Pilot Study on the Socio-Economic Impact of Large Forest Fires. Tiétar Valley (Spain).

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Abstract

Forest fires have become one of the most serious environmental problems in Spain, with more than 100,000 hectares being burnt each year. Apart from environmental and economic losses, there are other additional problems that can occur in the medium term, such as the socio-economic deterioration of rural environments (usually the neglected mountain areas) where forest fire adds to the deterioration of very frail local economies.

This work analyses the effect of the large forest fires that occurred from 1960 to 2000 according to different, previously established socio-economic indicators. The Tiétar Valley in Avila province (Spain) was chosen as the study area.

Résumé

Les incendies de forêt sont devenus l'un des plus graves problèmes environnementaux en Espagne: chaque année, plus de 100 000 hectares sont calcinés par le feu. Outre les pertes environnementales et économiques, il existe d'autres problèmes que l'on perçoit à moyen terme, tels que la détérioration socio-économique du milieu rural (en général, des zones montagneuses moins favorisées), où les incendies de forêt ne font qu'aggraver le déclin d'une économie locale déjà très fragile.

Cette étude est une analyse de l'effet produit par les grands incendies de forêt pendant la période 1960-2000, en fonction de différents indicateurs socio-économiques établis au préalable. La zone d'étude délimitée a été la Vallée du Tiétar, dans la province d'Avila (Espagne).

1. Introduction

Since the early 1970's, forest fires have become one of the most serious environmental problems in Spain, to the extent that more than 100,000 hectares are burnt each year, despite the material efforts that have been put into practice and that have led to a slight fall in the burnt area over the past decade.

Forest fire can pose a great loss in environmental terms and translate into well-documented problems such as a reduction in plant cover, erosion, lack of water regulation and loss of biodiversity.

However, there are other problems apart from the environmental and economic losses that are not immediately obvious but occur in the medium term, such as the socio-economic deterioration of rural environments, usually more neglected mountain areas (INIA, 1983), where forest fire can add to the deterioration of very fragile local economies.

It is necessary to bear in mind that forest areas are valuable not only for their direct use but increasingly because of the external factors they generate, especially the recreational use they can be put to and the tourism they can attract. A forest fire can ruin an area's economic backbone when the service industries that depend on rural tourism (and which are particularly fundamental to the survival of mountain areas) disappear.

This work analyses the effect produced by the large forest fires that occurred from 1960 to 2000 in terms of the deterioration of different and previously established socio-economic indicators (Garro and De la Fuente, 1988). The Tiétar Valley in Avila province was chosen as the study area, where forest fires have frequently occurred since the mid-1970's as a result of the non-profitability of its woodlands following a slump in the resin industry that led to them being abandoned. Furthermore, the local economy is tourist-based (Del Canto, 1992) and the deterioration of natural resources (the area's main tourist attention) is also especially important.

The southern side of the Gredos Plain in Avila province, otherwise known as the Tiétar Valley, is characterised by rough terrain with high ground rising to nearly 2,000 metres and an abundance of rain. This has allowed the development of forest areas of great ecological wealth, both in terms of occupied area (90,000 forest hectares out of the 110,000 total hectares in the province) as well as a diversity of forest species including holm and cork oak, Quercus toza, chestnut and pine trees (Martínez Ruiz, 1996).

As early as the 13th century, when the rural environment was finally shaped, this wealth of natural resources ensured important development of the towns that based their local economies on them.

Economic interest in the different ways the forests were used over time helped the landscape evolve, mainly through the promotion of coniferous trees over leafy ones, so that by the mid-1970's areas of Pinus pinaster (which produces firewood and, especially, resin) occupied most of the forest area. It was then that the slump in the resin industry occurred and the first large forest fires broke out, the evolution of which is shown in Table 1.

The Table clearly shows that, beginning in the mid-1970's when the resin market was in crisis and resin tapping was being abandoned in the mountains due to the lack of economic interest in resin, the number of fires increased con-

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Table 1. *Evolution of the number of forests and wooded areas burnt in the Tiétar Valley (Spain).*

Period	No. of fires	Wooded area burnt (ha)
1971-75	217	1,724
1976-80	612	8,271
1981-85	894	5,579
1986-90	1,111	11,214
1991-95	1,042	3,042
1996-00	822	2,979
Total	4,698	32,829

Source: *Statistical yearbooks of the Junta de Castilla León.*

siderably and affected a large part of the wooded area of the valley.

