



PORTUGAL

The Deep Roots of the 2003 Forest Fires in Portugal

1. Introduction

Portugal is Atlantic by geography, but Mediterranean by climate; the consequences of this for the forest is the susceptibility to fires, created by the long dry summers which makes wildfires a major and striking concern in the country (Table 1 and Figure 1).

Table 1. Rate of burn (percentage of forest area and shrub land burned) and number of fires in Southern European countries. Source: UNECE statistics and GFMC websites for the year 2000.

Country	Burned area (ha)	Number of fires	Rate of burn (%)
France	20.459	2.908	0.13
Spain	187.026	24.117	1.31
Italy	140.384	10.038	1.40
Portugal	159.605	34.109	4.31
Greece	14.650	14.650	4.64

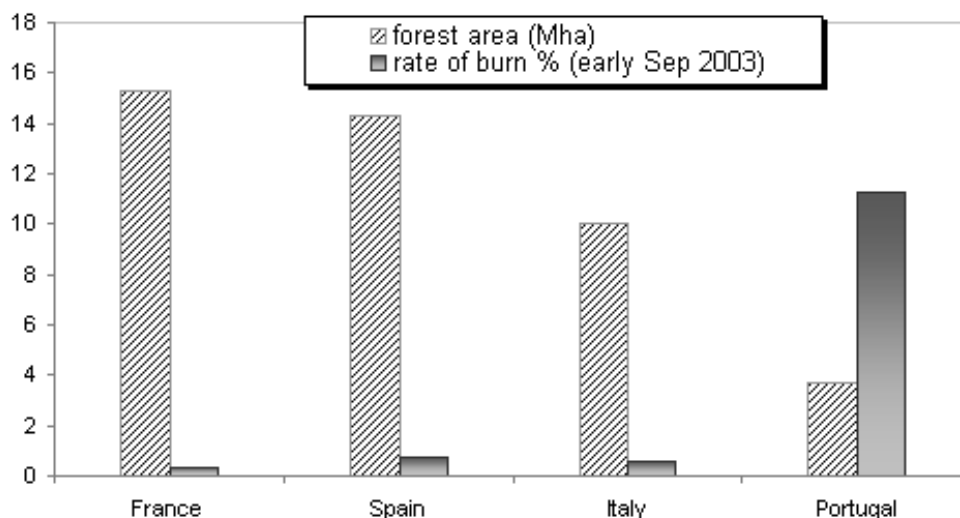


Figure 1. Rate of burn in 2003 by beginning of September. Source: UNECE (2003)

However the dramatic explosion of the area burned during the summer of 2003 was unprecedented when compared with previous years (Figures 2a,b, 3, 4).

Energised by an abnormal hot and dry weather wave that acted as a spark over the immense easy-burnable landscape in the Portuguese forest in 2003, the normal forest fire incidences turned into a catastrophe that gained terrifying proportions.

Conjunctural and structural causes explain the reasons for the frequent forest fires in Portugal

Natural phenomena linked to weather, economical interests, accidents, social conflicts, and negligent or delinquent behaviour are the conjunctural causes.

The devastation which occurred during the summer of 2003 was amplified by structural causes such as:

- the chaotic structure of small private property that encourages abandonment of many of these small holdings
- the absence of a sustainable long-term national forest policy
- lack of a strategy for the rural economy comprising forestry sector
- the deterioration of the Forest Services
- poor organisation of the fire-fighting structure and lack of specific training of fire-fighting corps
- poor education and poor public awareness campaigns on the increased risks of forest fires

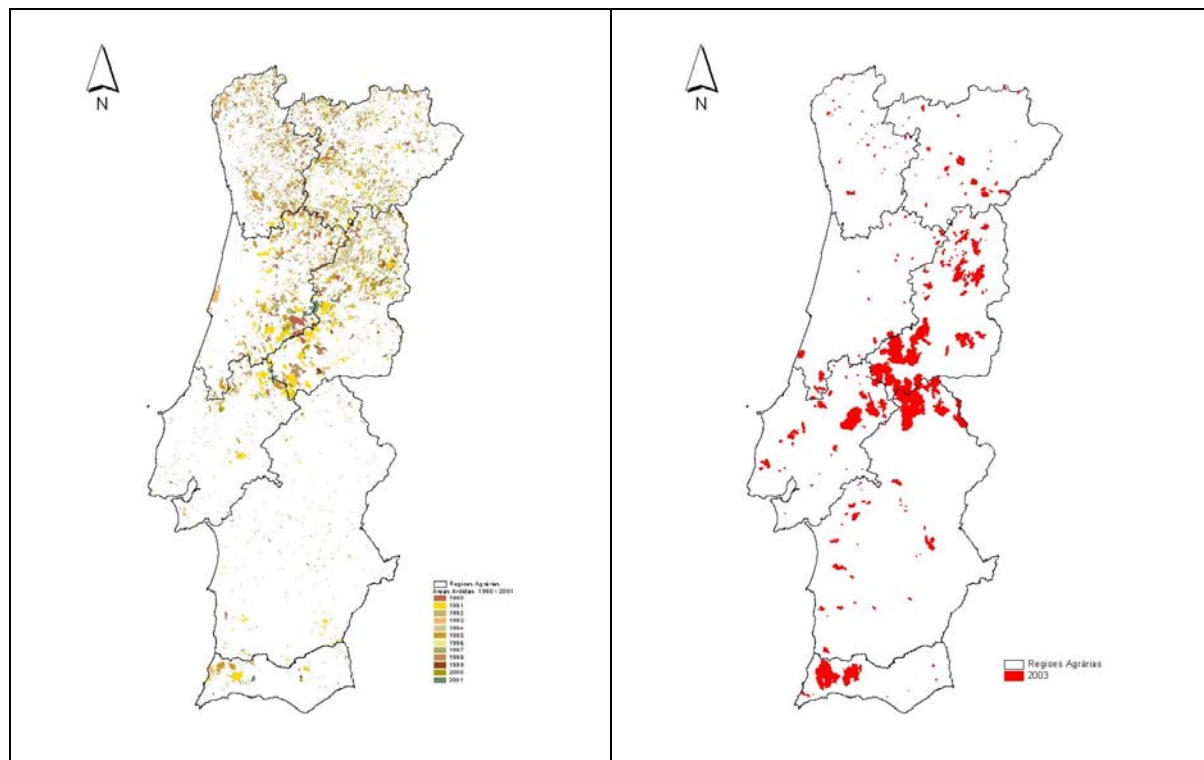


Figure 2. (a) Area burned by wildland fires in Portugal 1980-2001 (left), and (b) in summer of 2003 (right). Source: DGF (2003).

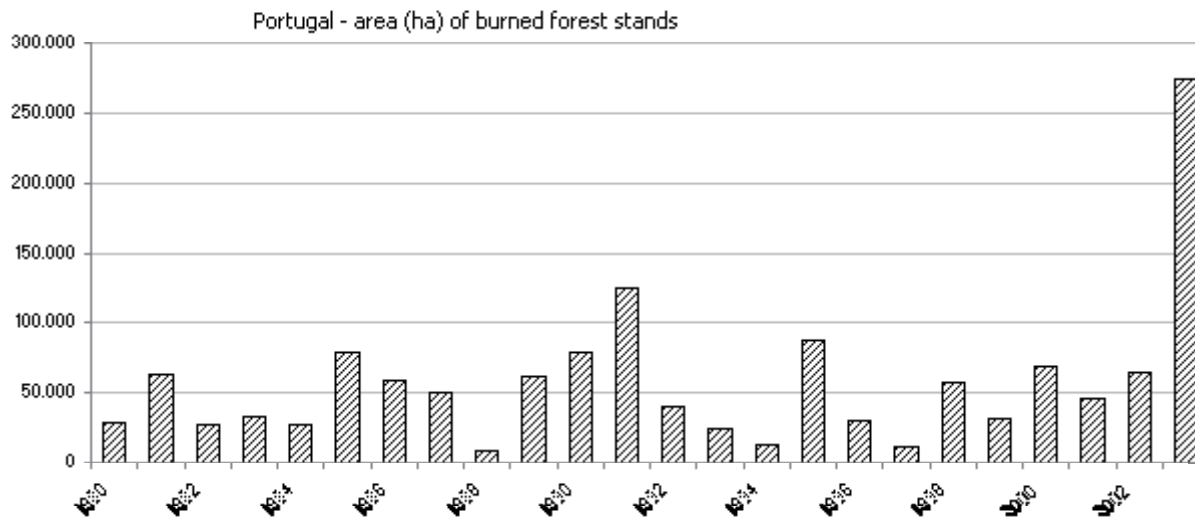


Figure 3. Burned area of forest stands in Portugal 1980 to 2003 (for the period 1 January – 15 October). Sources: Data from 1968 to 1979 – IPF (1987); data from 1980 to 2003 – DGF (2003).

