Forestry in Changing Societies in Europe

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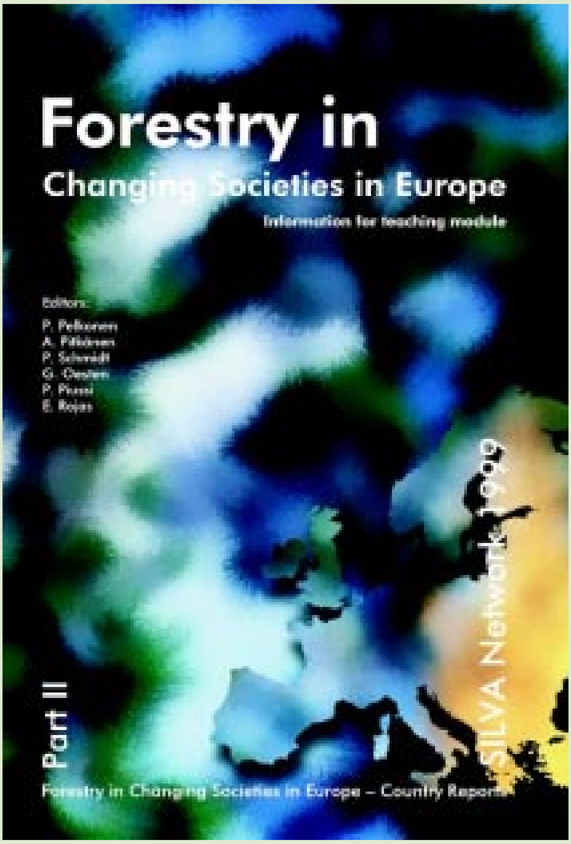

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Contents

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Forestry in Changing Societies in Europe

The study books were published at the:
Joensuun yliopistopaino (University Press)
University of Joensuu
P.O.Box 111
FIN 80101 Joensuu
FINLAND

Layout done by:
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University of Joensuu

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ISBN Number 951-98298-1-4

Key words: forestry, forestry education, society, changes

This CD-ROM has been partially funded by the SOCRATES/ERASMUS -Programme of the European Union

Preface

Forestry in Changing Societies in Europe has been prepared within the framework of the EU SOCRATES Thematic Network for Agriculture, Forestry, Aquaculture and Related Sciences (AFANet). AFANet aims to promote a European dimension to higher education in universities and colleges offering degree programmes in agriculture, forestry, aquaculture and related sciences.

AFANet, which was launched in 1996, as a joint initiative of ICA, SILVA, NATURA and AQUA-TT and is addressing a number of key issues, both structural and discipline-based, in achieving its aims. The structural considerations have
- strengthened communication within our Network of European Universities,
- developed approaches to enhance the preparation of our students' competence in a second language,
- assessed how information and communications technology (ICT) can assist in the delivery of such courses across Europe.

At the discipline level the Network has:
- considered the future educational needs of the agriculture, aquaculture and forestry industries,
- assessed the impact of issues such as sustainability in the design of curricula, and
- developed courses which focus on providing students with a European perspective to their studies.

Forestry in Changing Societies in Europe is one such course. AFANet has funded the meetings of the contributors to discuss the aims of the course and to evaluate progress. The publication has been partially funded by the EU SOCRATES/ERASMUS -Programme.

The AFANet Co-ordinating Committee present this publication not only in the expectation that forestry students in Europe will develop a broader understanding of the industry in which they will pursue their future careers, but also as an exemplar of an approach that academics in other disciplines may adopt when developing a course for delivery on a European wide basis.

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Further information about the activities of AFANet can be found at
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[1] ICA - Interuniversity Conference for Agriculture and Related Sciences in Europe - currently comprises over 70 European institutions of Higher Education in the field of Agriculture and Related Sciences. Created in 1996 its objectives are to reinforce collaboration and European integration and dimension within higher education.
The SILVA Network is a Standing Committee of ICA. It presently comprises 29 institutions in forestry education.
AQUA-TT Ltd. is the European Network for Training, Education and Technology Transfer for Aquaculture and its related sciences.
NATURA – Network of European Agricultural (Tropically and Subtropically oriented) Universities and Scientific complexes related to agricultural development - is an international association created in 1998 which currently comprises 33 European Higher Educational Institutions. It aims to contribute to the transfer of knowledge and the creation of new technologies that are essential to the economic, social and cultural development and to the protection of the environment

Acknowledgements

A project like the teaching module “Forestry in Changing Societies cannot be carried out without co-operation of many people and institutes. I would like to thank

The European Commission DG XXII Education, Training and Youth for funds through the SOCRATES Programme,

ICA and its staff for valuable assistance,
DEMETER for the framework,

Authors of country reports and supplementary chapters for good co-operation and remarkable input,
Prof. Drs. Leena Aho and Leena Kaukinen for valuable comments concerning educational aspects,

Members of the co-ordinating and editing committee for excellent co-operation,
and Ms. Anne Pitkänen for her great contribution to the project management and co-ordination.

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Forestry in Changing Societies in Europe

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Austria

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1 The Country

1.1 Nature

1.1.1 Topography

The Republic of Austria is a landlocked country in central Europe. Extending about 760 km lengthwise from east to west and almost 300 km north to south the total land area is 83,858 km^2. With this size it is one of the smallest countries in Europe. The country's westernmost third only consists of a narrow corridor between 32 and 60 kilometres between Germany and Italy. Austria has borders with eight countries. Starting in the north and going clockwise, these are the Czech Republic, Slovakia, Hungary, Slovenia, Italy, Switzerland, Liechtenstein and Germany. The former four belonged to the Eastern block until the fall of the ”Iron Curtain” and Austria traditionally has been a link between the ”East” and the ”West”. The most important river is the Danube running through the north of this country. Quite a few important cities, among them also the capital Vienna, which is excessively large for this small country, are located on this river.

1.1.2 Geology, climate, soils, vegetation

Austria is characterised by the Eastern Alps dominating almost two thirds of this country because of which it is often referred to as the ”Alpine Republic”. Covering exactly 62% of the territory the Alps are sharply structured in zones running in an east-west direction. The narrow northern boundary zone of the Alps (”Flysch” zone) mainly consists of soft sandstone, marl and argillaceous schist. Rounded peaks and soft slopes covered with mixed forests and meadows are typical. Adjoining to the south are the Northern Limestone Alps (*Kalkalpen*). Consisting of permeable limestone and dolomite they reach heights of up to 3,000 metres and show the typical forms such as steep slopes, narrow valleys and abruptly rising steep walls. The highest peaks are covered by glaciers and scarcity of water in regions of karstic plateaus is typical. The lower parts (up to 2,000 metres) are covered densely with spruce forests. The following lower ”greywacke” zone (*Grauwackenzone*) (slate and shale ranges) is suited for mountain pasturage and is of economical interest due to its mineral deposits such as magnesite, iron or copper. The Central Alps (*Zentralalpen*) build the band further south consisting of hard gneiss and crystalline shales. Austrias highest summits and most glacierous regions are to be found in the western part of the Alps peaking at 3797 metres (Grossglockner), whereas the eastern part is lower, intersected by many basins, and predominantly covered with forests. The Southern Limestone Alps (*Südlichen Kalkalpen*) only reach Austria in the very south. The predominant soil types in the Alps are Rendzinas, Lithosols, and Dystric Cambisols (FAO classification). The climate type in the Alpine regions - *Alpine climate (Df in the Köppen classification)* - shows several regional variations according to the altitude. Generally speaking, summers are cool and rather short, in higher areas snow cover may stay for up to four months of the year. The ”Föhn” wind is a typical feature of this climate: it is a dry and warm wind usually blowing from the south and raising temperatures.

Only slightly more than one quarter of the federal territory is flat or moderately hilly curving around the Alpine ”tongue” from the north-east to the east; these are the lowlands and hills of north-eastern and eastern Austria. In this area forestry plays a minor role as this is Austria’s most intensively cultivated agricultural region. On fertile brown and black soils cereals and vegetables are grown. The Pannonic climate in this area – little precipitation and hot summers – is also ideal for growing wine of high quality mainly in extensive vineyards situated south-east of Vienna, on the hills of the ”Wine District” (*Weinviertel*) covered with fertile loess and being situated in the north-east of the capital, and in the Danube Valley (starting approximately 120 kilometres west of Vienna). A natural vegetation of oak and hornbeam can be found in the lowlands and plains, in the hilly regions mixed forests stands with different pine species and deciduous trees dominate. The south–east is subject to a more sub-Mediteranean (Illyric) influence and sweet chestnut as well as deciduous forests are found. As this climate favours agriculture, fruits and maize are grown on small scale. Along the river Danube, alluvial deciduous forests (*Auwald*) are typical and regular inundations take place. On alluvial soils, ranging from gravel to sandy forms, poplars and willows grow close to the water; going further, the vegetation changes to deciduous stands with oak, hazel and other broadleaved trees.

The remaining tenth of the territory of Austria is the Bohemian Granite Massif in the north-west, a medium upland (up to 1,300 metres). It is part of the central European intermediate climate dictating the weather conditions there as well as in the Alpine Foreland (*Alpenvorland*) – this is where the Alps start rising. Predominately westerly winds carry humid Atlantic air masses and this results in abundant precipitation - especially in the west and decreasing eastwards - at all seasons at comparatively mild temperatures. But in the Granite upland the climate is rougher and cooler; the stony soils yield rather modest crops in both agriculture and forestry. In its eastern parts the conditions for agriculture are better and potatoes, rye and oats are grown. This region is densely wooded with mixed stands in the lower regions and spruce stands dominating the higher points.

1.2 Society

1.2.1 Population, economy

Austria is inhabited by slightly more than 8 million people (exactly 8,046,500). This gives a population density of 96/km^2 , which is low in central European terms and reflects the Alpine character of this country. The distribution of the population is – according to the geographic conditions – very uneven. Roughly two thirds of the total population live in the Danube valley and the Austrian lowlands. The biggest concentration is Vienna (about 1.5 million inhabitants) and its environs. Within the Alpine regions, population concentrates in valleys (such as the Inn valley in Tyrol in the West of Austria or the basins in the eastern Alps). Major Austrian cities are also situated there, such as the capital cities Innsbruck, Graz or Klagenfurt. The second biggest city is Graz.. Apart from such places the Alpine region is quite scarcely populated.

Tourism is the main source of income in Austria. The country is well known for its skiing resorts in the western Alps, mainly in the federal provinces Tyrol and Salzburg (both the city and the province have the same name). But Austria is also a popular place for spending the summer holidays; in the Alps tourists go hiking, walking, mountain biking or take part in adventure sports such as paragliding and rafting. The ones who want to relax, sunbathe or do some water sports chose one of the numerous lakes in Carinthia in the south, in the ”Salzkammergut” in the northern-central part or decide to visit the biggest lake of Austria, the ”Neusiedlersee”. It is located at the Hungarian border, only 1 – 1.5 metres deep and is a paradise for sailors and surfers. Another important form of land use is agriculture: production on a large scale can only be found in the plains in the east (”Marchfeld”). Crops such as cereals, vegetables and fruits are grown in the east where the soil and climate conditions are ideal for agriculture. In the Alps livestock farming with beef cattle and dairy production is predominant. As with agriculture, forestry is also mainly done on a small scale which will be discussed later in several chapters. Industry is located around Vienna and other cities such as Linz; both cities lie at the river Danube and have the biggest Austrian ports. Another big industrial zone is in the federal province Styria which, in addition, is economically significant due to the mineral deposits such as magnesite, copper or iron ore, the former is among the biggest world-wide. Industry ranges from heavy industry to the production of high-tech articles such as parts for machines or engines and also includes chemical and textile fibre production. Due to its many rivers and mountainous lakes, Austria is a net producer of ”clean” electrical energy mainly produced in small to large water power plants. This energy is also exported. There is no nuclear power plant in operation. Figures about the forest industries are given in Chapter 3 dealing with forest economics.

1.2.2 Political structure and society

Austria is a Federal Republic (*Bundesrepublik*) and consists of nine federal provinces (*Länder*). According to the Constitution of 1920, amendment 1929, the head of the state is the President of the Federal Republic (*Bundespräsident*) who is elected every 6 years directly by the citizens of Austria and has mainly representative and administrative functions. The parliament consists of 183 representatives of the various political parties (*Nationalrat*). This is the legislative institution, together with the 58 representatives of the federal provinces who constitute the 2nd chamber (*Bundesrat*) which only has the power of veto. At the moment five political parties are represented in parliament (i. e. at least 5% of all voting citizens gave them their vote). The Social Democratic Party (SPÖ) is the biggest one with more than 35% and is in coalition with a Christian-democratic party, the People’s Party (ÖVP). They together form the government, the Federal Chancellor is a member of the stronger SPÖ. Each federal province has a governor; the function of whom, the role of federal and state law as well as the administrative system is more deeply discussed in Chapter 4.1. Since January 1995 Austria has been a member of the European Union.

The majority of the Austrian population is German speaking and Roman Catholic. There are, however, ethnic minorities in the south and east of Austria.

2 Forest resources and their uses

In the beginning of this chapter two terms should be explained briefly: Forest and forestry. Generally speaking, land covered by forest tree species and exceeding 1,000 m^2 (minimum width of 10 metres required) is defined as *forest* according to the Austrian Forest Act 1975 (exceptions exist). Further important definitions in Austrian forestry are given in the Chapter 2. 5. 4 (Forest functions). Forestry from the management perspective – the term *forest management* can be used - can be described as management of forest land to provide goods and infrastructural services; typical features include the long-term planning and consequences, the variety of functions, the high degree of indetermination, the risk and uncertainty as well as the identity of capital and product (Brünig and Mayer 1987). Forestry as defined in constitutional orders – here the term *forestry affairs* would be appropriate – covers all matters dealing with maintenance, tending, and protection of forest land; this includes matters such as forest management, import and export of raw wood, forest education, torrent and avalanche control.

2.1 Forest history

In the times towards the end of the glacial period (11000 - 10000 B. C.) the vegetation comprised mainly of bushes but in some regions pines and in the Alpine forlands also birches developed. In the beginning of the post glacial period different pine species, according to the altitude, and birches were the main species, in the southern regions the spruce appeared. The climate of the Boreal (around 6000 B.C.) favoured the expansion of spruce covering most of the Alpine areas. In the lower parts mixed stands of oak and pine dominated. During the Atlantikum (around 4000 B.C.) first mixed stands comprising of spruce, fir and beech developed in the southern and eastern parts of the Alps peaking in the Subboreal time (around

1500 B.C.); during this period the forest line reached highest levels with spruce, fir and cembra pine in high elevations. In the south-east, hornbeam appeared and mixed with oak, beech and, in some regions, fir. Up to the present, the share of fir has decreased drastically, also the beech has gone back whereas spruce expanded. Before the strong influence of man changed the naturally developed forest zoning, Austrian forests could be described as follows: a broad spruce zone in the inner Alps, a belt of spruce-fir-beech stands on the Alpine border line with a narrow band of spruce-fir forest in between. In the lower regions, oak and hornbeam stands dominate; pine and larch is mixed in the forests according to the altitude.

2.2 Forest ownership

The Austrian forest is primarily in private hands. Roughly 80% is private forest and managed according to a small-scale structure; more than 213,000 silviculturists (often farmers who also own small forest land) manage enterprises of less than 200 hectares forest area, but this accounts for almost half of all Austrian forests. In 1993, about 140,000 forest enterprises in the size class 1 - 5 hectares and 57,000 enterprises in the size class 5 - 20 were recorded; both account for one quarter of the forested land. About one third of the entire forest area is looked after by major forest enterprises. The remaining 20% are public forests, more than three quarters of which are in the hands of the Federal Austrian Forests; the rest is provincial and communal forest land (figure 1) .

2.3 Land use and forest resources

2.3.1 Global overview of land use

Austria is a land of forests - after Sweden and Finland it is the third most densely wooded country in the EU. Of the 8.39 million hectares total federal territory of Austria almost half - exactly 47% - is covered with forest; this means 3.92 million hectares, in total, or approximately 0.5 ha of forest per capita. One third (33%) is agriculturally used land, 11% is either alpine meadows or unproductive areas (such as the many glaciers in western Austria); 7% is developed land such as settlements or transportation systems, and 2% is covered with water. A regional development survey over the time period between 1975 and 1996 shows a decline in agriculturally used land (-9%) whereas developed land and forest land are increasing (+17% and +7% respectively). The annual growth of forest area is 7,700 hectares at present.

2.3.2 Extent and distribution of the forests

The forests in Austria are not evenly distributed over the federal territory. The mountainous slopes in the Alpine areas and in the highlands - especially in central and southern Austria - are most densely covered with forests, also the granite uplands in the north. Areas particularly poor in forest land lie in the east where agriculture is the main form of land use. The forest cover in the high mountains in the western parts of the country is lower. In addition to the altitude, intensive pastures are responsible for this fact. The

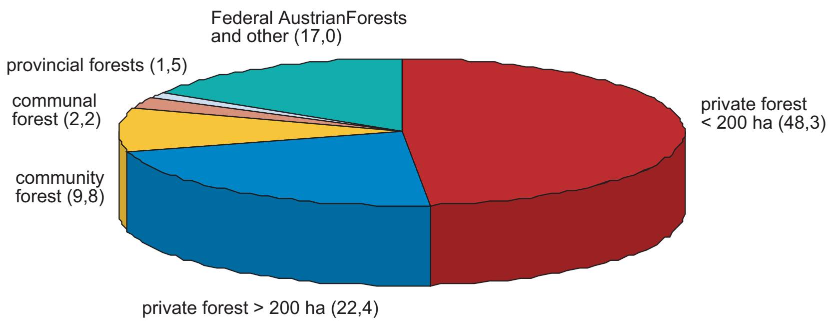

Figure 1. Forest ownership in percent of forest area (grey = private forest; black = public forest) (BMLF 1998b)

forest line, the border of the dense forest, in the Central Alps runs at 1,900 metres above sea level, in the limestone Alps some 200 metres lower. The tree line lies about 300 metres above the forest line.

2.3.3 Tree species origin and distribution

In Austrian forests coniferous trees dominate. Their share (77.3%) has been high for a long time due to the climatic conditions in predominantly mountainous regions. For economic reasons, however, it was increased in the past by the planting of spruce and pine. By far the most important species is spruce (*Picea abies*) with a total share of 61.8%. The most frequent deciduous tree is beech (*Fagus sylvatica*) with a share of almost 10%. A detailed overview of the tree species in Austrian exploitable forests (about 85% of the total forest) is given in ´table 1.

The above species are native to Austrian forests but in the past non-native tree species were also introduced. Examples would be the Douglas Fir (*Pseudotsuga menziesii*), and other fir species or poplar species which are commercially grown. Their share is, however, very small. In total, approximately 40 tree species (including rare species, too) can be found and the forest management distinguishes between coniferous, deciduous and mixed forests. In the plains and on hilly ground, foliage forests dominate; along big rivers (such as the river Danube), alluvial forests are found where inundations are a regular phenomenon. In mountainous regions, coniferous species form the forests with spruce and cembran pine growing up to the forest line and tree line respectively.

2.3.4 Total growing stock, growth and total fellings

The total growing stock in Austrian exploitable forests is almost one billion cubic metres (exactly 987 million m^3). With about 295 cubic metres standing timber per hectare, Austria has one of the largest growing stocks in the EU. The annual increment is 27.3 million cubic metres (8.2 m^3 per ha). As only 19.5 million cubic metres are felled annually, almost one third or 29% of the increment remains in the forest.

2.3.5 Forest threats

Various threats cause damage to Austrian forests every year and keep silviculturists and forest managers busy. They can be classified in biotic threats (animals, diseases), abiotic threats (wind, snow/hoar-frost, falling rocks) and human threats (pollution, recreation, harvesting damages). These threats are dealt with in this order.

Table 1. Tree species in Austrian exploitable forests by forest area in %

Tree species	**Forest area (%)**
Spruce (*Picea abies*)	61.8
Fir (*Abies alba*)	2.7
Larch (*Larix decidua*)	5.0
Pines (*Pinus sp.*)	7.7
other conifers	0.1
Beech (*Fagus sylvatica*)	9.8
Oaks (*Quercus sp.*)	2.2
other deciduous hardwood (such as Hornbeam – *Carpinus betulus L.*; Ash - *Fraxinus excelsior*; Maple - *Acer sp.*; Elm – *Ulmus sp.*)	6.4
other deciduous softwood (such as Birch – *Betula sp.*; Alder - *Alnus sp.*; Poplar - *Populus sp.*; Willow - *Salix sp.*)	4.2

Source: BMLF 1998

Austrian forests are the habitat for a variety of animals, many of them hunted by man. Unilateral promotion of specific game species appealing to the hunter combined with the fragmentation and reduction of game habitats, often enforced by recreation activities such as skiing, is one of the biggest problems for Austrian forestry. Problems are browsing of regenerating saplings, mainly by roe deer and chamois, and bark-peeling by red deer.

According to the regeneration survey of the Austrian Forest Inventory 1992/96, 85% of all regeneration areas show signs of browsing, jeopardising a mixed regeneration, particularly as firs and deciduous tree species are preferred by game. In some cases sufficient regeneration is prevented at all, causing severe problems particularly in protection forests. Forest authorities report that in about 1/5 of forest areas, regeneration is impossible without protective and prophylactic measures (such as fencing) against browsing; fraying damage has been assessed on 8% of all trees in Austrian production forests, debarking by red deer is however estimated still higher, both causing rotting of the stem and a destabilisation of the stands. 10% of forest land are still pastured, and domestic animals browse at forest plants and cause damage to roots and soil by trampling. These problems are outlined in Chapter 5.

