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Introduction

Continental Portugal is a rectangular shaped territory with a total area of 8.9 Mha, the formation of which dates back to the first half of the 13th century. The northern and central regions are hilly, as is the southernmost region of the Algarve. The average altitude is about 400 m. The mountain tops often reach more than 1200 m, but never above 2000 m. The valley of Tagus and the region of Alentejo are flat, with an average altitude of about 250 m. Most of the major rivers flow from east to west. With the exception of the northern region, the principle mountain chains also have a similar orientation.

The total population in 2001 was about 9.9 million inhabitants (Instituto Nacional de Estatística, 2003a): 68.5% in the coastal area between Viana do Castelo and the Setúbal Peninsula. A total of 3.2 million inhabitants live in the Lisbon and Oporto metropolitan areas. During 1991–2001, the population grew by 5.3%, mainly due to the positive migration balance; in the interior regions, the total (rural and urban) population decreased, with only the urban areas showing some resistance to this general trend.

The average forest area in Continental Portugal is 0.34 ha per capita – higher than the average for Europe and, indeed, higher than the averages for all the other regions within Europe except the nordic countries (Kuusela, 1994). According to the 1995 Forest Inventory, there were about 565,200 ha of forest in the coastal regions between Viana do Castelo and the Setúbal Peninsula (16.9% of total forest area). This part of the country thus has 0.08 ha of forest per capita, compared with 0.89 ha per capita in the rest of the territory.

With some regional variations, the climate is essentially characterized by hot and dry summers and humid winters. This feature, combined with the fact that most vegetal species in forests and scrub lands have a relatively high degree of inflammability, put forest resources under a high natural risk of damage by fire throughout the summer. The regional variations result in a series of climate regions ranging from Atlantic to Mediterranean, with some intermediate types where either one of these two influences is dominating. Macedo and Sardinha (1993) distinguish the following climatic regions (average rainfall and average temperatures are in parentheses):

- Atlantic region, including the north-western part of the country (1000–2500 mm; 10–14°C)
- Atlantic region with a Mediterranean influence, including the western central part of the country (600–1000 mm; 15°C)
- Mediterranean region with an Atlantic influence, including the intermediate central part of the country, going southwards to the western part of Alentejo (450–800 mm; 16°C)
- Continental region, including the north-eastern part of the country, with the exception of the Douro Valley (500–1200 mm; 10–13°C)

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- Mediterranean region with a continental influence, including most of the eastern part of the country (500–800 mm; 14–17°C)
- Mediterranean region, including the Douro Valley and the Algarve (400–600 mm; 15–18°C).

Forest Resources

Trends in land use and forest area

Forest area is about 3.3 Mha (Table 22.1). It has actually increased by a factor of 2.7, from 1867, when the first estimate was made, to 1995 – the date of the most recent inventory. Up until the 1950s, there was simultaneous growth of both forest and agricultural land, due to the large amount of uncultivated land made available after a secular process of deforestation. With the intense rural emigration in the 1960s and 1970s, the area of farmland started to fall, while forestland continued to expand. However, since the 1970s, not all abandoned farmland has been reforested, which recently resulted in an increase in uncultivated land.

The increase in forestland is the combined result of the following dynamics in the three main forest species:

- Continued expansion of maritime pine (*Pinus pinaster*) forests until the end of the 1960s, followed by a decline due to forest fires
- Continued expansion of cork oak (*Quercus suber*) forests until the end of the 1930s, followed by a decline that has been reversed since the mid-1980s
- Continued and rapid expansion of eucalyptus (*Eucalyptus globulus*) plantations since the mid-1950s as a substitute for farming or for other forest uses, namely burnt pine forests.

In spite of the increase in area, forests are currently threatened by several types of risks. According to the United Nations Economic Commission for Europe/Food and Agriculture Organization (2000), in 1995, there were 641,000 ha of degraded forest and other wooded land, i.e. 18.5% of the total forestland; 11.3% due to insect damage and diseases and 2.5% due to forest fires. Fires are publicly perceived as the main threat to forests, not only because they are much more visible, but also because they have been increasing in severity since the mid-1960s.[2] During this period, on average, the forest area burnt was more than twice the area (re)afforested with support by public incentive schemes. The most affected areas were the central and north-western regions, where pine forests are concentrated.[3] More recently, the risk of forest fires is expanding to the southern regions of cork oak and holm oak forests, probably due to the decline in farming activities and to the increase in scrub lands and other forms of accumulation of inflammable materials in or near the forests.

Forest functions and forest biodiversity

In 1995, the main function of 51.8% (24.4% of conifers, 17.7% of broad-leaves and 11.6% of mixed stands) of the forestland was for wood supply (Leite and Martins, 2000a,b). The second main function, corresponding to 48.2% of the forestland, was for non-wood forest products (NWFPs), mostly cork production in the southern regions. The 11.3 million m^3 o.b. of annual fellings for wood supply are almost of the same amount as the 12.9 million m^3 o.b. of net annual increment in the forests with this function (Table 22.2). Therefore, the derived demand by forest industries is in tight tandem with the wood supply.

There are 1.5 Mha (17.1% of the total land area of Continental Portugal) under some sort of special protection status, including Natura 2000 and the National Network of Protected areas (such as national or natural parks) (Table 22.3). In the Natura 2000 sites, there are around 594,500 ha of forests, and in the National Network of Protected Areas there are 162,600 ha. Since almost all protected areas are Natura 2000 sites, it may be assumed that 39.1% of the area of these sites is covered with forests. As expected, the species of main commercial interest such as maritime pine, cork oak and eucalyptus have a lower incidence in these zones.

All tree species existing in the country, including all those endangered, are associated with forest ecosystems. These ecosystems are

Table 22.1. Land use in Continental Portugal since 1867 (000 ha).

Species	1867	1902	1910	1920	1929	1939	1950/56	1963/66	1968/78	1980/85	1995/98
1. Forest and other wooded land[a]	1,240.0	1,736.9	1,956.5	2,022.5	2,332.0	2,467.0	2,832.3	2,825.7	2,969.1	3,108.2	3,349.3
A. Forest land by tree species dominance											3,201.1
Conifers	210.0	250	430.2	913.7	1,132.0	1,161.0	1,189.5				
Maritime pine								1,287.6	1,293.0	1,252.3	976.1
Other conifers											
'Montados':	370.0	712.9	782.7	868.9	940.0	1,050.0	1,274.5	1,215.4	1,192.5	1,128.7	1,174.4
Cork oak	121.0	325.5	366.0	413.7	560.0	690.0	651.4	636.8	656.6	664.0	712.8
Holm oak	249.0	387.5	416.7	455.1	380.0	360.0	623.1	578.6	535.9	464.7	461.6
Other oaks and chestnut	60.0	174.0	131.0	174.0	193.0	188.0	170.0		99.8	143.2	171.5
Other oaks	NA	78.2	47.0	78.2	108.0	108.0	94.0		70.6	112.1	130.9
Chestnut	NA	95.8	84.0	95.8	85.0	80.0	75.0		29.3	31.1	40.6
Eucalyptus	0.0	—	—	—	8.0	NA	113.3	98.9	213.7	385.8	672.1
Other	600.0	600.0	612.7	66.0	59.0	68.0	85.0		170.0	198.2	207.0
B. Other wooded land	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	148.2
2. Agricultural land	1,886.0	NA	3,111.9	3,229.0	3,282.0	3,380.0	4,762.0		4,205.9	3,902.4	2,972.9
Uncultivated land fit for cultivation	5,462.9		3,426.7	3,245.7	2,883.2	2,648.0	885.6		1,279.9	1,419.3	2,054.6
Productive, but uncultivated land (fallow, grazing, etc.)	2116.0		1,926.0	1,639.0	1,565.0	1,484.0	395.6	NA	NA	NA	NA
Other uncultivated land fit for cultivation	3,346.9		1,503.8	1,606.71	1,318.2	1,164.9	490.0	NA	NA	NA	NA
3. Land unfit for cultivation	291.0	374.0	381.7	382.7	382.7	384.0	400.0	NA	425.0	450.0	503.1
4. Total land area	8,772.5	8,772.5	8,772.5	8,772.5	8,772.5	8,772.5	8,772.5	8,772.5	8,772.5	8,772.5	8,772.5
5. Inland waters	107.3	107.3	107.3	107.3	107.3	107.3	107.3	107.3	107.3	107.3	107.3
6. Total area	8,879.9	8,879.9	8,879.9	8,879.9	8,879.9	8,879.9	8,879.9	8,879.9	8,879.9	8,879.9	8,879.9
Forest coverage (1./4.)	14.1%	19.8%	22.3%	23.1%	26.6%	28.1%	32.3%	32.2%	33.8%	35.4%	38.2%

Notes: [a]'Other wooded land' is defined here as being burnt forests, areas of clearcut and land with trees below the density needed to be classified as 'forests'.
Sources and methodology: Mendes (2002)
NA = not available

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Table 22.2. Area, growing stock, increment, fellings and removals in 1995.

