

Social Impact of Large-Scale Forest Fires¹

José M^a Rábade,² Carmen Aragoneses²

Summary

Growing public alarm at the problem of large-scale forest fires, is evident from an assessment of their past and present repercussions on the population in general. Numerous and varied media reports indicate the extraordinary social and environmental impact of forest fires.

Emergency situations caused by evacuations, physical injury and at worst, loss of human life are extensively covered in the media which moreover lists environmental damage and figures for the numbers involved in the suppression operations, police firemen, volunteers, army air and land resources etc...

Blocked roads and railway lines, electricity, mobile and land telephone lines cut, destruction of homes and industries, and the way of life of many communities are annual news stories and the balance of the catastrophe caused by fire results in a wealth of articles, editorials and communications.

A search in the newspaper archives reveals shocking figures, which we offer here to illustrate the magnitude of a problem which is now unsustainable and to which the managers and politicians responsible have become accustomed.

The figures

Spanish forest land covers more than 26 million hectares, 52 % of the country's surface area, of which approximately 14 million hectares are covered by fairly densely wooded forest ecosystems, which makes Spain the country with the second largest forest area in the EU and the fourth in terms of woodland.

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² Tecnologías y Servicios Agrarios, S.A. (TRAGSATEC). Julián Camarillo, 6. Madrid. CP 28037.

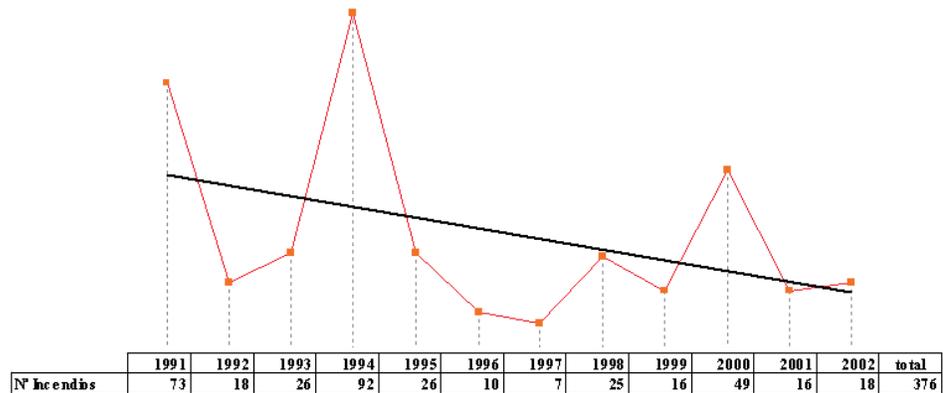


Figure 1—Number of large-scale fires. 1991-2002. Source: B.D. EGIF.MIMAM

In the last twelve years (1991-2002) more than 232.000 fires spread over 1.800.000 hectares of woodland, scrubland and pasture, 7% of the forest surface area. Of these, 376 fires spread over more than 500 hectares (large fires) covering an extension of 738.000 hectares, 41% of the burned surface. 1991, 1994 and 2000 were particularly bad years with respectively 73, 92 49 large-scale fires which burned 550.000 hectares (fig. 1) (fig. 2).

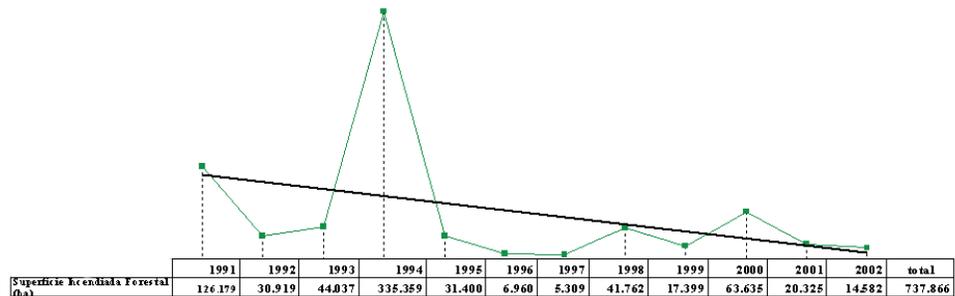


Figure 2—Surface covered by large-scale fires (hectares). 1991-2002. Source: B.D. EGIF. MIMAM.