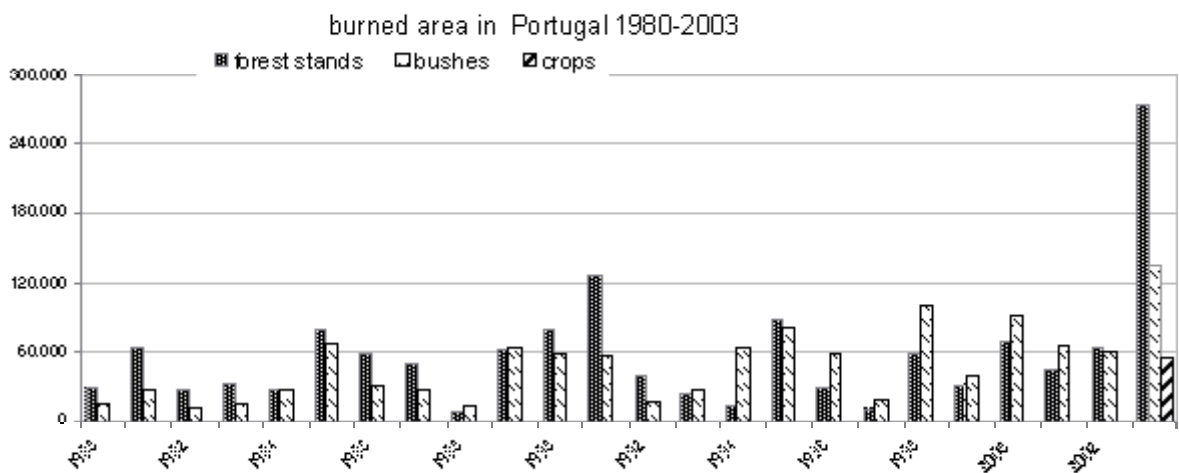


Figure 4. Burned areas of forest stands and other vegetated lands in Portugal 1980 to 2003 (for the period 1 January – 15 October). Source: DGF (2003).

Twenty one human lives were lost, near to 500,000 hectares of forest, shrub land and agriculture crop were burned in 2003, hundreds of domestic houses and agricultural facilities were destroyed and thousands of farm animals were killed. Losses on wildlife, soil erosion, CO₂ release are further negative impacts to be included. The costs of fire-fighting, especially from the air with aircrafts, were enormous.

The direct and indirect costs of the 2003 fires will be reflected on the Portuguese economy for many years to come and the delicate ecological balance will suffer long-term damages.

2. The economical and social importance of forest in Portugal

Forest covers more than 3,200,000 ha, about 1/3 of Portugal's surface (Figure 5). If shrub land is also considered, the percentage of vegetated cover vulnerable to fire increases to more than 50% the country's surface (see data for 1995 in Table 2).

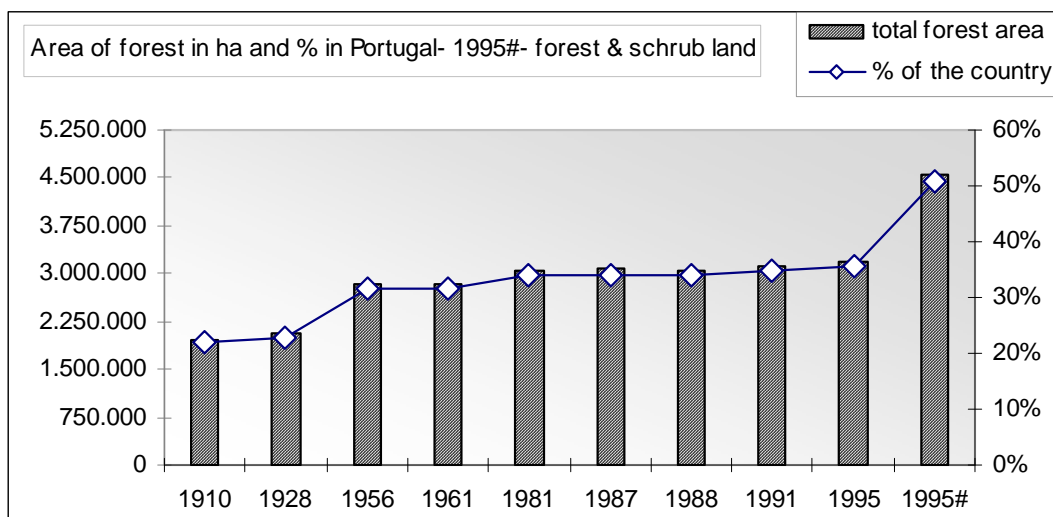


Figure 5. Forest area in hectares and in percentage for the country total area. Note: The percentage of cover in 1995 includes forests and shrub lands.

Apart from ecological, landscape and wildlife irreplaceable values, the forest is an important element in the overall Portuguese economy as data on Tables 2 to 5 reveal.

Table 2. The Portuguese forest by area of the main vegetation types and main species. Source of Tables 2-5: DGF (2003)

Vegetation Type	Area in 2001 (ha)
Total forest area	3,201,131
Shrub land	1,350,000
By species	
<i>Pinus pinaster</i>	976,069
<i>Eucalyptus globules</i>	672,149
<i>Pinus pinea</i>	77,650
<i>Quercus suber</i>	720,000
<i>Quercus rotundifolia</i>	441,577
<i>Castanea sativa</i>	40,579
Other broadleaves	130,899
Other conifers	27,358

Table 3. Economical profile and international trades of forest products for the year 2001

	Import (million €)	Export (million €)	Coverage Rate ¹	Import price / ton	Export price / ton	export / import price
Resin products	26	29	111%	0.60	0.95	1.59
wood	525	393	75%	0.33	0.21	0.63
Cork	89	894	639%	2.80	6.65	2.38
pulp	904	475	534%	0.49	0.42	0.85
paper	211	798	88%	1.14	0.81	0.71
furniture	1895	150	71%	1.14	0.81	0.71
TOTAL		2.739	145%			

¹ Coverage rate – The ratio of export/import expressed in %

Table 4. International trade of forest products compared with the overall trade of Portugal

Export and import	Value (million Euro)
Total export for Portugal	27.090
Export of forest products	2.782
%	10%
Total import for Portugal	44 054
Import of forest products	1894
%	4%
Coverage rate for the forest products ¹	145%
Coverage rate for the overall trade of Portugal	60%

¹ Coverage rate – The ratio of export/import expressed in %

Table 5. Employment, industries and added value for the forest sector in Portugal, 2002

Industries (n)	Employment (n)	Value of the production (x 1000 Euro)	Gross added value (pm)- (x 1000 Euro)
12,418	74,170	5,992,181	1,793,584

The direct economic importance of forestry to the overall Portuguese economy and employment is remarkable. Forest supports more than 74,000 direct jobs, comprising a trade coverage rate of 145%, in contrast with the value of 60% for the country's overall trade (Figure 6).