	Area (000 ha)	Growing stock volume (000 m^3 o.b.)	Annual net increment (000 m^3 o.b.)	Fellings (000 m^3 o.b.)	Annual removals (000 m^3 o.b.)	Annual removals (000 m^3 u.b.)
Trees in forest, total	3,383	275,760	14,312	11,500	11,300	9,400
Coniferous	1,179	147,782	8,323	6,200	6,100	4,900
Broad-leaved	2,204	127,978	5,989	5,300	5,200	4,500
Trees in forest for wood supply[a]	1,897	188,020	12,900	11,200	11,000	9,100
Coniferous	1,021	140,871	7,890	6,200	6,100	4,900
Broad-leaved	876	47,149	5,010	5,000	4,900	4,200
Trees in forest with other purposes		87,740	1,412	300	0	
Trees in other wooded land		16,246	213	0	0	
Trees outside forest and other wooded land			670	0	0	
Total		292,006	15,195	11,500	11,300	

[a]The 344,000 ha of mixed stands are split evenly between coniferous and broad-leaved species.
Sources: Direcção Geral das Florestas (1998, 1999)

Table 22.3. Total area under special protection status in the year 2000 (000 ha).

Protection status			Total protected area	Forest land in protected areas
Natura 2000		Directive Birds	744.8	
		Directive Habitats	1094.3	
		Total[a]	NA	594.5
National Network of Protected Areas (NNPA)	Areas of national protection status	National parks	70.3	
		Natural parks	527.1	
	Areas of regional protection status	Natural reserves	63.2	
		Botanic reserves	0.0	
		Protected landscapes	12.8	
		Classified sites	2.3	
	Total (without double counting)		638.3	162.6
Total (without double counting)			1520.0	NA

Sources: Direcção Geral das Florestas (2001) and data collected from the DGF Internet site, on 19 November 2000
NA = not available.
[a]The sum is not double-counted.

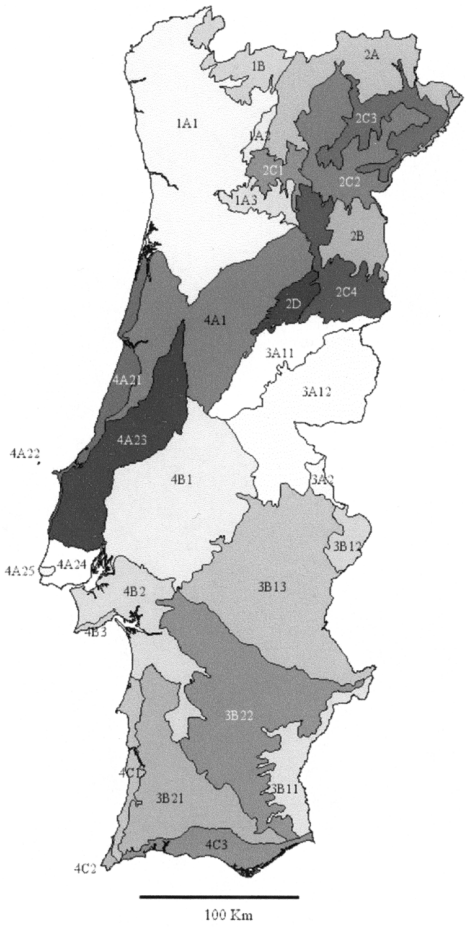
also important for animal species, especially mammals, birds and butterflies. Of the endangered animal species, 64% of mammals and 30% of birds are associated with forests.

Potential natural forest types and current forest cover[4]

Aguiar and Capelo (2004) distinguish six types of potential natural forests in Continental Portugal: deciduous oak forests; birch forests; oak forests adapted to calcareous soils; evergreen oak forests; other evergreen forests and other forests adapted to calcareous soils; and hygrophilic forests (Fig. 22.1).

Deciduous oak forests

Potential natural forests of deciduous oak trees are of two main subtypes according to the dominant species: *Quercus robur* or *Quercus pyrenaica*. Potential natural forests dominated by *Q. robur* (alone or mixed with *Q. pyrenaica*) correspond to the north-western part of



Legend:
1A1 and 4A1: potential natural forests of deciduous oak trees with *Quercus robur* as the dominant species, currently substituted by agricultural land uses, maritime pine and eucalyptus; 2A, 2B and 2C: potential natural forests of deciduous oak trees with *Quercus pyrenaica* as the dominant species, partially substituted nowadays by agricultural land uses and maritime pine; 1B and 2D: potential natural forests of birch (*Betula celtiberica*); 4A21, 4A22, 4A23, 4A24, 4A25 and 4B3: potential natural oak forests adapted to calcareous soils (*Quercus faginea*) which, nowadays, are residual after destruction by fires and pastoral land uses, or substituted by maritime pine maritime pine in the sandy lands along the coast; 2C3, 3A11, 3A12, 4A23, 4B1, 4B2, 4B3, 4C1, 4C3, 3B21: potential natural evergreen forests of cork oak, currently man made, in most cases, and managed for cork harvesting; 2B, 3B11, 3B12, 3B13, 3B22: potential natural evergreen forests of holm oak, currently legally protected by conservation laws; 4A24 and 4C3: potential natural forests of *Olea europaea* adapted to calcareous soils; 4C3: other potential natural forests adapted to calcareous soils composed by *Quercus faginea* and carob.

Fig. 22.1. Map of potential and actual forest vegetation[6] in Continental Portugal.

Continental Portugal with an Atlantic climate (1A1 and 4A1)[5]. Potential natural forests dominated by *Q. pyrenaica* are typical of the highlands of the north-eastern and central eastern regions (2A, 2B and 2C), where the Atlantic climate is subject to Continental and Mediterranean influences.

Since Neolithic times, these forests regressed due to agricultural and pastoral land uses. This regression process was concluded by the end of the Middle Ages, leaving only residual areas. These forests have been replaced with agricultural lands in the lower altitudes, single or mixed stands of maritime pine (*Pinus pinaster*)

and *Eucalyptus globulus* in the lower or intermediate altitudes, and shrub lands of *Cytisus* sp.pl., *Genista florida* subsp., *Polygalaephylla*, *Ulex* sp.pl. or *Erica* sp.pl. in higher altitudes.

Birch forests

The typical species of potential natural birch forests in Continental Portugal is *Betula celtiberica*. This species can coexist with the deciduous oak forests where hydric conditions are appropriate, as is the case of the mountains of Gerês (1B) and Estrela (2D).

Oak forests adapted to calcareous soils

Potential natural forests of *Quercus faginea* subsp. *broteroi* (class *Quercetea ilicis*) are typical of the calcareous soils of the Extremadura and Arrábida regions (4A2 and 4B3), where there is a mixture of Atlantic and Mediterranean climatic influences. These forests are now very residual, after a long period of regression due to fires and pastoral land uses. In the sandy lands along the coast, there are forests of maritime pine planted by the Forest Services at the beginning of the 20th century to prevent erosion.

Evergreen oak forests

The two major species of potential natural forests of evergreen oak trees in Continental Portugal are cork oak (*Quercus suber*) and holm oak (*Quercus rotundifolia*, class *Quercetea ilicis*). Cork oak is present in the provinces of Trás-os-Montes (2C3), Beira Baixa (3A11 and 3 A12) and Estremadura (4A23, 4B1), and in the western part of Alentejo and the Algarve (4B2, 4B3, 4C1, 4C3 and 3B21). Holm oak is typical of some of the more arid and interior areas, in the provinces of Beira Alta (2B) and Alentejo (3B11, 3B12, 3B13 and 3B22) and in the eastern part of the Algarve (4C3). Most of the stands of cork oak existing today are man made and managed for the production of cork.

Other evergreen forests and other forests adapted to calcareous soils

Other potential natural forests of evergreen species and of species adapted to calcareous soils are typical of the surrounding region of Lisbon (4A24) and the eastern part of the Algarve (4C3). The main species here is *Olea europeia* subsp. *sylvestris*. On the calcareous soils of the Algarve, *Quercus faginea* subsp. *alpestris* and carob (*Ceratonia siliqua*) can also be found. Today, carob trees are managed for fruit production.

Hygrophilic forests

As far as riparian forests are concerned, the main species existing in Portugal are alders (*Alnus glutinosa*) and willows (*Salix atrocinerea* and *S. neotricha*). In other wet areas, but not swamps, the main tree species is ash (*Fraxinus angustifolia*).

Institutional Aspects

Forest ownership

Most forests and other wooded land (93.4%) are under private ownership and management, the remainder being almost entirely communal forests managed by the Forest Services (Table 22.4). The main stakeholders involved in forest management in Portugal are:

- The non-industrial private forest (NIPF) owners of northern and central Portugal, typically with small holdings, managing more than four-fifths of the pine forests and almost all cork oak forests (concentrated in southern Portugal); the Forest Services are in charge of most of the rest of these forests which are located essentially in communal lands
- The pulp and paper industry, managing 28% of the eucalyptus forests, the rest being almost entirely with non-industrial private forest owners.

There are contrasting forestland ownership structures between the north and south of Continental Portugal: small-scale forestry (mostly < 10 ha) in the northern and central regions, and much larger holdings (mostly > 100 ha) in the south. The communal forests are located mostly in the northern and central regions.

Table 22.4. Area of forest and other wooded land by types of ownership and tree species in 1995 (000 ha).