Another threat for Austrian forests is insects. Between 1990 and 1997 a volume of about ten million cubic metres of damaged wood was caused by bark beetles, mainly by the spruce bark beetle (*Ips typographus*) and by the six-toothed spruce bark beetle (*Ips chalcographus*). The infestations occur predominately in hot and dry summers and often after abiotic catastrophes such as thunderstorms. Victims are mainly pure and artificially planted spruce stands below 800 metres in the Alpine forelands, but also healthy and natural stands in higher altitudes have already been infested. Apart from these two beetles, various other insects cause regional damage to forests. These include the European spruce saw fly (*Gilpinia polytoma*) and various moths. Different types of fungi cause rotting or discoloration and as a consequence a devaluation of the timber; one worth mentioning is the annosus root rot (*Heterobasidion annosum*) accessing spruces from the root system and hollowing the trunk from the inside. Oaks, especially in the east of Austria, are dying to an alarming extent due to an unknown cause; although a combination of weakening circumstances such as dryness and frost combined with biotic factors are believed to be the reason for the ”dying of oaks”.

Thunderstorms, snow, hoar-frost and falling rocks are the main abiotic threats occurring regularly in Austria. In 1990, a catastrophic thunderstorm blew down or broke approximately half of the average annual felling quantity of Austria. Landslides and also heavy loads of ice and snow are hazards for forests particularly in the mountainous regions in western and central Austria. An average of 27% (within the last ten years) of the total annual timber harvest was damaged by wind or snow. Almost 17% of all trunks in protection forests show signs of damage caused by falling rocks indicating clearly the important role of the forest.

Austria has strict laws on permissible pollution for all kinds of sources. Since the discussion of ”forest decline” in the 80’s a lot has been done on the environmental sector. Due to its position in the middle of Europe, deposits of various kinds of ”foreign” sources come down on Austrian soil: this may include pollution caused by transit-traffic through Austria (especially from north to south) as well as pollution from other countries carried over long distances. Measurable effects on the forest ecosystem are regional high levels of heavy metals, yellowing of leaves or even defoliation. Roughly one third of all Austrian trees show visible top defoliation with fir, pine and oak being particularly affected. Pollution is also seen as one of the reasons for the ”die-off” of single tree species (see ”dying oak” above).

Austria is a popular country for tourists and well-known for its skiing resorts. But also in summer, Alpine and other regions are frequented and the sports such as mountain biking, hiking, paragliding are a burden for the forests; game is disturbed permanently and takes refuge in still smaller areas where browsing and fraying destabilises stands particularly in highly sensitive protection forests. In addition, skiers outside the marked and prepared rundowns damage roots and young trees. Further damage is caused by foresters and forest workers themselves: Almost 7% of trunks in production forests show bark damage caused by timber harvesting. As harvesting techniques are getting more and more sophisticated this kind of damage should decrease in future.

2.4 Silviculture

In Austria various kinds of silvicultural methods in regeneration, tending and harvesting are used. Table 2 gives a general overview of the silvicultural management methods.

Protection forests play an important role in Austria, 755,000 hectares are identified as such forests, 38% of which are with commercial yield. Protection in this context means that these forests need to be protected (according to the Austrian Forest Act) and therefore require special treatment to fulfil their function; see definitions in Chapter 2.5.4. Although regulations exist on the management of protected forests, the Austrian Forestry Inventory proves rather unsatisfactory for those sensitive stands. Decreasing stability, overmature stands and lack of regeneration require effective measures. This problem will be discussed in Chapter 5. It has to be pointed out that in Austria silvicultural management is done on a small-scale basis; this is also true for removals as, due to the strict forest law, clearcuts bigger than 2 hectares are prohibited and for clearcuts extending 0,5 hectar a permission of the forest authority is required. Roughly three quarters of the felling quantity is made up of mature trees, the rest arises from tending, such as thinning (table 3).

This small-scale management with a high proportion of small-scale removals and regeneration fellings has also an impact on regeneration. An increasing emphasis is put on natural regeneration which is already taken into consideration when harvesting. While artificial reforestation with coniferous trees was the main ”regeneration” method in the past, now the natural regeneration is increasingly taking place in Austrian forests. This also has a positive ecological impact as the area of mixed and deciduous stands is permanently increasing. In the 1990s, the forest comprises of 24% mixed forests, 11% deciduous and 65% coniferous forests. This is a development in favour of mixed stands. Foresters and silviculturists use methods of natural regeneration and work increasingly towards mixed stands - where natural - for reasons of stability, amelioration of soils and diversity. In 1996 the age distribution was as follows: 40% up to 40 years, 24% 41 to 80 years; 8 % brushwood, the rest was older than 80 years.

2.5 Forest production

In Austria, forests do not provide only timber, but a wider variety of products and services. Due to the many mountainous regions, it often has a protective function, too. The main use of forests, however, is for timber production which will be shown in this chapter.

2.5.1 Harvesting systems, accessibility

Since Austria is a mountainous country and forests expand from lowlands up to the forest line, many different harvesting systems are employed according to the accessibility. As in Austria many farmers own small forest land, this ownership

Table 2. Silvicultural management methods in Austria (after Frank et al.)

Silvicultural management methods	% of total forest area
Commercial forests	75.7
Protection forest with commercial yield	7.4
Protection forest without commercial yield	11.9
Forest roads and operational areas without commercial yield	2.6
Coppice stands	2.4

Table 3. Removals 1992/96 (after Schwarzbauer, undated)

Structure of removals	Percentage of total removals
Clearcut (5000 - 20000 m^2)	28
Small-scale removals (up to 5000 m^2)	25
Thinning	16
Regeneration fellings (here: e. g. shelterwood systems; including final felling)	13
Incidental felling/clean up cutting	10
Natural decay	8

has also an impact on the harvesting methods due to the machinery available.

Depending on surface conditions and accessibility, timber harvesting is either done with harvesting machines or manually with chainsaws. The transportation of the timber to the forest road is also done according to above factors; Figure 2 shows the methods and their relative importance.

Most important is hauling. As a very dense network of forest roads and logging trails exists in Austrian commercial forests, this is a very economic method. Cable yarders are employed mainly in the mountainous regions inaccessible for vehicles. The reason for the rather high proportion of logging by tractors is found in the characteristics of the ownership: farmers who own woodlands and manage their forest adapt their tractors for forest work such as timber harvesting. Other transportation includes transport by helicopter, horses or special “log-lines” (half pipe-like slipways).

2.5.2 Timber uses

Austria has a well developed timber and timber processing industry. Even roundwood is imported to cover the demand of sawmilling, paper and board, and wood based panels industries. These semi-final and final products are exported to a large extent. The uses of timber in the various industries in the national context are discussed more deeply in Chapter 3.1.

2.5.3 Non-timber forest products

Apart from timber, Austrian forests provide other products and services, too. Some of them may not be seen directly as non-timber forest products, like hunting; in this chapter, however, non-timber products somehow related to forests are listed contributing to the income of the forest owner. Other services and functions are dealt with in Chapter 2.5.4.

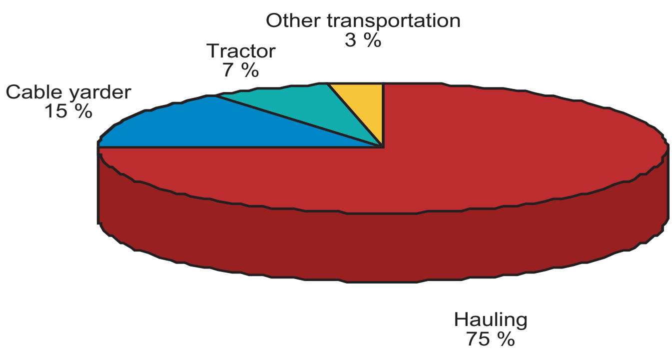

Figure 2. Methods of timber transportation from felling site to forest roads (Forest and Wood in Austria 1998)

A very important income for forest owners is hunting. According to Austrian law, the owner of forest land also owns the rights for hunting in his forests. Depending on the federal province (hunting falls under the jurisdiction of the federal provinces, so there are nine different hunting laws in force), a hunting area has to exceed a defined size limit to be counted as a ”hunting district”. These hunting districts can be rented as a whole to hunters or permission for a certain number of animals is sold. Small forest owners have to put their areas together to reach a hunting district, whereas big forest enterprises often divide their property into several districts. Not everyone is allowed to hunt; a hunting license is required. Approximately 110,000 annual hunting licenses were issued in 1993/94, which indicates the high popularity.

The renting of fishing districts or buildings can also contribute to the income of a forest enterprise. The selling of Christmas trees or income gained from touristic activities might also be of interest in particular regions.

2.5.4 Forest functions

In mountainous and touristic countries like Austria, forests fulfil a variety of functions. The protective function is most significant in the Alpine region which would be uninhabitable without forests protecting from landslides or avalanches. Before talking about this in more depth, three terms have to be explained.

It has to be pointed out that the term ”protection” in connection with forests is unclear, as in Austria it comprises two different aspects: protection by the forest and protection for the forest. The former refers to the protective function, the protection of villages, of the population against falling rocks or landslides by the forest. This land use term is defined in the Regulation on the Forest Development Plan. The latter meaning - the protection for the forest - is defined in the Forest Act; in this case protected forests are sites endangered by erosive powers such as wind or water and therefore require a particular treatment ensuring the protection of soil, vegetation and reforestation. Sites are defined in the Forest Act which are automatically protected forests; special regulations for these kinds of forests exist. This paper follows the literature (Weiß 1998) and therefore the terms ”protective forest” (protective effects by forest against natural hazards) and ”protection forest” (forest which needs to be protected as it guarantees site protection) will be used.

The Austrian Forest Act also formulates another term for forests in connection with protection: Ban forest (protective forest by decree). Ban forests are defined as ”Forests which serve to protect man, human settlements and installations or cultivated soil from certain dangers as well as forests whose beneficial effects are more important than their economic effects, shall be protected by decree, provided that the national economic or other public interest to be protected (purpose of protection) proves to be more significant than the disadvantages connected with the limitation of forest management due to the formal decree proclamation as ban forest” (§ 27 sec. 1, Austrian Forest Act 1975, amendment 1987; in Frank et. al.). A purpose of protection, particular measures or prohibitions laid down by the authority, and a beneficiary of the protection who has to bear the cost, are provided for by decree in the case of ban forests.

According to the Austrian Forest Act of 1975 (amendment 1987) four key functions of the forests are distinguished:

- Production: the economic function, i. e. in particular the economically sustainable production of the resource wood
- Protection: the protective function, i. e. in particular the averting of elementary dangers and damaging environmental impacts, as well as the maintenance of soil fertility against erosion by surface water, debris formation and landslides
- Welfare: the beneficial function, i. e. the effect forests have on the environment, in particular on the balancing of climate and water budget, on cleaning of air and water, and on the reduction of noise
- Recreation: the recreational function, i. e. in particular the effect forests have as a recreational area for people visiting forests.

The instrument referring to the above functions is the Forest Development Plan (FDP). It is one of the land use plans provided for in the Austrian Forest Act and can be defined as a planning frame showing actual forest conditions and describing the key functions of the forests for the whole federal territory. The FDP is described more in detail in Chapter 4. According to this plan the key functions of Austrian forests are distributed as shown in table 4.

It has to be pointed out that the same forest can have more than one function, i. e. that the share of recreation areas in Austrian forests is by far higher than 1.1%; this figure indicates only the leading function, the one most important in a particular area. The area where the commercial function is the major one is by far the largest. Forests with this key function are mainly found in the northern, central and south-eastern part of Austria, whereas forests with a protective function are dominating in the mountainous western part. Forests serving welfare are distributed over the territory particularly in regions providing drinking water; highest shares are found in the north-east, mainly around Vienna. The spots with recreation as the key function are well distributed throughout Austria.

3 Forest economics

3.1 Forest and forest industries in national economy

Although Austria is rich in forests and is a large producer of forest products world-wide, the forest sector's contribution to the national economy - measured as the gross domestic product (GDP) - is small. In 1996, the share of the total forest sector amounted to 3.8%, of which only 0.2% were attributed by the forestry sector and 3.6% by the processing industry. During recent decades this share has fallen substantially with forestry losing more of its share than forest industry. Looking at the contribution to foreign trade, the situation changes: with 5% of total imports and 10% of total exports the forest industry sector is the second most important contributor to the balance of trade, following tourism.

3.1.1 Production and consumption

Austria is a large producer of forest products in Europe. Although the number of forest industry mills has decreased dramatically within recent decades (with the exception of panel industry mills), production is rising. Big mills offset the capacity lost by closures of smaller ones and so steadily increase their market share. Taking the example of Austrian sawmills in 1996, 76% (46%) of total sawnwood was produced by mills with an annual output of more than 10,000 (100,000) cubic metres which is a rise in market share of 51% (no figures for sawmills > 100,000 m^3) compared to 1965. An overview of production, domestic consumption and changes of production/consumption within the periods 1988/97 and 1962/71 is given in Table 5.

Production and domestic consumption is rising in all categories except non-coniferous sawnwood where production falls steadily. For the consumption of residuals no accurate figures can be given but it has to be stated that a rising share of these products is used in the pulp and panel industry. Panel and ”paper&board” production grew considerably more than coniferous sawnwood production in the last decades; the reason why pulp production does not rise as fast as ”paper&board” production can be ex-

Table 4. Key functions of Austrian forests (in %)

Key function	**Percent of total forest area**
Production	64.5
Protection	30.7
Welfare	3.6
Recreation	1.1

plained by the facts that, firstly pulp is increasingly imported and secondly it is increasingly replaced by waste paper; almost half of the fibres used in paper production is from recycled waste paper.

The grade of self sufficiency with timber and timber products in a country can be expressed by the ratio of production (without imports) to consumption calculated on the basis of ”Wood Raw Material Equivalents” (WRME); with a ratio of 1.32 the position of Austria as a timber exporting country is clearly given and is also significantly higher than the ratio of Europe (0.88) or Germany (0.62).

Table 5 shows that the domestic demand for coniferous sawnwood grew more than the production which results in a decreased share of net exports. Panel and paper developed in the opposite way showing a rising importance of exports relative to domestic consumption.

3.1.2 Forest product trade and markets

Austria is a net-importer of roundwood and a net-exporter of wood products. In 1996, Austria (net-)imported about the same quantity of coniferous industrial roundwood as the whole of Europe (in terms of net-imports). But there are also considerable amounts of non-coniferous industrial roundwood, fuelwood and other forest products imported every year. Figures of imports and the shares for each country is given in figure 3.

Most important suppliers of raw-wood are Germany and Eastern European countries, especially the Czech Republic and Slovakia.

When looking at the exports of forest products, the picture is different. Austria exports large amounts of forest products mainly into countries of the EU and to Eastern Europe but also increasingly to Japan. In 1996 Austria was the 6th biggest exporter of coniferous sawnwood world-wide. The main market is Italy absorbing two thirds of total sawnwood softwood exports and considerable amounts of wood based panels followed by Germany which is the biggest customer of Austrian wood based panels and paper&board products. The rest is exported mainly to other European countries and Japan.

3.1.3 Employment

About 130,000 persons were employed in the Austrian forest industry sector in 1996 (3.9% of the total workforce). Only about 15,000 or 11.6% make their living on forestry in a narrower sense (forest owners managing enterprises less than 50 hectares are excluded). 47,000 jobs

Table 5. Production and consumption of forest industry products in Austria 1997 (different years shown in brackets) (after Schwarzbauer 1994)

Product	**1000's cubic metres/tonnes**		**changes in production (within periods 1988/97:1962/71) in %**	**changes in consumption (within periods 1988/97:1962/71) in %**
	Production	Consumption		
Coniferous sawnwood	8,146	4,318	+ 48	+ 118
Non-coniferous sawnwood	193	256	- 14	+ 23
Sawmill residues	3,254	n.a.	+ 77	n.a.
Particle/fibre board	1,811 (1995)	772	+322 (88/95:62/71)	+ 178
Pulp	1,629	1,488	+ 95	+ 222
Mechanical pulp	378	396	+ 86	+ 97
Paper & board	3,817	1,588	+ 300	+ 192
Fuelwood (excl. residuals)	2,93 (average 1987/96)	3,570	+ 30 (87/96:62/71)	+ 31

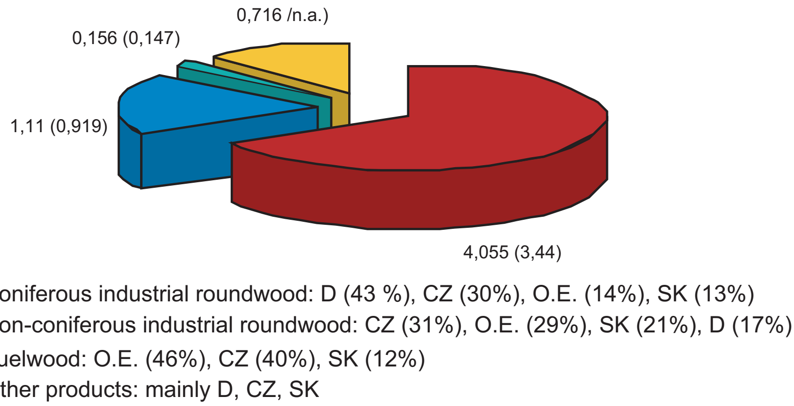

Figure 3. Imports of raw-wood in million cubic metres (in brackets net-imports) and the share of most important supplying countries (D=Germany, CZ=Czech Republik, SK=Slowakian Republic, O.E.=European countries except CZ, SK and members of EU) in 1997

are in the wood processing industry (sawmilling and paper industry roughly 10,000 each, wood processing industry 27,000). The timber manufacturing sector provides most jobs (52,700 in joinery and related sectors); 15,100 people – the same amount as in the forestry sector – work in the timber trade and the administration/service sector. Although the amount of jobs provided by the forest and forest industry sector is small, it has to be pointed out that they are very important in rural and remote areas lacking other employment or well developed commuting facilities.

3.1.4 Profitability and productivity

The profitability of Austrian forestry is annually published by the Ministry of Agriculture and Forestry. To measure these data four networks are supported by the Federal Ministry: one network for farm forests, two for jointly owned forests in the two western provinces where this kind of management prevails (ended 1994), and one for forests larger than 500 hectares. The Austrian Federal Forests are not included and are cited separately. These networks are based on voluntary membership, and four underlying principles for the calculation of the data obtained have to be stressed:

1) The data such as costs or profit refer to the allowable cut to obtain more stable results for the time series; as the actual cut is usually slightly higher (approximately +20% in enterprises exceeding 500 hectares), due to several reasons the actual profit is also higher.
2) The results refer only to the income made from forestry not including hunting or other non-forest income.
3) The data are calculated on a cost accountancy basis; with farm forests the labour input of farmers in forestry is taken, and on the basis of cost accountancy a contribution to the income from forestry work is calculated.
4) Calculated interest is excluded.

According to the Austrian Forestry Report, enterprises > 500 ha earned ECU 0.94 / m^3 allowable cut. In 1994 and 1995 it was ECU 2.54 and ECU 4.93 respectively. These figures indicate the difficulty the Austrian forestry had in 1996 due to the economic development and the opening to the European market. The contribution to the income of farm forestry was - depending on the region - ECU 23.26 and ECU 16.01 per m^3 allowable cut, respectively. A higher income could be received in the years before. The Austrian Federal Forests are cited separately; in 1994 and 1996 the result was a loss, the result for 1995 was roughly one third compared with the forest enterprises. One explanation for these results are the forests managed by the Federal Forests which are in many regions difficult and costly to manage.

One method used to measure the productivity is the production per employee. In 1996 the productivity per employee was 823 cubic metres in the sawmilling sector, 650 cubic metres in the panel industry and 349 tons in the paper industry. All of these industries could increase the productivity substantially over the last decades, especially the panel and paper industry.

4 Forest and forest related policies

4.1 Legislation and administration

Austria is a federal state with nine federal provinces (*Länder*). Two important constitutional characteristics have to be pointed out which are of interest in the context of this chapter:

1) The delegation of authorities between the federal state and the *Länder*
2) Indirect federal administration by the *Länder*

ad 1: In Austria, forest law is the responsibility of the federal government. The forest law comprises all forestry activities and ranges from tending, maintenance, harvesting operations to forestry education as well as subsidies. A detailed overview about the 12 sections of the Forest Act is given below. The other legal sectors of relevance to forests, such as hunting, regional planning or protection of nature, are within the competence of the federal provinces; this means that a) different agencies deal with these matters and b) each province has its law for purposes such as hunting or nature protection. This results in an often competitive coexistence of federal law and provincial law which are applied to the same piece of land and therefore can result in problems, especially when taking the example of forestry and hunting (see Chapter 5).

ad 2: Indirect federal administration by the *Länder* (*mittelbare Bundesverwaltung*) means that in many matters, such as forestry, the legislation is the responsibility of the central state while the execution of these regulations is a matter of the provincial authorities. There are three levels of forest administration in Austria (see Figure 3): The Federal Ministry of Agriculture and Forestry (*Bundesministerium für Land- und Forstwirtschaft, BMLF*) is the authority at state level. As no corresponding federal administrative bodies exist at provincial and district level, the administrative implementation falls within the competence of the authorities at these levels. This means that the provincial governor (*Landeshauptmann*) and the district governor (*Bezirkshauptmann*) are responsible in these matters; they have, however, forest authorities at each level on their side assisting them in these matters.