Within forest sector balance cork oak holds a unique profile. For the year 2001 this species has generated near € 900 million of yearly exports under a coverage rate of 639% and very low competition.

Differences on cork oak and eucalyptus go beyond the coverage rate. The terms of trade for the respective products have critical differences since for cork it has a strong favourable value close to 3 while for eucalyptus pulp it stays under 1, being only 0.85 on the threshold of the deterioration value (Figure 6). If the overseas prices of pulp decrease the continuity of pulp production in Portugal may be in threat leaving behind thousands of hectares of a high inflammable species devoid of economical interest.

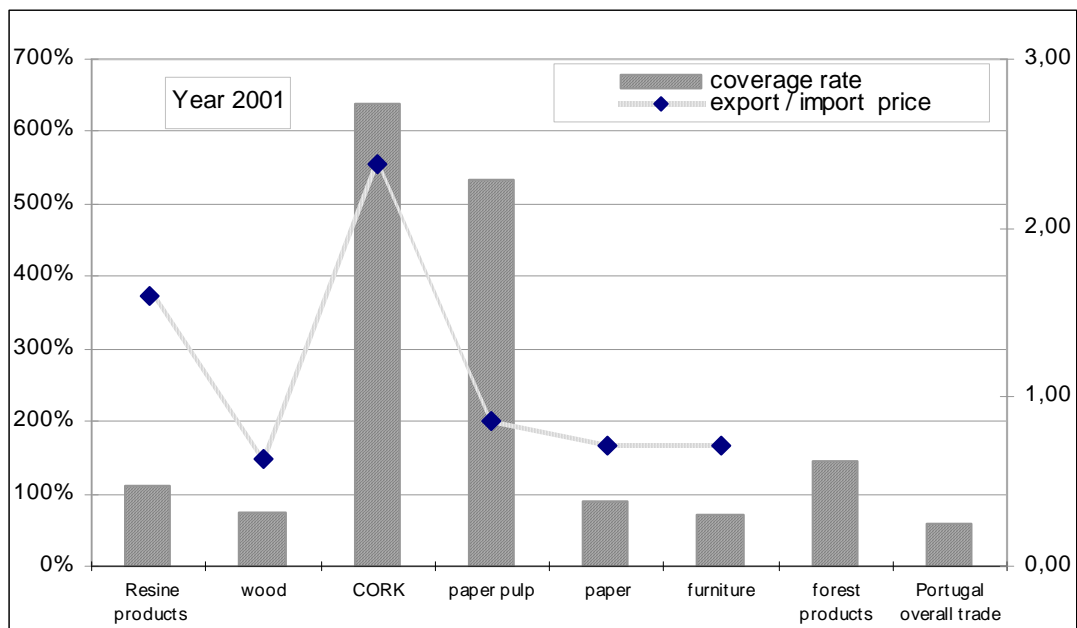


Figure 6. Coverage rate for forest products in bulk and individually and export/import ratio compared with the overall trade of Portugal. Sources: INE (2003), DGF (2003)

The long life span of the forest species, the long rotation and the stand's large areas instil particular inertia into the forest sector, dramatically different from the agricultural sector. Forest's inertia is shown by a slow rate of income generation and also by the effects of poorly developed policy.

The profile of the sector requires a sound national policy that must withstand short-term political changes and short-term economical interests and be extremely vigilant towards wildland fires.

However, the history of forestry in Portugal during the last three decades shows a different picture.

3. Forest fires in Portugal during the last decades

The Mediterranean profile of the Portuguese climate is a major reason for the dangerous forest fire situation. The risk of forest fires and the need for strong measures on prevention are repeatedly addressed at the Portuguese forest technical and scientific works. Already by 1888 Sousa Pimentel considered that forest fires prevention should be part of forestry management programmes.

Although scientific knowledge highlights the concrete measures to minimize forest fires risk (Natividade, 1950) no echoes are seen on the forest policy.

From the seventies to date the occurrence of forest fires shows a clear increase in trend (Table 1 and Figures 3 and 4). The period coincides with several processes of profound changes in the rural economy in Portugal which interacted to increase the incidence of forest fires:

- dramatic decrease of rural population accompanied by the abandonment of cultivation of numerous zones together with decrease of animal grazing on forest and shrub lands
- incentives to afforestation disconnected from a concerted national strategy for the rural economy, that should be designed to support extensive and familial agriculture and continuing rural settling
- lack of national forest fire prevention plan integrated with traditional agriculture and a global network of compartmenting with soft fire-profile's species
- Afforestation primarily focused on highly inflammable species, mainly eucalypts (*Eucalyptus globulus*) and pines (predominantly *Pinus pinaster*)

In the first half of the 20th century the exotic genus *Eucalyptus* had an almost negligible share of the Portuguese forest. Over the past 50 years, however, its coverage grew by about 700,000 ha (Figure 7). Eucalypts are grown in monocultures for the production of cellulose pulp, managed under intensive silviculture in dense pure coppice stands, on an average rotation of 10 years. Nowadays eucalypts occupy considerable large continuous areas or are growing in mosaic amid Maritime Pine and Cork Oak. The genus spread out through the range of those two native species due to the fact that it has similar ecological requirements. However, the ecological conditions of the natural range of Holm Oak area are, generally, too dry to sustain economically profitable stands of eucalypts.

The total area of Maritime Pine and eucalypts, the species whose physiology and silviculture create the most susceptible conditions for forest fires, is currently 51% of the total forestry area.

If unmanaged after wildfires these fire-adapted species take full advantage of the fire-response mechanisms and increase the area occupied.

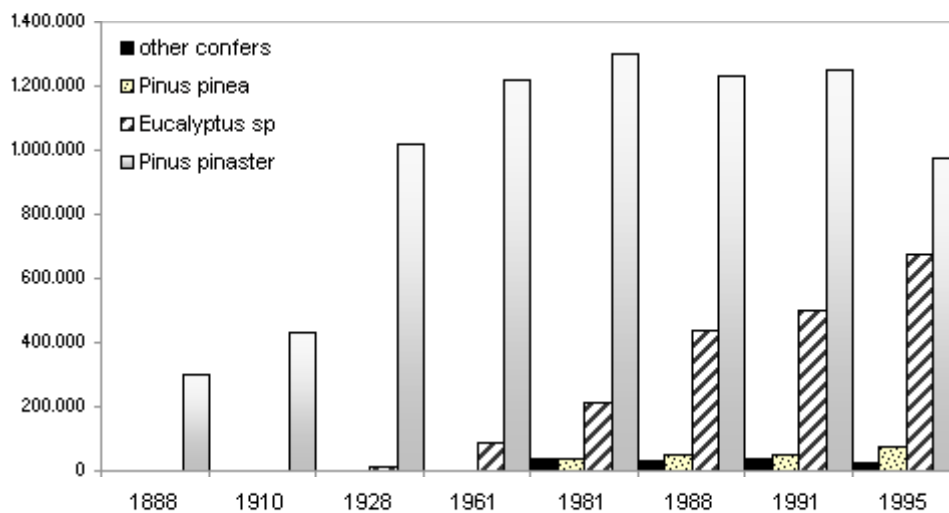


Figure 7. Evolution of the area of highly inflammable species between 1888 and 1995

Maritime pine and eucalyptus are extremely important species for the Portuguese forest economy. The preservation of their economical status claims severe measures for fire prevention, considering the high susceptibility to fire.

But in sites where their growth is under the economical viable threshold, those species should be completely eradicated and substituted for less prone to fire species or set-aside for natural vegetation covering for environmental and landscape benefits.

The cost-benefit analysis of the “unproductive” natural vegetation land in comparison with the fire prevention and combat on poor productive areas of pines or eucalyptus has certainly a positive balance.