	Total		Maritime pine		Eucalyptus		Cork oak		Other forests and wooded land	
Type of owner	Area	%	Area	%	Area	%	Area	%	Area	%
State forests	40	1.2	27	2.8	0	0.0	2	0.3	11	1.1
Communal forests	180	5.4	116	11.9	14	2.1	1	0.1	49	5.0
NIPF	2,910	86.9	822	84.2	470	69.9	690	96.8	928	93.9
Forest industries	219	6.5	11	1.1	188	28.0	20	2.8	0	0.0
Total	3,349	100.0	976	100.0	672	100.0	713	100.0	988	100.0

Source: Mendes (2004) based on the authors' estimates and on data from Direcção Geral das Florestas (1992, 2001) and form Associação da Indústria Papeleira (2002)

Administration and policies

The Forest Services, with different denominations since their creation in the end of the 19th century, and, most of the time, under the umbrella of the Ministry or Secretary of State for Agriculture, are the national forest authority. Given the large amount of uncultivated land existing at the time these services were created, afforestation was their main policy priority for a long time. Their main mission in this area, accomplished during the first quarter of the 20th century, was the afforestation of the sandy lands along the coast to prevent erosion. This was an important and effective project. Another important project carried out between the 1930s and the start of the 1970s was the afforestation of the communal lands in the mountain areas of the northern and central regions. This was effectively accomplished, however, sometimes against wishes of the local population and traditional land uses.

In a country where a very large share of forestland is privately owned, the main aim of the Forest Services should have been to support improvements in the management of private forests. Here the track record of the Forest Services is not so good. Until the beginning of the 1980s, only a few attempts were undertaken: a programme started in the mid-1950s has provided support in kind[7] and cheap credit for improving the cork oak stands; and, during the 1960s, eucalyptus plants were distributed free of charge.

From 1980 to 1988, a World Bank-funded programme was the first major attempt to intervene in the afforestation of private lands. The funds were allocated to a pulp and paper company and to the Forest Services who carried out all the afforestation works on the lands of those private owners willing to participate in this initiative. This strategy of public direct intervention in private forestry failed to meet the initial targets.

A major turning point in Portuguese forest policy towards private forestry happened with the first (re)afforestation programme co-funded by the European Union (EU), which started in 1987. Here the Forest Services switched from an intervention focused mostly on public and communal lands, and an intervention in private forests based on assistance in kind, or on direct intervention, to a position of incentive regulator of private forestry which has since remained. The difference now compared with the mid-1980s is that the Forest Services gradually lost their initial role throughout the decision chain of designing the incentives schemes, and reviewing, approving and monitoring the applications of private owners for grants. Nowadays these responsibilities of review, approval and monitoring of the applications for grants are with the public institute in charge of processing the agricultural structural funds (IFADAP).

The grant-driven (re)afforestation which has been happening since the mid-1980s with the strong support of the EU-co-funded programmes led to the organization of the private forest owners into associations capable of providing the technical assistance they need to prepare grant applications and to undertake the (re)afforestation works. The number of these types of associations grew rapidly in the late 1990s: 67 in 1998, 110 in 1999 and 130 in 2002 (Direcção Geral das Florestas (DGF) data).

Contribution of the Forest to the National Economy

Contribution to the gross domestic product

In Portugal, in 1998, the forest sector represented 2.93% of the gross domestic product (GDP), which places the country in a top position within the EU 15, in terms of this indicator, being surpassed only by Finland and Sweden (Table 22.5).

Contribution to foreign trade balance

Exports, and not domestic consumption, have been the main driving force behind forest production in Portugal over the last century. In particular, exports account for the increase in the production of cork, eucalyptus pulpwood and pine wood, contributing positively to the trade balance. Until recently, these products were the second major export group before a big project in the car industry took off. Nowadays, these products occupy the fourth position, generating 11% of the total export value, a figure maintained since the 1880s, most of the time.

Contribution to employment

Official statistics underestimate the employment in the forest sector by excluding some of the small and medium sized forest enterprises, as well as most of the services related to forestry and forest industries. The author's own estimate for 1995 (Mendes, 2004), taking into account these omissions, gives a total of around 227,800 persons employed in the sector, which is 5.1% of the total workforce. This number is comprised of: 33,600 persons (0.8%) in silviculture, logging and hunting; 188,900 persons (4.2%) in forest industries and connected activities; and 5300 persons (0.1%) in non-marketed supporting services. This places the forest sector in seventh position, in terms of employment, after the following clusters of activities: agricultural and food industries, wholesale and retail, construction, public administration, textile and clothing industries, educational services and research.

Economic Value of Forest Production in Continental Portugal

Scope of the estimates

The scope of this estimation is the economic valuation of forestry *outputs* in Continental Portugal, including those that are not marketed. Some of these outputs contribute positively to the society's well being and are therefore referred to as *social benefits*, while others contribute negatively, being referred to as *social costs*. This study is mainly concerned with the 'resources' side of a forestry production account (in the national accounting sense of the word), extended to include some forest public goods and other non-marketed forest goods and services (Bergen, 2001). Estimates of some of the 'uses' in the forestry production account are given only for the depreciation in forestry capital due to fires. Therefore, a complete estimate of the net social added value for forestry is not obtained.

To make these estimates comparable with the other country chapters, timber and cork

Table 22.5. Gross value added of the forest sector at current market prices (million €).

		1995	1996	1997	1998
Forest	Forestry	644.2	595.5	559.5	606.4
Sector	Forest industries	1,873.8	1,723.6	1,766.2	1,880.4
	(1) Total	2,517.9	2,319.1	2,325.7	2,486.8
(2) Economy		69,044.1	73,879.6	78,994.4	84,964.0
(1)/(2)		3.65%	3.14%	2.94%	2.93%

Sources: Instituto Nacional de Estatistica (2001); Ministério da Agricultura, do Desenvolvimento Rural e das Pescas (2000).

production is evaluated at roadside prices. This implies that we are dealing with the 'resources' side of the consolidated production account of forestry, logging and cork extraction. Hunting and animal production based on acorns and grazing from forest areas are not included in this consolidation. What is estimated related to these two activities is the value of forest outputs that are their intermediate consumption.

Direct use values

Timber harvested

Data regarding the production of the different types of timber harvested are provided by the official agricultural statistics (Instituto Nacional de Estatística, 2003b). These data, published in cubic metres under bark, were converted[8] into cubic metres over bark. Monetary valuation is based on roadside prices for 2001 (Sistema de Informação de Cotações de Produtos Florestais na Produção, 2003a), considering that: the price for coniferous pulpwood, sawlogs and fuelwood refers to maritime pine; the price for broad-leaved pulpwood refers to eucalyptus; the price for broad-leaved sawlogs refers to oak sawlogs[9]; the price for other industrial wood refers to oak sawlogs; and the price for broad-leaf fuelwood is a weighted average of the roadside prices for eucalyptus, chestnut and oak fuelwood.

Net growth in timber stock

Physical valuation considers the difference between the annual forest increment and timber harvested in 1998. Direcção Geral das Florestas (1999) reports a forest increment of 15 Mm^3 o.b., of which 54% accrues to conifers and 46% to broad-leaves. Based on data of the Instituto Nacional de Estatística (2002a)[10], the quantity of timber harvested is 11.3 Mm^3 o.b., of which 55% is coniferous and 45% is broad-leaved. Monetary valuation is based on half of the stumpage price for sawlogs, considering that not all of the net growth of timber stock has an exchange value. This valuation does not include the annual variation in the value of timber stock as a carbon sink, which is a public good. The latter is incorporated in the value of the forest environmental services. The stumpage prices are the price of maritime pine (for coniferous growing stock) and of oak (for broad-leaved growing stock) (Sistema de Informação de Cotações de Produtos Florestais na Produção, 2003b).

Cork

Data for production of virgin and reproduction cork in 2001 comes from the official agricultural statistics (Instituto Nacional de Estatística, 2003b). The source for the roadside market price ('*preço de venda na pilha*') of reproduction cork is SICOP's leaflet (Sistema de Informação de Cotações de Produtos Florestais na Produção, 2003a). The price for the virgin cork is given by the SICOP website (Sistema de Informação de Cotações de Produtos Florestais na Produção, 2003b). It was assumed that the price reported for virgin cork is a roadside price.

Resin

Data for production comes from the official agricultural statistics (Instituto Nacional de Estatística, 2003b). The producer market price per kg for 2001 was calculated considering the producer market price per incision for 2001, according to Sistema de Informação de Cotações de Produtos Florestais na Produção (2003a), and a production of 1.8 kg of resin per incision (Goes, 1991).

Honey

Valuation of honey distinguishes between origin labelled production and other production. For the former, data regarding production and price in 2001 are provided from the answers to questionnaires sent by the Instituto de Desenvolvimento Rural e Hidráulica (Oliveira, 2004) to producer groups. The price refers to sales of those groups to wholesalers and other buyers.

Data for the other production was obtained by subtracting the origin labelled production from the total production of the country in 2001 (except 4 t of production in the Azores), as reported by official agricultural statistics (Instituto Nacional de Estatística, 2003b). The

price is the average export price in 2001 according to these statistics (Instituto Nacional de Estatística, 2002a).

Pine nuts

There have been no official data regarding the production of pine nuts since 1972. The volume of production reported in Table 22.6 is an estimate made by Alpuim *et al*. (1998), and not the actual production for 2001. The price for 2001 is the producer market price, according to Sistema de Informação de Cotações de Produtos Florestais na Produção (2003a).

Chestnuts

The data for production and the market producer price in 2001 come from the official agricultural statistics (Instituto Nacional de Estatística, 2003b).

Carob

There have been no official data for carob production since 1977. According to the official agricultural statistics, the average annual production for 1968–1977 was 43,193 t. Current opinions of local experts give estimations ranging from 28,000 to 35,000 t. The valuation considers the average of the two estimates (31,350 t) and the producer market price for 2001 as reported by the official agricultural statistics (Instituto Nacional de Estatística, 2003b).

