Mechanisms for the Internalization of the Environmental Benefits of Forests and Their Application to Forest Fire Prevention[1]

Ignacio Elorrieta,[2] Concepción Rey[3]

Abstract

Forests provide society with a series of environmental benefits which could nevertheless be lost through poor management or a lack of incentives to preserve them. These benefits include the protection of the soil and the hydrological cycle, the fixing of atmospheric carbon, biological diversity, landscape, recreation, etc. These benefits are rarely valued until harmful effects make their presence felt in the form of damage. Forest fires represent a direct physical manifestation of those effects. Steps taken as preventative measures assist in ensuring these environmental benefits are not lost. Regulatory mechanisms have been proved insufficient to channel the acts of individuals into patterns of behaviour which avoid forest fires. Such measures have proved difficult to implement and require a high, often excessive, rate of investment in surveillance and enforcement. Economic instruments such as subsidies, taxes and the creation of markets, in addition to voluntary agreements, complement regulatory efforts at fire prevention. This paper outlines appropriate fire prevention mechanisms and their consequences, thus providing sufficient incentives for society to have regard to the environmental benefits generated by forest areas when engaged in decision making processes.

Introduction

Forests provide numerous goods and services demanded by a society which is increasingly appreciative of their utility. More than half of Spain's total surface area is covered by forests, of which at least two-thirds are privately owned. The Forests Act 43/2003 acknowledges the social function of forests both as the source of natural resources and the supplier of a wide range of environmental services.

This recognition of the benefits to be obtained from forests and the externalities they produce, enjoyed by society as a whole, obliges the State to take active policies to promote preventative measures and the conservation, protection, replacement, improvement and use of forests. Empirical (Gobierno de Navarra 2001, Azqueta Oyarzun 2002) and theoretical (Elorrieta et al. 1998, Plana and Piqué 2003) studies have demonstrated the need, sometimes attended to, to take the benefits to be gained from forests into account in individual decisions and in State policies.

---

[1] An abbreviated version of this paper was presented at the second international symposium on fire economics, policy, and planning: a global view, 19–22 April, Córdoba, Spain.

[2] Doctor in biology. Director of the Environmental Integration Service of the Directorate-General for the Environment at the Environment Department, Town and Country Planning, the Government of Navarre. Avenida del ejército, 2. 31002, Navarra, Spain.

[3] Environmental economist. Rural Development Section, Environmental Planning Department, Tecnologías y Servicios Agrarios, S. A. c/ Conde de Peñalver, 84. 28006, Madrid, Spain.

Forest fires have historically represented a means of regulating our ecosystems. Nevertheless, the present day frequency and intensity of forest fires caused by specific social, economic and climatic conditions in the geographical area in question, has built up a degree of pressure on the environment which will be difficult to sustain. Any forestry policy, whether it involves long-term development or day-to-day planning, management or economic utilization, must take forest fires into account as a threat to sustainability.

State intervention aimed at minimising or mitigating the negative effects of forest fires on the positive externalities of forests is implemented by means of a series of mechanisms which internalise the environmental benefits of forests. This paper aims to identify the most appropriate mechanisms for the prevention of forest fires and their consequences, to ensure they provide sufficient incentives to encourage society to bear the environmental benefits of woodland in mind when taking decisions.

Environmental benefits of forests

From the classical perspective of linear economics, natural resources have been assigned the value of raw materials, which, following appropriate processing, are converted into goods which satisfy human needs - these are productive aspects. This approach holds that if something has no price it has no value, and the protection of the natural environment is pointless unless there are economic advantages in protecting it.

Linear economic models were superseded in the second half of the twentieth century by circular economic models, and it is now established that society also satisfies its needs by contemplating the landscape or by enjoying Nature in the countryside - these are recreational aspects. Furthermore, it is acknowledged that ecosystems are also capable of providing very important services free of charge – these being environmental aspects – such as carbon fixing by plants, which helps prevent the greenhouse effect, soil protection, which generates a proper layer of organic material, a positive impact on water quality in reservoirs, pollination by insects, etc. These new models will make it possible to put a monetary value on goods which have not, to date, been integrated into market mechanisms due to their lack of a price.

Figure 1 - The circular economic process (From left to right – Environmental aspect, Productive aspect, Recreational aspect).

