join forces into the creation of a Forest Intervention Zone or, as it is spelled in Portuguese, *Zona de Intervenção Florestal*. A ZIF is a continuous and limited area predominantly covered by forest in which plots of different owners are jointly managed by a single managing body, under a forest management plan. This instrument finds several challenges to its implementation since it entails the coordination of thousands of landowners with different expectations concerning the use and management of their lands. In fact, several ZIFs have already been implemented in many areas of the country, but with a level of success that has been inferior to what was previously expected. Many of the already introduced ZIFs did not accomplish the plans that were initially defined at the time of the constitution and in 2017 some of them have burned too.

The founding group of the *ZIF Ribeira do Sinhel*, as it is going to be called, is composed of six owners with properties located in different places across the parish. Living outside of Alvares, the dynamism and interest for the land of these younger generation of landowners made them dedicate their entrepreneurial capacity into the constitution of the ZIF. However, the challenges to its implementation already started to emerge. For example, just to be approved the founding group had to collect the support of the landowners of 50% of the total forest area. In an area with thousands of landowners this was not going to be an easy task. Some landowners are still sceptic about this sort of instrument and still prefer to manage their property by their own means. After the approval of the ZIF, however, each landowner will still be entitled and responsible for his own property as far as it follows the guidelines of the common forest management plan.

It seems clear that concerted action between thousands of landowners poses

several challenges to the implementation of the *ZIF*. Therefore, its sole constitution is not enough to change the paradigm if it is not accompanied by structural changes in forest management among the landowners. In search for new alternatives, the founding group resorted to a group of researchers that could guide them in redefining forestry practices in Alvares.

## A Multidisciplinary Project for Alvares

“Alvares – Um caso de resiliência ao fogo”<sup>3</sup> or, roughly translated – a case of fire resilience – was an interdisciplinary plan that counted with entities such as CEF<sup>4</sup>, ICNF<sup>5</sup>, IGOT<sup>6</sup>, IDL<sup>7</sup>, CITAB<sup>8</sup> and that also relied on the inputs of major stakeholders within the forestry industry in the region: paper pulp companies<sup>9</sup>, the Forestry Association of Góis and the founding group of the *ZIF Ribeira do Sinhel*<sup>10</sup>. Their goal, despite ambitious, was simple: understand what it takes to change the fire regime in the region of Alvares from frequent and massive wildfires to less frequent and more benign and, finally, to do so in a manner that would be economically sustainable.

### The challenge of the fire regime

A fire regime is determined by the history and patterns of fire occurrences, frequency, size, intensity, severity and seasonality in a particular area. When the researchers started their work, the challenge was set to study what were the drivers in that region making it susceptible to wildfires of such a dimension and intensity. The first important distinction was between the factors causing ignitions and those propagating ignitions. The number of occurrences seems to be a minor problem since it is nowadays actually lower than it was some decades ago. The problem, specialists say, is the size and intensity of forest fires. Akli Benali, a fire expert at the University of Lisbon and one of the researchers of the study, says peremptorily “where there is forest there will be wildfires, that is given. We can either have small, low frequency and low intensity forest fires, associated with various potential benefits for biodiversity and fuel management, among many others, or less frequent, but large and intense fire events that may result in huge economic losses and put at risk the safety of local populations.”

An independent commission of fire specialists convened by the parliament<sup>11</sup> pinpointed two factors that potentiated the dimension of the 2017 fires: adverse weather conditions (extreme heat and strong winds) and the accumulation of biomass. The authors of the study do not hesitate in ratifying this idea that such accumulation of biomass on a windy, dry and hot weather made the forest especially prone to the fast proliferation of the fire. Another aspect that cannot be neglected and is actually emphasized in the study is that the dense, disorganized and hilly forest allows the fire to spread without many obstacles.

To try to avoid this in the short term, researchers were very pragmatic by presenting a forest management plan that includes a network of specially designed fuel breaks. The primary purpose of these fuel breaks is to prevent the rapid proliferation of fire in order to allow for better protection of populations and increase the efficacy of fire suppression activities. These networks of fuel breaks are to be managed under

substantial constraints, namely it prevents the accumulation of biomass and imposes that such areas should be used for other non-forest activities such as crops, cattle or recreational activities.

