

ADVERSE EFFECTS AND RESPONSIBILITY OF ENVIRONMENTAL POLICY: THE CASE OF FOREST FIRES



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It is generally known that forest fires are one of the main factors of environmental degradation. Although a great deal of scientific literature on this issue exists, little progress has been made to help us understand and explain the reasons for their appearance. In this work we highlight how forest fires could also be the result of the adverse effects of environmental policies related to the management of forest fire emergencies. With regard to the area of the Gargano National Park (Southern Italy) and with the use of a panel data technique, we attempt to observe the forest fire phenomenon as related to some of the socio-economic conditions existing there. We find a significant statistical relationship between the number of forest fires and the unemployment level in the area. This provides evidence to argue that

when setting up environmental safeguarding policies it is important to take into consideration the socio-economic conditions existing in the area, if the probability of adverse effects is to be avoided and a more socially responsible legislative framework is to be established. Copyright © 2004 John Wiley & Sons, Ltd and ERP Environment.

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INTRODUCTION

Although many authors refer to corporate social responsibility (CSR) as a concept specifically related to an idea of 'ethical business' only (Baker, 2003), it can hold an even broader meaning. In fact, other authors such as Lunheim and Hydro (2003) look at the concept of CSR as a wide umbrella under which various issues can be considered: environmental concerns, public relations, human resources management, community relations etc. Following this approach to CSR, and by focusing on the specific problem of

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forest fires, this paper aims to highlight that, along with CSR, government responsibility also deserves some attention. In fact, forest fires can often be the result of adverse effects generated by the legislation for the management of environmental safeguarding. Through the consideration of this aspect, which is strictly related to the issue of individuals' incentives, this paper also attempts to provide a further point of future research in the field of CSR and environmental management.

It is broadly known that forest fires represent one of the main and most long-term factors of environmental degradation. In fact, apart from causing wildlife destruction and air pollution problems, they significantly contribute to the enormous and persistent threat to the hydro-geological equilibrium due to the slowness at which forests can be rebuilt. Although a great deal of scientific literature on the issue of forest fires exists, little effort has been made to analyse specific aspects which can help to enlarge the range of possible explanations and to understand better the reasons why they happen. In fact, most of the work has focused on aspects such as the control management and the chemical–physical effects of forest fires rather than trying to understand their actual causes. As a result, a consistent gap is often claimed in understanding how ecosystems work and this negatively affects our ability to find and implement adequate safeguarding strategies for forests (Scarascia-Mugnozza *et al.*, 2000). As anticipated, the intuition behind this paper is that, among various reasons, forest fires can even be caused by the inadequacy of certain governmental policies which generate some distortions by not taking into proper account individuals' responses to specific aspects of legislative framework. This means it is very likely that different results from those initially pursued will be achieved. When this occurs, we are faced with a case that is generally known as adverse policy effects (Anderson, 1997; Hahn and Stavins, 1992; Kent and Myers, 1998). A significant example of such a phenomenon can be seen in the Italian

policy for the management of the emergency services in the fight against forest fires. To cope with this problem, in Italy a considerable amount of financial resources is transferred to local governments by the central authority every year with the aim of organizing schemes of prevention and intervention, which involve a huge number of people and tools. With regard to this, there seems to be evidence to argue that this funding is likely to be an incentive for the proliferation of forest fires rather than a means of diminishing their probability of occurring.¹ More particularly, the way in which fighters are recruited when a forest fire breaks out seems to provide incentives for individuals – who are usually unemployed – to undertake morally hazardous behaviour. Broadly speaking, this means that individuals may have an incentive to behave in such a way that the probability of an undesired event occurring is increased.² For this reason, it is important that the design of environmental safeguarding policies should take more carefully into consideration the socio-economic conditions existing in the area where they are to be implemented since these are likely to affect individuals' responses to the policy. With the aim of providing some early empirical evidence to support such an argument, in this work we refer to the specific case study of the Gargano National Park in the South of Italy and analyse the forest fire problem as related to some specific socio-economic characteristics observable in the municipal territories in this area. With the use of econometrics we run a panel data analysis to consider the varied time and spatial dimension of the investigated phenomenon and attempt to estimate the effects that social and economic variables generate on the number of forest fires observed. This analytical approach should be helpful in identifying some important aspects for a more appropriate implementation of environmental

¹ See also Foldvary (2002).