Arbutus berries

The most recent data for *Arbutus unedo* come from the first revision of the Forest Inventory (1969/1974), according to a Forest Services' publication (Direcção Geral do Ordenamento e Gestão Florestal, 1979). The production of berries per hectare comes from Goes (1991). The price paid to pickers at the distillery gate is the author's own estimate based on a price of €15/l of arbutus brandy, a transformation ratio of 100 kg of berries per 15 l of brandy (Goes, 1991) and about 50% of the price of the brandy corresponding to the cost of berries at the distillery gate.

Elderberries

Data regarding quantity are the author's own estimate of the average annual production for Continental Portugal based on local informants from the area where this species is more frequent (Vale do Varosa; published in the CESE report (Conseho para a Cooperação Ensino Superior/Empresa, 1996; Mendes, 1997)). The market price paid to pickers is the price for 1995 obtained from local informants in that area inflated to 2001 prices according to the producer price index for agricultural products (Instituto Nacional de Estatística, 2002a).

Mushrooms

Production is based on the author's own estimate for the average quantity of mushrooms picked and sold in the period 1997–1999, based on a report prepared by a consortium led by the Instituto da Conservação da Natureza (2001). The price paid to pickers is based on information collected in October 2000, from local sources, in the border regions with Spain where this activity is more intense (Paulino, 2000). This price is less than half the export price.

Plants

The production is the author's own conservative estimate based on the quantities exported in the period 1988–1992, under positions 0910 and 1211 of the Nomenclature of Foreign Trade Statistics. The averages for this period were 60.6 t for cooking plants (with a maximum of 75.3 t in 1992) and 822.6 t for the aromatic and medicinal plants (with a maximum of 1027.5 t in 1992). The market prices paid to pickers in 2001 are the author's own estimates.

Forest products for intermediate consumption in animal production

There are four types of forest goods to be considered as intermediate consumption for animal production: (i) acorns; (ii) grazing resources under forest cover; (iii) grazing resources in scrub land; and (iv) litter lying on the forest floor.

Table 22.6. Economic values of forest products in Continental Portugal (2001).

Outputs	Physical production (intermediate or final)	Valuation method	Unit value (euros per physical unit)	Value of production (000 €)
Direct use values				
Wood forest products				543,590
Timber harvested				430,600
Pulpwood				
Coniferous	2,153,000 m^3 o.b.	Roadside market price	€19.54/m^3 o.b.	42,070
Broad-leaved	6,684,000 m^3 o.b.	Roadside market price	€31.70/m^3 o.b.	211,883
Saw logs				
Coniferous	4,733,000 m^3 o.b.	Roadside market price	€33.42/m^3 o.b.	158,177
Broad-leaved	221,000 m^3 o.b.	Roadside market price	€41.89/m^3 o.b.	9,258
Other industrial wood	220,000 m^3 o.b.	Roadside market price	€41.89/m^3 o.b.	9,212
Fuelwood				37,273
Coniferous	286,000 m^3 o.b.	Roadside market price	€38.22/m^3 o.b.	10,931
Broad-leaved	488,000 m^3 o.b.	Roadside market price	€53.98/m^3 o.b.	26,342
Net growth in standing timber stock				75,717
Coniferous	2,060,000 m^3 o.b.	50% of the stumpage price	€19.53/m^3 o.b.	40,232
Broad-leaved	1,794,000 m^3 o.b.	50% of the stumpage price	€19.78/m^3 o.b.	35,485
Non-wood forest goods				584,771
Cork harvested				390,726
Reproduction cork	128,000 t	Roadside market price	€2.94/kg	375,936
Virgin cork	30,000 t	Roadside market price	€0.49/kg	14,790
Resin	15,444 t	Roadside market price	€0.20/kg	3,089
Honey				7,619
Origin labelled honey production	172.5 t	Market price at producer group gate	€3.97/kg	684
Other honey production	4,361.5 t	Average export price	€1.59/kg	6,935
Fruits collected				53,310
Pine nuts	70,000,000 pine cones	Market price at farm gate	€0.20/pine cone	14,000
Chestnuts	26,118 t	Market price at farm gate	€0.99/kg	26,055
Carob	31,500 t	Market price at farm gate	€0.27/kg	8,577
Arbutus berries (*Arbutus unedo*)	15,130 ha × 200 kg/ha	Market price paid to pickers at distillery gate	€1.13/kg	3,404
Elderberries (*Sambucus nicra*)	650 t	Market price paid to pickers	€1.96/kg	1,274
Edible wild mushrooms picked for sale	6,500 t	Market price paid to pickers	€2.5/kg	16,250

continued

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Table 22.6. *Continued*.

Outputs	Physical production (intermediate or final)	Valuation method	Unit value (euros per physical unit)	Value of production (000 €)
Plants picked for sale				1,400
Thyme, laurel and other cooking plants	80 t	Market price paid to pickers	€3.75/kg	300
Aromatic and medicinal plants	1,100 t	Market price paid to pickers	€1/kg	1,100
Forest goods for intermediate consumption in animal production				112,377
Acorn grazed big pigs in extensive rearing	51,450,000	Surrogate market price	€0.13/FU	6,704
Grazing resources under forest cover	673,900,000	Surrogate market price	€0.13/FU	87,809
Grazing resources in scrub land (consumption by goats)	137,100,000	Surrogate market price	€0.13/FU	17,864
Acorns and other products grazed by other animal species				No estimate
Net growth in the production capacity of non wood forest goods				No estimate, but probably positive
Recreational services				37,883
Hunting	219,005 hunters	Cost-based method		21,383
Informal forest recreation	6,000,000 day-visits	CVM	€2.75/day-visit	16,500
Total direct use values				1,166,244
Indirect use values				
Carbon storage	1,450,000 tC	Shadow pricing	€20/tC	29,000
Protection of agricultural soil				49,209
Protection of water resources	8,772,520 ha	Cost avoided method	€3.30/ha	28,934
Forest landscape and biodiversity conservation	594,509 ha	Cost-based method	€95.36/ha	56,695
Total indirect use values				163,838
Negative externalities				
Damage caused by forest fires		Cost-based method		136,850
Costs of fire prevention				17,350
Social costs of fire fighting				35,853
Losses of forest products burnt				38,320
Reforestation costs				45,327
Other forest externalities				No estimate
Total negative externalities				136,850
Total economic value				1,193,232

ACORNS. The main sources of acorns currently grazed by animals are the cork oak and holm oak stands in the southern regions. The total and mean annual production of acorns of these stands are reported in Table 22.7, as given by the Forest Inventory of 1995 (Direcção Geral das Florestas, 2001). Not all this production is actually grazed by animals. For the farms surveyed in the project carried out by Moreira *et al*. (1995), the production of acorns grazed by pigs in an extensive regime ('*porco de montanheira*') is 37 kg/ha/year. This is about 5.5% of the mean production reported in Table 22.7. Applying this percentage to the total production reported in that table, a total of 22,714 t for the cork oak stands and 16,903 t for the holm oak stands is obtained, which makes a total of 39,617 t. This is possibly a lower bound estimate of the amount of acorns grazed by pigs in extensive rearing. Another estimate can be made based on the number of pigs in this regime and their feeding needs. According to the same research project (Moreira *et al*., 1995), in 1989 there were 6000 sows, each of these animals giving birth to ten sucking-pigs per year. If eight out of these ten sucking-pigs go on for fattening up to the age of 2 years, this gives 48,000 fattening pigs per year. If each of these pigs needs 1400 kg of acorns, a total of 67,200 t of acorns grazed by fattening pigs in an extensive regime is obtained. An estimate for this kind of use of acorn production is around 70,000 t/year.

To convert this quantity into forage units (FU), the coefficients proposed by Vieira da Natividade (1950, p. 317) are taken as a basis: 730 FU/t for acorns from cork oak and 743 FU/t for acorns from holm oak. Considering an intermediate value of 735 FU/t, 70,000 t/year of grazed acorns correspond to 51.5 million FU/year. This quantity of grazed acorns is a lower bound estimate of the amount of acorns used in animal production because there are other animal species, besides pigs, in an extensive regime, fed with this type of forest good. An attempt is not made to estimate this kind of intermediate consumption of acorns. To value this forest good, the price of barley for animal consumption in 2001 (Instituto Nacional de Estatística, 2002a) is used as a surrogate market price, assuming the equivalence 1 kg of barley = 1 FU.

Table 22.7. Total and mean annual production of acorns in cork oak and holm oak stands in 1995.

Species	Type of stand	000 t	kg/ha
Sobreiro	Pure	343.0	579
	Mixed dominant	49.5	411
	Mixed dominated	20.4	177
Azinheira	Pure	266.4	688
	Mixed dominant	31.8	428
	Mixed dominated	9.1	130

Source: Direcção Geral das Florestas (2001)

GRAZING RESOURCES UNDER FOREST COVER. Based on information provided by the 1995 Forest Inventory (Direcção Geral das Florestas, 2001) on natural and artificial grazing grounds under forest cover, their total forage production is estimated as reported in Table 22.8. The mean annual production of forage in terms of dry matter (DM) is the author's own estimate, based on the information provided by Moreira (1980), as is the ratio of FU per kg of DM: 0.3 FU/kg DM for the natural grazing grounds and 0.45 FU/kg DM for the artificial grazing grounds.