This looks simpler than it is. Each protection strip has 125 meters large and many kilometers long and is, in its vast extension, owned by a large number of private landowners. It requires the design of a payment mechanism that would guarantee that these landowners are compensated from not being able to explore the forest. The conception of such mechanism and the implementation of the plan will be laborious, and it will take a long time until becoming fully or even only partially operational.

Still, regarding the firefighting operations, it is worth emphasizing that in the cases where forest fires achieve vast dimensions, containing it is a virtually impossible task. In such cases, firefighting resources are therefore heavily employed in the protection of human lives. A difficult task whose complexity increases by the fact that the population is scattered through many villages. A successful implementation of the protection strips proposed by the study may thus significantly also improve the efficiency of firefighting in such context.

### Eucalyptus

A month after the fire, the Portuguese Assembly of the Republic approved new legislation to block the expansion of eucalyptus forest area. Since the first day of 2018, new eucalyptus plantations must now have to be compensated with the anticipated removal of trees from lands that were previously occupied by that species, severely punishing forest managers who plant it illegally. In a country where forest products represent around 10% of total exports, such a policy is undesirable for the players in the industry. CELPA, the association that represents the Portuguese paper industry, disappointed with the current image of the eucalyptus on public opinion and political decision makers, is promoting campaigns to inform public opinion and to instruct landowners about the best practices in eucalyptus production (*Melhor Eucalipto Project*<sup>12</sup>). As a response to the legislation, it criticized the government, calling the new law “the greatest attack on the forest in the history of the Portuguese democracy [since 1974]”. The association that represents four leading Portuguese companies (Navigator, Altri, Europac and Renova) claims that this proposal finds no reason in empirical evidence since, according to them, only 13% of the burnt area was occupied by eucalyptus, and 50% of that area was unmanaged forest. Still, according to the members of that association, the absence of economically valid alternatives, such a law would lead forest owners to abandon forest management, expanding the area of unmanaged forest and further exposing the territory to fires.

Akli Benali refuses to blame the eucalyptus alone. According to him, the main causer of the current situation is the lack of forest management, an idea that is shared by many in the academic community. The current structure of land ownership and the sociodemographic characteristics of the interior of Portugal led to a cycle of low investment and low activity, instigating an intrinsically hazardous accumulation of inflammable material. Apart from the woodlands that are state-owned or

professionally managed by large paper companies, the other private forest holders are medium to small in size and have limited means to invest in fuel management, a costly effort for wildfire prevention. Even if some of these small private owners are willing to spend money on cleaning activities, they have no incentive to do so if their neighbours do not clean the contiguous plots. In this context, the eucalyptus can be a threat as it is compatible with no cleaning and encourages small owners to abandon forest management once the plantation is done and only come back years later for the final harvest, a strategy that maximizes their payoffs individually but puts everyone in danger.

Despite the flammability of pine and eucalyptus trees, the latter has a considerable advantage over the alternatives: it is managed in short-rotation coppice. An investor that plants eucalyptus in his plot of forest typically does not need to wait longer than 12 years to sell it to the paper industry. After the cut, the eucalyptus has the natural capacity to regenerate itself, thus allowing for a substantial saving in installing new plantations in the successive rotations. This natural ability is also helpful after forest fires, imposing lower damages for the land-owner by possibly avoiding the cost of planting new trees (**Exhibit 9**).



*Exhibit 9: Eucalyptus forest in the region of Alvares.  
Source: [www.alvares-fogo.com](http://www.alvares-fogo.com)*

In other regions of the globe, such as Brazil, different species of eucalyptus can grow much faster than in Portugal and, therefore, produce higher quantities in shorter revolutions. However, the competitive advantage of Portugal does not rely on quantity but on the quality of the product. Eucalyptus globulus, the species of eucalyptus that is more common in Portugal, finds in the country favorable



conditions to properly mature a more productive input for pulp, which is at the same time a premium product used in the production of high-quality paper. Furthermore, apart from paper, the remains of the eucalyptus pulp cooking in the production process include the so-called “black liquor,” a liquid that can be used to produce biofuels and energy allowing for extra revenues and, in some paper mills, to become energy self-sufficient.