² For a general treatment of the issue on incentives see Laffont (1989). Furthermore, see Bohm and Russell (1985) and Katzman and Cale (1990).



policy. This would help face the problem of forest fires more adequately and pursue a sustainable management of the local forest heritage.

The paper is organized as follows. In the next section, we will look at the main policy features adopted by national and regional governments to fight forest fires. More specifically, we will try to highlight those policy aspects that are likely to generate adverse effects by providing individuals with the incentive to gain financial benefit. The empirical analysis and its achieved findings will be presented and discussed in the third section. Concluding comments and policy indications will take place in the fourth and last section.

SOME ASPECTS OF ITALIAN LEGISLATION ON THE MANAGEMENT OF FOREST FIRE EMERGENCIES

Data from the 'Corpo Forestale dello Stato' – the main Italian institution responsible for forest management control – shows that in 2001 about 77% of forest fires occurring in the area of the Gargano National Park were malicious. Similarly high percentages can also be observed if data corresponding to previous years are considered (Ministero delle Politiche Agricole e Forestali, 2001; Sabetti, 2002, p. 9). It is our belief that, among other factors, this figure heavily depends on some inadequate aspects of the national legislation for the management of forest fire emergencies, although some changes have been introduced more recently in the regulation framework.³ If we examine the content of law No. 47 of 1975 and consider the specific social and economic context of the area – mainly characterized by a high level of unemployment and the presence of an extended shadow economy – it is easy to

see that together these were likely to create a system based on 'perverse' mechanisms (see *Gazzetta Ufficiale della Repubblica Italiana*, 1975). Indeed, this system would intrinsically hold conditions that could give both local governments and individuals the incentive to behave adversely to the law. First, funding operated by central government for the management of forest fire emergencies did not provide an incentive for local governments to implement an adequate policy for forest fire prevention. Second, as already anticipated in the previous section, the organization of the recruitment scheme for forest fire fighters could be a condition that induces them to behave in a morally hazardous way. More specifically, law No. 47 stated that every year all regional authorities had to set up a programme for the conservation of forests and their defence from fire. In this programme they had to report the quantity, consistency and territorial position of all the 'tools' – cistern planes and trucks, water sprinklers, extinguishers etc. – available to them for the prevention and extinguishing of forest fires. It must be pointed out that as 'tools' the law under examination even considered the organization and training of squads, composed largely of volunteers, to be drafted in the case of forest fire. Furthermore, article 7 of this law stated that all individuals, not only those forming the squads of drafted volunteers, but also any other person employed at the time of the fire, had to be remunerated. The remuneration was computed per working hour on the basis of the ongoing provincial wage tariffs determined for workers in the sector of 'agriculture and forestry'. In practical terms, on the basis of this law, the subsequent costs arising from forest fires burdened the budget of central government. Indeed, the payment of wages to the individuals involved in extinguishing forest fires, as well as the expenditure borne by the local municipal councils in restoring the forestry areas damaged by fire, were transferred to the national budget. As can be easily perceived, this mechanism of the law was not incentive compatible. In fact, local authorities

³ In Italy, the management of forest fire emergencies was regulated by law No. 47 of 1975, which remained valid until 2000 when law No. 353 entered into force.



might consider forest fire as an opportunity for gain rather than as something to stop, since it gave them the possibility to get additional resources from central government to alleviate the enormous social and political costs deriving from the high level of local unemployment. In other words, they had no incentive to take adequate initiatives and put much effort into the operation of forest fire prevention.⁴ It is therefore evident that such a situation was coherent with the expectations of some unemployed people, who might see forest fires as an employment opportunity.

It is perhaps to avoid a situation of potential – if not real – danger for the national forestry heritage that the more recent law No. 353, approved by the Italian parliament in 2000, makes provision for a different mechanism to allocate financial resources from the central to regional governments in the fight against the forest fire phenomenon (see *Gazzetta Ufficiale della Repubblica Italiana*, 2000). Between 2000 and 2002, which can be considered as a transitory and experimental period for the implementation of this law, the central government made provision for a fixed budget of about ten million Euros per year to face the forest fire problem. This amount is distributed to the regional authorities, which in turn redistribute the money to the various municipalities on the basis of the following principles. Half of the figure is allocated in a way which is directly proportional to the size of the local forestry area. The remaining half is allocated in a way

which is inversely proportional to the ratio between the size of forestry land destroyed by fire and the original size of the forested land. It is evident that law No. 353/2000 has tried to introduce a management of the financial resources used in the fight of forest fires in such a way as to discourage any form of free-rider behaviour that could be taken up by regional or other local authorities.