In order to address this overwhelming number of fires—20.000 per annum— the Spanish state has had to mobilise more than 3.200.000 fire-fighters from the ranks of professional firemen, volunteers and the armed forces, which amounts to an average of almost 270.000 fire-fighters per year. This was implemented with the aid of 318.000 machinery units on land –automatic pumps, heavy and light tractors and other equipment– a total of 27.000 units per year, and 1.4 units per fire, to which 71.300 air fire fighting units should be added –‘planes, helicopters and coordination planes–, an average of 6,000 units per year or 0.31 units per fire.

The impact

The social impact of fires, particularly large-scale fires, is plainly evident from numerous media reports.

Typing the term forest fires into the Google search engine in Spanish, English

and French resulted in around 236.500 references for the period between 1991-2003 with the development shown in *figures 3 and 4*, where it is evident that the number has tripled between the beginning and end of the period.

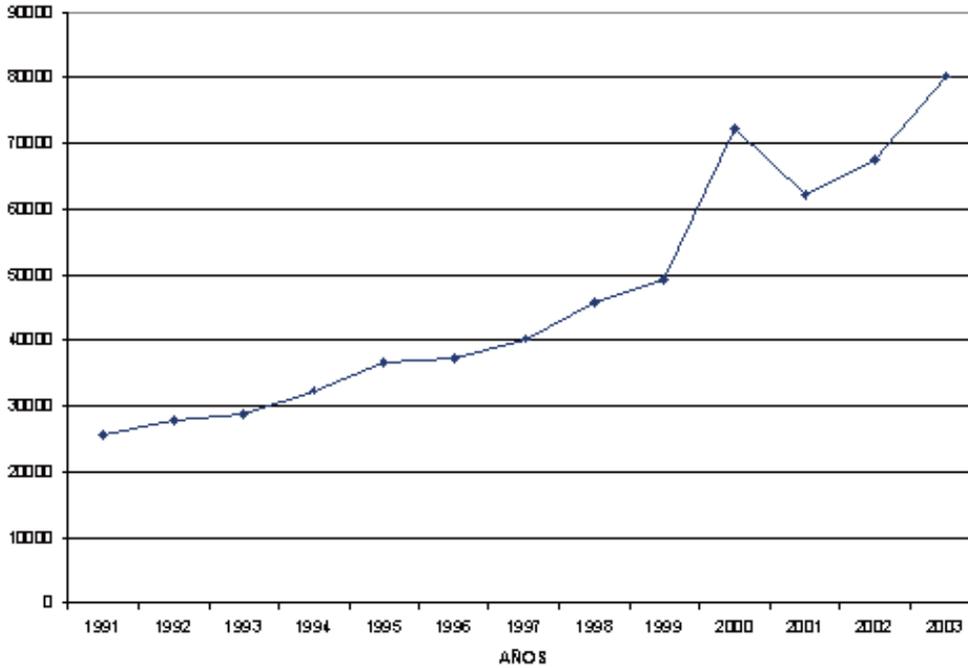


Figure 3—Number of references to forest fires taken from a Google search enquiry during the period 1991-2003. Source: Author’s own.TRAGSATEC.