With a total of 1.4 million t DM/year, most of which is from cork oak and holm oak stands, it is possible to raise livestock equivalent to 1.4 million head of sheep. According to Moreira *et al*. (1995), in 1989, the livestock in the southern regions of '*montados*' (forest stands dominated by cork oak and holm oak trees), pigs excluded, corresponding to authoctonous races usually in an extensive regime, amounted to a number of female adult animals equivalent to 1.5 million head of sheep. This is an indication that the estimate of forage production presented in Table 22.8 is probably of the same magnitude as the forage production actually used by livestock (pigs excluded) in an extensive regime, at least for the southern regions. To value this forest good, we use, as a surrogate market price, the price of barley for animal consumption in 2001 (Instituto Nacional de Estatística, 2003b), assuming the equivalence 1 kg of barley = 1 FU.

GRAZING RESOURCES IN SCRUB LAND. According to Rego (1991), the mean forage production of scrub lands is 1.5 t DM/ha/year. According to the 1995 Forest Inventory, there were 2 Mha of

Table 22.8. Estimate of the forage production of grazing grounds under forest cover in Continental Portugal, in 1995.

	Natural grazing grounds				Artificial grazing grounds			
Forest species	ha	t DM/ha/year	t DM/year	000 FU/year	ha	t DM/ha/year	t DM/year	000 FU/year
Maritime pine	0	1	0.0	0	29,283	3.0	29,283.0	13,177
Cork oak	46,282	1	46,282.0	13,885	690,569.5	2.5	644,287.5	289,929
Holm oak	22,336	2	22,336.0	6,701	645,466.0	2.5	623,130.0	280,409
Eucalyptus	0	1.5	0.0	0	33,607.5	2.5	33,607.5	15,123
Other oaks	4,690		9,380.0	2,814	45,160	4.0	35,780.0	16,101
Stone pine	4,101		6151.5	1,845	27,019.5	3.0	20,868.0	9,391
Chestnut	0		0.0	0	26,680.0	4.0	26,680.0	12,006
Other broad-leaves	0		0.0	0	27,820.0	4.0	27,820.0	12,519
Other coniferous	0		0.0	0	0.0	3.0	0.0	0
Total	77,409		84,149.5	25,245	1,525,606.0		1,441,456	648,655

scrub lands. Applying that coefficient, a total of 3 Mt DM/year is obtained. Considering a ratio of 0.5 FU/kg DM (1978), a total of 1540.9 million FU/year can be calculated. Most of this production is left without being used by animals, and therefore contributes to forest fires. The animals more likely to consume this type of vegetation are goats. In Continental Portugal, in 2001, there were 544,000 animals of this species (Instituto Nacional de Estatística, 2002a). Assuming that each of them consumes 300 FU/year from this kind of grazing ground, a total of 137.1 million FU is obtained. This amount is assumed to have been consumed in animal production, in 2001.

LITTER LYING ON THE FOREST FLOOR. Litter composed of leaves and fallen branches lying on the forest floor is a product that can be consumed by livestock, at least partially. Another part of these materials is needed to maintain the fertility of the forest soils. What is unused for these purposes contributes to the risk of forest fires.

Based on the coefficients proposed by Rego (1991) and the areas of forest in the 1995 Forest Inventory, the annual production of litter is 1.2 Mt DM in cork oak and holm stands (1.2 Mha ×1 t DM/ha) and 5.0 Mt DM in other forest stands (2.0 Mha × 2.5 t DM/ha). Adding up these estimates gives a total of 6.2 Mt DM/year. Based on a coefficient of 0.6 FU/kg DM (Vieira de Sá, 1978), this corresponds to 3744.7 million FU/year. It is assumed that all this production is left on the ground, or burns in forest fires.

Comparison between the value of forest goods used as intermediate consumption in animal production and the value of animal production

Since grazing resources are the most valuable non-wood forest goods after cork, it is important to verify the reliability of the estimate using a different method. In national accounts, the estimated value of €112.4 million of forest products used in animal production in 2001 is part of the value of animal production and not part of the value of forest production. That amount should be compared with the value of the following components of animal production: meat, milk and cheese from goats; origin labelled meat and cheese; origin labelled meat from cattle; and origin labelled meat from pigs.

According to the official agricultural statistics (Instituto Nacional de Estatística, 2003b), the value of meat production from sheep and goats in 2001 was about €163 million. According to the questionnaires sent by the Instituto de Desenvolvimento Rural e Hidráulica (Oliveira, 2004) to the producers' groups of origin labelled products in 2001, the value of origin labelled meat products from catlle and pigs was €117.2 million and the value of origin labelled cheese from sheep and goats was €12.8 million. Adding up these values, a total of €187.4 million is obtained for the animal production likely to be dependent on grazing products from forests and scrub lands. Therefore, the previous estimate of €112.4 million for the value of these forest products can be considered as a reasonable approximation.

Net growth in the production capacity of non-wood forest goods

The net growth in the production capacity of non-wood forest goods is not estimated; instead, qualitative information regarding the trends in this forest resource is given. Cork harvesting is subject to regulations preventing removals beyond sustainable limits. It is believed that the industrial demand for cork induces harvesting of all sustainable production. Since the end of the 1930s, the cork oak area did not change substantially, but the stand's quality improved considerably during a programme carried out by the Forest Services in the late 1950s. Since the mid-1980s, the EU financial incentives prompted a renewal and expansion of the cork oak stands. Thus, the future trends in the productive capacity of cork oak stands are likely to be positive.

The demand for pine nuts, chestnuts and carob is in tandem with the harvest, which is believed to be within sustainable limits. Since the mid-1980s, these species have also benefited from public financial incentives. So, the conclusion for this group of products is similar to the case of cork. In the case of mushrooms, there are situations of over-picking, but there are also areas of underpicking where there are no workers available and willing to do this job. Therefore, it is difficult to make a well founded guess about the trend in the production capacity of this product. With respect to resin, honey, arbutus berries, elderberries, plants, acorns and grazing resources, there are reasons to believe that the trends in production harvested may not be following the trends in the production capacity. Starting with resin, the situation can be described as follows:

- A sharp decline in resin tapping since the mid-1980s: from 115,200 t on average per year in the period 1980–1986 to 21,300 t in the period 1996–2002
- A decline in the area of maritime pine not as large as the decline in resin tapping: from 1.3 Mha in the second revision of the Forest Inventory (1980/85) to 976,000 ha in the third revision (1995/98), the decline continuing in more recent years because of forest fires.[11]

These trends led to a decline in production capacity of resin, with no overuse of the resource. Other products (honey, berries, plants, acorns and grazing resources) are harvested below potential production; their production capacity is probably growing, not only because of no overuse, but also due to the growth in forest and other wooded land. The global conclusion is that the net change in production capacity of non-wood forest goods is probably positive.

FOREST HUNTING BENEFITS. The value of the hunting benefits of forests is estimated by using the costs paid by hunters, including hunting permits, fees for gaming services in hunting zones with excludable access, and membership fees to associative hunting areas.

- *Hunting permits*. In the 2001/02 hunting season, 219,000 hunters paid €5.5 million for their hunting permits[12]
- *Gaming services paid by hunters in hunting zones with excludable access*. According to Cipriano (1999), in the 1996/97 hunting season, average expenditure per hunter on gates, posts, game management and other gaming goods and services in hunting zones with excludable access was €674 in touristic zones, €311 in associative zones and €104 in social zones.[13] Assuming that the distribution of hunters across types of zones in the 2001/02 hunting season was the same as in 1996/97, the total amount paid is €26.5 million[14]
- *Membership fees to associative hunting areas*. Membership fees to associative hunting areas averaged €207 (Cipriano, 1999, updated to 2001 Euros). Given 96,000 members in 2001 (Bugalho and Carvalho, 2001), this amounts to €19.9 million.

Adding up these figures results in a total cost paid by hunters of €51.9 million. Not all of it can be attributed to forests, however. Although forests are very important for game feeding, other areas – agricultural areas and uncultivated lands – also play a role. A crude but simple criterion to impute the value of hunting to forests is to multiply it by the percentage of forests and other wooded lands in the total area with hunting capacity, which is 41% (Bugalho and Carvalho, 2001). Thus the value of hunting benefits

attributable to forests is estimated at about €21.4 million.

INFORMAL FOREST RECREATION. No data are available regarding the number of visits to forests and other wooded lands for recreational purposes. Therefore, available data reporting the number of days spent in camp sites are used as part of a proxy for that variable; as almost all camping grounds are under forest cover, it is reasonable to assume that enjoyment of forests may be one of the motivations of most campers.[15] This makes a total of 4.6 million days spent in camp sites, in 2001 (Instituto Nacional de Estatística, 2002b, 2003c).

In addition, 0.4 million nights were spent by guests in rural tourist facilities. These numbers do not include a large and increasing number of urban people who visit forest areas on weekends and holidays without staying overnight. The number of such visits is estimated very roughly by assuming that half the households in the two metropolitan areas of Porto and Lisbon (1.2 million households in 2001; Instituto Nacional de Estatística, 2003a) visit forest areas at least once a year, and count for just 1 day-visit per household, for a total of 0.6 million day-visits. This gives a total of about 6 million days a year for all types of visitors to forest areas.

The willingness to pay per day-visit is based on the only available empirical study of the recreational value of a Portuguese forest area (Loureiro and Albiac, 1996). Using a contingent valuation method (CVM), the authors found a mean willingness to pay for access to a forest reserve in the Terceira Island of the Azores of €2.75/day-visit (in 2001 Euros). Given the estimated 6 million day-visits, the total value of informal recreation in forests is estimated at about €12.5 million.