In the area of the National Park of Gargano the forest fire emergency is mainly a seasonal phenomenon, since the majority of fires are recorded in the period between the months of May/June and September/October. During this period the management of the anti-fires service is made on the basis of a regional plan. In fact, within the framework of the national legislation referred to above, at a local level the activity and personnel organization to fight forest fires is provided by yearly programmes prepared by the regional authority.⁵ In general terms, they estimate the number of workers to be employed in activities of forest fire prevention and extinguishment.

With the aim of better understanding some basic aspects of the anti-fire service organization and to get a clearer idea of what its implications could be, it is important to highlight some features of this planning activity. First, it must be noted that these programmes are prepared at the beginning of the summer season. Hence, the squads of fire fighters are not gathered together at the moment a forest fire breaks out, but they are prepared well in advance when the programme is approved. Nevertheless, to enforce these squads, further fire fighters can also be employed at the scene of a fire. This is a very common situation and is possible through the mechanism of direct call to work.⁶ Second, the request of workers to be

⁴It must also be noted that law No. 47/1975 set a real constraint on the use of forestry land destroyed by fire. Indeed, it was stated that for a period of ten years no change in the use of the land could be allowed. Actually, this constraint – whose period has been extended to 15 years in the more recent law No. 353/2000, which will be examined later in this section – was introduced with the aim of avoiding any form of land speculation. More precisely, the aim was that forest fires could be used as a tool to deforest pieces of land and use them for different purposes, such as for building development and pasture. With regard to this specific aspect, it must be added that to respect this rule, that is to make the constraint work, the law placed – and still places – its trust in the initiative of the local authorities, who had to point out all land register details of destroyed forestry areas to the central authority. However, it is claimed by many sources that local authorities quite often and voluntarily fail to cope with this commitment.

⁵Until 1999 these programmes were prepared by the 'Corpo Forestale dello Stato'.

⁶This means that any persons available and willing to work in fire fighting are recruited in the event of a fire by representatives of the local authority or personnel of the 'Corpo Forestale dello Stato'. They are taken to the scene of the fire with the implicit agreement that their employment contracts be settled in the shortest time possible.



employed in the operation of fire prevention or extinguishment is numerical – that is non-nominal – and made by the Corpo Forestale dello Stato or the municipal authority to the local employment office, which calls up those workers, listed in the specific sector of ‘agriculture and forestry’, at their place of work.

Furthermore, it is interesting to point out that the majority of the workforce employed during forest fires is composed of low-skilled and long-term unemployed people who usually work in various sectors of the shadow economy and are used to organizing their lives on the basis of public welfare assistance. If we consider that the national general agreement on work in the sector of ‘agriculture and forestry’ establishes that an individual must work a minimum number of days per year to achieve the unemployment subsidy, we can clearly perceive how the whole system in analysis is built on a basis that is highly likely to generate perverse incentives and create the ideal conditions for morally hazardous problems.⁷ In fact, it is not unlikely that the aim of various unemployed individuals becomes that of working a sufficient number of days in the public sector – even as forest fire fighters, which is easily done if we think of some specific although extreme circumstances – to achieve the unemployment subsidy and thus free themselves of spending the residual time at their disposal working in the shadow economy. This risky condition is recognized by the already mentioned law No. 353/2000, whose aim is to avoid this happening. This aim was met by introducing the following rules: (a) the seasonal workforce must be recruited well in advance with respect to the periods of high fire risk and predominantly employed in oper-

ations of forest fire prevention; (b) regional authorities are authorized to assign monetary incentives to the employed workforce on the basis of the reduction in the number and size of forest fires. However, it must be highlighted that these two prescriptions have not yet been put into practice.