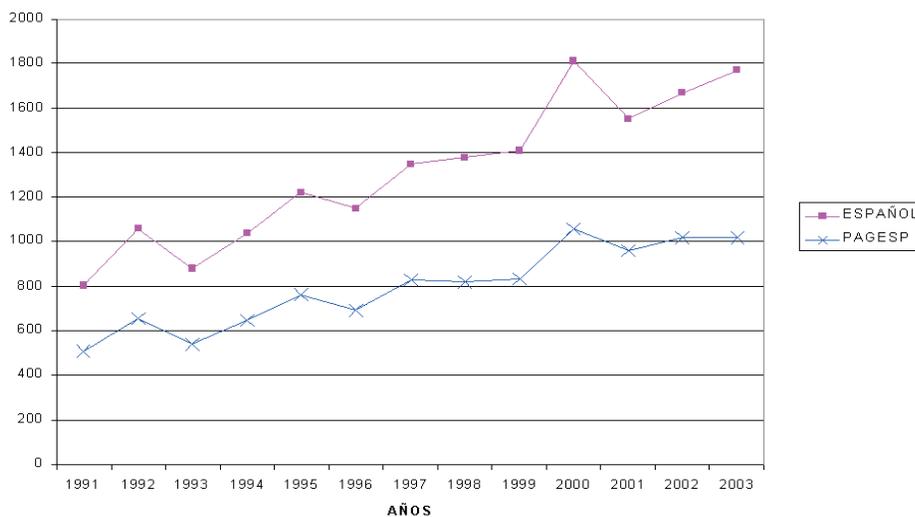


Figure 4— Number of references to forest fires taken from a Google search enquiry during the period 1991-2003. Source: Author’s own.TRAGSATEC.

If we confine this search to Spain, to the national press (prensa_incendios.mdb, TRAGSATEC) and to the same period 1991-2003, we find 226 articles covering news references to 102 fires, of which 82 spread over more than 500 hectares. *Figure 5* shows their distribution throughout that period, with articles corresponding to the years 1994 and 2003 being specially significant, reporting on 57 fires, 43 of which were large-scale conflagrations.

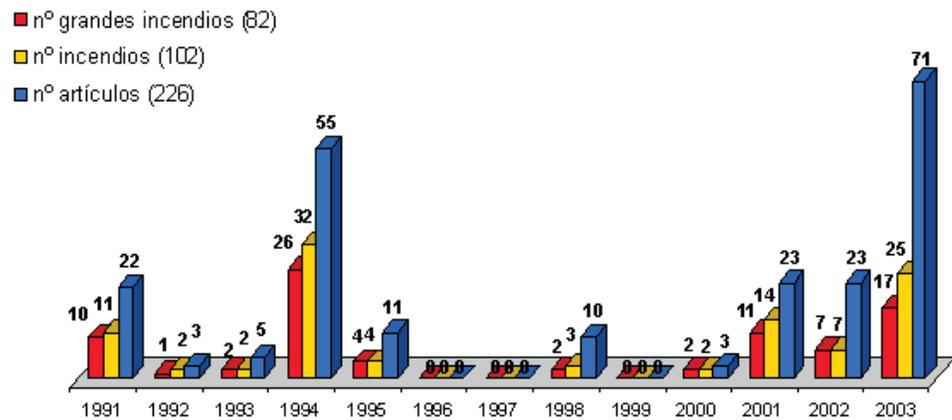


Figure 5—Number of fires, large-scale fires and press articles 1991-2003. Source: Database prensa_incendios.mdb. TRAGSATEC

Damage

Throughout the period analysed (1991-2003) forest fires caused serious damage to people, their properties and to the environment. As illustrated in *figure 6*, 59 people lost their lives, 30 of whom were professional fire fighters. 1994 was a particularly disastrous year with 41 mortal victims, 20 of whom died in a single fire (Millares, 25,930 hectares) and 15 in three fires (Montemayor, St. Mateu de Bages and Alicante, 45,000 hectares), followed by 2003 when seven people died. 118 people were injured, 64 in the 1994 fires and 27 last year in 2003 and 41,752 people had to be evacuated, 10,372 in the disasters of 1994 and 23,042 in the great fires of 2003. 169 homes were either partially or totally destroyed, 92 of these in the years 2000 and 2003. On 17 occasions there was long term collapse of electricity services and water supplies and national trunk roads were blocked 32 times.