### Alternative methods of forestry production

Researchers arrived at a fundamental conclusion: any solution for the forest would have to include the eucalyptus as a crucial ally. Since it is the species explored under lower rotation ages and with highest economic returns, it is the most viable option for both small and large landowners. However, the eucalyptus would only be part of the solution – and not part of the problem – if it is followed by a renewed and increased investment in forest management and fire prevention supported by the returns of eucalyptus production (**Exhibit 10**).



*Exhibit 10: New shoots grow from the roots of an old eucalyptus tree.  
Source: Pedro Granadeiro/Global Imagens*

With this in mind, the group of researchers recommends that the eucalyptus cannot cover more than 70% of the total area of the forest. For the remaining 30% of forests the study favours the reintroduction of native species and the adoption of new techniques that combine economic value with fire protection. Among the native Portuguese species, the most relevant for the case of Alvares are the sweet chestnut tree (*Castanea sativa*), the strawberry tree (*Arbutus unedo*), the English oak (*Quercus robur*) and the cork oak (*Quercus suber*).

Over the years, the production of these species in Portuguese territory was replaced due to a variety of reasons. In the beginning of the twentieth century, chestnut trees,



for example, were almost entirely decimated by the ink disease. The common oak, whose acorns were a vital source of protein for goats and pigs, lost its importance when livestock production in the region started declining.

These species that naturally prevailed in the region have been appreciated by their timber and, in some of the cases, by their fruits. The strawberry tree (*arbutus unedo*) grows a fruit that is commonly used to produce a traditional Portuguese alcoholic drink – *aguardente de medronho* – and chestnuts are frequently used in the regional dishes and were once an essential part of the Alvares and Portuguese diet. In what concerns timber production, both the chestnut trees and the common oak produce high-quality timber that used to be the primary material of traditional Portuguese furniture and artifacts. These productions, however, have been abandoned due to the appearance of alternatives that were more attractive from an economic perspective. Distinctively, the cork oak followed a different path. In the past century, its production was significantly amplified in the southern regions of the country where this species is of paramount importance to supply the cork industry in which Portugal is the absolute global leader.

The study, however, did not want to provide solely the traditional techniques to local landowners, which in most of the cases are already known by them and were voluntarily replaced for most advantageous alternatives. In the list of alternative methods of forestry production, some of them are innovative and new for the landowners of Alvares such as the production of cypress, the production of cork oak in short rotations, or the production of eucalyptus in larger rotations for timber and not pulp. The application of these new practices would have to play an essential role in fire prevention, be compatible with the expectations of forest owners and, most importantly, be economically competitive with the existing practices.

The cypress that exists in the territory – *Cupressus lusitanica* – or “Portuguese” cypress has its name since it was first imported from Central America to Europe by the Portuguese in the 17<sup>th</sup> century. Its first plantation was in Buçaco, not very far away from Alvares, and since then the species seems to have adapted well to the conditions of the territory. Researchers recommended the plantation of this species since it could have an essential role in soil conservation, biomass production and would additionally provide timber to be commercialized. Due to its characteristics, this species could flexibly be installed either in areas of production or in areas set to have protection or conservation functions.

The cork oak that is widely planted in the southern regions of Portugal but also subsists in the northern and central regions as well usually lives for 150 years, and the first cork stripping typically takes place for 20 to 25 years old trees. After that, in intervals of 10 years, the tree is ready for new cork extractions. The technique suggested in the study proposes a different procedure: to conduct the cork-oak forest in a coppice of short revolutions. In other words, following a first harvest to take place in 20-25 years, the trees would be clear-cut in cycles of 10-12 years, its timber commercialized as firewood, and the low-quality cork used for products such as pavements or insulation material. This method would allow for a higher frequency of revenue flows and work as an incentive to cleaning the forest since the

existing shrubs would compete with juvenile cork oaks.

Another suggestion made by the researchers of the study is the production of eucalyptus in a different management regime. Instead of densely populated plantations with shorter rotations to extract paper pulp, the same species could be used in a less dense pattern and in longer rotations with the intention to produce timber. In Galicia (Spain), this technique has already been tried out and consists of installing the plantation in pitches of 150-200 trees per hectare (instead of the usual 1000-1400) and clear-cutting the mature forest in cycles of 30 years (instead of the usual 12). Such a practice would help reduce forest density and facilitate the cleaning work, contributing to reduced exposure to forest fires while possibly delivering competitive economic returns.