4. Structural causes for forest fires in Portugal

Structure of private property

About 85% of the forest area in Portugal is in private ownership, with a considerable part based on very small holdings. The 8.9 millions of hectares of the country are fragmented amid more than 10.8 millions of rural holdings (data made available by courtesy of the Direcção Geral de Contribuições e Impostos [DGCI], Lisbon) in very skew distribution. Sharp differences across the country are patent at a plain analyzes of the average size by district (Table 6). Four districts representing 32% of Portugal surface host about 270,000 rural holdings while the other 14 districts – 68% of the area host about 10.5 millions.

Table 6. Distribution of rural holdings in Portugal

14 districts - 68% of the country			4 districts - 32% of the country		
Area (ha)	Number of holdings	Average area (ha)	Area (ha)	Number of holdings	Average area (ha)
6,019,700	10,532,916	0.57	2,874,700	264,949	10.85

The small size which is in itself a major obstacle to efficient economic forest management, is exacerbated whenever the plots are in compulsorily common ownership of several co-owners, as often happens.

The extreme fragmentation of the rural property has been a concern for governments since the early 20th Century. Law 5705 promulgated on 10 May 1919 encouraged individual owners to merge their dispersed plots by changing the small holdings among themselves. The law provided incentives through tax benefits and registration free of fee. However, impacts of Law 5705/1919 were deceiving, and the fractioning of the rural property among heirs into smaller and smaller holdings continued.

The failure to stop the “atomization process” of the rural estates by developing for Portugal a legal framework similar to the French’s “*bien de famille insaisissable*”, the Switzerland’s “*asile de famille*” or the Germany’s “*Erbhof*” led authorities to approve the Law No. 16731, promulgated on 13 April 1929. In Article No.107 it is declared the indivisibility and co-ownership among the co-heirs and “inalienability” of the plot in parts whenever it size is under 0.5 ha (Castro Caldas, 1998).

Whereas in cadastral maps the physical size of the rural estate will not be further divided, the arising problems are hidden behind the increasing number of heirs, and solutions are postponed.

In the following the issue will be shortly designated as “indivisible” property.

Incentives for merging of rural small property and impediments on fragmentation was a concern in the Portuguese legislation throughout the whole 20th Century. Merging is addressed in various legislative acts namely Law 2116 of 14 August 1962, and Decree No. 44647 of 26 October 1962.

However the principle of indivisibility will be maintained unquestionable, only the minimum size of the holding liable of division among heirs will change. The general indivisible area size of 0.5 ha decreed by the Law No. 16731/1929, was modified to 0.5 ha, 1 ha or 2 ha according to site (soil) productivity by Law 2116/1962 reaching 7.5 ha in the south districts by the Government Directive No. 202 of 21 April 1970 – both still in force.

The principle of “indivisibility” promulgated by Law No. 16731/1929, Article No.107, aimed to prevent the fragmentation of the rural property family patrimony into unviable holdings. However the effects of the law are the opposite and presently the load of the small unviable “indivisible” rural property is inexorably divided among the compulsive co-owners.

While the rural family was living in closeness and managing the plots in cooperation, and while the forest production was for self-consumption or for local markets with low exigency standards, the “indivisibility” principle shortcomings were hidden. But during the 1960s Portugal went through deep economical and social changes. Internal migration, especially the rural mass exodus and the rapid urbanization, resulted in irreversible splitting of the rural families. At the same time, the forest market became more competitive, making the exploitation of small plots uneconomical.

Deprived of economical viability, confounded on numerous owners that know less and less about one another, lost amid remote forest areas, thousands of those small pieces of “indivisible” land are nowadays in total and irretrievable abandon.

As time goes on, heritage process over heritage process, the number of co-owners increases, while the knowledge about one another, about the location and physical limits of the estate are lost.

Left as it is the entropy of the “indivisible” property can do but increase.

In Mediterranean conditions the land, devoid of human management or animal grazing, is quickly colonised by dense vegetation of trees, shrubs and tall grasses. Maritime pine profits from the abandonment due to the high ability for natural regeneration.

Eucalypts proliferated, boosted by afforestation programmes and by the involvement of cellulose companies that rented or purchased land, often by providing juridical assistance to overcome the legal constraints of a quantity of the “indivisible” holdings.

By human hand or by its absence, maritime pine and eucalypts, the “easy” species could eliminate the chances of oaks and noble hardwoods to survive on the abandoned land.

Under this scenario, large areas of the Portuguese forest became, in some decades, dominated by species of high combustibility establishing ideal conditions for immense and uncontrollable forest fires that have devastated considerable areas of Portugal during the last couple of decades (Figure 7).

When the small and unviable property is frequently overrun by fires the possibility to abandon the property is enhanced. A self-fed mad circle of abandon – increase of fire hazard – abandon becomes established.

The obsolete system of land ownership is, therefore, a structural cause for increasing wildfires in Portugal.

Measures

Structural changes on the “indivisible” small property are one of the key points to focus to reduce the occurrence of forest fires in Portugal. Changing the legal status is a long-term task and claims a deep commitment from the State on implementation and coordination. Furthermore it claims concerted expertise on various fields including among others, legislators, economists, foresters. The goal is to eradicate the uneconomical small holdings.

Implementation

- Survey on the level of “indivisible” small property by cartography with information on owners and location
- First phase – a time-scale for co-owners to involve themselves and to decide themselves on one single owner through purchase or compensation or on the sale of the property as a whole to an outside buyer or the State

Taking into consideration that Portugal is the EU country with lower forest state area and that some economical and social role of forest are not compatible with private ownership, the state shall allocate itself the status of first preferential purchaser. Expropriation under national interest shall also be considered.

Instruments

Since this type of property drives immense economical damage to the country, it is justified to create a special line of loan to help the acquisition whenever justified.

- “Voluntary” phase: Legal, economic and even social assistance shall be provided to the co-owners by the State
- Compulsory phase: If agreement among the co-owners is not reached within the fixed time-span the State shall purchase the property at a price agreed by independent adjudication.

In the short term these measures will assure each small forest plot to be under the responsibility of one owner. This is a basic requirement for establishing management plans. Yet in the long run there is a need to work towards a sustainable minimum size of the forestry properties. Measures for assembling the areas under the threshold size may be needed. The minimum viable size is different in the various regions of the country according to ecological conditions and the social profile of the human settlement.

4. National forest strategy and diversification of forest species

National forest strategy is addressed in various official documents; however the evolution of the Portuguese forestry policy shows the theoretical profile of the enterprise.

The lack of national long-term forest strategy can be assessed when analyzing the national distribution of the species, the fire-control measures, the inconsistencies on forest inventories and the lack of effective State responsibilities on various aspects of the sustainability of the Portuguese forest system.

Since 1960 Portugal has benefited from various programmes for large scale afforestation: *Fundo de Fomento Florestal* (Portuguese funding), World Bank and recently European Union. The foremost result of those large investments is the increase of the area of eucalypts and poorly managed maritime pine areas both under inefficient compartmentalization.

The easy aptitude to spread by natural regeneration added by funding incentives gave maritime pine the opportunity to fourfold the overall area in half a century. Eucalyptus increased its area about eight times in 50 years (Table 7, Figure 8) thanks to funding programmes and large investments from pulp companies.

All these changes occurred under poor compartmenting or total absence of it in some areas. In some cases even riparian areas were afforested with those species after the natural vegetation composed of *Alnus*, *Fraxinus*, *Salix*, *Populus*, etc. were eradicated.

Some of the afforestation plans include fire breaks. However cleared from the competition of the tree story, fire-breaks become zones invaded by intolerant high-inflammable shrubs when not maintained.

Well established and well maintained firebreak networks exist only in National Forests and those eucalypt stands that managed by the cellulose companies, or in some few large estates where good practices of silviculture are applied.

In zones with considerable proportion of small unviable, "indivisible" or abandoned properties, efficient fire-break strips are extremely difficult to establish.