Indirect use values

Carbon storage

The net annual increment of carbon storage in the woody biomass of Portuguese forests amounts to 1.45 MtC/year, based on the United Nations Economic Commission for Europe/Food and Agriculture Organization (2000). If this flow is evaluated at the mean social cost of carbon emissions of €20/tC, as estimated by Fankhauser (1995, p. 64) for the decade 1991–2000, an estimate of €2.9 million is obtained.

Protection of agricultural soil

Estimating the protection of agricultural land begins with the regions with a higher risk of desertification, such as Trás-os-Montes, Beira Interior and Alentejo, where the annual erosion of agricultural soil is 5–10 t/ha (Poeira *et al.*, 1990). Considering an apparent specific weight for sediments of 1.5 t/m^3 and a depth of 30 cm for agricultural soil, this erosion corresponds to an annual rate of soil loss between 0.11 and 0.22%. The average of these rates (0.165%) is used, assuming that it corresponds to the rate of loss in agricultural production.

Based on Rocha *et al.* (1986), the ratio of erosion between land with forest cover to land without is 2/3. Assuming this is proportional to the forests' contribution in reducing erosion, the value of the crops preserved due to soil protection by forest cover is equal to ×0.165% × gross value of crops.

If the (avoided) losses of crops were irreversible, for a 2% discount rate, the value of €1 million (Table 22.9) would correspond to a capital loss avoided of €53.4 million. If an amount of losses equal to v lasts for n years, the corresponding capital loss V_n is given by the following expression:

$$V_n = v$$

Considering a period of 50 years to recover from soil losses due to erosion and a 2% discount

Table 22.9. The value of crops preserved due to the soil protection provided by forests.

	Gross value of crops in the year 2000 (000 €)	Gross value of crops preserved in the year 2000, due to the soil protection provided by forests (000 €)
Trás os Montes	526,260	434
Beira Interior	236,470	195
Alentejo	531,970	439
Total	1,294,700	1,068

Source: Instituto Nacional de Estatistica (2003e).

rate, the annual value of losses avoided in the three regions is €33.6 million.

To estimate the value of agricultural soil protection in other regions, an annual rate of soil erosion of 0.055% is assumed – one-third of the average for the three regions. Based on the same method, a gross value of crops of €1812 million is obtained, corresponding to an annual value of about €15.6 million. Adding up the two estimates (annual flows) gives a total value of €49.2 million.

Protection of water resources

The protection of water resources is estimated by using the public costs of watershed management avoided by the existence of forests. These costs are considered as a lower bound for the forests' benefits in water conservation. The Management Plans for the main watershed basins (Instituto Nacional da Água, 2000) provide data for the total public costs planned for 2001–2020. They relate to the protection of ecosystems (PO3), flood prevention (PO4), fish and wildlife management (PO5) and water management (PO6) (Table 22.10).

To estimate the costs that would be borne in the absence of forest, it was assumed that the watershed management costs would increase in the same proportion as erosion would increase without forest cover. The increases in erosion were estimated for each watershed based on data from the 1995 Forest Inventory as reported by the Direcção Geral das Florestas (DGF) software AreaStat, and data taken from the work of Rocha *et al*. (1986) on soil erosion. The sixth column in Table 22.11 is the coefficient by which we have to multiply the costs in order to obtain the amount of public costs annually avoided in watershed management due to existence of the current forest cover. The results of this estimation for each watershed are reported in the last columns of Table 22.11. Since the Watershed Management Plans on which this estimation is based are from 2000, the estimate is not corrected for inflation. Converting into Euros, a value of €28.9 million is obtained.

Table 22.10. Total public costs of watershed management for the Portuguese international rivers planned for the period 2001–2020 (million escudos).

Watershed	PO3	PO4	PO5	PO6	Total cost for 2001–2020	Annual cost
Minho	980	206	858	630	2,674	134
Lima	391	1,021	63	2,076	4,118	206
Douro	1,498	763	578	10,572	18,613	931
Tejo	11,739	822	450	15,910	28,921	1,446
Guadiana	1,460	7,840	2,915	1,250	13,465	673

Table 22.11. Rates of forest cover, forest cover correction factors for soil erosion rates and the annual public watershed management costs avoided by the existence of forest cover (thousand escudos).

Watershed	Total area (000 ha) (1)	Forest area (000 ha) (2)	(2)/(1) %	C	(1-C)/C	Annual costs with current forest cover for 2001–2020	Annual costs avoided for 2001–2020 due to the existence of the current forest cover	
							Total	Per ha
Minho	79.9	29.4	36.8%	1/3	2	133,675	267,350	3.3
Lima	117.2	34.7	29.6%	2/3	1/2	205,900	102,950	0.9
Douro	1,853.9	506.0	27.3%	2/3	1/2	930,650	465,325	0.3
Tejo	2,432.9	1,124.3	46.2%	1/3	2	1,446,054	2,892,108	1.2
Guadiana	1,146.0	344.2	30.0%	2/3	1/2	673,235	336,618	0.3
Rest of Continental Portugal	3,142.6	1,310.8	41.7%	1/3	2		3,736,534	1.2
Continental Portugal	8,772.5	3,349.3	38.2%				5,800,885	0.7

Forest landscape and biodiversity conservation

FOREST LANDSCAPE CONSERVATION IN PROTECTED AREAS. The estimated value of forest landscape and biodiversity conservation is based on the only study available in Portugal (Santos, 1997). Using CVM, Santos estimated the willingness to pay of visitors to the Peneda-Gerês National Park for three different programmes of rural landscape conservation, one of which dealt with oak forest conservation. The best point estimate he obtained for the year 1996 amounted to 6634 escudos per household per year (Santos, 1997, p. 587). Based on the total number of households visiting the park between September 1995 and August 1996, an aggregated willingness to pay of 397,377 million escudos per year was calculated (Santos, 1997, p. 590).

Data regarding the area of forests and other wooded land in Peneda-Gerês National Park are not available, but can be estimated at around 60,000 ha, natural pastureland included. Dividing the aggregated benefit by this surface gives an estimate of 6623 escudos/ha. In order to arrive at a national level estimate, it is assumed that all protected forests in Continental Portugal have the same characteristics (visitor numbers, visit frequency and site composition) as those in the Peneda Gerês National Park. Extrapolating this estimate to the total forest and other wooded land existing in the Natura 2000 sites (Table 22.3) results in a total willingness to pay of €3937.4 million in 1996. Converting and updating[16] this value to 2001 prices, an aggregate willingness to pay of about €20.4 million is obtained.

PUBLIC EXPENDITURE FOR FOREST LANDSCAPE AND BIODIVERSITY CONSERVATION. The official statistics regarding the environment (Instituto Nacional de Estatística, 2003d) report data for investment and operating expenditures for landscape and biodiversity conservation by the Public Administration (Central Administration, municipalities and public institutes) and the public non-profit organizations. These data do not, however, specify the share of these expenditures attributed only to Continental Portugal. Based on these data, it is estimated that, in 2001, the operating expenditure for this part of the country is about €145 million. It is assumed that 39.1% of this amount refers to forests and other wooded land, based on the share of forests in the total area under some protection status. This gives an estimate of €56.7 million. This value does not include the contribution of public investment expenditures in landscape and biodiversity conservation for the increase in the capacity of forest areas to provide these kinds of services. Therefore, this value is a lower bound for the cost-based estimate of these services.

Adding up the €56.7 million with the €20.4 million estimated above for forest landscape conservation in protected areas would be double counting. Therefore, the former value is considered as the estimate for these services.

Forest negative externalities

Costs of forest fires

In 2001, of the 866 forest fires for which the cause was discovered, 95.2% were started by human actions: negligence (such as the burning of pasturelands, picknicking and cigarettes); accidental ignition (due to the operation in or near the forests of farm or forestry machinery, vehicles, trains and electric lines); conflicts regarding hunting; and arson.

This illustrates that forest owners are seldom among the initiators of forest fires; however, they bear part of the costs, together with other people in society (such as volunteer fire fighters and tax payers) not responsible for starting fires. Therefore, the costs of most of the forest fires in Portugal may be considered as negative externalities borne by the forest owners and other people in society who share those costs with them. Some of the components of these costs are estimated below.

COSTS OF FOREST FIRE PREVENTION. There are five main stakeholders in the forest fire prevention system: the non-industrial private forest owners; the pulp and paper companies; the Ministry of the Interior; the Ministry of Agriculture; and the municipalities. In recent years, the pulp and paper companies spent more than €3 million per year on this kind of operation (Associação da Indústria Papeleira, 2003). In 2001, the Ministry of the Interior spent €8.1 million, most of it in transfers to forest owners'

associations and municipalities for fire prevention actions (Ministério da Administração Interna-Gabinete do Ministro, 2003). Out of this funding, €3.1 million were allocated to the co-funding of brigades of fire sappers managed by forest owners associations. This co-funding represents about 50% of the total operating costs of those brigades. Through the EU-co-funded programmes of the Ministry of Agriculture, €3 million were transferred to public and private beneficiaries in 2000 to support forest fire prevention (Ministério da Agricultura, do Desenvolvimento Rural e das Pescas – Gabinete de Planeamento e Política Agro-Alimentar, 2001). Although no data for 2001 are available, the same amount as in 2000 can be assumed. Data on how much the Ministry of Agriculture spent from its own funding in running its network of forest fire detection are not available.

Adding these four components we get a total of €17.4 million, which is a lower bound for the social costs of forest fire prevention in 2001.