The present forest legislation in Austria has its roots in the medieval regulations of Austrian emperors with the focus on a sustainable forest utilisation in the interest of the early salt and iron smelting industries. As a result, the first comprehensive forest legislation incorporating the basic principles of conservation and protection was released in 1872. The legal foundations relevant to forests in Austria today are laid down in the Austrian Forest Act 1975 (amendment 1987) and its implementing regulations include the Regulation on Hazard Zone Plans, the Regulation on Forest Development Plan and some more. The Forest Act consists of 12 sections which are as follows:

1) Definitions: definition of forest, forest areas, and other definitions used in the Forest Act
2) Forest land-use planning: here the Forest Development Plan, the Hazard Zone Plan and other plans are defined
3) Maintenance of the forest and of the sustainability of its functions: a) General regulations; b) Forests requiring special treatment (like the protection forest or the ban forest); c) Regulations on using the forests for recreational purposes ; d) Forests with additional uses (such as pasture, water resources/protection)
4) Forest protection: Protection against fire, calamities and pollution
5) Logging and hauling: Regulations for forest road development, cable installations, skidding

6) Harvesting operations: strict harvesting regulations
7) Protection against torrents and avalanches: Torrent and Avalanche Control Service (TACS)
8) Forest personnel and forest education: duties of forestry personnel and their education and training
9) Federal Research Centre: Tasks and Regulations
10) Forest promotion: Regulation on measures promoted
11) Forest seeds and nurseries: regulations on treatment, production and import/export
12) General sanctions

ad 3: According to the Forest Act, everybody is allowed to walk in the forest for recreational purposes except for defined areas (such as regeneration areas and others). People are even allowed to pick defined amounts of mushrooms and berries. Problems arising with this ”opening of the forest to the public” arise increasingly with mountain bikers using forest roads, cross country ski tourists impacting forest saplings or orientation runners harassing wildlife to some (assumed) extent. This is still a ”grey area” in jurisdiction and is dealt with in Chapter 5.

ad 8: One method to ensure the sustainability of the forests and the surveillance by professionals is laid down in this section. Here the number of trained foresters who are required to manage a certain area of forest are clearly defined: up to 500 hectares no trained forester is required; forest estates exceeding 500 ha must employ a graduate from a forestry school, estates exceeding 1800 ha, require a forester with a university degree.

4.2 Actors in forests and forest related policies

Figure 4 gives an overview of the forestry organisation. The role of the forest authorities has already been dealt with in the Chapter 4.1. It should only be mentioned again that the Federal Ministry is responsible for the law making; the other forest authorities on provincial level and district level have the duty to implement the Forest Act by assisting the provincial/district governor who is as the general authority also the authority for forest and many other matters. The TACS, the Federal Research Centre, and Forestry Schools and Training Centres will be dealt with in the Chapters 4.3 and 4.5.

In Austria, two different kinds of interest groups exist: Statutory Interest Groups and Private Interest Groups.

Statutory Interest Groups, so called Chambers (*Kammern*), are established by public law and with obligatory membership including fees; they exist for all businesses and industries. The Chambers ofagriculture (*Landwirtschaftskammern*) deal with the matters of agriculture and forestry where all farm and forest owners are automatically members. Members may make use of the services offered by the chambers. Statutorily the Chambers of Agriculture have two different tasks: the representation of group interests and the consulting of foresters or forest land owners including the appropriation of subsidies. As these representatives only exist on district/provincial level the presidents of the Chambers of Agriculture are informally organised at state level. This Standing Conference of the Presidents of the Agricultural Chambers (*Präsidentenkonferenz der Landwirtschaftskammern*) represents the interests of forestry at state level and is a rather influential institution in forest politics. For the industry sector another Chamber exists with subdivisions representing the single forest industries.

The most important interest groups based on voluntary membership in Austria are the Austrian Federation of Forest Owners' Associations (*Hauptverband der Land- und Forstwirtschaftsbetriebe Österreichs*) and the Austrian Foresters' Association (*Österreichischer Forstverein*). The Austrian Federation of Forest Owners' Associations looks after the interests of private farm and forest land owners. It supports forest owners and tries to safeguard mainly the right of private ownership and free disposal of forest property. Since most owners of larger forest estates join this federation, the roughly 800 members represent a total forest area of about 800,000 hectares. Although it has no official effect on legislation, the Federation

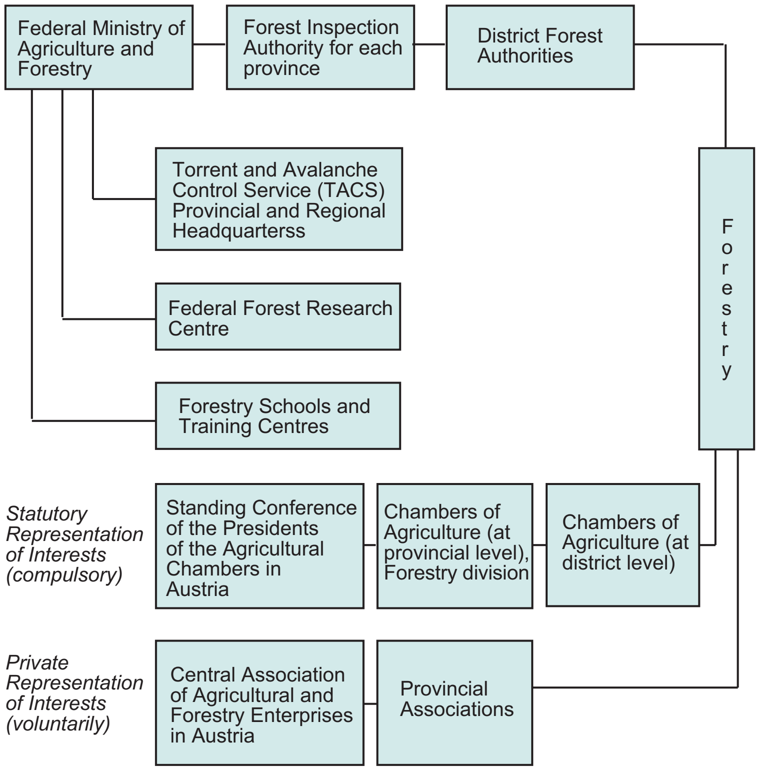

Figure 4. Forest organisation (after BMLF)

influences, to some extent, the legislative and administrative occurrences due to the high degree of organisation and the co-operation with other players and authorities in the field of forest politics. The Austrian Foresters' Association represents forest land owners as well as forest professionals working in the forestry sector. Roughly two thirds of the potential members join this Association (the 210,000 owners of small farm forests, mainly farmers, not counted) whose task is the promotion of forestry in Austria. For most forest professionals membership is taken for granted as it results from tradition which plays an important role in the forest sector. This might also be the reason that forest owners' associations have a rather strong relationship with the conservative, Christian-democrat party in Austria, the Austrian People's Party (ÖVP).

4.3 Forest policy tools

Generally speaking, in Austria three different kinds of policy tools can be distinguished: regulation, subsidies, information. These instruments sometimes are used in combination; due to the situation in the Alpine regions where forests are crucial for protecting villages and other developed land, there are several specific regulations referring to such forests. The instruments are listed below and some of them are explained briefly (after Weiß 1988).

Regulatory instruments:
- General prohibition to clear the forests for other uses
- Obligation to reforest after harvesting
- Regulations on forest management which in addition to above regulations ensures the sustainability

- Forest management regulations for protection forests
- Procedures for the establishment of ban forests
- Regulations on watershed management

Economic instruments:
- Subsidies for forest treatments and technical investments
- Subsidies for high-elevation afforestations and amelioration of protection forests
- Subsidies for watershed management projects (between Forest Authority and TACS)
- Subsidies for technical and biological measures of torrent and avalanche control

Informational instruments
- National Forest Inventory and Austrian Forest Report
- Extension service of Forest Authority
- Forest Development Plan by the Forest Authority
- Hazard Zone Plans by TACS
- Protection Forests Plan by the Forest Authority together with TACS
- Expertise by the TACS on natural hazards

The regulatory instruments are laid down in the Forest Act 1975 (amended 1987). The subsidies are administered by the Chambers and the Torrent and Avalanche Control Service (TACS). This is an agency directly subordinated to the Federal Ministry and is responsible for the protection of human interests against torrents and avalanches. Apart from granting subsidies (making up 50% of the total amount available for forestry), it carries out technical measures and works out plans to ensure the protective function of mountainous forests against hazards. The Hazard Zones Plans show catchment areas of avalanches and torrents as well as endangered areas of communities. Different risk zones are distinguished. Hazard zones plans are not binding unless incorporated into the municipal land-use plans; subsidies for preventive measures are only granted when this plan is taken into consideration. The second regional zoning tool is the Forest Development Plan by the Forest Authorities. It covers forest areas and areas afforested with regard to the four forest functions laid down in the Forest Act; a key function is determined - it is timber production unless another function is assigned as being of outstanding importance. The Austrian Forest Inventory registers on a statistical basis the structure and developments of the Austrian forests. Data about forest area, type of property, amount of wood stocked, increment and many more are obtained and updated every five years, therefore this inventory is an important monitoring tool. The Minister of Agriculture and Forestry has to give an annual report on the situation about forests and forestry to the *Nationalrat*. Many forestry measures are promoted and in 1996 the total volume of subsidised measures amounted to ECU 48.3 million and was 21% higher than the year before. The EU contributed ECU 3.91 million, ECU 24.78 million came from the forest owners, the rest were national subsidies. For the stabilisation and rehabilitation of protected forests ECU 23.77 million were invested in various projects covering about 12% of the area requiring such measures.

4.4 Forest policy in relation with other national policy areas

Forest policy influences and is influenced by other national policy areas. Protection of nature, hunting and regional planning are to be mentioned.

4.5 EU forest and forest related policies

Since Austria joined the European Union in 1995 policies affecting forestry have had to be adapted. The most important common policies are outlined briefly emphasising the effect on forestry in Austria. The subsidisation by the EU-agricultural structural policy takes place within the framework of six objectives, of which 1, 2, 5b and 6 are the regions concerned, the rest applies to the whole territory of the EU. The Objectives 1 to 5 are relevant for Austria. The federal province ”Burgenland” is a region under Objective 1, parts of Central Austria are regions under Objective 2, and many areas all over the federal territory are regions under Objective 5b. Of most significant importance for agriculture and forestry are the Objectives 5a (adaptation of agricultural structures throughout the Community), 5b (development of certain geographical rural areas), and 1 (speeding up the development of regions lagging behind). Table 6 gives an overview about the funding concerning these three Objectives:

Most money is available for Objective 5a where the subsidies for afforestation for agricultural land are also included. This should enable the restocking of agricultural land with appropriate species and, according to the kind of afforestation, the financial aid per hectare is calculated. Tending of such afforestations is promoted for a five year period. Several other forest activities and investments in forests are promoted either on a national level or in combination with aids from the Union. In 1997 7.83 million ECU were paid as co-financed subsidies for forest measures of which 0.9 million ECU were used for afforestation, 0.22 million for tending of afforestations, 0.46 million for exchange of forest stands, and 6.23 million were used for forest roads. Comparing with the figures in Table 6 the subsidies used for forestry are tiny.

Another EU policy in relation to forestry might be the Common Environmental Policy, in particular the fauna-flora-habitat directive and the bird protection directive. The implementation of these directives is within the responsibility of the Ministry of Environment, Familiy and Youth. The goal is the creation of ”Natura 2000” habitats which should be protected together with the animals and plants living in it. A working group consisting of representatives of the nine federal nature protection authorities, researchers, and representatives of the Federal Environment Agency have been working out a list of ”Natura 2000” areas. Such areas are found in all federal provinces with the emphasis on Alpine regions and regions which are still close to nature.

4.6 Forest education and research

In Austria, forest education and research has a long tradition. Several educational institutions are to be found in Austria: A one-year college course is offered to become a forest warden whose duties are mainly the forest protection and hunting control services. Foresters are educated in one of the two Forestry Schools taking five years. They finish with a degree in Forestry and get the title of an ”engineer” after a couple of years practice. The highest level of forest education is offered at the University of Agricultural Sciences (*Universität für Bodenkultur*), Vienna. Apart from Forest Sciences two other forest-related studies are offered: Sciences of Torrent and Avalanche Control and Wood Science. Five years of studying are required to become a ”graduate engineer” (*Diplom-Ingenieur*) in one of these subjects; aspects of economy, ecology and technique are covered in their theoretical principles and practical application. Jobs in forest management, public forest administration, the timber processing industry, and other fields are offered to graduates. Graduated foresters of both forest schools and university,who work in forest management have to take another(federal) exam(*Staatsprüfung*) after a few years practice which is required due to the Forest Act to ensure sustainably and well managed forests. Training in fields such as silviculture or harvesting are offered by two Federal Training Centres as well as by training centres of the federal provinces and the chambers.

Research in the field of forestry is covered by several institutions. According to the Forest Act the Federal Forest Research Centre is charged with the investigation of problems in the fields of forestry and their solution. The responsibili-

Table 6. Subsidies for integrated rural development in agriculture and forestry according to the missions of the Structural funds 1995 - 1999 in Austria (splitted according to the contribution: EAGGF = European Agricultural Guidance and Guarantee Fund) in billion ECU

Objective	EAGGF	Federal state	Federal province	Total
1	0.024	0.37	0.16	0.07
5a	0.026	0.59	0.16	1.35
5b	0.019	0.39	0.11	0.43

ties are laid down by the Forest Act 1975 (amended 1987) and include (BMLF 1993):

- Fundamentals of forest production: Site research, forest genetics, silviculture and research nurseries, forest techniques
- Forest condition and forest growth: Forest Inventory, forest growth and economics
- Forest damage, diseases and pests: Forest protection, air pollution research and forest chemistry
- Forest protection from erosion, torrents and avalanches: Torrent research, avalanche research, sub-Alpine forest research

To research the above fields and to obtain data monitoring systems are installed (e.g. on pollution; Forest Inventory), experiments are conducted, and there is co-operation with several other institutes. The permanent Secretariat of IUFRO (International Union of Forestry Research Organisations) is also located at this centre as Austria was one of the founding members.

Another important institution dealing with forest research is, of course, the University of Agricultural Sciences, Vienna. At the Faculty of Forestry and Wood Sciences the coordination of two forest die-back research initiatives (FIW I/II) was organised in the 80's and 90's, being followed now by a Special Research Programme (SFB) on Forest Ecosystem Rehabilitation, focussing mainly on secondary coniferous forests and on protection forests.

5 Main current conflicts and challenges

5.1 Relations between different actors in the field of forestry; forestry matters; the role of the state

One main conflict already mentioned in this report exists between forestry and hunting. Damage to trees by bark stripping as well as browsing of regeneration areas,especially in reforested clearcuts, (which is even more severe in protection forests) are results of an artificial high game population (deer, chamois). Measures such as fencing of regeneration stands or single tree protection are expensive but often required. A solution to this problem is difficult as different legal foundations are to apply (see Chapter 4.1). Many forest enterprises bear these costs as game management and hunting (such as renting hunting areas or selling the permission for a single game species) often contribute significantly to their income. As 10% of forest land in Austria are pastures, similar problems are caused by livestock animals (browsing, trampling). Such pastures represent a historically developed type of forest utilisation, so the farmer's rights of redemption are duly respected.

Concerning the mentioned ungulate game damages, there exist controversial ideas about main reasons and releasers: for example, bark stripping impacts are quite different in various provinces. But, according to reanalysed statistical forest inventory, deer harvest and other data, they are much less associated with game densities, harvest numbers, or supplemented winter feeding than usually assumed. It most significantly correlates with forest characteristics if they are assessed as highly artificial, site-unfavourable tree-dominance, high preharvest-thinning debts, high clear-cut amounts, and some other forestry practice characteristics (still) typical for most Austrian forests – although with provincial differences. Obviously, food shortage is a major reason, not to be compensated by supplemental feeding efforts. Similar research results exist for browsing impacts and the major role of forest characteristics as a main predisposition for browsing probability and its different threats to rejuvenation goals and techniques (e.g. shelterwood vs. clear cut rejuvenation).

Austria's most important income is tourism. In addition, also local people increasingly use the forest for recreational purposes. Especially new sports such as mountain-biking cause conflicts between foresters/hunters on the one side and bikers/tourism on the other. The main point of conflict is a ”grey area” in jurisdiction about the use of forest roads and the insurance in case of an accident. In single areas requiring ”open forest roads” for biking or horse riding an agreement is set up between these two parties regulating matters such as insurance, redemption, or marked ways. This is not possible in all areas as there is no existing organisation for bikers which could negotiate above matters. Efforts are undertaken permanently, and at least regional solutions have been negotiated.

Silvicultural practices have been changing. Artificial monocultural practices are increasingly replaced by natural regeneration and the promotion of mixed stands – where natural. The latter is regarded as an important practice against acidification of forest soils. Single tree felling and methods enabling natural regeneration (such as shelterwood cutting) show a rising trend at the cost of (small-scale) clearcuttings. Instead of hauling the whole tree out of the forest, branches and leaves are left on site to remove as little nutrients as possible out of the ecosystem. A similar natural approach is found when looking at the harvesting methods employed in the past and nowadays. In the past, timber was often pulled over the soil surface with cables and winders wounding standing trees; these old damages are still monitored. Now high-tech harvesting machines have been replacing cable hauling where possible and the damage decreases.

A challenge for Austrian forestry is the restoration of protection forests. These very sensitive forests require special treatment to fulfil their function. The law obliges the forest owner to maintain a stable forest and to provide for timely regeneration. Due to several reasons which cannot be discussed here in more depth and difficult jurisdiction, the measures are not carried out properly as they are in many cases too costly for the owner. In addition, accessibility and the forest road network is worse than in commercial forests and, as a result, investments in these forests are reduced. As the regulations are practically not implemented sufficiently, the protected forests in mountainous areas are abandoned. 12% of protection forest with commercial yield are unstocked, many stands are overmature and lack regeneration, and browsing by cattle and game makes the situation even worse. A similar situation is found for protected forests. 161,000 hectares need silvicultural treatment. Several measures have to be undertaken: Reduction of forest damaging pollutants, a sound relation between forest and game, separation of forest and alp management, silvicultural measures. Subsidies for such measures will be available.

Timber certification is a matter which is also discussed in the Austrian forestry and timber processing industry. As a first initiative ”PROHOLZ – Holzinformation Österreich”, an organisation promoting the use of timber products launched, in co-operation with other associations, a label of origin for Austrian timber and timber products. The label ”Timber from Austria. Natural. Controlled.” can be used voluntarily according to stipulated regulations. It mainly guarantees the origin of roundwood from Austrian forests and its ecological compatibility due to the strict forest regulations and the forest monitoring by experts and authorities.

5.2 Environmental aspects and issues arising from UN Conference in Rio related to forestry

The Conventions, principles and the Agenda 21 which were set up in Rio de Janeiro in 1992 influence not only the environmental policy in Austria but also aspects of forestry. The latter aspects will be briefly outlined in this chapter but should not be regarded as a comprehensive summary. Austria takes the requirements of the Convention into account in a number of measures already undertaken. Such measures include the provincial laws for nature protection as well as the Environmental Control Act, the introduction of subsidies for ecological treatment of agricultural land, the establishment of protected areas and of national parks.

Biodiversity: About one quarter of the federal territory is governed by conservation laws for the protection of nature and countryside of which five areas have been designated as national parks in Austria. Three parks (”Neusiedler See – Seewinkel”, ”Donau-Auen, ”Kalkalpen”) are internationally recognised as a national park (category II) according to the IUCN (International Union for Conservation of Nature and Natural Resources) definition; the other two (”Hohe Tauern” and ”Nockberge”) are protected landscapes (category V). Three more national parks are in the planning stage (data from 1995). Apart from these parks a number of nature preserves, landscape preserves, and protected landscapes exist; they include RAMSAR reserves (Convention on wetlands of International Importance Especially as Waterfowl Habitats). A series of workshops are held dealing with central issues discussed by the convention. A final report was published to provide a basis for implementation of the Biodiversity Convention. Plants and animals being under threat of extinction are listed on the ”red list of Austria’s endangered animal and plant species”; about one quarter of all animal species (in 1990) and 37% of all plant species (in 1986) were under some threat of destinction. As the main reason for the high number of endangered species is the destruction of habitats, one aspect of the environmental policy is to force their protection as well as habitat improvement or regeneration efforts (e.g. forest monocultures, hard regulated rivers and creeks).