If fire starts the well managed properties in vicinity are easily devoured by the flames coming from by the uncontrolled spread of fire from the adjoining poorly managed areas.

The distribution of the species at the Portuguese forest has been driven by short term objectives of the cellulose companies and private owners and not by a national strategy. Approved and sometimes even supported by the state, afforestation with pines and eucalyptus took place in agricultural land, creating inflammable situations in valleys that were buffer zones when former agriculture and grazing activities were performed.

The issue of the small "indivisible" property is in itself another evidence of the lack of a solid national forestry strategy.

In the Portuguese forest scenario oaks (except Cork Oak and Holm Oak) and riparian species have a low economic profile. Their use as fire-prevention species is beyond the scope of most private owners. In some circumstances it is possible to impose a compulsory use, for instance if afforestation has benefited from State funding. Taxes benefits may also be used as a support mechanism. However in most cases it is necessary to consider financial support to these species. This support should be part of the programme on fire prevention, especially in cases of small plots and small private owners. Such multifunctional approach for fire-breaking is not feasible in the "indivisible" small property.

The Portuguese forest is presently composed by more than 50% by pines and eucalypts (Table 7, Figure 8).

Table 7. Evolution of the surface of "inflammable" species in Portugal

	1910 (1)	1928 (1)	1956 (3)	1961 (4)	1981 (5)	1987 (6)	1988 (7)	1991 (8)	1995 (9)
Total forest area	1,956,500	2,050,000	2,826,000	2,830,000	3,041,000	3,062,550	3,055,800	3,102,200	3,201,131
<i>Pinus pinaster</i>	430,194	1,020,186	1,288,000	1,220,000	1,300,900	1,287,800	1,232,420	1,248,600	976,069
	22.0%	49.8%	45.6%	43.1%	42.8%	42.0%	40.3%	40.2%	30.5%
<i>Pinus pinea</i>					34,840	50,310	50,110	50,110	77,650
	—	—	—	—	1.1%	1.6%	1.6%	1.6%	2.4%
other conifers					35,000	39,400	32,550	39,600	27,358
	—	—	—	—	1.2%	1.3%	1.1%	1.3%	0.9%
<i>Eucalyptus</i> spp.		10,000	99,000	88,000	215,390	434,690	434,690	500,000	672,149
	0.0%	0.5%	3.5%	3.1%	7.1%	14.2%	14.2%	16.1%	21.0%
<i>Quercus suber</i>	365,995	560,000	637,000		654,900	667,600	668,700	659,800	712,813
<i>Quercus rotundifolia</i>	416,658	380,000	579,000		535,950	432,510	472,450	464,200	441,577
<i>Castanea sativa</i>					30,320	30,470	30,680	32,100	40,579
other oaks					66,420	69,750	81,700	85,700	130,899
other broadleaves							81,480	84,810	85,200
Percentage of conifers and eucalyptus	22.0%	50.3%	49.1%	46.2%	52.2%	59.2%	57.3%	59.3%	54.8%

Sources:

- (1) - C. Agrícola e Florestal (Radich and M. Alves, 2000)
- (2) - A.M.Almeida;
- (3) - SROA
- (4) - DGF (1981) *—"Distribuição da floresta em Portugal" - Estudos e Informação nº 289;
- (5) - IPF (1987)
- (6) - IPF (1988)
- (7) - DGF (1991)
- (8) - DGF (2001)

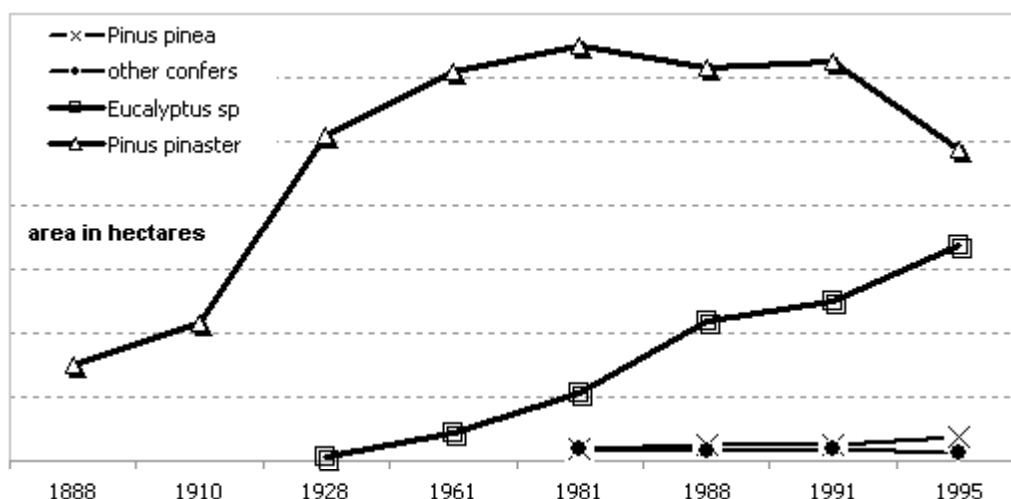


Figure 8. Increase of the share of highly inflammable species in Portuguese forests between 1888 and 1995

Yet the management on maritime pine is so poor that the losses on yield have been estimated on 2 million cubic meters (m^3) of yearly increment and $40.6 m^3$ on the standing volume (DGF, 1983).

The percentage of burned area by species (referred to the total area covered by the respective species) is provided in Figure 9. Maritime pine and eucalypts are the species mostly affected by fire.

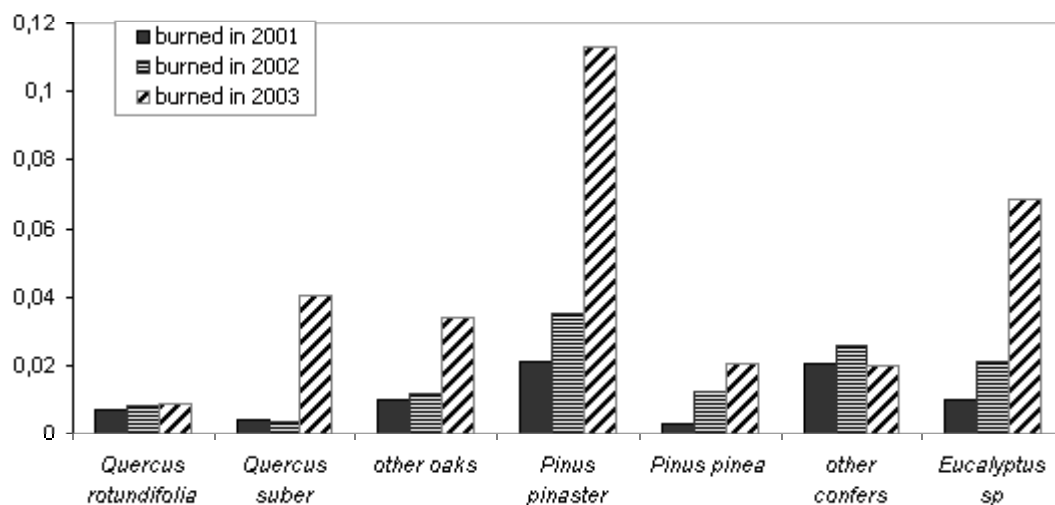


Figure 9. Percentage of burned area per species (referred to the total area covered by the respective species) for the years 2001-2003.

The relatively high rate of burned percentage observed for cork oak, and “other oaks” is due to pines and eucalyptus stands in close proximity from which fires – usually intense and difficult to fight – easily escape. It is generally known and confirmed by ground experience that wildfires in oak stands are easier to control than in pines or eucalypt stands.

The rate of burning of Holm Oak is lower than that of Cork Oak and “other oaks” because the species tolerates sites of dry summer harsh climate that are unsuitable for large plantations of pines and eucalypts.

The spreading effect of pines and eucalyptus on fire events is illustrated in Figures 10 and 11.