SOCIAL COSTS OF FOREST FIRE FIGHTING. There are three main stakeholders involved in fire fighting: the Ministry of the Interior;[17] the local fire departments;[18] and the pulp and paper companies. In 2001, the Ministry of the Interior spent more than €21 million on forest fire prevention and fire fighting (Ministério da Administração Interna, 2002), through its special agency in charge of supervising the fire departments (SNB; Serviço Nacional de Bombeiros). This money was spent directly by SNB and indirectly through transfers to the local fire departments. The source of this information does separate the amount allocated for fire prevention and fire fighting. Subtracting the €8.1 million spent by the Ministry in fire prevention, a figure of €12.9 million spent on fire fighting is obtained. The data source does not specify either the amount allocated to the local fire departments or the matching funding added by these departments. The pulp and paper companies contributed more than €1.5 million (Associação da Indústria Papeleira, 2003). The calculation of the opportunity cost of the voluntary fire fighters is based on the number of fires – 26,942 acoording to DGF – and the assumption of 20 volunteers per fire, each contributing 1 day of work per fire, giving an equivalent total of 2700 full-time workers per year. The value added per full time worker in agriculture and forestry, in 2001, was €8000. Assuming the same labour productivity for volunteer fire fighters, the opportunity cost of their time spent in fire fighting amounts to about €21.5 million.

COSTS OF LOSSES IN WOOD AND NON-WOOD FOREST PRODUCTION. For 2001, DGF estimates wood production losses at about €38.3 million (Direcção Geral das Florestas-Corpo Nacional da Guarda Florestal, 2003). Valuing the losses of NWFPs could be based on previous estimates (Table 22.6). However, as the burnt areas are not those where the more valuable NWFPs grow, such an attempt would overestimate these losses. Therefore, without further information, the estimate is limited to the losses of wood production.

COSTS OF THE RESTORATION OF BURNT FORESTS. DGF estimates the area of burnt forests as about 45,300 ha in 2001. Reforestation through new plantations would cost around €2250/ha. Reforestation through management of natural regeneration (in the case of pine forests) and stand improvement would cost up to €1000/ha. Using the least expensive option, a value of €45.3 million is obtained.

Other negative forest externalities

Other possible negative forest externalities not estimated here include: erosion, floods and landslides due to poor forest management; loss of landscape quality and recreational opportunities due to poor forest management; and loss of biodiversity and landscape quality and other losses due to intensive forestry and damage due to pest infections. It should be noted that the main consequence of poor forest management is the increase in the risk of forest fires. Therefore, some of the consequences of this kind of management are already covered by the estimation presented above.

Conclusions

Taken as an aggregate, the NWFPs turn out to be the main item in the TEV of forest production in Continental Portugal (€584.8 million). Cork stands out as the main contributor to this

value (€390.7 million). Acorns and grazing form the second major element (€112.4 million) whose value is not imputed to forestry in national accounts as forest final production, since they provide intermediate consumption for livestock production. Wood forest products (WFPs) amount to €543.6 million, pulpwood (€253.9 million) being the main item in this group. Recreational services provided by forests are on the rise, but they are still a minor component of the total direct use value (€37.9 million). Also a good part of this value is not yet internalized by forest owners.

The estimation of both indirect use values and negative externalities of forests is incomplete. However, the available estimates show that the costs of forest fires are about 83.5% of the social value of forests corresponding to carbon storage, and the protection of agriculture soils, water resources and landscape quality.

Notes

[1] This chapter is limited to the continental part of Portugal, hereafter called 'Continental Portugal'. Therefore, it does not include the islands of Madeira and Azores.

[2] They attained very tragic dimensions in 2003 when around 283,000 ha, or 8.5% of total forestland, were burnt.

[3] From 1982 to 1995, the area of pine was reduced by 41% in the north-western and by 21% in the central region.

[4] This section is the author's own summary of the contribution prepared by Aguiar and Capelo (2004) for this chapter, based on their earlier joint work regarding the biogeography of Continental Portugal (Costa *et al*., 1998). The author takes full responsibility for all the possible shortcomings and errors in preparing this summary of their work.

[5] Here and in the rest of the section, this kind of notation refers to the biogeographic regions shown in the map.

[6] This is the author's own adaptation of the biogeographical map of Continental Portugal made by Costa *et al*. (1998) where the names of the regions were changed in order to make them correspond to the forest types. The author takes full responsibility for all possible mistakes and shortcomings in this adaptation.

[7] Distribution of selected seeds free of charge, accompanied by technical assistance.

[8] Using the coefficients: 1 m^3 o.b. = 0.7 m^3 u.b. for conifers and 1 m^3 o.b. = 0.82 m^3 u.b. for broad-leaves.

[9] Probably due to the small number of observations, the roadside price reported in SICOP's leaflet for oak sawlogs in 2001 is lower than the stumpage price. However, the information reported in SICOP's website gives a price lower than those two prices, but does not provide data on roadside prices. So the roadside price reported in the SICOP's leaflet was retained.

[10] Converted into m^3 o.b. by using the same coefficients as for the timber harvested.

[11] 47,264 ha of maritime pine burnt from 1996 to 1999, according to the Forest Services.

[12] 134,000 national hunting permits issued for residents (€24.94); 85,000 regional hunting permits for residents (€12.47); 2000 hunting permits for non-residents (€44.89); and 33,000 special hunting permits for big game (€29.93) (DGF data).

[13] All amounts have been converted to 2001 Euros using the consumer price index for leisure, recreation and culture.

[14] According to Cipriano (1999), 17% of hunters only go to zones with excludable access (touristic, associative, social or national); 44.4% go only to zones in the 'general' regime (free access); and 38.6% go to both types of zones. Within zones with excludable access, 16.7% go to touristic zones, 64.7% to associative zones, 2.5% to social zones and 16.1% to national zones. The distribution of hunters as reported by Cipriano is somewhat ambiguous because it may include some double counting; in the calculations, it is assumed that this is not the case.

[15] The number of stays in the camp sites of the Algarve has been omitted since they are mainly located near beaches. Therefore, going to the beach, and not enjoying the forest, is likely to be the motivation for camping.

[16] By using the consumer price index for recreation, leisure and cultural services, as of December 2001, base 100 = 1997.

[17] From where originates most of the public funding for this purpose transferred to the local fire departments, or spent in the lease of airplanes and helicopters.

[18] The majority of which are based on volunteers.

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25 The Need for an International Agreement on Mediterranean Forests

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Mediterranean Forests: Important Ecosystems at Risk

Economic importance and economic risks

The country chapters of this book provide estimates of the economic values of the Mediterranean forests and of their contribution to the economies of the countries in this part of the world. These values and contributions vary across countries and, in general, they are not negligible. However, the problem is that most of these values correspond to non-market outputs and/or are not internalized by the forest producers in a suitable manner that provides them with the necessary financial means to maintain and develop the forestry activity. This situation seriously undermines the possibility of maintaining and developing the current forest cover in Mediterranean countries.

The fact that an important part of Mediterranean forest products are non-market goods and services does not necessarily mean that they do not have an economic significance. In fact, an important part of these goods and services provides intermediate consumption for other sectors that often use them free of charge, while the corresponding benefits are not internalized by forest producers. It is the case for grazing resources, water resources protected by forests, forest landscape quality consumed by tourist activities, and others. Therefore, some of the economic values of these forest outputs are included in the economic value of non-forest activities, such as livestock production or tourism.

Other economic factors put Mediterranean forests at risk, again because of the lack of internalization of some non-market benefits of forests. In some countries, especially in the southern part of the region, expansion of agricultural and pastoral land uses at the cost of forestland is an important factor. In these areas, the population is generally poor and no mechanism exists to internalize forest benefits, such as soil conservation and water protection. Consequently, people use land for what they need most in daily life, which is food. These negative effects on soil and water are fundamental issues, considering the following two facts: (i) in many Mediterranean areas, water resources are scarce; and (ii) the Mediterranean climate favours soil erosion.

Forests are the main and sometimes the only land use that can cope with these problems. In other cases where farming and forestry are coexisting in agroforestry systems, the harmony between the two kinds of land use is not always easy to maintain:

- Mechanization of agriculture may have negative effects on the density and health of trees
- Increase in livestock production may also be detrimental to forestry

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- Decline in the economic value of some livestock products (e.g. the Iberian pig when affected by swine fever) using forest products as intermediate consumption (acorns, for example) may also lower the economic value of the trees (such as holm oak).

In other countries, especially in the costal areas of the northern part of the region, forestland uses sometimes have to compete with urban and touristic uses that are not always respectful of sustainable forest management. In the areas where this tourist and urban pressure is lower, there are still problems for forestry, but of a different nature. These problems arise from the fact that, due to farm outmigration, agricultural land uses are declining, and forest and shrub lands are expanding, but often without appropriate management.

This urban pressure, and rural abandonment, combined with the characteristics of Mediterranean climates (wet winters and dry summers) contribute to what is nowadays the main threat to forestry in many Mediterranean areas, especially in the northern rim. This risk is the destruction by fire. Estimates of the costs of this phenomenon provided in the country chapters of this book show that there are countries (Portugal, for example) where every year they consume a substantial part of the benefits generated by forest production. Seen in a dynamic perspective, for obvious reasons, these fires are a very important factor impeding private forest investment.

Ecological importance and ecological risks

Mediterranean forests, together with tropical forests, have the richest biodiversity in the world. At the same time, they are also among the most threatened by ecological risks: (i) climate favouring forest fires, drought and erosion; and (ii) climate changes.