In the forestry sector, several measures have been undertaken to increase the stability and safeguard forest biodiversity. A Protection Forest Restoration Framework has been developed to stabilise and restore protection forests parts of which are in a bad condition because of the lack of regeneration or because of overmature stands. This framework includes several measures and gives great importance to the Mountain Forest Protocol (*Bergwald-Protokoll*), currently under preparation within the framework of the Alpine Convention. Measures to safeguard forest biodiversity are adopted by the forestry authorities; examples are forest management based on natural succession, biotope and habitat mapping of forests, and the separation of forest reserves. Such reserves are partly genuine residues of virgin forests, the majority are close-to-natural forests being very similar to the original state; in these reserves human intervention is prohibited and the main purpose is for demonstration, for silvicultural research, and for reasons of biodiversity. Since 1995, a representative network has been developed systematically, and the establishment of 430 natural forest reserves with a total area of 10,000 hectares is aimed at. Within the 1992 ”Man and Biosphere” Programme, the ”Hemerobia of Austrian Forest Ecosystems” was examined gathering data for the evaluation of the anthropological impact on Austrian forests. The results show that 25% of the forests can be termed as natural or ecologically compatible, 41% as moderately altered; only one third can be termed as highly altered or artificial. These percentages are quite unevenly distributed in the various provinces; for the mountainous (Alpine) regions, the following measures are of particular importance: high altitude reforestation programmes, guidelines for the preparation of tourist strategies, and the Convention on the Protection of the Alps (in force since 1995) promoting transregional co-operation among the Alpine countries and the EU to protect and preserve the Alpine region as a human habitat.

Guidelines for environmental policy are laid down in the ”National Environmental Plan” which was adopted by the Austrian parliament in 1997. It is based on the idea of sustainable development at the environmental, economic and social level.

Addresses of organisations related to Forestry:

Bundesministerium für Land- und Forstwirtschaft (BMLF): Federal Ministry of Agriculture and Forestry Sektion V (Forstwesen) Ferdinandstraße 4 A-1020 Wien Tel: +43/1/21323 http://www.bmlf.gv.at

Bundesministerium für Umwelt, Jugend und Familie (BMUJF): Federal Ministry of Environment, Youth and Family Affairs Stubenbastei 5 A-1010 Wien Tel: +43/1/51522 http://www.bmu.gv.at

Universität für Bodenkultur (BOKU): University of Agriculture Gregor-Mendel-Straße 33 A-1180 Wien Tel: +43/1/47654 http://www.boku.ac.at

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Azerbaijan

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1 The country

Azerbaijan borders to the east with the Caspian Sea, to the south Iran and Turkey, to the west Armenia and Georgia and to the north Russia.

1.1 Natural conditions

Topography
The total land area of Azerbaijan is 86 800 km^2. Forests occupy 11-12 % of the area. The topography of the country is difficult. The biggest part (40%) of the country is lowland (1/5 below sea level), 23% is low-altitude (up to 500 m), 25% mid-altitude (500- 1500 m) and 12% high-altitude (more than 1500 m). The highest peaks are Bazar-Dyzi mountain (4485m), Sahdag (4250 m) and Murovdag (4500 m). Relief is formed by the mountain systems of Great and Small Caucasus and Taljish and Kura-Arak lowland.

Geology
Azerbaijan is geologically one of the most complicated and original areas of alpine folded zone. Soil stratification encompasses phases from lower Palaeozoic up to Holocene Epoch. The formations of Mesozoic and Cenozoic (Miocene Epoch) soils are best developed. The modern tectonic structures were created in the beginning of the Neogene period. The territory of Azerbaijan is characterised by increased seismic activity: the minimum hum noise (background) seismic threat is equal to 7 points.

The Azerbaijan ground is rich in various minerals. Extraction and sale of oil and natural gas form the largest part of the national income. Both oil and natural gas are extracted at the coast and from the bottom of the Caspian Sea. Additionally Azerbaijan extracts iron and cobalt (Dahskestan), copper (Kedabek), alunit (Zaglik), barit (Chovdar), and various non-ferrous metals.

Hundreds of mineral springs of drinking and medicinal water are available in the territory of Azerbaijan. The glaciers are spread in mountain areas to heights of more than 3000 meters. Salt-marsh deserts and the semi-deserts occupy hundreds of hectares in the lowlands.

Climate
Eight different climate types can be defined in the territory of Azerbaijan:

1) Subtropical dry climate in lowlands of deserts, semi-deserts and in steppe. Precipitation of 200 - 250 mm falls during the hot summer (4-5 months) and mild winter.
2) Subtropical damp climate.
3) The continental dry climate, occurs in Nahichevan region at altitudes of 700 - 1000 meters.
4) Moderate warm dry climate, characteristic of the steppe plateau.
5) Moderately damp climate
6) Moderately cold climate.
7) The cold climate, characteristic at altitudes of 2000- 2500 meters.
8) Alpine tundra climate - alpine zone at altitudes of more than 3000 meters.

Soils
Grey soil and salt-marsh (solonchak) dominate in Azerbaijan lowlands. Desert-steppe chest-

Table 1. Distribution and altitude of main and associated subspecies as a percentage ratio to all forested areas in Azerbaijan.

Main species	Subdominant species	Altitude (m)	%
Fagus orientalis	*Quercus iberica, Q. Macranthera, Q. Erucifolia*	various	32
	Betula sp. *Div., Carpinus caucasica,*		
	Tilia caucasica		
	Acer platanoides, A. pseudoplatanus,		
	A. velutinum, A. laetum		
	Ulmus elliptica, U. Scabra, Diospyros lotus		
	Alnus subcordata, Rhamnus pallasii		
Carpinus orientalis	*Quercus iberica, Q. Erucifolia,*		
	Q. Hypochrysa, Q. Crispata	1800 – 2000	26
C. caucasica	*Fagus orientalis, Carpinus caucasia,*	Various	
	Juglans regia		
Quercus sp. Div			23.4
Q. rubescens		0 – 500	
Q. araxina		300 – 1150	
Q. castanifolia	*Carpinus grataegus, Parrotia persica,*	0 – 800	
	Ulmus hyrcana		
Q. iberica	*Carpinus orientalis, Zelkova carpinifolia*	500 – 1500	
Q. iberica + Q. *Macranthera*	*Acer trautvetteri, Sorbus caucasica, Betula sp.*	1600 – 2400	
	Viburnum lantata, Juniperus sp. Div		
Q. longpipes	*Pistacia mutica, Elaegnus caspica,*	River delta	
	Morus alba,		
	Rubus sp. Div., Prunus sp. Div., Ulmus araxina		
Populus sp. Div.			3.6
Populus tremula	*Crataegus sp. Div., Rubus sp. Div.,*	1000 – 1800	
	Carpinus orientalis, Fageta orientalis		
Populus hyrcana or	*Morus alba, Eleagnus angustifolia,*	River delta	
	Tamarix sp. Div		
Populus hibrida	*Hippophae rhaminoides, Pyracantha coccinea*		
Juniperus sp. Div.		Various	2.4
Alnus sp. Div			1.9
A. incana	*Periploca graeca*	1000 – 1500	
A.subcordata		River delta	
		0 – 600	
A. barbata		0 – 200	
Tilia sp. Div		Various	1.7
Ulmus sp. Div			1.2
U.scraba + Acer velutinum		200 – 600	
		River delta	
U. foliaceae + Populus hyrcana or P. hibrida		River delta	
Other species		Various	8.1

nut soil is predominant on flat lands. Chernozem (black earth) occurs in the foothills, brown soils within mountain forests, and mountainous meadow (subalpine and alpine) at high-altitudes. Yellow soil can be found in the area of Lenkoran lowland. Alluvial soils are advancing under forests in Alasan-Agrichai valley.

Vegetation
The forests of Azerbaijan can be classified into two distinct floristic regions: Ircumboreal (Caucasus province) and Mediterranean (Girkan province) areas. Forests occupy about 11- 12 % of the total land area of the Republic. The main species by forest area are *Fagus orientalis, Carpinus orientalis* and *caucasica* and *Quercus sp*. at 32, 26, and 23.4% respectively (table 1).

1.2 Society

Population
Population of Azerbaijan is about 7 million. Azerbaijanians form the basic population of the Republic. In addition to Azerbaijanians, other nationalities such as Russians, Georgians, Armenians, lesgins, tatis and others live in the country.

Nakhichevan autonomous Republic (capital Nakhichevan) and Nagorno-Karabah autonomous area (capital Hakkendi) belong to the Azerbaijan Republic. Azerbaijan became an independent state in 1991, after the disintegration of the Soviet Union. Azerbaijan is a Republic with an elected president and has a multiparty system of parliament.

Politically speaking, since February 1988, tension between Azerbaijan and Armenia has grown. After the declaration of independence in August 1991, the situation got worse. In November 1991, Azerbaijan launched a massive military operation against the Armenian enclave of Nagorno-Karabakh. Life of the people of that region began to deteriorate (food supplies, medications and water). As a result of this political conflict the number of displaced persons is increasing daily. There are now approximately 200,000 persons from or close to Nagorno-Karabakh who have been displaced, as refugees.

Economy
The Azerbaijan economy is based on the petroleum, chemical, electromechanical industry and metallurgy and metal processing. The country is richly endowed with mineral resources, especially with oil and gas. Azerbaijan's share of the world oil reserves totals 830 million tonnes. Agriculture is based on the production of cereals, cotton, tobacco, grapes and winemaking, and sheep breeding. The cultivation of citrus, almonds, and melon is well developed.

Industry
Azerbaijan forestry is a large, independent branch of the economy that is responsible for growing and use of forests. Sawmilling existed in the mountain forest regions of Azerbaijan until 1960. Now forest resources are used in insignificant amounts for fuel and, partly, for the manufacture of furniture, parquet and so on. There are about 40 forest areas in the country. Only sanitary fellings are carried out and an insignificant number of additional plantations exist. Besides this, afforestation is carried out to prevent soil erosion and to strengthen and stabilise stands. Cultivation of citrus, almonds, walnuts, *Diospyros* and pistachio (*Pistacia vera*) are best developed.

2 Forest resources and their uses

2.1 Forest ownership

Forests mean ecologically clean air, water, food, fuel, chemistry, construction materials and many other products, which are considered as national property, i.e. state owned, and cannot be the object of sale and private property. However, land and forests can be sold by a legislatively established order to state, NGO's and cooperative organisations. They can also be given free to private persons for example for farming construction or market gardening purposes.

2.2 Land use and forest resource

2.2.1 Distribution of the forests

Most of the forests distributed in the Azerbaijan area are old growth, or middle aged stands (table 2).

Table 2. Distribution of forests by age categories.

All forest territory	100.0
Young stands, class I	12.7
Young stands, class II	15
Middle-aged stands	21.6
Regeneration mature	15.3
Old growth	35.4

2.2.2 Protected areas

Nature reserves

In Azerbaijan there are 14 nature protection areas. They are habitats of endemic or relict species characteristic for the country. The reserves cover not only forested areas, but also areas covered by mountain xerophytes and moorlands. The following reserves have at least partial forest cover.

1) The Zakatalskii state reserve was established in 1930. Its total area is 25 190 hectares. Forests occupy approximately 14 500 hectares and sub-alpine and alpine meadows 7000 ha. The reserve is located on the southern slope of Principal Caucasus Range. The main forest forming species are *Fagus orientalis, Quercus macranthera, Acer trautwetteri, Pinus kochiana* and *Taxus baccata*.
2) The Girkanskii state reserve was created in 1936. Its total area is 2900 hectares. The reserve is located in Lenkoran area. The main forest forming species are *Arrotia persica* and *Quercus castanifolia* together with other species of Girgisian origin.
3) The Geigelskii state reserve was formed in 1926. Its total area is 7900 hectares. It is located in the north-east of the Republic. At altitudes of 300-500 m mountain xerophytes form the main vegetation. At higher altitudes two zones can be distinguished: a forest belt at 1100-2500 m and a mountain meadow belt from 2500 m up to 3060 m. The main species in the forest zone are *Pinus eldarica, Fagus orientalis, Quercus iberica, Betula sp. div.* and *Pinus kochiana*.
4) The Basutchaiskii state reserve was established in 1974 for preservation of a unique *Platanus orientalis* grove along the river Basutchaja. Several trees in this reserve have reached an age of 500 years. This forest reserve may have been destroyed as an outcome of the conflict in Karabah.
5) The Karajazkii state reserve was established in 1978. Its total area is approximately 4800 hectares. It is located in western Azerbaijan along the river Kura. It is basically “tugai” forest consisting of *Populus hibrida, Tamarix ramosissima, T. Hohenacheri* and others.
6) The Pirkulinskii state reserve was established in 1968 in the area of Shemahinskii. It consists of three separate areas, commonly of 1521 hectares. The reserve is located on south-east slope of Large Caucasus (Shemaha). All the areas are covered with forest.
7) The Turianchaiskii state reserve was created in 1958. It has a total area of 12356 hectares, of which approximately 4660 hectares are forested.
8) The Ismailliiskii state reserve is located on a southern slope of Large Caucasus. The whole reserve is forested.
9) The Ilisuinskii state reserve is located on Large Caucasus. The whole reserve is forested.
10) The Altiagachskii reserve is located on the easternmost slope of Large Caucasus. The vegetation consists of forest and mountain xerophytes.
11) The Tophaninskii state reserve is located in Shushinskii area. It is covered by arid light forest. At present the reserve is seized by Armenia.

2.2.3 Forest threats

Insects

Many species of forest insects are spread throughout the forests of Azerbaijan. *Operophthera brumata, Erannus defoliaria* and *Wiston hirtaria* are spread mostly on the foothills. The focal point of infection is in oak -

hornbeam forests (or plantings). On average up to 15.000 hectares are affected annually. Pest infestation frequently reaches 80-100 %. The strength of oak tortricid (*Tortrix viridata*) has multiplied in the foothills over recent years and mass reproduction of *Haltica quercetorum* has been observed in oak forests. Infestation affects hornbeam (*Carpinus caucasica*), oriental hornbeam (*Carpinus orientalis*) and oaks (*Quercus sp.*). Damage to foliage reaches 80-100%. *Capnodis tenebrionis* is significantly harmful to plantations of almonds in submountain areas. *Pineus orientalis* and *Lacchnis pineus* basically damage pine.

Fungus
Microsphaera alphitoides develops on all species of oak. Mass withering of foliage and shoot appear as the result of damage. Infestation is up to 50%. 50.000 oaks have perished over previous years because of *Ceratocystis roboris*.

Pollution
Contamination by industrial wastes, sometimes oil-processing wastes, also damage forests. Serious danger to forests is caused by sheep breeding. The forest is partially cut down for new pastures, and is partially trodden by sheep.

Abiotic factors
During the last decade the water level has constantly risen in the Caspian Sea. Some forest territories in the coastal areas have been badly damaged by floods. Tempests, damages caused by snow and forest fires seldom take place.

2.3 Forest production

Most forests are mountain forests (98,5%). They are significantly important for climate and water protection and soil conservation. They belong to the group I. That defines the main trends of forestry - the whole growing stock of mountain forests on average for all species is equal to 172 m^3 per hectare. Average annual increment is 1,34 m^3 per hectare. Until 1970 only about 150 000 - 160 000 m^3 of timber was cut every year. On average, about 130 000 -150 000 m^3 of poor quality timber would now be available for sanitary fellings.

2.3.1 Non-timber forest products

Annual amount of gathered wild fruits and berries is about 10 000-15 000 tonnes, which is only about 5-10% of the whole harvest of wild fruits and berries in the republic.

The gathering of fruits from plantations is not conducted, however it is considered, that these plantations play an important role in the food balance of the population. Azerbaijan is the third poorest area among the former republics of the former Soviet Union.

3 Forest economics

3.1 Economic structure

The principal industrial control organisation “Azerbles” supervises forest economy in the Republic. The forest areas, as a rule, are divided into separate economical units. People in charge of the economy, are often not experts in forestry. Forest management units carry out commercial wood cutting and sanitary fellings according to the regulations and laws in force, and also guard forests and afforestation.

4 Forest education and research

Up to the disintegration of the Soviet Union, there were 18 higher educational institutions, including some universities, but no special institute for forestry. The faculty of forestry existed within the agricultural institute between 1950 to 1960. At present there is no educational institution in the Republic to train foresters. The Azerbaijan Academy of Sciences was established in 1945.

The Botanical Institute forms part of the Academy, where there is a Department of Geobotany. The Forest Laboratory has existed within the structure of this department since 1970. This structure is unique in the country and is engaged in scientific forest research. The committee for forest economy is one of the governmental authorities. Its chairman is an agricultural scientist. In the Committee there are a few foresters, all at an average age of 70 years. In the forest regions of the Republic there is a lack of foresters.

Addresses of organisations related to forestry

ECORES, 68, Tagizade str, Baku - 370134 Azerbaijan
Tel. (99412) 31 78 81, http://solar.rtd.utk.edu/~ccsi/nisorgs/azerbaij/ecores.htm

Web-pages

Azerbaijan Organizations by City: http://solar.rtd.utk.edu/~ccsi/nisorgs/azerbaij/azerbaij.htm

Belgium

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1 The country

1.1 Natural conditions

Belgium has three major geographical areas: lower Belgium (up to 100m above sea level), central Belgium (between 100 and 200m above sea level) and upper Belgium (from 200 to over 500m above sea level). The soils are sandy to silty and deep in the north-western part of the country and become more clayey, stony and superficial, in the south-eastern part. Most Belgian forest soils belong to the group of Dystric Cambisols according to the FAO classification, with a multitude of local variations.

Lower Belgium begins in the west (see figure 1) at the coast, with the ‘Kustduinen’ (coast dunes) which extend in a straight line for 65 km. Inland from the coast lie the ‘Polders’, a clay soil. This is a flat and fertile land mainly used for agriculture. Bordered by the ‘Polders’ to the west and the Leie and the Schelde rivers to the east, lie the ‘Zandstreek’ (sand region) and the ‘Zandleemstreek’ (sand loam region). The ‘Kempen’ lies in the east of the country. The soil in the ‘Zandstreek’ and in the ‘Kempen’ is sandy and rather poor and the landscape is composed of grasslands and cornfields for agro-industry. In the ‘Kempen’ pine woods are another important landscape feature. In the more or less rich ‘Zandleemstreek’ several vegetables are grown.

Central Belgium is the area behind the ‘Zandleemstreek’ and the ‘Kempen’. Gradually rising to the Sambre and Meuse valleys, lies the ‘Leemstreek’ (loam region), with its low and very fertile loess plateau’s. This heavily urbanised area contains the forest of Zoniën (‘Soigne’). Furthermore, the ‘Leemstreek’ borders on Hainaut in the west and on Hesbaye in the east, both fertile areas with large farms and extensive fields and pastures.

Upper Belgium, the relatively sparsely populated (±178 inh. km^2, N.I.S. 1990) and densely wooded (>30 %, N.I.S. 1990) part of the country, begins south of the Sambre and the Meuse valleys at the Condroz plateau. The Condroz plateau is a fertile area. The natural forests were originally oak-beech *(Quercus robur, Q. petrea* and *Fagus sylvatica)* stands, but since a long time, humans replaced them by coppice with standards based on oak *(Quercus robur,* and *Q. petraea)* and noble hardwoods.

To the east lies the ‘Pays de Herve’ which due to its rich clay soil is suitable for grazing and cattle rearing. South of the ‘Condroz’ lies the area of ‘Fagne-Famenne’, a poor agricultural region. In the ‘Condroz’ and the ‘Fagne - Famenne’ the soils are silty-stony, acid or calcareous, mainly used as crop, pasture or forest land, according to their thickness, texture, drainage and pH.

Further to the south are the ‘Ardennes’, a region alternating between a wooded area with natural beech *(Fagus sylvatica)* forests on the plateau’s and homogenous spruce stands in the deep valleys. The soils of the ‘Ardennes’ are silty acid soils, containing a variable amount of stones. These soils are mainly used as pasture and forest land due to the cold climate. Peat soils are often developed in the High Ardennes, due to high precipitation and relatively impervious soils. These uplands are called ‘Hautes Fagnes’ (the elevation ranges from 600 to 700 m). Most of these lands were planted with conifers but still a few natural downy birch (*Betula pendula*) stands remain in natural reserves. The 'Ardennes' are a natural tourist attraction, and its southernmost part is called 'La Lorraine' (Belgian Jura).

The country's relief raises from sea level, in the plains of Flanders, to 694 m, the culminating point located in the Ardennes. Belgium is characterised by Cfb (Köppen 1930) as a marine climate, which is a humid climate with a short dry summer. Heavy precipitations occur during the mild winters. Average annual temperatures vary between 9.6°C at the coast and 6.4°C (N.I.S. 1990) in the high Ardennes, where frost often occurs. Precipitation varies between 750 mm at the coast and 1400 mm at higher altitudes.

1.2 Society

Three communities, three regions: one country
In recent years Belgium has evolved, via institutional reforms, into a federal structure. The decision-making power in Belgium is no longer exclusively in the hands of the Federal Government and the Federal Parliament. Now, the management of the country is the responsibility of several partners, who exercise their competencies independently.

A first redistribution gave rise to the Communities, a concept that refers to the peoples' language and culture (figure 1). Belgium has three Communities based on language: the Flemish Community (6,300,000 people), the French Community (3,800,000) and the German-speaking Community (70,000). For instance, a responsibility of the Communities is education.

The second main line of the State reform is historically inspired by economic concerns, expressed by Regions who wanted to have more autonomous power. This gave rise to the founding of three regions: the Flemish Region, the Brussels Capital Region and the Walloon Region (Figure 2). Their competence covers among others infrastructure, environment, and nature.

The Federal State retains important areas of competence, including: foreign affairs, defence, justice, finance, social security and agriculture. The Regions and Communities are entitled to run foreign relations themselves in the areas in which they are competent.

Forestry in federal Belgium is devolved upon each of the three regions since 1980: Flanders, Wallonia and Brussels. Furthermore forestry is not incorporated in the agricultural administration, which is still a federal matter in Belgium.