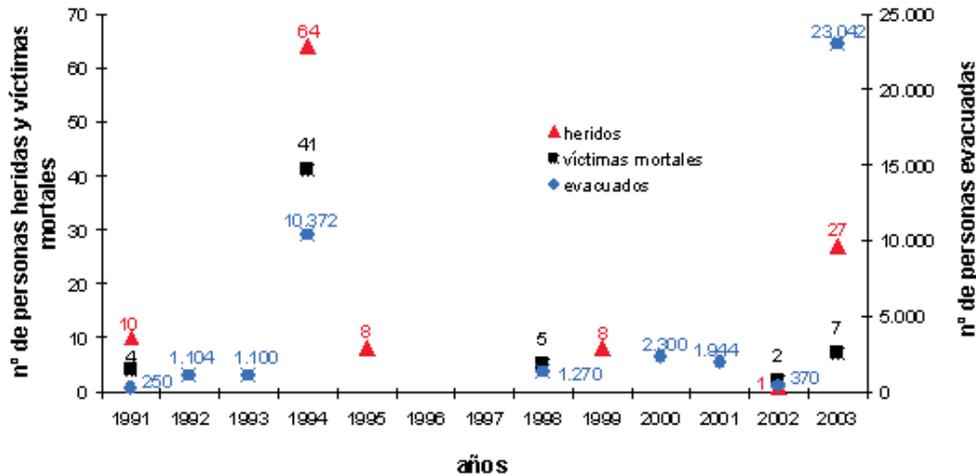


Figure 6—Number of deaths, people injured and evacuated. 1991-2003
 Source: Database: prensa_incendios.mdb. TRAGSATEC

Environmental damage is yet another aspect of the impact of large-scale fires, which destroy the habitat of species, some of which are threatened, facilitating the spread of disease and pestilence, sterilising and eroding soils, modifying the quality of water and water courses, in general, making valuable forest space unsustainable.

A clear example of environmental damage to the soil and water courses is the case of Lújar in the Granada mountains. On 19, 20 and 21 August 2000, a fire spread over 1.207 hectares of forest ecosystem where water flows directly into the Rules dam, on the River Guadalfeo. *Tables 1, 2 and 3* show the considerable changes in maximum flow and return over 50 years, average loss of soil and average emission of sediment generated by the disappearance of part of the cover of the water basin.

Table 2—*Variation in average soil losses before and after fire. Source: Environmental Department Regional Government of Andalusia.*

Basin	Before the fire (tons/hect./year)	After the fire (tons/hect./year)	%
Bco. de las Piedras	29,11	33,61	15
Bco. del Algarrobo	15,72	120,78	668
Bco. de los Hornos	9,67	68,47	608
Bco. de Miranda	13,40	98,13	623
Bco. Cortijo los Romeros	19,24	47,69	148
Bco. del Olivo	111,11	206,28	86
Bco. del Muerto	15,55	55,93	260
TOTAL	21,01	87,67	317

With regard to impact on the annual average emission of sediment deposited in the Rules dam, in the River Guadalfeo, the figures show that the number of tons per year has multiplied by 18.

Table 3—*Variation of average annual emission of sediments before and after fire. Source: Environmental Department Regional Government of Andalusia.*

Basin	Surface area (hec)	Emission prior to fire (tons/year)	Emission following fire (ton/year)	%
Bco. de las Piedras	395,81	1.966,98	2.887,50	47
Bco. del Algarrobo	559,65	1.329,50	67.595,33	4.984
Bco. de los Hornos	987,31	2.389,70	42.581,66	1.682
Bco. de Miranda	710,21	1.668,20	48.761,81	2.823
Bco. Cortijo los Romeros	110,46	188,69	578,08	206
Bco. del Olivo	190,89	2.998,40	39.377,08	1.213
Bco. del Muerto	121,19	239,94	1.306,34	444
TOTAL		10.781,41	203.087,80	1.784

Equally significant is the impact on our forest ecosystems' crop biomass. During the period 1991-2002, approximately 671.000 hectares of forest have been affected by fire, 22.000.000 of mature trees ($\varnothing > 75\text{mm}$) and at a bark volume of 27.000.000 m³ growing at a rate of 1.500.000 m³ per annum. The fire at Pedro Bernardo (Avila, 2000) which spread to 4.000 hectares of woodland with 1.322.000 mature trees and 192.000 m³ of timber was particularly damaging as was the fire at Valencia de

Alcántara (Cáceres, 2003) which spread to 19,300 hectares, of which 9,000 were forests of cork oak, chestnut, Pyrenean oak, holm oak and pine, affecting a bark volume of 167.500 m³ which incorporated 7,200 m³ of timber per year.