The study, however, focused exclusively on the economic analysis of the returns of eucalyptus plantations because it is recognized that there is scarce academic research and practical experience in the new techniques. A situation that could drive landowners away due to lack of information and predictability about the future commercialization of these products. In a sector that is already considered risky, the predominant small landowner may not tolerate bearing further risks. Still, if resources are provided to forest owners, the adoption of these new techniques can be a valid alternative for some and is well-matched with fire prevention.

## Conclusion

The forest is a distinctive asset of the Portuguese economy and is particularly crucial for the communities of the interior of the country. Numerous socio-economic changes occurring throughout the 20th century led, however, to a fire-regime that severely threatens the sustainability of this sector and the livelihoods of the populations living in those areas. While the tragic events of 2017 may have finally triggered both the public and private actors with the necessary will to change that state-of-affairs, finding effective on ground solutions is still an ongoing endeavour. The upcoming years will be decisive, if no successful reform is implemented devastating fires will continue to shape the landscape of the country with severe consequences for the national and local economies. Eliminating forest fires from the territory is a utopia, the challenge, therefore, lies on finding solutions that result in a new fire-regime compatible with economic development, ecological sustainability while granting also the security of local populations.

The multidisciplinary project for Alvares discussed in the text highlights the importance of properly managed eucalyptus forest plantations in the design of such a solution but also proposes alternative forest production methods. If the study offers a detailed Net Present Value analysis for eucalyptus plantations, the economic value of its alternatives remains, however, an open call for both researchers and entrepreneurs. Finally, while the project focuses mainly on timber production, one should also have in mind that forests provide a large set of environmental amenities, such as the sequestration of CO<sub>2</sub>, water regulation, biodiversity conservation, among many others. Finding ways to compensate forest owners for the provision of

such services constitutes a huge challenge for both the public and private sectors, but may be particularly relevant for lands with low timber productivity. By promoting a better management of such areas, those compensations could help reducing the risk of forest fires in areas where it is unlikely that proper forest management will emerge as a result of market forces. The challenges in finding effective payment solutions for these services should, however, not be understated in a context where most forest land is privately owned, and properties have typically less than 1 ha.

## Endnotes

<sup>1</sup> [www.nytimes.com/2017/06/18/world/europe/portugal-pedrogao-grande-forest-fires.html](http://www.nytimes.com/2017/06/18/world/europe/portugal-pedrogao-grande-forest-fires.html)

<sup>2</sup> [www.alvares-fogo.com](http://www.alvares-fogo.com)

<sup>3</sup> Pereira JMC, Benali A, Sá ACL, Le Page Y, Barreiro S, Rua J, Tomé M, Santos JML, Canadas MJ, Martins AP, Novais A, Pinho J, Zêzere JL, Oliveira S, Gonçalves A, Câmara C, Trigo R, Nunes S, Pinto MM, Fernandes, P. "Alvares – um caso de resiliência ao fogo (relatório executivo)", 2018.

<sup>4</sup> University of Lisbon Forest Research Centre.

<sup>5</sup> National Institute for Nature Conservation and Forests.

<sup>6</sup> University of Lisbon Institute of Geography and Spatial Planning.

<sup>7</sup> University of Lisbon Institute Dom Luiz.

<sup>8</sup> Centre for the Research and Technology of Agro-Environmental and Biological Sciences.

<sup>9</sup> The Navigator Company and Altri Florestal

<sup>10</sup> Founding group of the "Ribeira do Sinhel" Forest Intervention Zone namely: João Baeta Henriques, Manuel Cortez Barata, Nazaré Moreira, António Luís Arnaut, Carlos Pires and Carla Duarte.

<sup>11</sup> "Análise e apuramento dos factos relativos aos incêndios que ocorreram em Pedrogão Grande, Castanheira de Pera, Ansião, Alvaiázere, Figueiró dos Vinhos, Arganil, Góis, Penela, Pampilhosa da Serra, Oleiros e Sertã, entre 17 e 24 de junho de 2017". Comissão Técnica Independente - Assembleia da República (2017).

<sup>12</sup> [www.celipa.pt/melhoreucalipto/](http://www.celipa.pt/melhoreucalipto/)