With a population of 10,170,000 at the end of 1996 (web site of the Belgian federal government) and a slight increase of less than 1 per 1000 inhabitants, the population of Belgium is nearly stable. With an area of 30,528 km^2 (N.I.S. 1990), Belgium has a population density of 333 inhabitants per square kilometre. The capital region of Brussels is the most densely populated, with 5,909 inhabitants/km^2 (N.I.S. 1990) followed by the Flemish region with 337 and the Walloon region with 178 (N.I.S. 1990). The least populated area is the German-speaking community in eastern Wallonia with 65 inhabitants/km^2 (N.I.S. 1990).

Industry employs about 30 % of the active population and is mainly centred on textile, chemistry, iron and steel transformation industries and agribusiness (N.I.S 1990). Less than 5 % of the population are employed in agriculture which is very intensive, associating corn with industrial crops such as beet, and with bovine and porcine breeding. The service sector employs about two thirds of the working population (N.I.S. 1990).

Heavy industry is concentrated in the northern harbours of Antwerpen, Gent and Zeebrugge and on the Meuse river in the south (Namur and Liège). A very dense network of railroads (0.9 km/km^2), waterways (0.05 km/km^2) and motorways (0.5 km/km^2) links all industries (N.I.S. 1990).

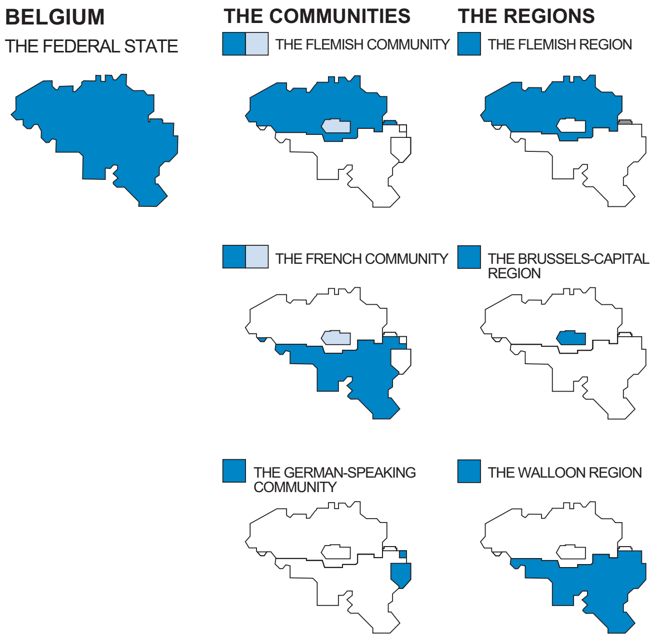

Figure 1. Federal Belgium with its Communities and Regions

2 Forest resources and their uses

2.1 Definitions

Forest in Flanders: a ground area, an ecosystem, characterised by more or less dense and extensive tree and woody shrub cover. The vegetation has its own fauna and flora and associated processes and fulfils one or more of the following functions: economical, ecological, shelter, educational, scientific or recreational (Het Bosdecreet 1990, Helms 1998).

Forestry in Flanders: a science and/or a technique of creating, managing, using and conserving forests and associated resources in a sustainable manner for human benefit to meet desired goals (Helms 1998).

Forest in Wallonia: a natural, semi-natural or man-made ecosystem, dominated by woody species. This ecosystem has its own fauna and flora and associated processes, and fulfils one or more of the following functions: economical, ecological, shelter, educational, scientific or recreational.

Forestry in Wallonia: a science and/or a technique for the management, silvicultural treatment, conservation and regeneration of forests and associated resources in a sustainable manner for human benefit to meet desired goals.

2.2 Forest ownership

The ratio public/private forest is stable, there is no policy towards centralisation or privatisation of our forests.

The great majority of the private owners posses only a few ares to a few hectares. The Belgian forest is extremely fragmented. In Flanders 70% of the fragments are less than 10 ha and 14% even less than 1 ha. Due to the numerous private owners, the average area of a private forest in Wallonia is 3 ha per owner; however, more than half of the private properties are less than 1 ha. Table 1 shows the differences in ownership between the regions.

In Belgium, all of the public forests (state forest & communal forest) are under the management of the regional forest services which are for Flanders ‘Bos en Groen’ and for Wallonia ‘Division Nature et Forêts’. These public forests are managed in a long-term perspective.

2.3 Land use and forest resource

2.3.1 Global overview of the land use

Wallonia can be considered as a rural region. Thirty percent is forested (table 2). The main tree species are Pedunculate and Sessile oak (*Quercus robur* and *Quercus petraea*), beech (*Fagus sylvatica*), and Norway spruce (*Picea abies*).

As few as 8.5% of Flanders is forested. The built-up area in Flanders amounts to 170,000 ha, which is far more than the forest area of 114,220 ha (table 2). So it can be considered as a highly urbanised region. The forests are mainly located near the north-eastern border to the Netherlands. The main tree species are oak *(Quercus robur, Q. petraea* and *Q. rubra*) beech *(Fagus sylvatica)*, poplar (*Populus cv.*) and pine (*Pinus sylvestris* and *P. nigra*).

Due to the federalisation, forest and nature conservation is a regional competence and so, there are no national parks.

2.3.2 Tree species origin and distribution

The Belgian forest is by nature a mixed hardwood forest, with oak *(Quercus robur* and *Q. petraea)* and beech *(Fagus sylvatica)* as the main tree species. From the geographical point of view, the Atlantic and sub-Atlantic regions can be distinguished in Belgium. Three phytosociological alliances are prevalent (Noirfalise, 1984): *Fagion sylvaticae*, *Carpinion betuli* and *Quercion roboris-petraeae*.

There are various forest types in Wallonia, due to the diversity of natural conditions: 27 ecological areas, differing in terms of climatic, geological or topographical conditions, have been identified in Wallonia. In Flanders 22 forest types can be distinguished.

History also contributed to the diversity of the forest due to over-exploitation by man, wood consumption, and the increased conversion to cropland. The productive forest cover has been restored, increasing the forested area from 434,596 ha in 1866 to 617,000 ha today. Finally, the diversity of forest owners leads to diversity in forest management. Due to all these factors, the Belgian forest is a mosaic of vegetation types, tree species and management techniques. There are still some broad-leaved stands which are considered as ‘old forest stands’, comparable to the climax vegetation. However, of the current forest area of 617,000 ha, 48% consists of mono-specific conifer stands, mainly *Picea abies*, *Pinus sylvestris,* and *Pinus nigra*. *Picea* dominates large parts of upper Belgium, *Pinus* are prominent in the Kempen. These plantations were highly promising, but actually, in some places, they give rise to ecological as well as forest health problems. Broadleaf species are also sometimes in mono-specific plantations: *Fagus sylvatica* on plateaus in central and up-

Table 1. Ownership of the Belgian forest

	FOREST AREA			
	Wallonia		Flanders	
	ha	%	ha	%
State forest	62 692	12,2	12 553	11,9
Provincial forest	2 017	0,4	677	0,7
Communal forest	190 964	37,3	13 452	12,7
Forest owned by public institutions	7 501	1,4	3 673	3,5
Public forests with private status	14 554	2,8	3 446	3,3
Strictly private forest	233 582	45,6	71 815	67,9

Table 2. Distribution of the forest area over the Belgian regions (Verbruggen 1994)

	Total area ha	forest area ha	Forest area %	Forest area per capita ha
Walloon Region	1,684,263	500,254	30	0.15
Flemish Region	1,350,925	114,220	8.5	0.020
Brussels capital Region	16,179	2,446	15	0.0025

per Belgium, *Populus* (most recent cultivars: Beaupré, Ghoy, Hazendans, Hoogvorst) in valleys in lower and central Belgium.

Only a very small part of the Belgian forest can be considered as mixed: some coppice and coppice with standards and some standards from hardwoods as well as from softwoods.

Considering the species composition it can be concluded that about half of the forest area in Belgium is occupied by young to middle-aged coniferous high forests. The area of poplar plantations is important in Flanders (29.7% of the forests and additional 2 million solitaire or line plants of poplar).

The current situation is the direct result of an increase in the forest area between 1866 and 1960, due to an active afforestation policy that greatly modified the composition of the Belgian forest in favour of the conifers. During the last century, the major conifer species was *Picea abies*, introduced at the end of the last century, mainly in order to transform uncultivated and unproductive crop or pastureland into productive forestland. *Pinus sylvestris* was mainly important in Flanders and was used as mine building wood.

In the last decades, the Flemish region's forest area is slightly but constantly decreasing because of infrastructure projects, housing, agriculture and industrial estate.

2.3.3 Total growing stock, growth and total fellings

The characteristics of the two main forest regions, Wallonia and Flanders, are described hereafter. The region of Brussels only holds a small part of Belgium's forests, which is mainly dedicated to recreation as it is an urban forest. The data given for Wallonia are from the document DGRNE (1997a), which gives the results of the latest regional forest inventory, referring to about 30 % of the whole inventory plots of this region. The Flanders data is a compilation of N.I.S. (1990) and AMINAL (1993). It is to be noted that the data for Flanders is not coherent.

Wallonia

Wallonia is a forested region. In 1996, it was covered by 529,000 hectares of forest amounting to 31% of its territory. The productive forests cover 473,750 ha which is 90% of the total forested area. The remaining 10% are forest roads, firebreaks, moor land, ponds, etc. The forest is unequally distributed within Wallonia, varying from 9 to 51% depending on the province, and reflects the population densities. The Wallonian forest is constituted of about 50% broad-leaved and 50% conifer species (DGRNE, 1997a).

Table 3 shows the distribution of the forest areas (hectares) and wood volumes (1,000 m^3) per tree species in 1996. The main broad-leaved species are oak (*Quercus robur* and *Quercus petraea*) and beech *(Fagus sylvatica)*. The main conifer species are Norway spruce (*Picea abies*), Douglas fir (*Pseudotsuga menziesii*), Scots pine (*Pinus sylvestris*) and larch (*Larix decidua*). The other broad-leaved species are *Prunus avium*, *Acer pseudoplatanus*, and *Fraxinus excelsior*. One of the major coppiced species is *Carpinus betulus*.

The annual increment for *Quercus robur* and *Q. petraea* is 2 to 3, for *Fagus sylvatica* 3 to 5, for *Picea abies* 12 and for *Pseudotsuga menziesii* 18 m^3 ha^{-1} a^{-1} (AMINAL 1993).

Picea abies is the most important species of Wallonian forests, followed by *Quercus robur, Quercus rubra, Quercus petraea* and *Fagus sylvatica*. The broad-leaved species represent about 50,000,000 m^3, which is 45% of the total standing volume. Among the conifers, *Picea abies* alone represents 48,000,000 m^3 which is 43.6% of the total standing tree volume. The volumes are calculated on the basis of a tree height where the circumference is of 22 cm, bark included.

The total area of broad-leaved species has decreased since 1895, but the proportion of even-aged high forests has greatly increased, mainly through the transformation of coppice and coppice with standards stands to even-aged high forests. Coppice stands lost their interest when other combustibles substituted wood. Conifer stands have greatly increased, mainly through the afforestation of land that was not valuable for agriculture.

Compared to the inventory data of 1984, in 1996 the total forested area of Wallonia has decreased 10,000 ha. This is partly due to the vast areas affected by the heavy winds of February 1990, when numerous stands were blown down. A lot of these areas have not been replanted since. Compared to 1984, the areas of even-aged broad-leaved high forests have increased, while the areas of coppice and coppice with standards have decreased. The areas devoted to conifers have also slightly decreased since 1984, especially regarding *Picea abies*.

The annual increment is of 7.5 m^3 ha^{-1} a^{-1}, which means in absolute figures 4.6 million m^3. Table 5 compares the annual cutting with the annual consumption in detail. The cuttings and the increment are in balance. The annual consumption exceeds the production 3 times.

Flanders

The West and East -Flanders provinces have an afforestation index of respectively 2 and 5%. The Brabant and Antwerpen provinces have an index of 10 and 12%. The Limburg province has a forest cover of 13%. In total 20,373 ha are accessible to the public.

The forests in Flanders consist of 50% broad-leaved, 39% conifers, 6% mixed conifers and 5% mixed broad-leaved. The main tree species

Table 3. Distribution of the forest area (hectares) and wood volume (1000 m^3) per tree species in 1996

Forest type	**Area in**				**Volume**	
	Wallonia		**Flanders**		**Wallonia**	**Flanders**
	ha	**%**	**ha**	**%**	**1,000 m^3**	**1,000 m^3**
TOTAL BROAD-LEAVED	239,250	50.4	65,250	49,8	49,735.4	7,800
Fagus sylvatica	38,000	8.0	3,650	5.6	9,435.4	
Quercus robur, *Q. petraea /Q. rubra*	49,250	10.4	10,309	15.8	9,751.6	
other broad-leaved	68,000	14.4	31,907	48.9	1,409.3	
Coppice with standards	59,500	12.6	8,618		8,650.3	655
Coppice	13,250	2.8	4,750		4,892.3	190
Populus sp.	11,000	2.3	19,400	29.7	2,912.7	
TOTAL CONIFERS	234,750	49.6	49,900	38.1	60,531.4	7,150
Picea abies	179,000	37.8	2,750	5.5	48,155.2	
Pseudotsuga menziesii	12,250	2.6	400	0.8	1,986.6	
Larix decidua	8,250	1.7			2,203.6	
Pinus nigra & P. sylvestris)	18,750	4.0	41,400	83.1	4,076.3	
Others	16,500	3.5			4,109.7	
MIXED BROAD LEAVED CONIFERS			14,700	11.2		
PRODUCTIVE FOREST	**473,750**	**100.0**	**131,000**	**100.0**	**110,266.8**	**15,615**

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are oak *(Quercus robur and Q. petraea)* beech *(Fagus sylvatica)*, poplar (*Populus cv.*) and pine (*Pinus sylvestris* and *P. nigra*). Ash *(Fraxinus exelsior)*, sycamore *(Acer pseudoplatanus)*, birch *(Betula pendula)* , wild cherry (*Prunus avium*), black alder *(Alnus glutinosa)*, willow (*Salix sp.*) and exotic species such as red oak *(Q. rubra)* and larch (*Larix decidua*) are also used. In the Kempen, *Prunus serotina* dominates the natural regeneration and became in less than 30 years a forest pest. Although the use of native species is recommended, the use of *Pinus sylvestris* and *Quercus rubra* will persist since it has economic meaning. An effort is currently being made to manage these stands more naturally.

The annual timber production is approximately 650,000 m^3, which is 10% of the annual timber consumption. The total annual growth in Flanders is estimated at 862,500 m^3.

The annual increment for *Quercus robur* and *Q. petraea* is 3 to 5, for *Quercus rubra* 5 to 8, for *Fagus sylvatica* 5 to 8, for *Populus* 10 to 15, for *Pinus sylvestris* 4 to 6 and for *Pinus nigra* 10 to 13 $m^3\ ha^{-1}\ a^{-1}$.

2.3.4 Forest threats

See 'Main current conflicts and challenges'.

2.4 Silviculture

The broad-leaved species are submitted to different silvicultural systems (classification of Matthews 1989), the most important of which is now the group system, but also of minor importance coppice, coppice with standards and selection system.

In southern Belgium, when seed is present, the shelterwood method is sometimes practised in broad-leaved forests. In Belgium the majority of the state owned forests are managed under the group system. Natural regeneration as well as artificial regeneration is used. Biocides are not used on a regular basis nor recommended by the forest service.

Private forests are either managed by the owner himself or by private forest managers or left unmanaged. As opposed to Flanders, a management plan is not mandatory for private forests in Wallonia, and so there is almost no control of how these forests are managed. The private forests are managed by a short-term forestry due to small areas and to high taxes on private property. In Wallonia, private forests are based on conifers, and especially on *Picea abies*, and in Flanders they are based on *Populus* and *Pinus sylvestris*. Privately owned forest fragments with poplars and conifers are often clear cut whereas

Table 4. Volume per hectare in $m^3\ ha^{-1}$ per tree species in 1996, Data for Wallonia DGRNE (1997a). The Flanders data is a compilation of N.I.S. (1990) and AMINAL (1993), and is not coherent.

Forest type	**VOLUME $m^3 \cdot h^{-1}$**	
	Wallonia	**Flanders**
TOTAL BROAD-LEAVED	207	154
Fagus sylvatica	248	
Quercus robur, Q. petraea / Q. rubra	198	
other broad-leaved	207	
Coppice with standards	145	76
Coppice	369	40
Populus sp	264	
TOTAL CONIFERS	257	143
Picea abies	269	
Pseudotsuga menziesii	162	
Larix decidua	267	
Pinus nigra & P sylvestris)	217	
Others	249	

in forests with a management plan, cuttings over 2 ha are rare, so clear cutting is abandoned. Strip and selection cutting are seldom used.

2.5 Forest production and forest services

In the most urbanised area of the country, where there is less than 10% forest, the major forest good is found in non-profitable services such as recreation, education, wind-, water- and noise screens. However, the only source of income is still cuttings.

In the southern part of Belgium, where there is more than 30% forest, the major forest production is timber. In Wallonia, hunting is a regular, non-negligible source of forest income. The hunting rent amounts to about ECU 25 ha^{-1} a^{-1}. Side revenues of hunting are the selling of venison and of hunting licences.

In Belgium there is no market for secondary forest products such as berries, mushrooms, sap etc.

In Wallonia there are eight State Forest reserves which total an area of 244 ha. They have been established according to the 1973 Law concerning Nature Protection. These Forest reserves are all ‘directed’ according to a special management plan. In Flanders, since 1993, 1,400 ha of state forest are forest reserves (Vandekerckhove 1998). Moreover six forests are protected as nature reserve covering an area of about 500 ha (AMINAL 1993).

Skidders or adapted agricultural vehicles are used for the extraction of big trees to the road. The use of forwarders and processors is rare. Horses are increasingly popular for transport of pre-commercial thinnings. Most timber is sold on stump. The uses of the harvested wood are shown in table 5.

3 Forest Economics

3.1 Forest industries and employment

Within the total Belgian economy the primary sector (agriculture, fishery and forestry) makes 1.9% of the GNP of which forestry is 5.4%. This means that the contribution of forestry to the GNP is 0.11 %. Due to a reduction in the contribution of agriculture, the contributions of forestry and fishery are increasing in the primary sector (N.I.S. 1990). The contribution of forest exploitation in the national economy is negligible. The first links in the processing chain is the sawing, the planing and the kiln drying. In 1989 there were 323 sawmills (3,383 employees), 7 enterprises for planing (124 employees), and 5 for kiln drying good (11 employees). The sector is dominated by small and medium-sized enterprises: 40% of the enterprises have less than 5 employees, 66% of the enterprises have less than 10 employees (N.I.S. 1990). The small and medium sized enterprises are situated in the northern part of the country and the big enterprises in the southern part.

The wood-based semi-manufacturers include the following industries: veneer and multiplex, woodfiber and chips, improved wood, carpeting, wrapping materials, and other wood industries. These industries employ 5,385 persons in 466 enterprises. The contribution of these industries is 0.89% of the GNP (N.I.S. 1990).

Employment in industries, based on or linked with forestry and wood processing, is estimated to 70,000 employees in more than 6,000 enterprises. This is 2.3% of the Belgian employees in 2.6% of the Belgian enterprises (N.I.S. 1990).

The weakness of the wood industry is that only 30% of the wood used is actually grown in Belgium (table 5). The industry strongly depends on wood import as its main resource.

Belgium is the worlds fifth largest exporter of wood-based panels especially particle and fibreboard. The growing global interest in these products is the strength of the Belgian forestry and wood industry.

3.2 Profitability

The gross income per hectare was in 1991 about 2,8 times higher for coniferous forests (ECU 320 ha^{-1}) than for broad-leaved forests (ECU 125 ha^{-1}). This is due to more important cuttings: 11,7 $m^3 ha^{-1}$ in a productive conifer stand against 3,8 $m^3 ha^{-1}$ in a productive broad-leaved stand. The average price though is lower for conifers (ECU 30 m^{-3}) than for broad-leaved (ECU 32 m^{-3}). It must be indicated that these prices, as well as the production in 1991, have greatly been influenced by the gale, which occurred in 1990.

In four of the ten provinces there is a provincial tax ranging from 3.6 to 6%. There is a national estate tax depending on the geographical region ranging from ECU 5 to 50 $ha^{-1} a^{-1}$. Last but not least, there is a succession tax (see paragraph 5.1).

Grants are given for afforestation ranging from ECU 500 to ECU 2500 depending on the tree species and the presence of an understory. Accessibility is subsidised from ECU 25 to 50 $ha^{-1} a^{-1}$ depending on if the forest is used for hunting. Forest grouping, which means that different forest owners make a common management plan for neighbouring forests, can be subsidised for the tending. There is also the possibility of obtaining grants for the afforestation of abandoned agricultural lands.

3.2.1 Picea abies in Wallonia

Ninety percent of the total forest income is due to the harvest of timber, and especially to the sales of conifer wood. Conifer species represent almost 70% of the wood volumes sold and 60% of the incomes, whereas they only cover 42% of the productive forest area. This is why private owners and municipalities prefer to invest in conifers rather than in broad-leaved species (DGRNE, 1997 a and b).

3.2.2 Populus in Flanders

In Flanders poplars are the only profitable tree species. In a 15 year rotation on a suitable soil the wood value exceeds 10 000 Euro. With the existing financial support the cost-effectiveness of the investment is estimated to be between 6% and 9% at an internal discount rate of 5% (LUST 1995a).