Fuel

The current situation of our forest lands, analysed from the perspective of reaction and resistance to fire leads to the conclusion that the negative impact on people, property and the environment will not decrease unless, and this is unequivocal, strenuous preventive measures are taken. This fact may be deduced from simple observation of the data shown below.

If we examine the annals of the Spanish National Forestry Inventory (IFN) throughout its three twelve-year cycles (IFN1, IFN2 and IFN3) (1964-2004), we note the sharply increasing densification occurring in our forests in terms of the number of trees, vegetation, undergrowth and dead vegetable matter in contact with the ground.

If we compare the number of mature trees ($\varnothing > 75\text{mm}$) per hectare in the nineteen sixties (1st national forestry inventory, IFN1) with those of the eighties (2nd national forestry inventory, IFN2) and those of the nineties (3rd national forestry inventory, IFN3) we note a marked upward trend of the dasometric indicator. To give the figures for some relevant cases: in IFN1 the forests of Cáceres contained 52 trees per hectare and in IFN3 the figure is 148, three times as many. In Cantabria the *Pinus pinaster* and *Pinus radiata* ecosystems have risen from 692 trees per hectare (IFN2) to 918 trees per hectare (IFN3). The eucalyptus woods of Pontevedra have risen from 446 trees per hectare (IFN2) to 663 trees per hectare (IFN3). The density of pines in Asturias has doubled, from 411 trees per hectare (IFN2) to 825 trees per hectare (IFN3). The *P. halepensis* pinewoods of Murcia, have also duplicated stocks, from 180 trees per hectare (IFN2) to 321 trees per hectare (IFN3).

If we turn our attention to undercover vegetation –undergrowth – and take as an example the woods of *Pinus halepensis* in the south of the Community of Madrid the area covered by the species *Quercus coccifera*, *Rosmarinus officinalis*, *Rhamnus lyciodes*, *Helichrysum stoechas* and *Thymus spp.* which, at the beginning of the nineties (IFN2) covered 14 % of the ground, today cover 59 %. A similar situation exists in the undergrowth of the *Pinus sylvestris* ecosystems in Barcelona, comprising *Calluna vulgaris*, *Ligustrum vulgare*, *Quercus coccifera*, *Rosmarinus officinalis*, *Phillyrea sp* and *Thymus spp.* which in the mid-nineties (IFN2) covered 16 % of the forest floor, today cover 62 % of the pinewood area.

An indicator of ignition capacity could be the thickness of the dead vegetation covering the forest floor. Thickness of more than 4.5 cm which, according to IFN2 in Barcelona covered 12% of the forest surface and in IFN3 it had jumped to 22 %.

In Cáceres, the progression is similar, the thicknesses which in IFN2 reached 3% have doubled in 10 years (IFN3). The situation in Ourense is even more extreme where the percentage of cover greater than 4,5 cm in IFN2 were 45 % and are predicted in IFN3 at 98 %.

This high densification suffered by our forests may be explained both from the perspective of intense silviculture applied to our forest ecosystems. The samples taken by the IFN over a national network of 90,000 plots reveal that at a national level, cultivated forest in the nineteen-eighties accounted for one in every four hectares of woodland (25 %). IFN3, which started in the mid-nineties shows that this

is now one in every six hectares, (15%) The case of Galicia is particularly striking where there has been a 60% reduction between inventories (IFN2/IFN3), and the cases of Ourense and La Coruña are particularly alarming where cultivated forest accounts for one in ten hectares (10 %) (table 4).