This second factor is worthy of being stressed because the geographical location of Mediterranean areas puts them in a situation where they are among the regions in the world where the effects of climate changes are likely to be more intense.

Cultural importance and cultural risks

For historical reasons related to the geographical patterns of emergence and diffusion of human civilizations, Mediterranean forests are among those where the presence and effects of human actions are more important. Therefore, their characteristics are a result of that human intervention and those characteristics are also part of the cultural identity of Mediterranean regions. In spite of this cultural importance, probably because of the economic factors mentioned above, forests are very rarely part of the political agenda and social debate. When they are considered by politicians or by the (urban) population, it is not always for good reasons (e.g. in summer, when there are forest fires). So what is found most of the time is ignorance, neglect or indifference.

Regional and Global Mediterranean Forest Problems

The previous section highlighted the following global public goods involved in the management of Mediterranean forests: (i) biodiversity; and (ii) cultural value.

There was also mention of the following public goods that may be considered to have regional scope, at least:

- Soil protection
- Water protection
- Landscape quality
- Knowledge about the specificities of Mediterranean forest and agroforestry systems.

With these global and regional public goods provided by Mediterranean forests, there is already plenty of room for inter-regional cooperation. Other areas for this kind of cooperation can be added to that list. An important one – already mentioned in the first section – has to do with forest fires. This is a problem common to many Mediterranean countries. Therefore, there is need for an exchange of experiences about good practices in fire prevention and fire fighting and the giving of assistance to countries or regions in situations of emergency.

Another area for international cooperation is integrated rural development. As mentioned in

the first section, the human pressure on existing or potential forestland in the southern Mediterranean countries is still strong in many places and the standards of living of the rural population are low. Without successful integrated rural development projects, the pressure on forests will continue to be strong, the living standards of the population will not rise and, in the long run, there will be risks of desertification and emigration to the urban areas of the country, or abroad, mainly to the northern Mediterranean rim and to other European countries.

Current Networks of Cooperation Among Mediterranean Countries

In spite of the need for international cooperation on Mediterranean forests, in the areas mentioned previously, there is not yet a forum where they can and have been addressed in a specific, comprehensive and continued way.

Silva Mediterranea

Silva Mediterranea is the oldest network dealing specifically with Mediterranean forests. It is an international network of technical and scientific cooperation with an intergovernmental nature, since it is part of the Food and Agriculture Organization. It started its activities within the framework of this organization in 1948, more than 30 years after the idea was proposed by the French forester Robert Hickel who succeeded in creating a network with the same name that functioned from 1922 until the end of the 1930s (Morandini, 1999). Since then, the activities of Silva Mediterranea have been very much dependent on the will of governments and the initiative of groups of researchers who want to push forward research and international cooperation on specific technical issues of Mediterranean silviculture. Socio-economic issues were on the agenda in the early days of Silva Mediterranea, but they lost ground later on. In more recent years, there were active networks in forest fires, cork and cork oak, stone pine and cedar.

The weak commitment of many countries to support the activities of this network reached a point where the extinction of Silva Mediterranea was considered as a possible option some years ago. This drastic decision was not taken, perhaps because this would have put an end to the only intergovernmental body specifically concerned with Mediterranean forests. However, the fact remains that, after that crisis, Silva Mediterranea was not reformed in order to gain a sufficiently high political commitment by the participating countries, accompanied by an effective support for international cooperation sufficiently comprehensive to cover the main areas where there is need for that kind of action.

A positive characteristic of Silva Mediterranea is that it includes all countries in Europe, northern Africa and the Middle East that have Mediterranean forests, and not only the countries bordering the Mediterranean Sea.

Mediterranean Action Plan

In 1975, the United Nations Environment Programme (UNEP) and the European Commission adopted a convention supplemented by an action plan (Mediterranean Action Plan) whose main objective was the protection of the Mediterranean Sea and of its coastal environments.

The pillars of this initiative involving the 21 bordering countries were as follows:

- A set of legally binding agreements for the contracting parties, more precisely the Barcelona Convention supplemented by specific protocols (dumping protocol, emergency protocol and new emergency protocol) related to marine pollution
- A set of 'regional activity centres' located in some of the participating countries which provide research and technical work on specific problem areas fitting within the general framework of the Barcelona Convention (monitoring and research of maritime pollution, prevention and emergency intervention for marine pollution accidents, prospective studies about sustainable development, planning of integrated coastal development, protection of the coastal environment and endangered marine species, protection of historical heritage and environmental remote sensing).

In the follow-up of the 1992 Rio United Nations Conference on Environment and Development (UNCED), this initiative was relaunched with the adoption of an Agenda 21 MED in Tunis in 1994, the revision of the Mediterranean Action Plan (MAP II) in Barcelona in 1995, and the creation of a Mediterranean Commission on Sustainable Development (MCSD) in Montpellier, in 1996. MCSD works as an advisory body of MAP, meeting every year and including representatives of the contracting parties and non-governmental organizations (NGOs) concerned with the issues covered by the MAP.

With this relaunching of MAP, the initial focus on marine pollution was expanded to the sustainable development of the coastal regions. This shift is important for the issues dealt with in this present study because it facilitates the inclusion of forest ecosystems in the work programme of MAP II. The regional activity centres of MAP, and especially the Plan Bleu, produced very interesting prospective work and organized useful symposia about Mediterranean forests and about the interactions between forests, soils, water resources, tourism, urbanization and population (Marchand, 1990; Lanquar, 1995; Boisvert *et al.*, 1997; Ramade, 1997; Villevieille, 1997; Margat and Vallée, 2000; Attane and Courbage, 2001; Moriconi-Ebrard, 2001; de Montgolfier, 2002; Margat, 2002; de Franchis, 2003; Margat and Treyer, 2004).

Compared with Silva Mediterranea as far as forest issues are concerned, MAP loses in specificity of its focus, but gains in putting those issues in the broader context of sustainable development. Keeping a predominant technical nature such as Silva Mediterranea, it relies on more transdisciplinary capacities and on more political commitment by the contracting parties. It also has the advantage of providing a forum for multiple stakeholder dialogue (MCSD). The problem for forest development is that it has not been raised to a sufficiently high profile in the agenda of MAP to lead to a strong work programme in this area. The main focus is still the protection of the Mediterranean Sea and of its coastal regions. Other Mediterranean regions, non-bordering countries and terrestrial Mediterranean ecosystems are not a priority.

Euro-Mediterranean Partnership

The Euro-Mediterranean Partnership was launched in 1995, with the Barcelona Declaration signed by all the 15 EU countries and by 12 non-EU Mediterranean countries. This declaration shows the political will of the EU to contribute to peace and stability in the region, not only by promoting cultural exchanges and political dialogue, especially in the Middle East, but also by contributing to build up the economic basis on which such peace and stability can be founded in a sustainable way. More precisely, this partnership has the following aims:

- Progressive establishment of a free trade area
- Economic and financial cooperation and concerted action namely in industry, agriculture, transport, energy, telecommunications and information technology, regional planning, tourism, environment, science and technology, water and fisheries
- Development of human resources and cultural exchanges.

It is interesting to note that even though forest ecosystems are not excluded from the Barcelona Declaration, they do not deserve a special mention among the areas for cooperation and concerted action.

There are four important points to note about this partnership. One is that it involves all the current and possibly future EU countries and is open to all the non-EU Mediterranean countries. Therefore, it is not limited to the countries bordering the Mediterranean Sea. Another point to note is that this partnership embraces the MAP, but goes beyond, not only in terms of scope, but also in terms of Contracting Parties, political commitment, and resources allocated to the work programme. This leads to the third important point to note about this initiative which has to do with the fact that the EU has funds specially allocated to programmes of cooperation (MEDA, for example) and concerted action fitting in the framework of this partnership. Finally, it is stated within the Barcelona Declaration that periodic ministerial conferences can be organized on specific areas, which has been the case in Foreign Affairs and Environment. Therefore, if there is enough

political will and pressure from society for that, the door could be open for the organization of a Ministerial Conference for the Protection of Mediterranean Forests.

Measures Required and the Nature and Role of an International Agreement on Mediterranean Forests

This series of Ministerial Conferences for the Protection of Mediterranean Forests (MCPMF) should take advantage of the experience of the Ministerial Conferences for the Protection of Forests in Europe and should work in close cooperation with this pan-European process. It could also take advantage of the scientific and technical basis provided by Silva Mediterranea and by the regional activity centres of MAP. It could also lead to relevant development projects using this knowledge basis and the financial instruments put forward by the EU for the Euro-Mediterranean Partnership.

The major step required to get this kind of initiative started is to build up sufficient awareness in society and among policy makers about the importance and risks concerning Mediterranean forests. The research community and the NGOs concerned by these issues have an important civic role to play here, and some are actively working in this direction. Good examples are the MEDFOREX Regional Centre of the European Forest Institute and the International Association of Mediterranean Forests (Bonnier and Poulet, 2002).

The MCPMF cannot and should not be based on some kind of legally binding agreement (Glück *et al*., 1997). The socio-economic and political conditions relevant for forest development vary greatly from country to country, around the Mediterranean basin. Imposing common rules on everybody would be bound to result in failure and is unnecessary. Much more important would be the setting up of a regular forum of effective political commitment to develop and share knowledge, as well as technical and financial resources, and to debate, design and implement concerted policies in those areas more concerned by the regional and global public goods provided by the Mediterranean forests.

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