4 Forest and forest related policies

4.1 Legislation

Different laws ensure the protection of forests in Belgium since about 150 years. The forest code, voted in 1854, imposed a management plan for the public forests. In 1931 a law was established for the protection of private forests but it was never applied. It prevents private owners from forest clearings inducing damage to the general interest. It also protects remarkable trees or forests. In 1973 a law on nature conservation allows the creation of forest reserves and natural reserves (DGRNE, 1997b).

Table 5. Wood production and consumption in Belgium (F.A.O. 1997)

	Production 1989-1991 (1,000 m^3)	**Consumption 1989-1991 (1,000m^3)**
Saw- and veneer wood	3,183	2,664
Construction wood	1,201	2,858
Triplex and veneer	109	329
Paper and cardboard	1,200	2,116
Pulp	466	774
Particle- and fibrepanels	2,266	745
Fibrewood	1,217	3,602
Total	**4,610**	**11,709**

In 1981 the federal forest service was regionalised, and each region established its own administration. Differences in the distribution of forests and the degree of urbanisation determine the policy emphasis.

In Flanders the public forests are managed by the Forest Service (Afdeling Bos & Groen) of the Administration Environment-, Nature-, Land- and Water Management (AMINAL) of the Environment and Infrastructure Department (LIN) of the Ministry of the Flemish Community.

In Wallonia there is a similar Forest Service (Division Nature et Forêts) of the General Direction of Natural Resources and Environment of the Ministry of the Walloon Region, commissioned with the ecological management of the natural environment.

In Flanders, since 1990 'Het Bosdecreet' (the Forest Decree) is considered as a law. In 1994: a decree on hunting in Wallonia aimed to provide a better balance between forest and game. It was followed in 1995 by a decree on accessibility in Wallonian forests to limit the bad effects of motorised activities in forests. Also in 1995, the Walloon Parliament approved the 'Plan for the Environment and for Sustainable Development', containing indications on specific forest management situations such as soil protection areas, wells, rivers, etc.

Both regions participate and collaborate in international meetings and supranational structures such as the EU, Rio, Helsinki, Lisbon.

4.2 Forest policy tools

4.2.1. Flanders

The major forest policy tool in Flanders is the 'Bosdecreet' (Grayson, 1993). In the Flemish Region there is a strong emphasis on multiple use with an accent on conservation. The policy statement shows the following numbers of Articles devoted to each forestry function: 2 to 'economic' (production of wood as a raw material); 2 to protective; 4 to 'ecological' (concerning conservation of native plants and animals); 5 to social and educational (principally recreational and concerning access) and 9 to scientific, including forest reserves. Despite the relatively small amount of space given to wood and other marketable products, a fair degree of importance is attached to this function: the novel feature of the decree is the emphasis it gives to the other forest functions.

The following list records both the general objectives of this decree and those specific to private woodlands.

- To promote the opening up of woodland for recreation and educational purposes, but subject to nature conservation requirements.
- To designate certain areas as protection forest.
- To operate a rather conservative form of yield control, notably by restricting the cut in years following an unplanned and abnormally high level of cut undertaken for whatever reason.
- To favour silvicultural methods which are closer to nature, specifically through conservation or reconstitution of the natural fauna and flora; use of native species or provenances suited to the site; natural regeneration; uneven-aged stand or selection forest; 'ecological equilibrium' and regulation of the use of herbicides.
- To form perpetual forest (nature) reserves, using management techniques outlined in 4 in order to conserve and develop woodland vegetation associations, stands and 'typical' habitat forms.
- To promote management according to the designated aims by making working plans compulsory for all private woods over 5 ha except in forest nature reserves where a nature conservation plan is applied, and as part of this, to require that private woodland owners conduct inventories of their properties every 10 years.
- To encourage co-operative management in order to secure better the desired benefits, such co-operative units being formed normally between private owners or occasionally between private and public sector forest owners.
- To provide grant aid or compensation in support of these measures in private woodlands.

Actors affecting the forest and forest related policies in Flanders are: the forest service which is responsible for the management as well as the policy, the union of private owners ‘Royal Forest Society of Belgium (KBBM-SRFB)’, nature service, agricultural service and the unions of farmers. Next to the above ‘classic’ actors there is a trend in involving local actors such as: scouts, neighbours, local environmental organisations etc.

The most important EU ordinance is 2080/92 for the afforestation of abandoned agricultural lands. In 1997, 175 ha of forest were planted within this frame. The average size of a forest was 1.53 ha. Private owners planted 120 ha, the rest was planted by the provinces. More than 40% of this area was planted with *Quercus robur* and *Q. petraea*, 24% with *Populus sp.*, and 65 % of the *Populus* stands were planted with a shrub layer (Gorissen & Schepens, 1998).

4.2.2 Wallonia

The 1854 forest code together with the 1994 and 1995 decrees are considered as laws.

The main actor affecting the forest and forest related policies in Wallonia is the ‘Royal Forest Society of Belgium’, which has represented private forest owners for more than 100 years. It informs its members by way of a journal, field excursions and conferences. It also offers an insurance service to private owners and creates software to help private forest management. This society created a trade union of private forest owners concerned with all the subjects related to forest policies in private forests. The participation of all the concerned people in the decisions concerning the forest is ensured by the ‘Conseil Supérieur Wallon de la Forêt et de la Filière bois’, a consultative organ. Moreover, several private owners have come together to create forest co-operatives in order to group operations such as wood sales, purchase of plants etc.

The Walloon region gives subsidies to public and private forest owners in order to encourage silvicultural practices such as thinning, pruning and regeneration, which should in turn ensure a sustainable management of this renewable resource. The Walloon region has published an ‘afforestation guide’ (Fichier écologique et Guide des boisements), a tool which helps the forest manager to plant the right species (indigenous or exotic) in the right site, by taking into account climate and soil data such as drainage, pH, etc.(DGRNE 1997b)

The most important EU ordinance is 2080/92 for the afforestation of abandoned agricultural lands. Since 1995 in Wallonia, 63 ha of forest were planted within this frame. More than 37.5% of this area were planted with poplar, 40.8% with other broad-leaved and another 21.7% with conifers (Balleux 1997).

4.3 Forest policy in relation to other national policy areas

In Flanders forestry and forests are seen as a part of nature, a place for recreation and a source of additional income. In the policy there are relations, conflicts and overlaps between nature conservation and forestry. Outside the forestry, administration forestry is neither seen as a way to create sustainable employment nor as a way to increase the economic activity. It is interesting to note that there is no relation between forest policy and the policies of economy, recreation and tourism, land-use planning, agriculture, employment…

In Wallonia forestry has an economic interest. For many municipalities and private owners it is a way of to make living. There are no links between forest policy and other policies. Forest legislation in both Regions has to be seen as a free-standing entity of policy. For actors affecting the forest policy see paragraph 4.2.1 for Flanders and paragraph 4.2.2 for Wallonia.

4.4 Forestry, research and education

Several institutions are involved with forestry education and research: 12 secondary schools give an education in forestry; 2 high schools teach forestry at a non-university level, and 4 faculties of agronomy allow students to graduate, after 5 years of study, as forest engineer: the University of Gent and the Catholic University of Leuven in Flanders; the University of Gembloux and the Catholic University of Louvain-la-Neuve in Wallonia.

The Flemish Community has a research Institute for Forest and Game Management (IBW) in Geraardsbergen. In Wallonia the similar institute is the Forestry Research Station (SRF) in Gembloux. The objectives of these institutes are long term monitoring and research in different areas related to forest ecosystem functioning, wood technology, forest genetics, game management, etc.

5 Main current conflicts and challenges

5.1 Fragmentation

In both regions many forests have a low profitability. This low profitability, maintained by the tax-system, discourages forest ownership. Private and public owners often prefer to sell their forests as housing or industrial estate areas.

High taxes on forest ownership are paid by the people who inherit forest. First line heirs have to pay 7% taxes on the value if the forest is 10 ha and up to 30% if the forest is bigger than 70 ha. For a forest of 10 ha, brothers or sisters have to pay 50% of succession taxes. The inheritance of a forest often results in partial deforestation to enable the heirs to pay the succession taxes, and fragmentation of the ownership in parts for the different heirs. A possible solution for this problem is the exemption of the succession taxes, which should be linked with good forest practices. Due to the different forest policies, the preconditions of good forestry practices are different in the two regions.

The fragmentation of forest ownership and the characteristics of forest owners have far reaching social, technical and silvicultural consequences. Whatever the initiative undertaken to improve either the actual forest distribution, economic production, organisation of social function or development of ecological values, it has to start with consideration of and respect for forest ownership. It must always imply a serious attempt to modify management of the private forest. But following the same line of thinking, it is also necessary to find new approaches to manage the public forest.

5.2 Stability

Loss of forest vitality and biodiversity are pan-European problems in which Belgium takes its share.

The afforestation between the late 1800s and mid 1900s was mainly based on the use of *Picea abies* in the South, *Pinus sylvestris* in the North-east, while *Populus cultivars* became widely used in Northern and central Belgium. These stands were planted with a single goal: wood production for a specific type of industry e.g. mining, matches. As well as the common problems of even-aged, mono-specific, dense plantations, the vast areas planted with these species give rise to species specific problems.

Populus trees suffer from leaf fungi (*Melamspora sp.*) during humid summers. This causes a loss of tree growth and might result in the death of the trees or of the whole stand. Because of the use of monoclonal stands and the use of a very limited number different cultivars in Belgium, an attack of these fungi results in widespread economic damage.

Pinus nigra in the north-eastern part of Belgium are weakened by strong winters and air pollution, which result in harmful fungi attacks on the trees (*Sphaeropsis sp., Brunchorstia sp.*).

The management of the Spruce stands in the southern part of Belgium is often characterised by a lack of pruning and thinning and the use of the species on unsuitable soils. This results in soil acidification and in a poor stand stability. In 1990 a gale damaged more than 4,7 millions m^3 of wood.

5.3 Vitality

Another long-term threat for the Belgian and central European forests in general is air pollution and soil acidification. Agro-industry, central-heating, transport and industry are the major sources of atmospherical pollution agents. Forests and especially conifers have the property to filter these agents in amounts, which are toxic for the functioning of the forest ecosystem. This may result in an accelerated acidification of the forest soil, to levels that affect plant growth. For this reason, part of the Belgian forests should be transformed: by replacing some conifer stands by broad-leaved stands and by creating more mixed stands, introducing species such as *Quercus sp.* and several other species, in even-aged mono-specific *Fagus sylvatica* stands. *Picea abies* stands should be thinned more intensively in order to improve the biogeochemical cycles and to reduce soil acidification. Recently however, forest management is paying more attention to soil conservation and stability in *Picea abies* stands. This is obtained by frequent thinning and the use of lime in some extreme cases.

The management of the even-aged homogeneous stands is oriented on a short rotation (15 to 60 year) biomass production. A more sustainable and profitable forestry could be reached if more emphasis were laid on the production of quality timber.

5.4 Game

The abundance of game limits the use of natural regeneration in close to nature forestry because the game prefers to browse the native tree species. Fencing is necessary in most regions for both, natural and artificial regeneration. In the northern part of the country, rabbit *(Oryctolagus cuniculus)* and especially roe *(Capreolus capreolus)* are abundant. In the southern part of the country roe and deer *(Cervus elaphus)* are important.

5.5 Region specific conflicts and challenges

5.5.1 Flanders

Decades of urban emigration in combination with poor land use planning made forests the most wanted housing areas of Flanders. Deforestation for housing, industry and infrastructure is still a threat. The pressure on the open space and forests is very high. Every single piece of land is wanted by agriculture, forestry, nature conservation, housing, tourism and economic development. Every change in land-use gives rise to a conflict between the above mentioned sectors. The only sector that yields land is the agricultural sector. These lands are often poor and wet soils. There is no tradition between farmers and forests, and the farmers' union uses this lack of knowledge to create hostility. Farmers prefer to sell their lands to more profitable land uses. Afforestation of abandoned agricultural lands is a very sensitive and difficult issue.

With a forest cover of only 8%, an extension of the forested area is necessary. The ratio of 8% is insufficient to cover the recreational needs of Flanders. Cities like Gent and Antwerpen with more than 250 000 inhabitants lack recreational forests in the vicinity. The most western province, bordered by the North Sea and France has a forest cover of 2%, and over 300 000 persons in this province are living in a town or city with more than 50 000 inhabitants, without urban forest.

The high fragmentation of the existing forests makes migration of flora and fauna between these fragments either hard or impossible. Some populations are extinguished by road kills while others can not migrate because of motorways, railroads or waterways.

There is a real need to connect the existing forest fragments to urban forests in the vicinity of towns and cities and to productive forests. Wallonia imports50 % of the processed wood and Flanders needs to import as much as 90%.

For Flanders, where afforestation is urgent, the needs are translated in the 'structure for land use planing' (Structuurplan Vlaanderen 1997). The main goals of this plan are a moratorium on deforestation, afforestation of 10 000 ha abandoned agricultural land, and afforestation of 10 000 ha of other lands.

Other priorities are the exemption of the succession taxes on forests, a legal frame for forest management groups, the conservation of biodiversity and a close-to-nature forest management. Private owners are encouraged to and the forest service is obliged to use close-to-nature forest practices (Pro Silva), e.g. trees should be given time to get old; native species should be the basis of the forest ecosystem; self regulating processes should be the basis of the forest management; there should be dead wood in a forest; no chemicals should be used in forests.

The forest service has an important role to play in the next decades. Because of the legal framework, the forest service has to establish multiple-use forests, managed in a close-to-nature way which meet the requirements of the FSC or Helsinki. The extra economic cost of these goals should be beared by the whole society. The high costs are justified by the high demands of the forest services in terms of wood, recreation, shelter, watershed management, education, conservation,... and the low quantity of forests which can truly be multiple-use.

5.5.2 Wallonia

Aware of the economic, ecological and social importance of forests, the Walloon Region tries to follow the rules of 'sustainable forest management' defined at the conferences of Rio and Helsinki.

The forest has to be managed in a sustainable way, in order to ensure its regeneration and its different functions: the production of wood, the ecological role in the sense of biodiversity and of carbon stock; and the social and cultural role of the forest. The long-term vision of the Walloon forest in its multifunctional dimension is put forward. Its quality and its diversity have to be maintained.

The weaknesses of the Walloon forest concern the economic and the environmental aspects.

From the economic point of view, the parcelling out of the private forest (3 ha per owner) makes it difficult to manage. Moreover, inheritance duties are very important for private owners and contribute to this parcelling out. This fragmentation of the private forest makes wood certification very difficult.

From the environmental point of view, the human pressure on forests is increasing (tourism and recreation), and there is still a lack of information and education of forest users. The forest is also submitted to some atmospheric pollution and to climatic changes, but these are problems at the European, and even at the global scale.

The remedies to this situation would be to reduce the fragmentation of the forests, to decrease the tax pressure on private forest owners, to make management plans mandatory in private forests, to improve forest exploitation, to develop the multifunctional role of forests and to promote afforestation and wood transformation. Efforts are currently being made for the promotion of wood as construction material.

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1 The Country

1.1 Nature

Denmark is situated between approximately 54 and 57 °N, and 8 and 15 °E. The country covers an area of 43,100 sq. km. It comprises the westerly peninsula Jutland (Jylland) connected with Germany to the South, and a great many islands the biggest of which are Sealand (Sjælland) and Funen (Fyn). The country is intimately connected with the sea, the coastal line totals approximately 7,300 km. Denmark belongs to the Scandinavian Countries.

A large part of the land surface is shaped by the late glaciation (Weichsel). So, the eastern part of the country (East Jutland and the islands) shows a gently undulated moraine landscape reaching no more than 200 m above sea level. The western part (Central and West Jutland) is formed from diluvial Weichsel glaciation deposits. Yet, elevations in the landscape are found, originating from the glaciation before the last (Saale).

Small streams are found in nearly all parts of the country but no rivers. There are many lakes scattered all over, the biggest of which being 40 sq. km. The total area of lakes makes up 1% of the land surface.

The climate is cool-temperate and oceanic. It is influenced by the Gulf Stream. The mean annual temperature (1961-1990) is 7.7 °C varying from 0.0 °C in January and February to 15.7 °C in August. Coldest and hottest temperatures ever registered are -31 °C and 36 °C respectively. The mean annual precipitation (1961-1990) is 712 mm ranging from less than 500 mm in the driest parts to more than 800 mm in the wettest parts of the country. In the late winter and early spring months there is a precipitation of 40-45 mm, in autumn months 75-80 mm per month. Westerly winds play a significant role and gales are not uncommon.

Soils in those parts of the country formed by the moraine count Inceptisols and Alfisols as the most important types. Commonly there is an intimate mixture of coarse and fine sand, silt

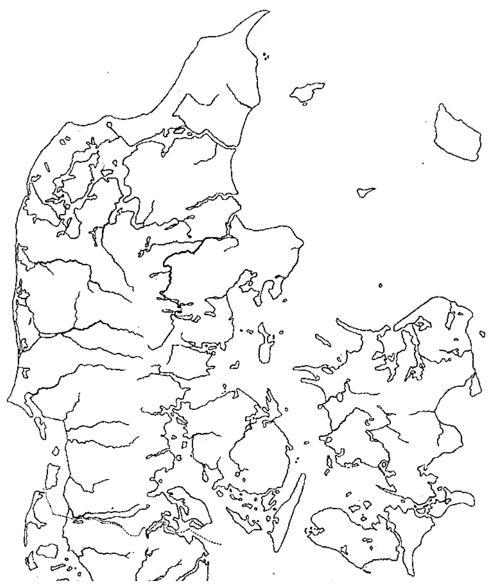

Figure 1. Map of Denmark

and clay and medium to high fertility. In many soils there is a calcareous intermingling. Where diluvial deposits are found, the texture is dominated by sand and the common soil type found is Spodosol. Here, the soil fertility is low and the water holding capacity is critical. In some areas Histosols (peaty soils) are found, and they may make up an important part, but on a country-wide basis these peaty soils play a minor role.

Since the country is situated in the cool-temperate zone, the vegetation is of the nemoral type and close to the sub-boreal. This means that the deciduous forest is original to the country, dominated by beech (*Fagus sylvatica* L.), oak (*Quercus robur* L.), ash (*Fraxinus excelsior* L.) and birch (*Betula spp.*) as endemic species with sycamore (*Acer pseudoplatanus* L.) as an important exotic newcomer. Lime (*Tilia cordata* Miller), elm (*Ulmus glabra* Hudson), and alder (*Alnus glutinosa* (L.) Gaertner) also play a part. The basic feature of the forested land today is that hardly no original forest exists, plantations prevail. A great many coniferous species play a significant role. They have been introduced from Central Europe (Norway spruce (*Picea abies* (L.) Karsten), Scots pine (*Pinus sylvestris* L.), Silver fir (*Abies alba* Miller), and larch (*Larix decidua* Miller)) as well as western North America (spruce (*Picea spp.*), fir (*Abies spp.*), pine (*Pinus spp.*) and Douglas fir (*Pseudotsuga menziesii* (Mirbel) Franco)). In Central and West Jutland, heather used to dominate but has now been replaced by coniferous plantations and agricultural land.

1.2 Society

The Danish population is 5.3 M (1998) and the population density 123 inhabitants per sq. km. There is a slow increase in population mainly due to immigration. Population growth is 0.43% (1997).

A major part of the population lives in Copenhagen (1.3 M) and there is a high population density in the urban areas around the capital. The same is true for the greater towns in East Jutland and Central Funen. But otherwise villages are evenly distributed all over the country and except for the smaller islands, all parts of the country are inhabited.

Until the middle of this century, Danish economy was dominated by agriculture production. This production is still important, but industry, including oil industry, transport, services and tourism increasingly influence economy. Today the contribution from the industrial sectors to the gross domestic product - GDP can be made up as illustrated by table 1.

Over the last decades, the employment of the grown-up population has changed considerably from primary production in agriculture and heavy industry to advanced industry, communication, the social sector, the health sector, the education sector and public administration. A great part of the population is not in the labour market, the reasons being unemployment, payed vacancy and early retirement. There is no political consensus about the size of this group.

Table 1. Contribution to the gross domestic product - GDP by industrial sectors, per cent (1997)

Agriculture, forestry, fishing, mining	5.2
Industry, oil and gas	17.8
Energy and water	2.2
Construction	5.2
Wholesale end retail, hotels, restaurants	15.4
Transport, communication	7.2
Financial, real estate, business activities	23.4
Public administration	7.1
Education	5.4
Health and social work	10.3
Other services	0.8

Source: Statistics Denmark, 1998a

The political framework in Denmark is based upon a one chamber parliamentary system. Parliament has 179 members. Generally, approximately ten different political parties are represented in Parliament, making the political negotiations onerous. The two largest parties are the Social Democratic Party and the Liberal Party.

2 Forest resources and their uses

2.1 Forest history

After the last ice age, the country was gradually re-covered by forests. During 15,000 years there has been a gradual change in forest composition caused by a changing climate. Around 1000-2000 B.C., the beech (*Fagus sylvatica* L.) arrived. Today beech is considered the naturally dominating broadleaved species. Until 1200 A.D. the utilization of the country for agriculture was modest. But around this time, the arable land expanded, and the forest cover decreased significantly. Through the centuries to come, agriculture completely took over, and at the same time the remaining forest area was treated in a very destructive manner. Around the year 1800, the forest area made up only 3% of the land area.