Furthermore, wood prices began to fall and the gathering of firewood (a main source of primary energy up until this period) began to decline. If we add tourist pressure on the woodlands, we have the perfect breeding ground for the proliferation of forest fire.

We should bear in mind that the villages in the Tiétar Valley quickly went from "flourishing" municipalities, thanks to the wealth provided by their woodlands, to suffering the practical disappearance of this income, which eventually involved maintenance costs that local governments were unable to bear. Today, following a pronounced process of demographic emigration, the local economy depends on income from tourism (the Tiétar Valley lies 100 km from Madrid) and related service industries (Arenillas and Juarez, 1990), which means the woodlands have become secondary to rural society, compounded especially by the fact that their external factors have not been linked to the local economy.

While the local population fell from around 100,000 inhabitants in 1950 to 40,000 in 1975 and 35,000 in 2000, the immigrant population rose from 60,000 tourists in 1975 to more than 100,000 in the year 2000 (Martínez Ruiz, 2000). This happened in the 70's when people from Madrid started buying holiday homes to spend week-ends in the Guadarrama and Gredos Mountains, so the economy of these areas improved, (Troitiño, 1990). The area now depends on a single industry - based exclusively on tourist activity - which by itself is unable to maintain a sustainable economy to conserve the local population level.

However, as in many other areas, the problem of fires in the Tiétar Valley is very old. Records show it was a problem for the owners of the woodlands (the nobility and clergy) as far back as the 13th century. In the case of the northern side of the Gredos Plain, it was the reason for the disappearance of most forest cover (by the 15th century only remains were left), while fires in the Tiétar Valley led to a very important drop in cover, especially in the lower areas in order to foster agriculture. This mainly affected holm and melojo oak areas, where woods were turned into pastures. However, it is a problem that still occurs today, although it is not terribly important with regard to pine areas because of the economic interest the woodlands hold for the local population (Ortuño, 2000).

Furthermore, forest fires are leading to a "natural" fall in wooded areas, as town-planning, agricultural and stock-farming pressure from the lower areas lead to rises in the height above sea level where wooded areas begin on the one hand, and fires and erosion lead to a fall in the height above sea level of wooded areas (currently under 1,500 metres) on the other, with the appearance of rocky ground, pastures and thickets of Cytisus balansae (Martínez Ruiz, 2000).

Table 2. *Municipalities of the Tiétar Valley and current value of the indicators.*

MUNICIPALITY	Population (1998)	Area (ha)	No. of holiday homes (2001)	No. of industrial licences (2000)	Registered unemployment (1996)
Casillas	896	1,195	1,269	44	60
Sta. Mª. Tiétar	364	1,194	1,200	39	20
Sotillo de la Adrada	3,522	4,318	6,294	445	183
Higuera de las Dueñas	322	3,513	440	24	8
La Adrada	1,979	5,872	3,500	243	118
Fresnedilla	111	2,455	160	4	3
Piedralaves	2,124	5,488	2,300	206	141
Casavieja	1,644	3,943	1,930	139	81
Mijares	1,013	4,632	900	82	44
Gavilanes	745	2,813	850	44	21
Pedro Bernardo	1,354	6,916	1,600	86	56
Lanzahita	912	3,818	1,150	68	49
S.Esteban del Valle	921	3,077	900	70	34
Sta.Cruz del Valle	654	2,980	525	23	29
Villarejo	508	3,185	850	34	18
Cuevas del Valle	659	1,938	750		52
Mombeltrán	1,198	7,081	1,200	110	59
El Arenal	1,090	2,715	1,100	71	46
El Hornillo	432	2,256	325	32	24
Guisando	688	3,610	600	53	38
Poyales Hoyo	762	332	743	53	35
Candeleda	5,137	21,551	5,280	482	270
TOTAL	33,383	114,494	40,549		1,922

Although we have only included current values, we took into account the evolution over the analysis perioc
Source: The National Statistics Institute (INE) and the Junta de Castilla León.