SOME EARLY EMPIRICAL EVIDENCE

The empirical investigation we present in this section is an early trial to test the consistency of the arguments presented so far. Our attempt is to explain the number of forest fires in the area of the Gargano National Park as a phenomenon mainly related to the unemployment levels observed in the investigated area. More specifically, through the use of a panel data analysis technique, we investigate the relationship existing between the number of forest fires – that is our dependent variable in the model formulation we present below – and other independent or explanatory variables.⁸ Apart from the unemployment variable we have already highlighted, another two independent variables are employed for our analysis purposes. These are represented by the number of civil vehicles – here considered as a proxy of the spending capacity of the local populations, that is a sort of indicator of their levels of wealth – and the number of industrial vehicles – which can be looked at as a proxy of the various levels of local productivity capacities – observed in the municipalities of the investigated area. All data was collected with regard to the time period between 1995 and 1999 and for each municipality within the area of the Gargano National Park, with the excep-

⁷ More specifically, the national general agreement on work in the ‘agriculture and forestry’ sector establishes that an individual must work for at least 121 days per year to benefit from the unemployment subsidy. This subsidy is raised if the unemployed individual increases the number of working days.

⁸ The use of the panel data technique is imposed by the small dataset available to us. Indeed, this technique allows us to combine the time series with cross section techniques. This gives us the opportunity of handling and investigating a higher number of observations than it could if the two techniques were used separately. It is generally known that, in the case of limited available data, the use of a panel data technique can help to achieve more consistent results.



tion of the data on unemployment.⁹ The latter was supplied to us with regard to a different spatial dimension corresponding to an administrative organization which has recently been implemented in Italy and represented by the so called 'circostrizioni del lavoro'.¹⁰ Hence, with the aim of guaranteeing homogeneity of all statistical information treated in the analysis of the data on unemployment, we aggregated the data on fires and vehicles, thus moving from a maximum disaggregation level represented by each municipality to another less disaggregated level corresponding to the administrative organization of the 'circostrizione del lavoro'. In general terms, the model we have estimated can be represented by the following functional relationship:

$$\text{Fires} = f(\text{Unemp}; \text{CivVehic}; \text{IndVehic}) \quad (1)$$

where Fires is the number of forest fires observed in the territories of the municipalities belonging to each 'circostrizione del lavoro'; Unemp is the ratio between the number of people listed in the local employment offices and the number of people aged between 15 and 64 living in the municipalities of each 'circostrizione del lavoro'; CivVehic is the number of civil vehicles observed in the municipal territories of each 'circostrizione del lavoro'; IndVehic is the number of industrial vehicles observed in the municipal territories of each 'circostrizione del lavoro'.¹¹ The functional

form we estimate is based on the following log-linear (or log-log) relationship:¹²

$$\ln \text{Fires}_{it} = \alpha_i + \beta_1 \ln \text{Unemp}_{it} + \beta_2 \ln \text{CivVehic}_{it} + \beta_3 \ln \text{IndVehic}_{it} + \varepsilon_{it} \quad (2)$$

with $t = 1, \dots, T$ being the period of time considered in the analysis and $i = 1, \dots, N$ being the territorial areas corresponding to the 'circostrizioni del lavoro'. Furthermore, $\ln \text{Fires}$, $\ln \text{Unemp}$, $\ln \text{CivVehic}$ and $\ln \text{IndVehic}$ are the transformations in natural logarithms of the considered variables and ε represents the random error term. Table 1 reports the variable specification, which provides for easier reading.

The panel data analysis, which we refer to for the estimation of Equation (2), gives results in the form of models such as OLS, fixed effects and random effects. The latter two are capable of catching the existence of eventual heterogeneity among the various spatial areas of the investigated territory. This aspect, instead, is ignored by the OLS model. More specifically, the fixed effect model only takes into consideration those variations that can be observed within the investigated territorial areas. Hence,

⁹ Data sources are 'Corpo Forestale dello Stato' for the number of forest fires recorded in the municipal territories of the Gargano National Park area; 'Ministero delle Infrastrutture e dei Trasporti' for the number of civil and industrial vehicles; 'Direzione Provinciale del Lavoro di Foggia' for the levels of unemployment recorded in the 'circostrizioni del lavoro' existing in the Gargano National Park area.

¹⁰ It must be highlighted that, due to recent administrative organization of the local employment offices, which were previously placed in each municipality, they have now been regrouped into the so-called 'circostrizioni del lavoro', which are able to deal with larger territorial areas.