Already some 200 years before, the King had started issuing decrees aiming at reclaiming the state of the forest but with rather limited success. Not until 1805 when the first Danish Forest Act was issued an end was put to the forest exploitation. In the subsequent period, there has been a substantial increase in the quality of the forest. Additionally a tremendous increase in the forest area has taken place. The development through the last 100 years appears from table 2. A focal point in the 1805 Forest Act is the introduction of the concept of Forest Reserves, i.e. forest areas clearly delimited to surrounding areas and protected against any kind of misuse such as grazing, pannage and the like. Today the total forest area comprises 10.3% of the land area.

In connection with the increase in the forest area, a number of exotic tree species, mainly conifers, have been introduced. Conifers therefore play a major role in present-day forestry as appears from table 6.

An important consequence of the historical development just described is that the Danish forest area is dominated by plantation forestry. Only relicts of original natural forest still remain. Today, foresters, conservationists and natural scientists are increasingly interested in investigating the specific features of the original Danish forest.

2.2 Forest ownership

As shown in table 2, the forest area is 445,000 ha (1990). 417,000 ha are under tree cover. An estimated 85% of the forest area is Forest Reserve under the Forest Act.

In table 3, the forest area is divided into ownership classes. From this it appears that approx. 70% of the area is on private hands in one way or the other. Well over 30% is under public administration.

2.3 Land use and forest resource

2.3.1 Global overview of the land use

Looking at the present-day land use as it follows from table 4, it is obvious that agriculture is the sector dominating the landscape. Forest makes up only a minor part. On the other hand, the forest area is increasing from afforestation

Table 2. Development in size of the forest area, 1,000 ha (1990)

1881	**1907**	**1923**	**1931**	**1951**	**1965**	**1976**	**1990**[1]
206	324	367	391	438	472	493	(445)

Source: National Forest and Nature Agency & Statistics Denmark, 1993
[1] Not comparable to the former inventories.

Table 3. Forest area by ownership classes, per cent (1990)

Privately owned forests	45.4
Foundations, organisations and independent institutions	6.5
Danish Land Development Service	0.9
Joint-stock companies, cooperative societies	15.8
The National Forest and Nature Agency	25.6
Other state-owned forests	0.9
Benefices	0.3
Counties and municipalities	4.6

Source: National Forest and Nature Agency & Statistics Denmark, 1993

of arable land. Since 1990 this increase is estimated to 10,000-15,000 ha. According to a government decision from 1989, see section 4.1, it is a target of Danish land use policy to double the forest area in a rotation (60-100 years). This afforestation is expected to take place in all parts of the country. Attention is payed to maintaining profitability in the agricultural sector.

Part of the cultivated land is set aside in accordance with present EU-regulations.

2.3.2 Extent and distribution of the forests

A basic feature of Danish forestry is the very high number of small forest holdings. Thus, there are close to 20,600 forest properties smaller than 50 ha. At the other end only some 60 estates exceed 1,000 ha. Furthermore, the medium-sized and big estates are generally composed of a number of separate forests. The result of this is that the forest area is highly fragmented. Table 5 shows the distribution of forest estates and forest area by size class. It follows that forest properties sized less than 50 ha make up 106,100 ha or 24% of the total forest area. It is obvious that such fragmentation leads to an enormous length of the outer borders facing open areas.

2.3.3 Origin and distribution of tree species

It was mentioned in section 1.1 and 2.1 that forests in Denmark are basically of the broadleaved type, but of historical reasons and supported by the fact that the country is close to the sub-boreal zone, a number of conifers have been introduced. Table 6 informs on the division of the forest area by species.

In the eastern part of the country including East Jutland, beech (*Fagus sylvatica* L.) is the dominating broadleaved species, but oak (*Quercus robur* L.), ash (*Fraxinus excelsior* L.), birch (*Betula spp*.), alder (*Alnus glutinosa* (L.) Gaertner) and sycamore (*Acer pseudoplatanus* L.) to a varying degree play a part. Several of these species seem to be expanding their areas. Yet, in this part of the country as well as in others, Norway spruce (*Picea abies* (L.) Karsten) is the dominating species except for some of the coastal areas.

Table 4. Area analysed by use, per cent (1982)

Cultivated land, market gardens, orchards	62
Forests and plantations - incl. agricultural forests	12
Meadows, marshland, moorland, sand dunes, bogs	11
Lakes and streams	1
Hedgerows, ditches, track roads	3
Farmbuildings, farmyards and houses in rural areas	5
Urban areas	4
Traffic areas outside urban areas	2

Source: Statistics Denmark, 1998a

Table 5. Forests and forest area by size classes (1990)

Size class, ha	No.	Area, ha
0-5	13,354	25,687
5-10	3,273	22,094
10-20	1,948	26,082
20-50	1,078	32,229
50-100	373	26,040
100-250	280	45,368
250-500	127	44,808
500-1000	73	51,300
>1000	57	171,783
Total	**20,563**	**445,391**

Source: National Forest and Nature Agency & Statistics Denmark, 1993

Table 6. Forest area by species, per cent (1990)

Beech, *Fagus sylvatica* L.	16.2
Oak, *Quercus robur* L.	6.7
Ash, *Fraxinus excelsior* L.	2.2
Sycamore, *Acer pseudoplatanus* L.	1.8
Other broadleaves	5.2
Norway spruce, *Picea abies* (L.) Karsten	30.3
Sitka spruce and other spruce, *Picea* spp.	7.9
Silver fir and other fir, *Abies* spp.	3.4
Noble fir and Caucasian fir, *Abies* spp.	4.3
Mountain pine and lodgepole pine, *Pinus* spp.	6.1
Other conifers	8.3
Permanently and temporarily uncovered area	7.6

Source: National Forest and Nature Agency & Statistics Denmark, 1993

In the central and western part of Jutland, the important species apart from Norway spruce are Sitka spruce (*Picea sitchensis* (Bong.) Carrière), Serbian spruce (*Picea omorica* ((Pancic) Purkynê), Silver fir (*Abies alba* Miller), Grand fir (*Abies grandis* (D.Don) Lindley), Douglas fir (*Pseudotsuga menziesii* (Mirbel) Franco), Western red-cedar (*Thuja plicata* J.Donn ex D.Don), Scots pine (*Pinus sylvestris* L.), mugo pine (*Pinus mugo* Turra), lodgepole pine (*Pinus contorta* Douglas), Corsican pine (*Pinus nigra* Arnold) and larch (*Larix spp.*). A great number of these coniferous species are cultivated in the eastern part of the country as well.

Noble fir (*Abies procera* Rehder) and Caucasian fir (*Abies nordmanniana* (Steven) Spach) are grown for christmas trees and greenery primarily.

2.3.4 Total growing stock, growth and total fellings

Throughout this century, the growing stock has been steadely increasing due partly to the increased forest area, partly to a change from broadleaved to coniferous species. Yet, there have been backlashes caused by gales and, as for the last decades, by a general forest decline in Norway spruce. Also, there has been a gradual increase in thinning intensity. The latest estimate shows a total growing stock of 55 M m^3 corresponding to 132 m^3 per ha under tree cover. Norway spruce and beech count 65% of this, see table 7.

It appears from table 7 that the annual increment per ha under tree cover amounts to 7.9 m^3.

From table 8 it is seen that the annual cut amounts to about 1.8 M m^3. During the last 10 years, the annual cut varied between 2.1 and 1.8 M m^3. This is somewhat below the estimated annual volume increment of 3.3 M m^3 as appears from table 7. It should be concluded, then, that the standing volume has been increasing during the last decade.

2.3.5 Climatic and biological forest threats

The dominating biotic threat in Danish forestry is root rot (Heterobasidion annosum (Fr.) Bref.) which plays a significant role in Norway spruce cultivation. Attacks from European spruce bark beetle (Ips typographus) in edges of Norway spruce stands exposed to wind is of some importance. A number of insects exert regular, often local outbreaks. Lice (Dreyfusia nordmannianae) is of major importance to christmas tree production in Caucasian fir. During the last decades, game has increased in density. This is particularly true for roedear, which causes troubles in regeneration of broadleaved species. In some areas dense populations of red deer are found.

Since the 1980s air pollution has been considered a stress factor of substantial importance to the vitality of forests. This perception is still valid, but today the forest decline is considered a very complex prosess in which silviculture comes into play.

Among abiotic factors, wind is of particular importance. To a marked extent this influences the silvicultural conditions in coastal areas. Gales have caused much damage during this century and at an increasing frequency. There are several examples of the equivalent of more than one years cut being destroyed in a gale. Airborne salt from the sea has some influence on the cultivation in coastal areas, particularly in Norway spruce. Summer drought in some years kills trees in forest stands. Late frost significantly influences the choise of tree species in the more continental parts of the country.

2.4 Silviculture

Traditional silviculture is based on the clear cutting system. This is particularly true in conifers, but the system is used in oak and beech as well. Usually only one species is planted, but quite often more species are mixed in varied designs. This aims at either establishing permanent mixtures of species or creating possibilities for harvesting the species at different intervals during the rotation. The uniform system plays an important part in beech silviculture and there has been a tendency throughout the last decades towards an increased use of the sys-

Table 7. Growing stock 1990 and mean annual volume increment 1990-2000 by species, M m^3 (1990)

Species	Growing stock	Annual increment
Beech, *Fagus sylvatica* L.	17.3	0.6
Oak, *Quercus robur* L.	3.6	0.2
Ash, *Fraxinus excelsior* L.	1.0	0.1
Sycamore, *Acer pseudoplatanus* L.	0.8	0.1
Other broadleaves	1.2	0.1
Norway spruce, *Picea abies* (L.) Karsten	18.9	1.4
Sitka spruce and other spruce	4.9	0.4
Silver fir and other fir	3.1	0.2
Noble fir and Caucasion fir	0.3	0.0
Mountain pine and loblolly pine	1.9	0.0
Other conifers	2.1	0.2
Total	55.1	3.3

Source: National Forest and Nature Agency & Statistics Denmark, 1993

Table 8. Annual cut by species and assortment, 1000 m^3 (1997)

Species	Sawnwood	Fuelwood	Total
Beech	296	168	464
Oak 30	26	56	
Other broadleaves	29	99	128
Conifers	837	332	1.169
Total	1,192	625	1,817

Source: Statistics Denmark, 1998b

tem. A main reason for this is to avoid clearcutting. During the last years, concerns about a „close to nature“ silviculture has been influencing the debate among forestry professionals and nature conservationists. The emphasis here is put on systems based on unevenaged mixtures of particularly broadleaved species. This will eventually move silviculture away from clearcutting. Small areas of forest, particularly in south and east, are covered by coppice. In such areas, when owened by the National Forest and Nature Agency, it is a target to consolidate previous forest management systems.

About 5% of the forest area is used for production of christmas trees and greenery. This is a highly specialized form of silviculture based on intensively managed systems and using large amounts of fertilizers and pesticides. The trend is towards an ecologically founded production banning pesticides and decreasing the use of fertilizers.

2.5 Forest production

2.5.1 Harvesting systems, accessibility

To a great extent felling broadleaved trees takes place by using chain saws. Logs are skid to forest roads using small skidding machines. The machinery used depends very much on the size of the property and the willingness of the owner to invest in transport equipment. During the last decades, there has been a trend towards increased mechanization. Thus, the major part of harvesting conifers is carried out by using harvesters which cut, strip and divide the stem to length. When using heavy machinery, which is the case in some forest estates, a great deal of attention should be paid to the risk of soil compaction and root destruction. It is still common in many forest estates to employ their own labor for felling and skidding of logs and timber, though the use of contractors for harvesting increasingly takes place.

The access to forest roads is generally good. The average length of forest roads amounts to approximately 3,500 m per 100 ha.

Standing sales is not widely used but may be increasing. By far the most common is roadside sales. The major part of the long distance transport to the sawmill is on road. Some transport is on rail, especially when crossing borders. Auctions are not used any more.

2.5.2 Timber uses

The total timber consumption cannot be calculated from statistical tables, but it should be estimated at approximately 7.5-8.0 M m^3 per year. This figure is based on an annual cut of approximately 1.8 M m^3, a self-sufficiency in conifer wood of 20-25% and in broadleaved wood of close to 100%, and an import of almost all paper consumed.

It appears from table 8 that by far the greatest part of the annual cut is sawnwood. This is transported to and processed in sawmills. Usually the mills are designed for sawing wood from either conifers or broadleaves. A great number of Danish sawmills are small. On the other hand the number of sawmills is large, around 200, but steadely decreasing. The main part of conifer wood is processed in medium sized mills ranging from 30,000 to 90,000 m^3 annual round wood consumption. Hardwood processing is dominated by one large plant consuming close to 500,000 m^3 round wood annually.

Plants are found which produce some fiberboards and the like, using roundwood as well as residues from sawnwood as raw material. Not more than approx. 25% of roundwood from the forest ends up as sawnwood which can be further processed for use in house constructions, furniture and the like.

Wood chips from conifers used for fuel in energy plants play an increasing role. Today approximately 25% of the wood production from the forest is used for this purpose.

There are only a few paper mills in Denmark. They produce approximately 200,000 tons of paper per year on the basis of recycled fiber.

2.5.3 Non-timber forest products

The most important non-timber forest products are christmas trees and greenery. The major tree species are mentioned in section 2.3.3, but 5 or 6 more species come into consideration.

Recreational access of the public comprises the possibility of gathering berries and mushrooms. In many properties, the right to do precommercial thinnings can be payed for. Very important as far as NTFP are concerned is sportsmens renting hunting rights. Important game is hare, pheasant, duck and deer.

Water supply from wells under forest land is of great importance. Due to the increasing pollution of water supplied from wells in urban areas and agricultural land, clean drinking water from the forest is considered essential and must be expected to be still more so.

Grazing cattle in the forest is illegal, and so is pannage. The strong deterioration of the forest area before year 1800 is partly explained by overuse and mismanagement due to cattle grazing. The first Forest Act abandoned cattle and pigs in forest reserves.

2.5.4 Forest functions

More than 200 years ago, afforestation activities were initiated in the western parts of Jutland along the west coast. The task was to raise protection forest aiming at prevent any sand drift and dune formation. Protection forest in these areas still plays an important role, and specific legislation for the prevention of sand drift secures the upkeep of the forest. There is no special need for protection forest in other parts of the country. As it is understood from section 1.1, erosion in general is of minor importance.

As for the recreation and tourism forest plays a key role. This is certainly true when it comes to forests in urban areas and popular targets for forest visits. By counting numbers of visitors it has been confirmed that recreational visits are of high value. Thus, at an investigation in 1993-94 it could be estimated that the total number of visits per year was 50 M. Walk***s***, jogging as well as riding and biking are of importance.

Since biodiversity came on the agenda, the focus has turned to forests containing significant biotopes for a great many species. This implies that the attention of the forestry sector concerning the impact of forest management on biodiversity should be a main issue in the future. This process also has started (see section 4).

The very strong fragmentation of the forest area mentioned in section 2.3.2 brings about a Danish landscape effectively influenced by forest. One easily perceives the landscape as a scenery containing forest fragments, not a continuous forest cover embedded with a few open areas but otherwise separated from the nonforested part of the landscape. The focal point is that these many forest fragments scattered all over the country lead to a protection of the landscape particularly as far as wind is concerned.

3 Forest economics

3.1 Forest and forest industries in national economy

Forestry and the derived industry play a minor role in the gross domestic product - GDP. In 1997 the GDP at factor prices for forestry (inclusive of christmas trees and greenery) was estimated to 150 M ECU corresponding to 0.1% of GDP (Statistics Denmark, 1998a, 1998b). Manufacturing of wood and wood products amounts to 1,440 M ECU and manufacturing of pulp, paper and paper products to 1,300 M ECU. More than two thirds of the round wood for the wood industry come from import. It is thus found that forestry production and production in the wood industry in 1997 make up 1.9% of GDP at factor prices. In the above- mentioned GDP at factor price for forestry, the production af christmas trees and greenery is estimated to 80 M ECU.

Renting out hunting rights to sportsmen in general plays a significant role to private forest owners' economy. In many forest estates the renting out of hunting rights is considered as important to the private economy as is the income from the production of christmas trees and greenery, and the income from the wood production.

3.2 Employment

The number of full time employees in forestry, logging and related services in 1996 was estimated to 2,400 (Statistics Denmark, 1998a). By far the largest group, more than 80%, are male. For a number of years there has been a steady decrease in occupation due, first of all, to increased mechanization in the logging process. It is expected that this trend will continue in the years to come.

In the wood industry the number af full time employees in 1996 was estimated to 13,700. More than 80% are male. Rationalization of the industry, i.e. fewer and bigger sawmills, leads to a gradual decrease in the number of employees.

The pulp and paper industry in 1996 counted for a number of full time employees of 9,200. In the furniture manufacturing industry the number of employees in 1996 was estimated to 21,300. However, part of the production in this industry is based on non-wood raw materials.

3.3 Profitability

An account of the general profitability in forestry is not possible. First of all the basic economic conditions are dissimilar in public and private forestry. Public forestry, dominated by the National Forest and Nature Agency, is responsible for managing forest in a profitable manner, but at the same time is faced with a great many commitments such as public access to forests, protection of nature, managing legislation concerning a number of regulations, information service, game management etc. This implies a range of cost intensive arrangements resulting in a gross income far below zero. However, it is politically acknowledged that a main reason for society possessing public forests is the gains mentioned above.

In private forestry, the size of the property is of major importance to profitability. Small properties are often part of farm properties or the like and the economic profit is insignificant to the overall economy of the owner. Moreover, the wood production in small forest properties is often low and wood quality bad, one reason being that the forest is exposed to wind. Due to the great number of small properties, see table 5, the situation mentioned above is significant to Danish forestry.

As for the medium-sized and large private forest estates, the profitability plays a major role for the owner. It is fundamental for his ability to keep the property. The key figure used when evaluating profitability in Danish forestry is the annual surplus per ha.

Information concerning the private forest economy, based on accounts for about 25% of the private forest area, is issued once a year by the Danish Forest Association. The average surplus (inclusive of subsidies) per ha in 1996 was estimated at 112 ECU, 42 ECU of which come from forestry per se. State subsidies for private forestry in 1996 made up approximately 9 ECU per ha and it is increasing.

In comparison, annual accounts from the National Forest and Nature Agency show that the average surplus corresponding to 42 ECU per ha in private forestry is estimated at -66 ECU.

4 Forest and forest related policies

4.1 Legislation

At present forestry in Denmark is preliminarly regulated by the 1996 Forest Act. This is the fourth Act, the first one being issued in 1805, see section 2.1, the second in 1935, and the third in 1989.

These Forest Acts reflect a development in the preferences in society over time and changes in the public perception of forest being a basic natural resource. In order to understand this development, the central objectives in the Forest Acts should be revealed.

The main policy problem at the time of the first Forest Act was a severe over-exploitation and a fear of timber famine. Therefore, the Act introduced the concept of Forest Reserves, implying a separation of agricultural farmlands and forest areas. This implicated that grazing in forests was abandoned.

At the time of the 1935 Forest Act, the forest area had expanded markedly and the management of forests had improved tremendously. The main issue of the second Act was to safeguard high quality wood production to meet the increasing demands of society. To a minor extent, the Act also took care of environmental values.

In 1989 the forest policy problem was a discussion over forestry practice. Green organizations were concerned with the public needs of change towards a multiple-use forest management. The third Forest Act maintained wood production as a basic target, but its objectives were extended to include multiple-use forestry. Additionally, monitoring forest health became part of the Act.

The fourth Forestry Act of 1996 increases the emphasis on non-timber forest values. A main requirement is that of good and multiple-use forestry, but wood production, biodiversity, sustainability, and the environmental interaction between forest and surroundings are important objectives as well.

Coinciding with the development described above, a number of acts relevant to forestry have been passed over the last three decades. These acts are concerned with public access to private forests, nature conservation, environmental protection, nature resource management and the like. It could be claimed that this bundle of acts together reflect a National Forest Program.

In the 1969 Act on Nature Conservation, public access to private forest was changed from a custom into a legal right. The appearance of this act was not without conflicts. It was, first of all, the result of increased demands in society for recreation and it resulted from a concerted action from green organizations being opposed to private forestry.

An important innovation in forest-related legislation was the 1989 Act on Nature Resource Management. The comments on the act determine the strategy for doubling the Danish forest area over 60-100 years, see section 2.3.1. The 1992 Act on Nature Conservation confirms this resolution, meaning that at this point there was a legal basis for the Government investing in state afforestation. Prior to this, rules were introduced in 1991 making it possible for private landowners to obtain subsidies for afforestation. Since 1996, the Forest Act has been the legal basis for private afforestation, including grant schemes for this activity.

The selection of areas for afforestation is contained in the Land Zoning Act, and is made by county authorities. In the beginning, it raised a debate as to the implications for the private landowners, who felt uncertain about for instance the consequenses on prizing and taxation of land. In the process of selection, designations are made not only on areas for afforestation, but also on areas where afforestation would not be allowed (minus areas) even without a grant.

Other pieces of legislation are also of importance to forestry, e.g. regulation on the use of nitrogen, protection of water resources, regulation on the use of pesticides, conservation of flora and fauna, regulation on hunting.

4.2 Actors in forest and forest related policies

The number of stakeholders in Danish forestry is very limited. The most important ones are the National Forest and Nature Agency and the Danish Forest Association.