In circular economics, the 'Environment' is defined as capital which provides surpluses in the form of goods and services of many kinds, both public and private. (*Fig. 1*). These produce three kinds of economic functions which help to satisfy human needs:

- The provision of productive goods.
- The provision of recreational goods and services.
- The provision of functions supplied by ecosystems which are necessary for life, and environmental services.

People do not always give these functions the importance they deserve. They seem to become aware of their value when the degradation of one of these elements requires them to 'open their wallets' to pay for the services which nature had previously provided free of charge. A clear example would be the additional cost of making water safe for drinking because the quality of the water at source has deteriorated through a failure to secure the appropriate natural filtration mechanisms at the site of precipitation in forests. (Elorrieta et al. 1998).

In order to calculate the total value of the forests, it would be necessary to take into account all its constituent elements, whether they have a market price or not, given that their absence from the marketplace does not imply they are valueless (*Table 1*). It is necessary to distinguish between private value - income from timber, firewood, fruit, etc. - and public value – recreational activities, enjoyment of the countryside, the capture and fixation of carbon etc. – and a non-use value - existence, options, bequests and gifts. Goods which have no price in the marketplace can be determined on the basis that to value something is to express its use and that positive preferences in our society are translated into a willingness to pay, for which money is the only measure.

Table 1—*Classification of forest values*

	TOTAL VALUE	
	USE VALUE	NON-USE VALUE
PUBLIC GOODS	Recreation Countryside / scenic beauty Carbon capture and fixation Erosion control Flood prevention	Existence Options Bequests Gifts
PRIVATE GOODS	Timber, firewood and cork Grazing Hunting and fishing Fruit and mushrooms Aromatic and medicinal plants Bee-derived products Wind	...

Great progress has been made in recent years in developing effective evaluation methods, and the economic valuation of forest ecosystems now represents an essential instrument in ensuring that public and private decision-making processes are well informed and directed. At the same time, the evaluation methods help forge a social conscience which is more in tune with environmental protection and make it possible to determine the value of the environment, whether it is well-preserved or degraded.

A series of techniques are available to evaluate environmental profit and loss in specific ecosystems. The aim is to identify the correct technique or methodology for each specific element, e.g. contingent valuation for non-use, hedonistic pricing for the landscape, the travel cost method for recreation, etc., while accepting that these are subjective values and are affected by the availability of information.

It is also necessary to bear in mind that our knowledge of the multifarious interrelationships and links between each of the natural elements is incomplete. This type of uncertainty cannot be eliminated and, as a result, the value thus obtained for a monetised environmental asset should always be taken to be a minimum.

The economic valuation of biodiversity and the resources of which it consists represents an important tool in creating well-directed and adjusted incentives. This is not an end in itself, but it can serve as a starting point for policy formation. Such valuation may prove insufficient to promote the effective conservation of the valued goods or service, and supplementary measures should also be drawn up.

Notwithstanding the environmental and social benefits provided by forests, it is a fact of life that both proprietors and the direct users of these goods and services focus on short-term objectives which produce higher returns, and completely forget the long-term benefits which require the sustainable use of resources.

Forest Fires

Over a large part of the Iberian Peninsula, forest fires are a natural part of the environment. Mountain and Mediterranean forest predominate, with a great many species being very well adapted to fire (*Pinus pinea, P. halepensis and P. pinaster*). As a result, forest fires do not necessarily imply an irreversible loss of vegetation, and sometimes even serve to reinforce certain forest areas (Vélez 2000).

However, most forest fires are currently anthropic, rather than natural in origin, and are the result of specific social and economic conditions (*Fig. 2*):

- The use of fire in agricultural practices, stubble burning, brush clearance and the disposal of agricultural waste.
- The use of fire to renew livestock grazing and to clear land for more grazing.
- The use of fire for hunting purposes, both to facilitate hunting and against the enclosure of land required to carry out hunting activities.
- The abandonment of silvicultural sites which leads to an accumulation of forest fuels.
- The abandonment of rural land as part of general migration to the cities.

– A fall in the profitability of land use with a view to changing the land use or due to conflicts arising from the limitation of use (Nature Reserves)

– Fires ignited by pyromaniacs and vandals, as an act of vengeance, etc.

Forest fires represent an extremely serious threat to forest conservation. They cause several kinds of loss: firstly, a drop in the economic output of the forest areas employed for productive purposes, which depends on the natural regenerative capacity of the forest to foster renewed economic activity; secondly, a deterioration in the recreational services provided by these areas, and in the beauty of the landscape, and finally, a reduction in the environmental functions of the stand, i.e., a decrease in the area's ability to capture carbon, an increase in erosion, a decline in standards of living, etc. (Bengoechea 2002).