¹¹ For purposes of clarity, it must be specified that the Gargano National Park area is composed of 19 municipalities: Apricena, Cagnano Varano, Carpino, Ischitella, Tremiti Islands, Lesina, Manfredonia, Mattinata, Monte Sant'Angelo, Peschici, Poggio Imperiale, Rignano Garganico, Rodi Garganico, San Giovanni Rotondo, San Marco in Lamis, Sannicandro Garganico, Serra-

capriola, Vico del Gargano and Vieste. For the reasons already explained, our analysis focuses on four territorial realities: Vieste (which includes the municipalities of Carpino, Ischitella, Peschici, Rodi Garganico and Vico); Sannicandro Garganico (including the municipalities of Apricena, Cagnano, Lesina and Poggio Imperiale); San Giovanni Rotondo (including the municipalities of San Marco in Lamis and Rignano Garganico) and Manfredonia (which includes the municipalities of Mattinata, Monte Sant'Angelo and Zaponeta). It must also be noted that, on the basis of this organization of our analysis, two municipalities of the park area (Tremiti Islands and Serracapriola) remain excluded from our consideration. In contrast, although it is not part of the park area, the municipality of Zaponeta becomes subject to consideration in our analysis, since its unemployment records are included and accounted in those corresponding to the 'circostrizione del lavoro' of Manfredonia. However, since the aspects investigated in our analysis are not so relevant in these three mentioned municipalities, we believe that the consistency of the final results will not be compromised.

¹² A very important feature of the log-linear functional form is represented by the fact that each coefficient of the considered variables (the estimated β) measures the elasticity of the dependent variable with respect to the independent variable. In other words, it measures the percentage change in the dependent variable as a response to 1% change in the independent variable (Gujarati, 1995, pp. 165–168).



Table 1. Variable specification

In Fires (dep. var.)	natural logarithm of the number of forest fires recorded in the municipal territories of each 'circonscrizione del lavoro';
In Unemp	natural logarithm of the ratio between the number of unemployed people and the population size recorded in the municipal territories of each 'circonscrizione del lavoro';
In CivVehic	natural logarithm of the number of civil vehicles recorded in the municipal territories of each 'circonscrizione del lavoro';
In IndVehic	natural logarithm of the number of civil vehicles recorded in the municipal territories of each 'circonscrizione del lavoro'.

it assumes that each territorial area i gives the same variable coefficients with different intercept values, that is different constant terms. Instead, the random effects model assumes that the constant term – or intercept value – and the variable coefficients are the same for all the investigated territorial areas and for the whole time span considered. Table 2 shows the results achieved by the estimation we have carried out.¹³

The results show the OLS model as the most consistent. This means that the homogeneity hypothesis among the investigated territorial areas can be accepted. Indeed, if we look at the result corresponding to the Lagrange multiplier test, it can be observed that the value is considerably low (chi-squared [1 d.f.] = 2.15) and gives a p -value equal to 0.142 761. Hence, the OLS model has been tested to check for heteroscedasticity and autocorrelation problems. While the earlier problem is completely absent, acceptable levels of autocorrelation can be observed. As proof of this, it can be observed how the rho value tends to zero ($\rho = 0.019$).

Finally, with the aim of verifying the consistency of the functional form used and to avoid problems related to omitted variables, we have run a RESET test. With regard to this, no evidence of such misspecification problems has been found.¹⁴ Hence, we can conclude by saying that our model can be considered as correctly specified.

We can now move on to commenting on the results achieved from the OLS model. First of all, the unemployment variable (In Unemp) is positively related to the number of forest fires (In Fires). Indeed, our estimation results show that a 1% increase in the unemployment level would generate an increase of about 2.42% in the number of forest fires. This empirical finding would support the hypothesis we made in the second section of the work, where we argued the possibility that the framework of the Italian legislation on the forest fire emergency management – particularly the previous one – can easily give space to morally hazardous behaviour among individuals. The relationship between the variables represented by the natural logarithms of the numbers of civil vehicles (In CivVehic) and forest fires (In Fires) is found to be of negative sign. As we considered the number of civil vehicles as a proxy of the local population spending capacity – or of their economic welfare – we can argue that in general terms the richer the population is the less the probability is that forest fires will occur. More precisely, the results show that a 1% increase in the level of the affluence of the local population corresponds to a decrease in the forest fires of about 3.13%. Lastly, a further positive relationship can be observed between the natural logarithms of the numbers of industrial vehicles (In IndVehic) and forest fires (In Fires). Since we considered the number of industrial vehicles as a proxy of their produc-

¹³ The econometric analysis was run by using Limdep software.