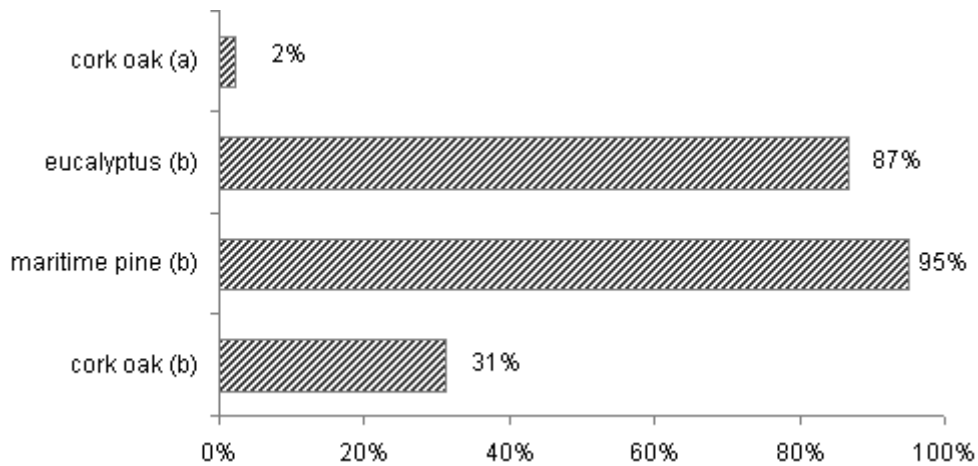


Figure 10. Comparison of rates of burning in 2003 – examples: (a) Monte Novo, Galveias, pure stand of cork oak, without eucalyptus in the vicinity; (b) Quinta da Lagoalva de Cima, where the fire started in a eucalypt stand, and Cork Oak stands intermixed with stands of Maritime Pine and eucalypts.



Figure 11. Cork Oak stand recovering after being swept by fire coming from adjacent eucalyptus stand. Portugal, 2003. Photo: MC Varela (2004)

5. Inconsistencies of the forest inventories

The inconsistencies of the forest inventories are simultaneously evidence and result of the lack of a solid long lasting forest strategy.

Cork Oak and cork policy

In spite of the fact that Portugal is the major world producer of cork, the inventory of 1965 lacks data for cork oak in the most important parts of its distribution (DGF, 1961).

The document “Forest Profile” produced by IPF (1987) refers to an area of 313,000 ha for eucalypts while including in a footnote that the number given by the extraordinary inventory of 1986 (made by cellulose companies) is 434,000 ha. The discrepancy is 38.6%.

The surface of 670,000 ha appointed to eucalyptus by the National Inventory of 1995 gather among various forest experts a feeling of being underestimated.

The lack of a strategic plan for the Portuguese forest is also patent at the State’s attitude towards Cork Oak, whose economical backbone product is the stopper.

This species holds a unique profile within the Portuguese forest balance not only due to the absolute exporting value (Table 4) but because that happens from cradle to grave under little competition and lots of national knowledge, contrary to the other forest activities. Furthermore, the cork exploitation makes use of more and higher diversified employment than maritime pine and much more than eucalyptus. Additionally it generates indirect values ranging from ecology to landscaping, and is crucial for the inland rural zones where “human desertification” and aging constitute increasing social problems.

In spite of the importance of Cork Oak to the Portuguese economy, the policy of the Portuguese governmental policy to the species is abysmal. During the sixties while the wine market was showing signs of growth, Portugal dismantled the Junta Nacional da Cortiça and the Estação de Investigação do Sobreiro, the State institutions that along decades provided orientation to the cork sector on management, research, international trade and legal aspects. From the extinction of Junta Nacional da Cortiça and Estação de Investigação do Sobreiro to date Cork Oak policy responsibilities lie among various institutions, with unclear objectives that have many weaknesses where overlapping and many gaps are evident.

The main focus of the current controversy on the cork stopper is the occurrence of TCA or “cork taint”¹. Nevertheless there is not a national agency for cork stoppers’ quality control either for the rates of occurrence of this defect, leaving room for speculation in numbers.

Since 1998 cork experienced a 300% increase on raw-material prices, while at the same time the wine industry has refused to accept a parallel rise on the price of stoppers. The oscillation on the prices is reported in numbers devoid of economical analyses or long-term forecasts.

Measures

Portugal has solid forest knowledge on technical and scientific aspects of the management of our main species² and the same holds for forest fires control. By the end of the 19th century the forester Sousa Pimentel produced a notorious forest compendium on the management of the main economic species of the Portuguese forest (at that time – pines, chestnut and evergreen oaks) (Sousa Pimentel, 1888). The chapter dedicated to forest fires in pine forests is impressively “modern”. Fire fighting is focused on the aspects of human behaviour, fire control on the ground, compartmentalization as a mean of developing fire-break strips and use of broadleaves, specially oaks and other broadleaves species. Even controlled fires during winter are addressed.

It is crucial to promote discontinuity with less fire-susceptible species such as oaks, hardwoods and riparian species. Yet as some of these species are of long economical return or of low economic value, it is virtually impossible to implement a sustained compartmenting and diversification of forest species when the property is scattered among a chaotic set of co-owners, as is the case of several parts of Portugal.

Species of poor economical profile such as oaks, some of the noble hardwoods and some riparian species are suffering various threats with shrinking area and fragmentation of habitats that demand conservation measures (EUFORGEN, 2004). The use of these species for constructing fuelbreaks or

¹ TCA is the short-cut wording for a set of products that can contaminate and spoil wine’s aromas, e.g. TCA – 2,4,6 trichloroanisole, 2,4 DCA – 2,4 dichloroanisole, PCA – pentachloroanisole, PCP – pentachlorophenol, TCP – 2,4,6 trichlorophenol, etc. (Pollnitz et al., 1996).

² Portugal also has the worlds oldest operating Fire Brigade in Porto; established in 1295, more than 700 years ago.

buffer zones is a way to establish them; these areas could also serve as conservation populations. Whenever possible the establishment or protection of populations of these species should be included on the forest fire prevention programmes. For the rationalisation of human and material means economical, environmental, social, wildfire-defence objectives and other aspects of forest approach should be merged as much possible.

6. Global strategy for the rural world

The mitigation of forest fires goes beyond forest and demands a strategic approach to include forest as an element of the rural economy, especially when social changes inducing decrease at the rural population and family farm level are going on.

In the Mediterranean climate, especially when meteorological conditions turn to extreme situations of heat and dryness, forest fires may attain gigantic proportions even if the landscape is managed in mosaic of diverse species and fire lines.

It is important to fragment the forest area through buffer zones of short vegetation, grasslands for cattle grazing, fruit orchards (Figure 12) and zones of irrigated crops. That is achieved when grazing and agriculture activity exists in a sustainable way amid forest areas.