Table 3. *Results of the Multiple Range Test for Burnt Area per Municipality*

MUNICIPALITY	Burnt Area Mean (1990-2000)	Homogeneous Groups
Casavieja	0	A
Fresnedilla	0	A
Cuevas	0	A
Piedralaves	0.461	A
Poyales	0.538	A
Gavilanes	1.384	A
La Adrada	1.692	A
Casillas	1.923	A
El Arenal	2.23	A
Sta. María del Tiétar	2.538	A
Candeleda	3.653	A
Míjares	5.615	A
San Esteban	7.43	A
Higuera	9.23	A
Villarejo	9.384	A
Sta. Cruz del Valle	10.615	A
Sotillo	13.307	A
Hornillo	17.23	A
Lanzahíta	17.73	A
Mombeltrán	35.23	A
Guisando	89.769	B
Pedro Bernardo	155.846	B

2. Aim and Methodology

The aim of this work was to determine the socio-economic deterioration that large forest fires have produced in the municipalities of the Tiétar Valley where large fires have been significant, (fires of more than 500 ha) and which have seen an important economic tourism-industry weaken and even disappear, both in terms of direct value and, especially, in terms of indirect value through the service industry which has grown up around rural areas with significant natural resources that are increasingly demanded by urban society (Azqueta, 1994 and Ortuño, 1998).

The municipalities analysed are listed in Table 2. Once the area had been chosen, we looked at the following socio-economic indicators (Weatherley, 1982) in order to analyse them and be able to carry out a comparative analysis:

Evolution of the population.

Evolution of employment.

Evolution of the holiday-homes market.

Evolution of the number of companies established in each municipality.

The variables measured in the municipalities were population, number of holiday homes, registered unemployment, number of industrial licences and wooded area burnt per municipality. We carried out a descriptive analysis of each variable to detect any possible anomalies and then checked whether there were statistically significant differences between municipalities with respect to burnt areas between 1988 and 2000 and how fires influenced the variables measured.

3. Results and Discussion

The first aspect we looked at was whether there were statistically significant differences between municipalities with respect to burnt areas. We carried out an analysis of variance, checking the hypotheses of normality, independence and homogeneity of variance for the remainders needed to apply the linear model theory (Rohatgi, 1976).

The p-value coefficient was 0.3525, so there were no significant differences in behaviour for the area burnt variable per municipality. We carried out a multiple range test which involved contrasting mean differences between the levels of the two to two factor (Martín, S, 2001) using the Least Significant Differences (LSD) method (Peña, 1999). As the following Table 3 shows, the behaviour of the municipalities was similar except for Pedro Bernardo and Guisando, where the incidence of fires was high for the years studied.

Since we found statistically significant differences between these two municipalities and the others, we continued the study to see whether the presence of fires influenced the other indicators in these two municipalities. We created a qualitative variable called level of annual fire incidence. A zero annual fire incidence was when the burnt area was 0 ha, low was 0-35 ha, medium was 35-100 ha and high was for over 100 ha.

Table 4 shows that there were no statistically significant differences in the population variable and in the registered unemployment, with regard to the number of industrial licences and the number of holiday homes. The Table shows that we had to accept that fires influenced this variable for a significance level of 0.05.

Table 4. *Results of the analysis of the influence level of annual fire incidence in the economic indicators (significance level of 0.05).*

Economic Indicator	p-value of ANOVA test
Population	0.23
Industrial Licences	0.0136
Holiday Homes	0
Unemployment	0.1564

4. Conclusions

Firstly, it is necessary to highlight the serious environmental problem posed by forest fire in the Tiétar Valley. This problem can furthermore be extended to other Spanish areas where fire is all too common and where land and vegetation are slowly and irreversibly disappearing.

From a social point of view, the disappearance of forests as a source of wealth for the Tiétar Valley has involved the loss of an important economic web and the disappearance of many traditional jobs, such as conveyors, carpenters, tappers, loggers and charcoal burners. More importantly, the ancient balance of man and forest has been destroyed to the

point that rural people have today turned their backs on the woodlands and no longer depend on them for their livelihood.

However, the study found a close relationship between natural resources and economic development, particularly in Pedro Bernardo and Guisando. This was shown by the fact that the number of holiday homes (the most important indicator for determining tourist activity) was lower in these towns than in the other municipalities, where there was a trend towards growth compared to the stagnation registered in Pedro Bernardo and Guisando.

Finally, with respect to the number of industrial licences variable, we found a statistical relationship with the presence of forest fires, but in a much more moderate form.

In conclusion, the most affected socio-economic indicator in the case of the Tiétar Valley was the number of holiday homes, which led us to conclude (as previously stated) that tourism is the most affected industry by forest fires.

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