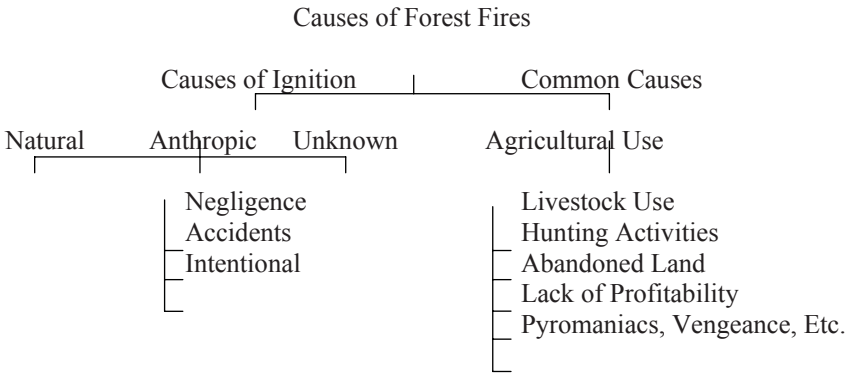

Figure 2—*Causes of forest fires*

The number of forest fires is currently rising significantly, and although a large number of these fires affect areas of less than one hectare, the sheer number of fires implies a continuous increase in resources dedicated to fire suppression activities. Given that the aims of prevention include a reduction in the number of fires, it may be observed that the ideal level of protection has not yet been achieved, which suggests that it might be necessary to reassess the prevention policy.

Fire prevention mechanisms

The planning and execution of the necessary measures to prevent forest fires in Spain are the responsibility of the forestry departments of the regional governments. These activities are carried out jointly with other government agencies and private bodies and individuals.

The forest fire strategy is implemented through prevention, detection and extinction programmes. The first of these activities should be considered the most important and fundamental element of forest fire activities, as prevention aims to avoid any fire incidents whatsoever. All use of forests should be informed by the need to prevent the ignition and spread of a forest fire.

Consequently, all forest fire prevention mechanisms should have two basic aims: to avoid ignition and, if ignition takes place, to prevent the fire spreading. The first of these objectives is clearly the most important and, unfortunately, the most

difficult to achieve, given that no-one is free from responsibility in this respect. The distinct governmental agencies have developed different mechanisms to achieve fire prevention goals. The mechanisms can be summarised as follows:

- Dissuasive vigilance. Through environmental awareness programmes, public information campaigns, the provision of statistical information and specialised training and support for groups interested in forest conservation and forest fire prevention.
- Forest planning. One of the primary objectives of such planning being to preserve forests through prevention and to regulate the uses and activities to which forest areas may be subject, by means of rules, limits and prohibitions.
- Investment in infrastructure: access roads and tracks, water supply points, protection for forest buildings, recreational facilities. The investments are overseen by a Forest Fire Priority Action Plan (FFPAP).
- Preventative silvicultural work: brush clearance, fuel removal, pruning, the creation of firebreaks, etc.

Everyone has to do what they can in the fight against forest fires, and the Forests Act provides that anyone who discovers a fire is obliged to report it and, where appropriate, to co-operate in suppressing it. Furthermore, the Act places a greater burden on those who benefit most from forests. As a result, the Act establishes the general principle that owners of forest lands are responsible for the management of the property, both in terms of organisation and work on the ground. However, who is to pay for maintaining and improving the forests, which benefit society as a whole? The State continues to be the principal body responsible for the prevention of forest fires, and it bears practically all the costs arising from preventative measures, given that preventative silvicultural treatments undertaken by private landowners might easily be more costly than the economic benefits to extracted from the forests.

The Forests Act provides for a levy on the owners of forest areas to raise revenue for spending on the conservation and enhancement of the forests. The Act establishes an improvements fund, using money raised from a 15 percent minimum levy on forestry products, although the rate has been increased by some regional governments, and is employed to partly finance spending on forest fire prevention. The charge may only be levied, however, on local corporations which are proprietors of forest areas officially declared to be of public utility. As a result, the funds generated are insufficient to cover the total cost of fire prevention activities.