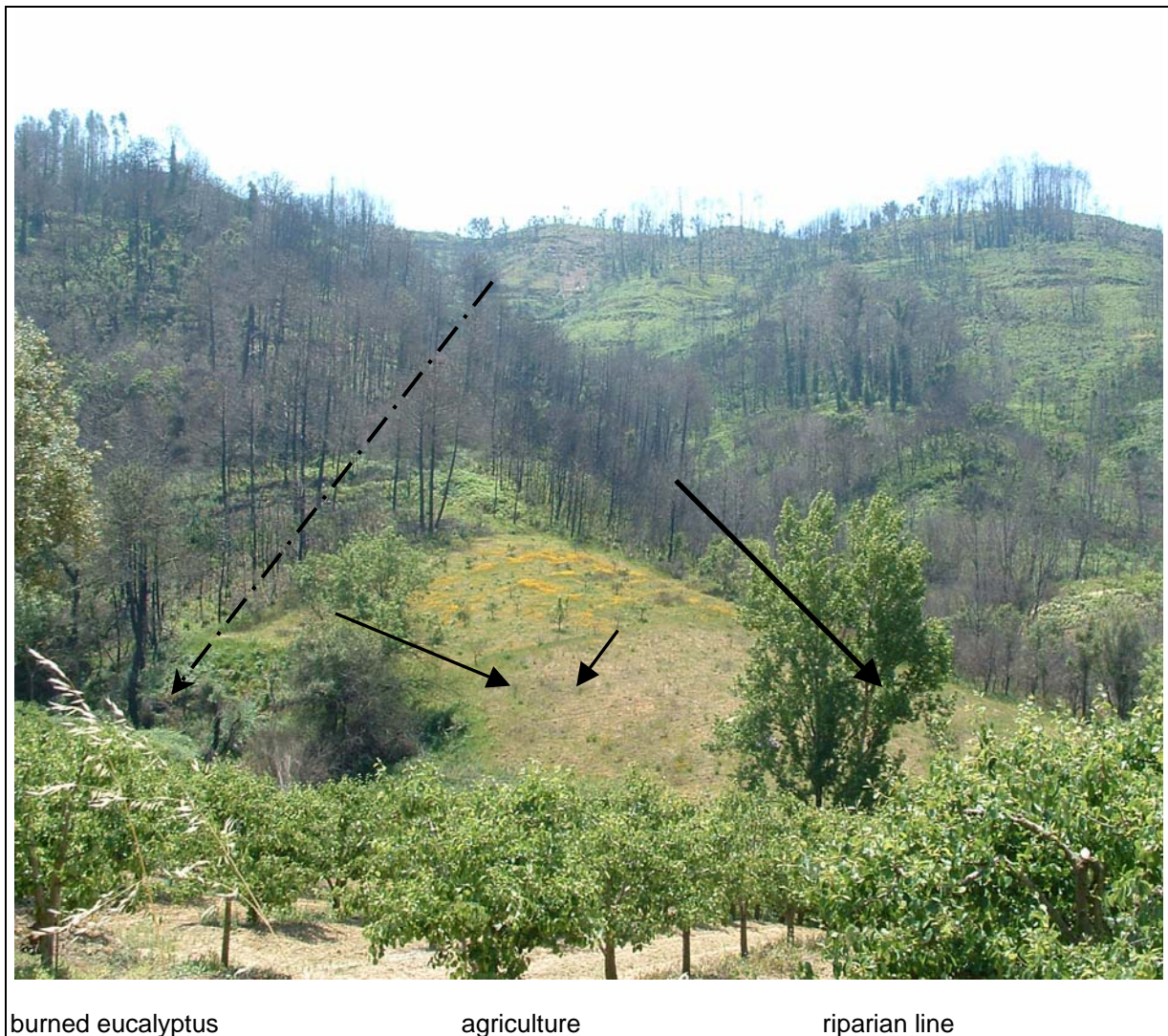


Figure 12. Agriculture and riparian trees acting as fire break. Location: Mafra (Portugal), after a fire of September 2003. Photo: MC Varela, 2003

Due to the human depletion in rural areas, aging of the rural population and remoteness of the consuming centres, the family agriculture and husbandry activities are not self sustained anymore. Support for these activities is dramatically needed and should be regarded not as farming subsidies, yet on the contrary as part of the investments in the rural economies that would be an integral part of forest fire prevention and combat.

In some parts of Portugal, especially where topography is unfriendly for agriculture many areas are being abandoned, allowing free space for the spread of dense shrub cover. The danger increases when invading vegetation is of tall grass type, a terrifying fuel when turning dry at the onset of the summer. These types of vegetation can easily get ignited by disposed cigarettes or sparks from train breaks. The level of abandoned agriculture land is an important factor that increases the dimension and risks of forest fires, especially when grass growth is amplified by wet springs.

During the past few years there have been some incentives to extensive animal farming and small agriculture on traditional products. However the structural results are poor, either for wildland fire reduction, or to a sustainable flow of traditional or biologic products, since the funding has been limited to some few small areas, not coordinated with an overall concerted strategy for rural Portugal.

7. Training and organisation of the fire combat

The dimension of the 2003 catastrophic forest fires in Portugal revealed critical deficiencies of fire suppression capabilities.

Over the last two decades forest fires combat in Portugal is executed by a corps of volunteer fire brigades devoid of special training for forest fires.

Furthermore, instead of an approach of military-command or standard Incident Command System (ICS) at the country level (as the dimension of a catastrophe is required for), the operations were overseen by local command disconnected from the national level.

Two situations provide a dramatic evidence of the need to establish a professional country-level command system for fire suppression, Mata Nacional de Leiria and Quinta da Lagoalva de Cima.

Mata Nacional de Leiria is the largest maritime pine national forest and was run by Forest Services for many decades till its disbandment by 1996. The Leiria National Forest is subjected to a long-term management plan which provides of a network of fire-lines and shrub control operations that still exist, in spite of the pullout of the Forest Service. The prevention measures were correctly implemented.

Yet the fire combat was done by about 30 volunteer fire-men poorly trained on methods of counter-fires and other forest fire peculiar ways of combat. The Forest Guard corps, an experienced group of fire-fighters, could not participate since the fire combat is now out from their responsibility. On 2 August 2003 the fire at Leiria National Forest became out of control, devastating around 2,500 ha out of the 9,000 ha in less than 24 hours.

Quinta da Lagoalva de Cima is a private estate of about 6,000 ha, where 5,000 ha are forest of Cork Oak, eucalypts and Maritime Pine. Fire prevention measures are also well established along all the forest area.

By the very same day a fire – originated by a dry thunderstorm – devastated an area of about 1500 ha, mainly eucalypt, Maritime Pine forest and a part of Cork Oak. The regional volunteer fire corps turned out to be poorly equipped in human and material means and lacking of knowledge on counter fires. Part of the combat was performed by the estate staff, while the fire corps concentrated on the surveillance of urban structures, leaving the forest area unattended.

Many other examples could be described all over the country, even in Cork Oak areas where the open character of the stands facilitates fire suppression.

Forest fires occurring in situations as described above require a response by a specifically trained forest fire corps under a strong command at country level. The specificity of forest fires also raises questions on the lack of forest experts at command level and during field operations.

Aircraft used in forest fire control are mainly a tool to facilitate ground suppression. When large forest areas are caught up by violent fires fed by strong winds, counter fires or tree felling to lower the fuel ability are, in some circumstances, the most effective tools, to contain the fire.

Counter fire is a risky intervention that claims a solid knowledge of the forest and geographic local conditions. Felling of trees by means of heavy machinery or chain-saw are also operations out of the scope of volunteer firemen. Furthermore in private property the fire corps cannot set counter fires or fell trees if not authorized by an adequate legal framework.

8. Disorganisation of the Forest Service

Along with other causes of forest fires of 2003 the dismantling of the structure of the Forest Service and the forest guard corps are facts to be considered.

When a third of the country is occupied by a long-lasting peculiar activity such as forest the need of a national regulator is a basic requirement for the efficient management of the sector.

The need for sustainable management of the forest claims a structure where experience can be processed into knowledge for coming generations in a continuous and enriching process. The physical and temporal dimension of forest makes it incompatible with regional institutions.

Established in 1824 under the designation of Administração Geral das Matas (General Administration for Forestry) (Radich and M Alves, 2000) the institution known by the general designation of Forest Service (a designation that has endured the various labelling and still survives at the common citizen wording) existed until 1996.

After decades of activity Forest Services left behind an overall positive balance. The accumulated knowledge is now in adrift in the Directorates of Agriculture.

The need of a strong structure to coordinate the forests of the country as well as professional corps for fire prevention and combat was also focus by Sousa Pimentel (1888).

The practical dismantling of Forest Services goes behind the “physical” extinction of the institution. Some years before the official extinction of the Forest Service, the forest guards’ corps was deprived of their forest activities and limited to some few law enforcements such as control on hunting.