Table 4—Intensity of silviculture systems in the forests of 15 provinces. Source: National Forestry Inventory of Spain .DGCN. MIMAM

Province	% of forest surface subject to treatment of canopy				Treatment of canopy
	IFN2	IFN3	(IFN3-IFN2)*100 /IFN2	Not noted	
	Treatment of canopy	Not noted	Treatment of canopy	Not noted	Treatment of canopy
Ávila	28,0	72,0	23,4	76,6	-16,6
Badajoz	30,9	69,1	27,2	72,8	-11,8
Illes Balears	13,6	86,4	13,2	86,8	-2,9
Cáceres	18,3	81,7	16,5	83,5	-9,7
A Coruña	30,8	69,2	12,6	87,4	-59,0
Lugo	30,5	69,5	14,3	85,7	-53,2
Murcia	43,6	56,4	22,1	77,9	-49,4
Navarra	11,3	88,7	8,0	92,0	-29,3
Ourense	28,9	71,1	11,4	88,7	-60,8
Asturias	10,5	89,5	7,2	92,8	-31,8
Pontevedra	45,1	54,9	18,7	81,3	-58,4
Salamanca	47,9	52,1	34,5	65,5	-28,0
Sta.Cruz de Tenerife	9,1	91,0	4,5	95,5	-50,7
Cantabria	14,3	85,7	7,2	92,8	-49,5
Tarragona	6,2	93,8	3,6	96,4	-42,1
Weighted average	25,6	74,4	17,1	82,9	-31,4

The accumulation of fuel in our forests has reached an alarming level. The Map of Fuel Models in Spain is one way of visualising this situation, the map is on a scale of 1:50.000, and the general panorama is shown in *figure 7*.

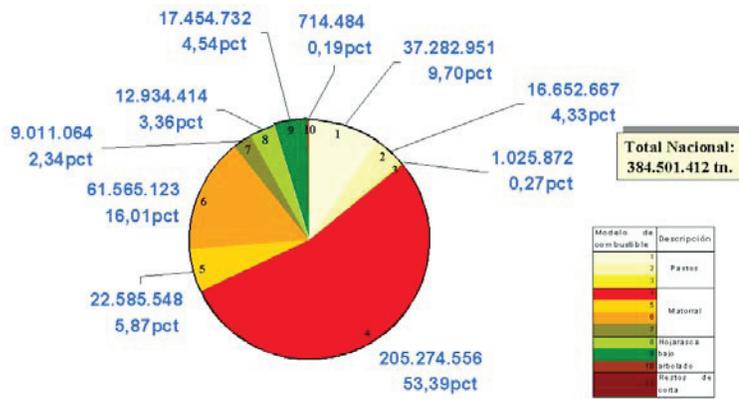


Figure 7—National distribution of fuel models in tons. Source: Map of fuel models in Spain 1:50.000. DGCN.MIMAM

The total quantity of forest fuel – dry material- at a national level is over 384 million tons, corresponding to the undergrowth models el 77 % of the total, pasture 14% and leaf litter and brush the remaining 9 %.

Territorial distribution, *figure 8*, places five provinces at the head of the list, Cáceres, Badajoz, Cuenca, Ciudad Real and León, with the greatest extent of forest areas, and their forest ecosystems contain more than 12.5 million tons, followed by a group of ten provinces with more than 9.5 million tons of fuel each.

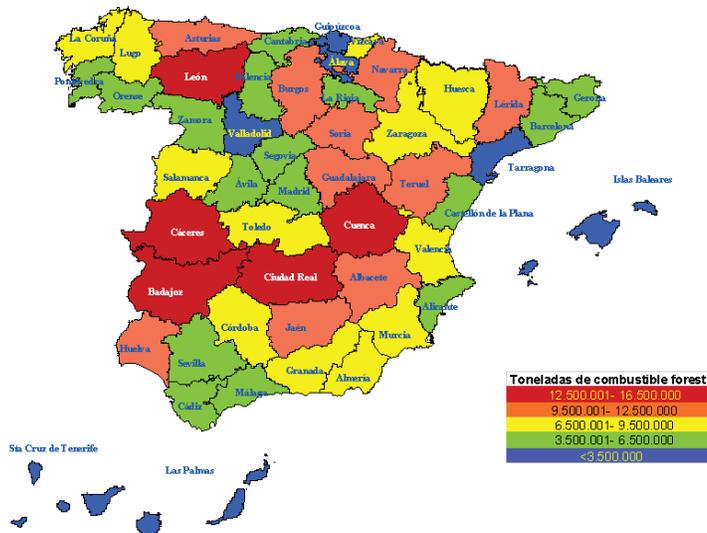


Figure 8— Territorial Forest Distribution, in tons. Source: Tragsatec own figure

In terms of surface, the areas of undergrowth are particularly significant basically comprising dense thickets and shrubs over two metres high with an average fuel load - dry material- of approximately 30 tons per hectare and wooded shrubby areas less than 2 meters high with inflammable or highly flammable species and fuel loads of approximately 12 tons per hectare, which makes a total of 16 million hectares, or to put it another way, one in three hectares of the geographical area of Spain. (fig 9 y 10).