¹⁴ With regard to the RESET test we compute a statistical value of $F = 1.29$ and a critical value of $f_{0.25(2,14)} = 1.43$. Hence, it can be observed that the hypothesis associated with the existence of problems of omitted variables and misspecification of the functional form are easily rejected.



Table 2. Estimation results for Equation (2) (Fires = dependent variable)

Independent variables	Pooled OLS	Fixed effects	Random effects
Constant	26.43882* (12.15906)	–	25.23205** (0.042922)
ln Unemp	2.43620* (0.93668)	1.11739 (1.86699)	2.37883* (0.99118)
ln CivVehic	–3.13752* (0.93265)	–10.42900 (11.82398)	–3.05703* (0.99719)
ln IndVehic	1.54527* (0.46761)	12.48105 (9.52598)	1.58336* (0.50700)
R ²	0.65	0.73	0.64
Adjusted R ²	0.58	0.60	–
F-statistics	9.78*	5.76*	–
LM statistics	–	–	2.15 [1 d.f.] (<i>p</i> -value: 0.142761)
Hausman statistics	–	–	3.73 [3 d.f.] (<i>p</i> -value: 0.292143)
Sample size	20	20	20

Significance levels: * at 0.01, ** at 0.05, *** at 0.10.

Standard errors in parenthesis.

tive capacity, we can generally say that an increase in the productivity levels generates an increase in the number of forest fires. In more detail, a 1% increase in the productive capacity corresponds to an increase in the number of forest fires by about 1.54%. It may be argued that this latter result is in deep contradiction to what was said about the relationship between the levels of wealth of the population and forest fires. Indeed, if we think that in general wealth is mainly the result generated by the productive capacity, we should have expected a negative relationship between industrial vehicles and forest fires. However, the observed positive relationship can be explained by referring to the fact that a great many of the industrial vehicles existing in the investigated areas can be associated with the local industry of the building development sector. It is easy to perceive how the conservation of the forest heritage can be seen as a constraint to the profit maximization of those firms belonging to this sector and operating in the area. This could provide incentives to act against environmen-

tal natural resources, among which those made against the local forestry heritage can be seen as one of the most evident.

CONCLUSIONS

This work represents an early reflection on the issue of adverse effects of environmental management policies through which we try to demonstrate that the design of a regulatory framework should take into greater consideration individuals' incentives if more socially responsible environmental policies are to be implemented. With reference to the proposed case study, we argue that Italian law on the management of forest fire emergencies enforced before the year 2000, coupled with the specific social and economic characteristics existing in the area of the National Park of Gargano, was such as to provide incentives for both individuals and local authorities to take up morally hazardous behaviour. The result



was that of increasing the probability of forest fire occurrence and making the problem worse. In this sense, early evidence has been provided by our empirical investigation, which has found a particularly high level of statistical significance in the relationship between the number of forest fires and unemployment levels observed. The achieved empirical finding would strongly support the above arguments, although we are conscious that our analysis suffers from some limits, particularly due to the restricted number of observations at our disposal. Common sense would recommend the provision of further empirical evidence to confirm what we have stated in this work. Hence, our aim is to enlarge the dataset available to us and proceed with further empirical analysis. Of course, this is our objective for future research.

On the basis of what we have reported in this study, we can conclude by remarking the need for paying attention to the aspect of individuals' incentives when an environmental policy is to be designed. This would help to build a more socially responsible legislative framework for environmental management. Furthermore, a positive note can be made with regard to the more recent Italian law No. 353/2000. Indeed, through its implementation the direction taken by the Italian legislation for the fight against forest fires is surely valid, since it attempts to eliminate incentives for individuals and local authorities to behave in an undesirable way. However, it must be said that the effectiveness of this law has still to be tested on the basis of the results it can generate in terms of the reduction of forest fires. This of course will depend on the way in which the law is enforced in practice.

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