9. Conjunctural causes

Economic interests

The easy aptitude of Mediterranean forests to get in fire has always been used as weapon on discord. Recently it is also a weapon of various economical interests.

Successive burning may be used to force down the forestry profile of land into other uses. This may be the case of urban or tourism interests.

Changes on the type of the species cover are also part of the economic causes for arson. Despite of the law, which rules that forest land cannot be occupied for other uses during ten years after a fire (Decree 327/1990, Law 54/1991, and Decree 34/1999) this “quarantine” is not dissuading investors from setting fire.

Despite the legal impediments in Portugal to cut evergreen oaks (*Quercus suber* and *Q. ilex*) (Decree 169/2001). it is possible to remove them once they are dead, e.g. due to fire. Thus, the forest can be liberated from these species and afforested by the fast-growing ones.

By the 1970s and 1980s the area of Maritime Pine (*Pinus pinaster*) was 1,300,000 ha while eucalypts covered less than 500,000 ha (IPF, 1987). Nowadays the areas are respectively 900,000 ha and 670,000 ha (DGF, 2002). The short rotation turns eucalyptus a more attractive species as compared to pines and oaks, especially for private owners. At least indirectly, the expanding *Eucalyptus* area has

benefited from the frequent fires on maritime pine as can be assessed when comparing former cartography of these species with the actual one.

Wood traders are profiting from cheap wood harvested post-fire: Properly debarked salvage-logged timber can be sold as non-burned wood – increasing the profit margin

Lobbies on wood trade are also liable to profit from fires since burned wood is an easy target to price speculation and attains, by rule, lower value on the field. Yet cut down shortly after fire and if debarked it may not be difficult to trade burned wood as non-burned.

Private companies specialized in fire combat are to be added to the horde of the potential beneficiaries of forest fires. Episodes of commanders of fire brigades that simultaneously own business of fire combat equipment are being reported by the media.

The fire control shall be under State responsibility. Involvement of private companies on fire combat may create conditions for arson fire to feed the fire business.

The “fire industry” creates additional economic interests. The Firefighters Corporation is a strong lobby that no government dares to face.

Forest fires are dramatic media events. Fearing electoral punishment any government gives ground to a panoply of cabinets, committees, task forces, seminars, etc. which pace of grow is dictated by the dimension of the forest fires of the previous year. As frequently happens in the Portuguese Public Administration, the temporary structures become established and go on existing and consuming tax payer’s money, especially when supported by lobbies.

The academic lobby is another one to be included in the horde of forest fire beneficiaries: The “fire industry” ends up to be an extra source of financing, especially in universities, that gives justification for cathedra posts and pays for research projects, studies, publication, etc. ...

In a country with a fragile economy any uncertainty of employment, even temporary jobs, attract sympathy of the common citizen.

The subtle beneficiaries of the “fire industry”, which honestly and clean is based on fire-created jobs, is finally infecting the society with an imperceptible feeling of indifference upon the fire devastation. To feel in peace requires nothing more than being certain of not having set any fire.

Indeed like the fire-adapted species, for a part of the society forest fires are not a factor of destruction, rather an active economic sector.

If wildfires become a rule, a part of the society may become fire-dependent, like some of the forest species ...

Education and penalizing

Education is also a point to address for minimization of forest fires; one may wonder why citizens in the European countries north of the Alps, have such a different attitude towards forests, and it is not just a question of different climate.

Negligent behaviour on debris burning, incorrect cigarette extinction, low care of barbecue fires, etc. start huge forest fires, especially during the hot and dry weather conditions of the Mediterranean summer. The forest area burned, after confessed careless events along the past years, is evidence.

However those types of jeopardy are unknown for many people, especially among the urban population.

The role of education campaigns and penalization on fire-risk behaviour is clearly included at the Decree 488 (20 October 1970) and Decree 334/1990 dedicated to prevention, detection and combat of forest fires. Looking back to the last three decades the legislation come out as an exercise of rhetoric on good intention and a painful demonstration of the dismissal of the State authority.

Intensive public awareness campaigns should run on TV and radio and panels using illustrative images should be placed at road side as well as within the forest.

Basic education programmes in Portuguese schools shall focus tangible aspects on forest fires risks in order to raise the public awareness. Children can be a very efficient way to educate adults.

Measures

Exceptional measures focused and restricted to periods of forecasted unusual hot and dry waves of weather total prohibition of barbecue, metal-cutting devices, etc. close to forest and shrub land are indispensable. Application of penalties on incorrect cigarette extinction, quarantine upon the use of summer festival rockets, already preview at the Decree 488/1970 and boost up by the Decree 334/1990, is a must on fire mitigation. Public awareness campaigns towards the common citizen for the various events that can start forest fires shall be reinforced along those periods.

Social causes

In Mediterranean it is said that “winter conflicts on forestry may end-up in fire during summer”.

Due to the high aptitude of Mediterranean forest to get in fire it is sometimes used to fight unfriendly autocratic uses of the forest land. The appointment of areas to environmental protection and private hunting exploitation, for instance, claim tactful approach with the surrounding human settlements, since resentful feelings may end up into anger and translated in vengeance fires.

10. Perspectives

Conjunctural and structural causes act in synergy enabling conditions for forest fires and other wildland fires in Portugal. Dramatic situations arise when the average hot and dry weather of the Mediterranean summer is exacerbated by extreme waves of hot and dry weather, as happened during the summer of 2003. If global warming simulation models (global circulation models) will be consolidated and become reality, and if the actual forest profile persists, worse wildland fire catastrophes will become more common.

Portugal holds a solid technical knowledge on forest fire prevention and combat. Controlled fires as a tool to minimize the summer hazards, compartmenting, civil behaviour, specific training of firefighters are aspects already discussed by Sousa in 1888. Thereafter the issue has been taken up frequently in forest technical documents in the country.

The 2003 tragedy emphasized the need of a long-term, multidisciplinary, national and comprehensive plan to manage forest fires.

The plan must be formulated through clear objectives, phases and calendar, instruments and milestones in order to assure the actors' commitment and results.

Major ways to mitigate forest fires include:

- Structural changes on “indivisible” property
Restructuring of the small uneconomical “indivisible” private properties under the aim to fight abandon is a basic requirement
- Forest structure
There is a need to implement a national forest strategy for; species' diversification and construction of firebreak and fuelbreak networks, particularly in cases when the main species are easy burnable; as is the case of pines and eucalypts.

Maritime Pine and eucalypts are extremely important species for the Portuguese forest economy. In sites where their growth is under the economically viable threshold, those species should be completely eradicated and substituted for less fire-prone species or set aside for natural vegetation cover for environmental and landscape benefits.

The cultivation of less fire-susceptible species such as oaks, hardwoods and riparian species should also be promoted. Yet some of these species are of long economic return or of low

economic value. Species of poor economic profile such as oaks, some of the noble hardwoods and some riparian species are demanding conservation measures. Whenever possible the establishment or protection of the populations of these species should be included on the forest fire prevention programme.

To minimize the risks and dimensions of forest fires in Portugal there is the need to carry out sharp changes on the Portuguese forest structure, profile and management taking forest as part of the rural world.

However silvicultural measures alone are insufficient to decrease the dimension and risks of huge forest fires.

➤ Concerted strategy for the rural world

The trend for concentration of human population in urban centres increases the abandon of agriculture and pasturage that once existed amid the forest in remote areas. It contributes to the increase of bush lands and unmanaged impenetrable forests where uncontrollable fires easily happen.

Incentives to create a dynamic network of sustainable small agriculture and grazing activities are needed.

➤ Other aspects

- exceptional measures when hot waves of weather are forecasted
- education, public awareness campaigns and penalties
- dissuasion policy of interests that benefit economically from fires
- national coordination under State responsibility and reorganisation of the Forest Service
- specifically trained forest fire management personnel under national command

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