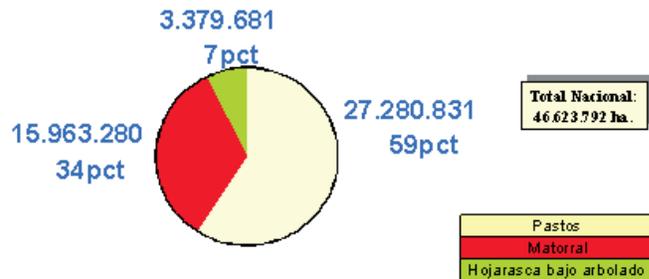
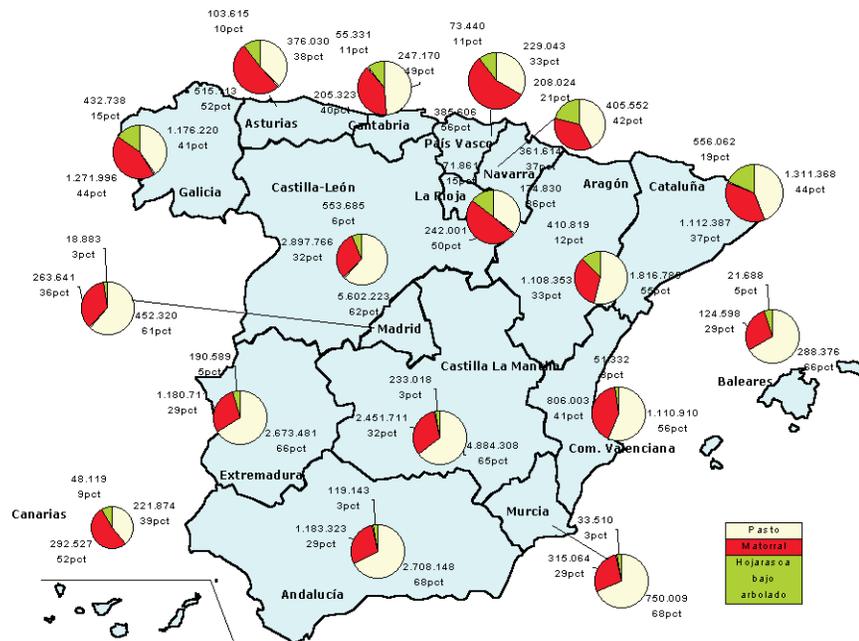


Figure 9— National Distribution of types of fuel in hectares . Source: Map of fuel types in Spain 1:50.000. DGCN. MIMAM



have seen, the handicap of accumulated fuels, some of which are highly inflammable and their worrying effect on the safety of land fire-fighting units. The extraordinary resources required to reach this level of efficiency have already been described. Fire suppression has indeed been effectively dealt with.

The main concern which remains to be resolved is prevention. The hoped for mobilisation of activity has not occurred to a solid or concrete degree, only aspects such as fire detection have been addressed. The Autonomous Communities of Spain have not devised a Fire Management Strategy.

If the commitments contained in the newly promulgated National Forestry Law do actually materialise, there may be some hope. We recall some of these below:

- Sustainable forest management.
- Proprietors are responsible for technical and material management.
- Forestry planning within the framework of land management
- Promotion of commercial forestry and of related social and economic sectors
- Creation of employment and development of rural areas

-In addition the requirement of proprietors and institutions to comply with the obligations enforced by the Basic Civil Protection Directive on Forest Fires in respect of local plans and self –protection, presupposes a radical change in future trends regarding the social economic and environmental impact of forest fires.

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