The support provided by the State specifically in respect of fire prevention activities should be reciprocated by an obligation applicable to all citizens, and in particular the proprietors of the forests, to assist in maintaining the source of the benefits from which they directly benefit. A clear demonstration of this principle is the Forest Fires Extinction Tax in Andalusia, which is payable by the forest landowners and covers the costs of extinguishing forest fires, while obliging them to co-operation actively in the implementation of measures aimed at preventing and fighting forest fires. Furthermore, landowners can be exempted from the tax where they have taken part in fire prevention activities.

Forest Incentive Policy

There is no single step which will prevent forest fires, given that each geographical area has differences in climate, in the structure of property ownership and in the overall approach to forests, all of which can have a direct influence not only on the incidence of forest fires but also on the means of preventing them.

All efforts to prevent forest fires must improve forest management in a way which makes it possible to generate positive benefits and externalities which are perceived to be symbols of identity in a cultural landscape, and which ensure that the agricultural, livestock and silvicultural activities which manage the area are able to continue populating, nurturing and protecting it against all attacks.

An incentive policy allows the State to move the focus of its fire prevention efforts onto the users of the forest, i.e. the direct beneficiaries, in such a manner that they can contribute to fire prevention by modifying their behaviour. There are two classes of instruments which can be employed for this purpose (Azqueta 2002, Carvalho 2002):

- Normative instruments, which act coercively on the behaviour of private individuals.
- Economic instruments, which represent positive and/or negative incentives aimed at achieving voluntary changes in individual behaviour.

Normative instruments

These require the State to impose specific rules of behaviour which generally affect everyone equally. Such instruments may be divided into several types (Azqueta 2002):

- Rules governing forest use. These regulate access to natural forest resources and their extraction and use. They include the obligation to give notice of a fire if discovered and prohibitions, authorisation, penalties, etc.
- Rules covering the planning and management of forest areas. These govern the type of activities which take place in a specific area, e.g. areas of high fire risk, fire defence plans, building regulations, changes in land use, etc.

Economic instruments

These instruments lack coercive force and simply allow individuals to choose whether to act in one way or another, each choice having its own costs. This is defined by the Spanish Forest Strategy as a mechanism which acknowledges the positive externalities of the multifunctionality of forests. The aim is for individuals to decide themselves whether or not the action in question is worthwhile, depending on the costs they must pay for each action (Azqueta 2002). There are two key requirements for these instruments:

- They must ensure Ecological Coherence, given that the instruments are basically aimed at guaranteeing the environmental benefits generated by forests, and not exclusively at improving individual financial return.
- They must establish a Voluntary sense of Commitment, which combines productive activities with the strengthening of social bonds and the

production of environmental services which have not previously been remunerated by the marketplace.

The recent Forests Act reserves a whole chapter for dealing with forest fires and their prevention and extinction. It establishes high fire risk areas and a requirement to draw up detailed plans specifying the preventative tasks required in order to avert forest fires. The Act proposes several ways of accomplishing those tasks, including collective agreements, individual agreements, the temporary assignment of land to the State, grants and subsidies and, where appropriate, compulsory execution of the tasks by the State at the cost of the landowner.

The State has traditionally employed the above-mentioned mechanisms to provide forest owners with varying types of financial assistance intended to provide them with partial compensation for the limitations placed on the private enjoyment of their land by the public aspect of forest lands.

Although this financial support is considerable, it has never, on the whole, been sufficient, and Art. 65 of the Forests Act has, for the first time, made it possible to increase the funds available by paying for the positive externalities and incorporating them through the following mechanisms:

- Subsidies for sustainable forest management activities aimed at the forest land owners. The eligible activities include forest fire prevention, by means of investment in infrastructure, replanting, spending on maintenance and improving the forest stand, silvicultural treatments, etc.
- The establishment of contractual relations with the land owners, including the local corporations, as well as encouragement and support for associations and pressure groups in favour of the prevention of forest fires, all designed to channel the co-operation of the forest land owners and thereby to improve the ability to manage forests.
- Direct investment by the State. Given that the beneficiary of the environmental goods and services provided by forests is society as a whole, it is only natural that the State should be the principal, albeit not the only source of financing for efforts to provide incentives for externalities.
- Environmental insurance. The Act contemplates establishing a Forest Fire Insurance Policy, with the added attraction of priority access for policyholders to subsidies for sustainable forest management.
- Low-interest loans. The Act specifies that the State should make low-interest loans available to finance investment in forests, which includes the mechanisms for preventing forest fires.

The Act takes into account the possible effects of human activity, which makes it possible to draw up incentive policies which help to internalise the environmental benefits obtained from forests. These incentives can, in turn, be used, as least in part, to undertake work or implement measures aimed at preventing of forest fires.

It is essential to acknowledge society's role in the battle against forest fires, in which the guiding principal might appropriately be the phrase associated with the Barcelona Declaration, i.e. 'he who engages in conservation will be rewarded', where the conduct in question positively works towards securing the environmental benefits for society in general. The Act also has regard to this principle in establishing that the

following factors, amongst others, should be taken into account in regulating the incentives:

- The conservation, recovery and improvement of biodiversity and landscape depending on the measures specifically adopted to these ends.
- The fixation of carbon dioxide in forests as a means of mitigating climate change, depending on the quantity of carbon fixed in the forest biomass and acknowledgement of the energy in forest residues.
- The conservation of forest soil and hydrological systems as a means of counteracting desertification, depending on the degree to which the plant cover and silvicultural practices contribute to reducing the loss or degradation of the soil and of surface and ground water resources.

These incentives encouraging sustainable forest management are intended to guide conduct towards safeguarding the environmental benefits produced by forests, which, in turn, helps to improve forest fire prevention.

Conclusions

Not only do forest fires cause financial loss, they are also one of the principal causes of a decline in the social function of forests and in the goods and services generated by these ecosystems.

The mechanisms envisaged in Art. 65 of the Forests Act which regulate the incentives for environmental externalities must be put into practice so as to ensure that land owners are actively involved in the defence of their forest lands and in the prevention and extinction of forest fires.

In order to achieve this it is necessary to assign a monetary value to the environmental benefits created by forests. This makes it possible to determine which specific incentives, by changing the conduct of individuals, will facilitate use of the mechanisms which serve to prevent forest fires, e.g. direct subsidies, taxes and other levies, soft loans, insurance, etc. The aim is to achieve sustainable management of forests by extracting maximum economic, social and environmental value, which, in turn, ensures they are not abandoned, guarantees their survival as part of our natural heritage and internalises the full value of Nature.

References

Álvarez, M.; Field, D. 2001. **Beneficio social de la gestión de uso múltiple de los espacios forestales**. III Congreso Forestal Español. Granada. Mesas 4 y 5: 55-61.

Azqueta Oyarzun, D. 1994. **Valoración económica de la calidad ambiental**. Aravaca (Madrid). Mcgraw-Hill; 300 p.

Azqueta Oyarzun, D. 2002. **Introducción a la economía ambiental**. Aravaca (Madrid). Mcgraw-Hill Profesional; 236-268.

Bengoechea, A.; Fuertes, A.M. 2002. **Valoración monetaria de la reducción del riesgo de incendio en un espacio natural.** Oviedo. V Encuentro de Economía Aplicada; 1-19.

Carvalho Mendes, A. 2002. **Economic Instruments for National Forest Programmes**. En Cross-sectorial policy impacts on forest. Tikkamen, I; Glück, D; Pajouja, H. (eds.). EFI Proceedings 46: 119-140.

Elorrieta J.I. 2001. **El capital natural ¡Ya es hora de hacer cuentas!**. III Congreso Forestal Español. Granada. Ponencia Mesa 10: Política sociología y economía forestal.

Elorrieta J.I.; Castellano, E.; García, A. 1998. **Valoración Integral de la Biodiversidad de Navarra**. En Mapping 63: 12-18.

Gobierno de Navarra. 2001. **Estrategia Navarra para la conservación y el uso sostenible de la diversidad biológica y plan de acción 1999-2004**. Biosfera. Consejería de Medio Ambiente, Ordenación del Territorio y Vivienda: 102-103.

Martínez Alier, J.; Roca, J; Sánchez, J. 1998. **Valoración de externalidades y de bienes ambientales. Internalización de externalidades**. PNUMA. México. Serie de textos básicos para la formación ambiental 1: 35-69.

Plana Bach, E.; Piqué Nicolau, M. 2003. **Casuística y posibles soluciones a los grandes incendios forestales de la cuenca mediterránea. El caso de Cataluña**. Madrid. ETSI; 1-8.

Vélez Muñoz, R. et al. 2000. **La Defensa contra incendios forestales. Fundamentos y Experiencias**. Madrid. Mcgraw-Hill.

Page left blank intentionally.