The National Forest and Nature Agency belongs under the Ministry of Environment and Energy. It was established in 1987 by merging the State Forest Service and the Nature Conservation Agency. It plays a dual role. Partly it is the managing body that administers the forest area belonging under the agency, see table 3. This obligation is carried out by local administrations connected with 25 state forest districts as well as a central administration at HQ. Partly, the Agency is in charge of administering the Forest Act. Generally speaking, the National Forest and Nature Agency is the most influential actor in formulating forest policy.

The Danish Forest Association is the central interest organization for private forestry. It counts as its members the medium-sized and large estates, the Danish Forestry Extension, which is an organization for small forest properties, the Danish Land Development Service and individual members. The National Forest and Nature Agency is an associate. The Society's role is to issue information about accounts and statistics concerning private forestry, offer supervision on legislation, play a part in exportation of timber and the like. Moreover it is actively involved in political lobbyism.

Among the stakeholders to be mentioned is also the Forestry Council advising the Minister of Environment and Energy on forestry and related issues.

Also, the green NGOs are important stakeholders influencing the political process when nature issues are on the agenda. The major organizations are Denmark's Nature Conservation Society with about 250,000 members, and the Outdoor Life Council which is an umbrella organization.

4.3 Forest policy tools

The essential policy tool is the legislation briefly discussed in section 4.1. Fundamentally, this piece of legislation includes a number of restrictions and regulative rules useful for managing forests. Among these, the concept of Forest Reserves and that of good and multiple-use forestry could be pointed out. As emphasized above, the Forest Act also comprises incentives aiming at improving forestry by use of grant schemes.

Some regulations are directed towards specific management activities. Thus, the Forest Act states that it is not allowed to dispose more than 10% of a property´s forest area for production of christmas trees and greenery. Another example is that due to EU regulation, seedlings purchased from outside the property must come from certified seeds.

It should be noted that the number of restrictions and incentives aiming at multiple-use and sustainable forestry is impressive and increasing. The staff at forest districts spend still more time informing about regulations and grant schemes aiming at a politically based forestry development and ensuring their implementation.

4.4 Forest policy in relation to other national policy areas

Over the last years, a clear trend could be observed directing forestry from being a separate and partly isolated sector towards being a more integrated component of society. This obviously means that looking at forest policy tools at present implies that forests, cultivated lands, non-cultivated areas and even urban areas are considered an integrated and interrelated whole. Forest plays an important role in this complex.

However, when it comes to the economic importance of forestry it is still true that forestry constitutes an in-significant share of GDP.

As appears from the comments on legislation related to forests it has been shown that over the last years, legislation has become important to more than one sector at a time. This applies in connection with afforestation in that agriculture gets deeply involved. The same is true when looking at legislation concerned with nature conservation or nature protection in one way or the other: Apart from the target areas, forests as well as cultivated land are dependent on this kind of legislation. Thus, increasingly, legislation is cross-sectorial.

4.5 EU forest and forest-related policies

Policies negotiated and decided in the EU, to a high degree express the goals based on national preferences. As one of the member states, Denmark is obviously committed to arranging its legislation in accordance with decisions in the EU.

Based on the fact that attitudes on sustainable multiple-use production, increased biodiversity, and improved ecological and socioeconomic stability are fundamentally the same in the EU as in Denmark, there are no major conflicting areas. Yet, conflicts may arise if Denmark desires to further its policy in a particular area, without being able to convince a majority of member states about its position. As an example could be mentioned, that at present Denmark wants to diminish the amount of pesticides used, particularely in christmas tree plantations. A decision has already been made by the Minister of Environment and Energy as far as the state forest areas are concerned. But it is still not sufficiently clarified whether the EU will agree on that decision.

4.6 Forest education and research

Forest education takes place at two institutions in Denmark. The Royal Veterinary and Agricultural University at present admits 60 students per year. The academic education is organized with a propaedeutic year for practical training, three years for a B.Sc. and two years for a M.Sc. including writing a masters thesis. Master students can choose between four programs and more programs are being planned. One master program is directed towards Danish forestry and is based on education in ecological, economic and technical subjects. Others are directed towards Land Use in Developing Countries, and Landscape Management. Teaching is based on research.

Opportunities for post graduate education is offered by the Graduate School for Veterinary and Agricultural Sciences. This program is carried out in a collaboration between the Royal Veterinary and Agricultural University and 13 sector research institutes. The length of the Ph.D. study-program is three years.

Education of Forest Technicians takes place at the Danish Forestry College which is associated with the National Forest and Nature Agency. 40 students are admitted per year. The length of the education is close to four years and approximately half of it is practical training. There are two programs directed towards forestry and landscape respectively. The College also carries out vocational training, particularly for forest workers.

Basic forest research takes place at the Royal Veterinary and Agricultural University. The Danish Forest and Landscape Research Institute takes care of the applied research as well as information service. It belongs under the Ministry of Environment and Energy. There is a co-operation agreement between the University and the Research Institute, and at present a more close association between the two is being negotiated.

5 Main current conflicts and challenges

As often stressed above, forestry in Denmark makes up a small sector with a diminutive influence on national economy. This implies that Danish forestry counts a rather small number of actors, but nevertheless the political interest in forestry is positive and almost overwhelming.

Trying to identify possible current conflicts seems to be a question of how the UNCED in Rio has influenced the debate over the years since 1992.

It should be taken for granted that the Danish population is satisfied with the forest when it comes to the practicability for making use of it for recreational purposes. Questionnaires informing on the recreational use reveals that the number of forest visits in many parts of the country rank above comparable leisure activities. Estimates also show that there is high satisfaction with the character of forests.

This ascertainment contains in itself the possibility of a future conflict. Within organizations that are very conscious about and committed to nature, say in Denmark's Nature Conservation Society, WWF and Greenpeace, there are fractions which strongly support a radical transformation towards forestry based on a" close to nature" development. This may lead to a situation where all exotic tree species are put under a ban. The extent of changes resulting from this is seen from table 6. Furthermore, it will bring along a strong change in forest structure. Whether this change is acceptable to the public is an open question.

On the other hand forest research, no doubt, has to solve the central issue of providing a better understanding of basic processes taking place in natural forests in order to ease a transformation from the traditional management towards a nature-oriented management. This will be an important challenge in the next century, the reason being partly the consequence of the international discussion on forestry issues over the last decade, partly the experience with the general forest decline and the unstable forest ecosystems in Denmark. Therefore, the focus will be on forests that are not founded on pure stands but on species-rich and unevenaged stands. Clearcutting will be avoided and natural regeneration will dominate.

The problem is to initiate such a transformation without harming the economic foundation for the existing management. In state forests, transformation could be decided for political reasons. But, as appears from table 3, a great part of the forest area is on private hands and thus cannot be fundamentally changed without taking into consideration the economic mechanisms. Finally, one also has to consider the ethical perspective based on the fact that if a wealthy country is not willing to safeguard a reasonable wood production, i.e. a production matching the wood consumption of that country to the greatest possible extent at the end of the day, this may lead to an increased tension on tropical forests. The desire to be a role-model by establishing and managing a „close to nature" sustainable forest thus may end up strengthening forest destruction in the tropics.

Likewise it is a requirement that there is a continued development of the political framework, which will refine a national forest program involving forest production and management that are beneficial to the part of the world where the forest is most threatened. This means that the institutional framework for a political development must be satisfactory. At present, the Forest Act makes up the political tool in dealing with the significant rules and regulations needed for the development of forests. Moreover the National Forest and Nature Agency is the central institution for developing future forest policy. On the threshold of a new century it is important to make sure that the institutional dynamics is still there as a guarantee for continued political development. And it is important that this political development conciders, with due care, the international trend in forestry as well as the need for a still more sophisticated and scientifically based understanding of forest functions. Finally, it is essential that forestry education is permanently adapting so that a holistic and optimal output of forest resources can be secured.

Addresses of organizations related to forestry

Skov- og Naturstyrelsen, [National Forest and Nature Agency], Haraldsgade 53, 2100 København Ø, Tlf. + 45 39 2720 00, Fax + 45 39 27 98 99

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Forskningscentret for Skov & Landskab, [Danish Forest and Landscape Research Institute], Hørsholm Kongevej 11, 2970 Hørsholm, Tlf. + 45 45 76 32 00, Fax + 45 45 76 32 33

Institut for Økonomi, Skov og Landskab, [Department of Economics and Natural Resources], Rolighedsvej 23, 1958 Frederiksberg C, Tlf. + 45 35 28 22 32, Fax + 45 35 28 26 71

Skovskolen , [Danish Forestry College], Nødebovej 77A, 3480 Fredensborg, Tlf. + 45 48 48 13 43, Fax + 45 48 47 55 43

Det danske Hedeselskab, [Danish Land Development Service], Klostermarken 12, P.O. Box 110, 8800 Viborg, Tlf. + 45 86 67 61 11, Fax + 45 86 67 15 17

De Danske Skovdyrkerforeninger, [Danish Forestry Extension], Amalievej 20, 1875 Frederiksberg C, Tlf. + 45 33 24 42 66, Fax + 45 33 24 42 66

Danmarks Naturfredningsforening, [Denmark's Nature Conservation Society], Nørregade 2, 1165 København K, Tlf. + 45 33 32 20 21, Fax + 45 33 32 22 02

WWF Verdensnaturfonden, [World Wide Fund for Nature], Ryesgade 3F, 2200 København N, Tlf. + 45 35 36 36 35, Fax + 45 35 39 20 62

Vildtforvaltningsskolen, Kalø, [Wildlife Management School], Molsvej 34, 8410 Rønde, Tlf. + 45 86 37 28 50, Fax + 45 86 37 23 65

Teknologisk Institut, [Technological Institute], Gregersensvej , P.O. Box 141, 2630 Tåstrup, Tlf. + 45 43 50 43 50, Fax + 45 43 50 72 50

Miljø- og Energiministeriet, [Ministry of Environment and Energy], Højbro Plads 4, 1200 København K, Tlf. + 45 33 92 76 00, Fax + 45 33 32 22 27

Danske Forstkandidaters Forening, [Danish Association of Graduates in Forestry], Strandvejen 863, 2930 Klampenborg, Tlf. + 45 39 97 01 00, Fax + 45 39 97 01 19

information about forestry in Denmark

Skov- og Naturstyrelsen (www.sns.dk)
Dansk Skovforening
Forskningscentret for Skov & Landskab (www.fsl.dk)
Institut for Økonomi, Skov og Landskab (www.kvl.dk)
Skovskolen (www.sks.dk)
Wood Creates Environment (www.trae.net)

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Acknowledgement

I am grateful to professor Finn Helles for reading and commenting on the manuscript and to Senior Lecturer Andreas Bergstedt for providing information about the wood industry.

Finland

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1 The country

1.1 Nature

Finland, one of the northernmost countries in Europe, is located between latitudes 60°N and 70°N neighbouring to Sweden and Russia. Finland is the fifth biggest country in Europe by the area of 388 145 sq. kms. Due to the length of the country (1100 km from south to north), the landscape and climate vary greatly from one part of the country to another. The west coast of Finland is a low-lying plain with several big rivers. The scenery on the eastern side, however, is an undulating mosaic of boreal forests and thousands of lakes. In the northern part of Finland, Lapland, high rounded fells are characteristic to the topography. The highest point of Finland at Haltiatunturi is only 1328 m from the sea level.

1.1.1 Climate

The Atlantic Ocean and the Gulf Stream affect the climate in the whole Scandinavia as well as in Finland remarkably, making the climate warmer than it is elsewhere at the same latitudes. The annual mean temperature in the south-western Finland is +5°C degreasing gradually towards north, and being only -1°C at the timberline in Lapland.

The length of the thermal growing season (number of days when the mean daily temperature exceeds +5°C) varies from 120 to 180 days in a region with a closed forest cover (Hannelius & Kuusela, 1995).

The mean temperature of the warmest month (July) is +17,5°C on the south-western coast and +13°C in the northern areas. In February, the coldest month of the year, the corresponding temperatures are -5°C and -13°C. However, the mean temperature in February in the very north-eastern corner is only -10°C due to the warming influence of the Arctic Sea. Similar dampings of the temperature extremes can also be seen in the areas close to the Baltic Sea.

In southern Finland the mean annual precipitation is 650-700 mm degreasing to 400 mm at the timberline. The rate of evaporation is smaller than the precipitation in the whole country excluding the south-western areas where evaporation is higher during the summer time. The mean annual evaporation is 425 mm in the south and 200 mm in the north. About 30% of the precipitation comes as snow in southern Finland. In eastern and northern areas the share is 40% or more. The permanent snow cover lasts for 4-5 months in the south and 5-7 months in the north. The thickness of the snowpack varies from 20 cm in the Åland Islands to 200 cm in the hilly areas of Lapland. (Hannelius & Kuusela, 1995)

1.1.3 The bedrock and the soil

The Finnish bedrock is very old. It is formed mostly of granite and gneiss, the types of rocks that are composed of minerals very poor in nutrients. There exists also small depositions of limestone, dolomite and the Karelian schists. The last continental ice sheet drifted the loose soil and stones away leaving the bedrock, if not exposed, covered only by a thin soil layer. The average thickness of the layer is only 7 m. The soils are relatively young and mostly formed by the last continental ice sheet. About 80% of the upland soils are glacial tills, mixtures of soil particles of different sizes. Other common soil types are sorted soils (5%), sandy soils (11%)

and silt and clay soils (4%). The last mentioned are fertile and, thus, mainly in agricultural use. (Hannelius & Kuusela, 1995)

Finnish forest soils are mostly podzols (Al-Fe-humus) with a typical profile of vertical layers. The mineral soil underneath the surface litter horizon and the humus horizon can be divided into a grayish eluvial horizon (A-horizon) and a reddish brown illuvial horizon (B-horizon) coloured by the accumulated inorganic Fe <HTTP://www.vyh.fi>.

Another typical feature of the Finnish soils is acidity. The soils have been undergoing a natural acidification ever since the last glacial period, but due to the human actions, such as the use of fossil fuels, the speed of the process has increased. Also the ground water supplies, which in general are relatively small, isolated and covered by a thin soil layer, are fairly exposed to pollution and acidity. <HTTP://www.vyh.fi>

1.1.4 Vegetation

The main vegetation zone in Finland is the boreal zone covering almost the whole country excluding only the southern coast which belongs to the hemiboreal vegetation zone, a transaction zone from temperate to boreal vegetation. The growing season on the hemiboreal zone is 175-205 days. The boreal vegetation zone can be divided into subzones by the length of the growing season. The west coast and the southern Finland belong to the southern boreal zone where the growing season varies between 160-175 days. Middle boreal vegetation zone, covering the riverplains of west coast and some areas in the eastern Finland have a growing season of 140-169 days. The north-eastern and the northern parts of Finland belong to the northern boreal vegetation zone with a growing season of 100-140 days (Maanmittaushallitus, 1988).

In the oceanic-continental scale vegetation in most parts of Finland should be classified closer to the oceanic than the continental end. The very extreme conditions from both types are missing, but the most oceanic areas can be found in south-western Finland and in some areas of Lapland. The most continental conditions may be found in Lapland. Overall, the vegetation in Finland is a mixture of both oceanic and continental characteristics.

One of the most characteristic factors of the Finnish nature are the peatlands. Due to the humid and cool climate one third of the country's land area is covered by peatlands. In certain regions of the country their share of the land area can be up to 60%. The total area of peatlands is 8 921 000 hectares of which 52,3% is drained and in forestry use (Finnish Forest Research Institute, 1997a).

1.2 Society

Finland has been a democratic republic ever since it became independent in 1917. The president is the head of the country's foreign policy and also holds the supreme executive power with the government of Finland. The legislative power is shared by the president and the one-chamber parliament of 200 members. Juridical power is held by the independent courts of justice.

1.2.1 Economy

Finland has experienced a massive structural change since the Second World War. Transition from an agriculture based society to a post-industrialised society have been extraordinarily fast. Today Finland is a highly industrialised, largely free-market economy. Its key economic sector is industry; wood, metal and engineering being its main branches. The share of different industrial branches of Finland's GDP in 1996 can be seen in table 1.

Table 1. The share of different sectors in Finland's GDP (1996).

Branch	**%**
industry	37
services	56
agriculture	7
Total	**100**

In the beginning of 1990s Finland fell into the deepest economical depression of the century which among other economical consequences lead to the second highest unemployment figures in the OECD countries. The situation has improved towards the end of the decade, for example the unemployment in 1996 was “only“ 16,3% whereas in 1994 it was 18,4 (Statistics Finland, 1997).

1.2.2 Population

The population of Finland, 5,1 million people, is distributed unevenly on the vast land area. Population is concentrated on a small south-western coastal plain, and nearly 20% of the population live in the metropolitan area (capital Helsinki and the surrounding cities), thus, leaving especially the northern and eastern parts of the country very sparsely inhabited. The mean population density is only 16 people per sq. km varying from 135,7 people per sq. km in the capital area and it’s surroundings to only 2,2 people per sq.km in the Lapland (Statistics Finland, 1997).

Due to the structural and societal change, the concentration of population to the densely inhabited area is ever increasing. Since the 1970s there has been a remarkable migration from the countryside to the cities, and from the northern and eastern Finland to the south-western coastal areas. At the moment the share of urban population is 65,1% (Statistics Finland, 1997).

2 Forest resources and their uses

2.1 Forest history

After the end of the last ice age the land in Scandinavia was gradually occupied by vegetation. Pine and birch were among the first arriving tree species and became dominant in the northern areas and on poorer soils in the southern area. Spruce spread to Finland over 4000 years ago from Russia. Finally, about 2000 years ago, the present forest zones in Finland were more or less formed (Fritzbøger & Søndergaard, 1995).

The relationship between man and the northern coniferous forests began over 9000 years ago when the first people, hunters, fishermen and nomads, moved to Finland. The effect of their activities, especially reindeer husbandry was remarkable to the forests. Grazing, fires and collection of wood affected the flora and fauna surrounding the permanent settlements. The population was limited, however, and outside the settlements the forest remained untouched (Hannelius & Kuusela, 1995).

Permanent settlement lead relatively fast to the practise of agriculture. Conversion of forests to fields, and especially slash-and-burn practise had a strong influence on the Finnish nature. As its greatest the slash-and-burn agriculture occupied ca. 4 million hectares of forest land and consumed 10 million m^3 of stemwood annually. When the population increased and slash-and-burn started to be over-exploitive, it was largely forbade in 1734 (Hannelius & Kuusela, 1995).

The pre-industrial use of forests consisted for example of the wood used in mining and glass manufacturing, sawn wood, and wood used as fuel. The most important was, however, the production of tar using at least 10 million m^3 of pine annually during the 17th and 18th centuries. The combined wood consumption of tar production and the slash-and-burn agriculture was comparative to the current levels of industrial consumption (Hannelius & Kuusela, 1995).

The industrialisation of forest sector first started in the 19th century. A permit for establishing the first steam-powered saw-mill was granted in 1857 and mechanical pulp production was started in 1860. First chemical pulp mills were established in the 1880s. (Hannelius & Kuusela, 1995) Especially the sawmill industry grew rapidly increasing its production and wood demand, and was soon considered to be one of the greatest threats to Finnish forests. Together with slash-and-burn agriculture and tar producing, the selective thinning for providing rawmaterial for industry caused a substantial reduction in the volume and quality of Finnish forest resources (IUFRO, 1995).

In the 20th century the development of the forest industry has continued. Whereas in the 1920s the share of industrial wood was 20% of the total removal of stemwood, nowadays the share is 82%.(Hannelius & Kuusela, 1995) However, despite the vigorous utilisation the forest resources have not decreased during the 20th century. Due to the investments in silviculture, the drainage of peatlands and the thinnings, the growing stock has increased, and it seems to continue to grow also in the near future. The sustainable annual allowable cut in 1996-2005 is estimated to be 67 million m^3 and in 2006-25 about 70 million m^3 (Hänninen, 1998).

2.2 Forest ownership

Private non-industrial ownership of forests is characteristic to Finnish forestry. Private citizens own 64% of the forest land area, about 8% is owned by companies and 28% is state- or community owned. (Finnish Forest Industries Federation, 1997b) Private forest owners also obtain 80-85% of the total stumpage income from the total timber sales (Hannelius & Kuusela, 1995).

Due to the societal changes (industrialisation, urbanisation etc.) the image of a typical private forest owner has changed. Whereas a couple of decades ago a private forest was owned by a farmer residing permanently on the holding, now half of the forest owners are city dwellers, mostly wage earners and pensioners.

Not only the structure, but also the interests and needs of the forest owner class have changed. The emphasis has moved from the mere timber production towards the multiple-use forestry. This has been anticipated to lead to a problematic situation from the forest industry point of view. Their wood supply could became uncertain, if the forest owners were not so willing to sell wood. The effect of this change, however, has remined rather insignificant.

Third trend in forest ownership development is the fragmentation of the forest holdings due to the estate distribution. The current average size of a private forest holding is 26 hectares (Finnish Forest Association, 1997). The average size of a forest holding overall is 38 hectares (Finnish Forest Industries Federation, 1997a).

2.3 Land use and forest resource

2.3.1 Overview of the land

The total area of Finland, 338 000 sq.kms, constitutes of 304 000 sq.kms of land (90%) and 34 000 sq.kms of water (10%), including approximately 60 000 lakes (Statistic Finland 1996). Forestry land covers 86% of the land area, 10% is under agriculture use, and only 4% of the area is built up. The forestry land area in total covers 263 000 sq.kms, which can be divided to three productivity classes. The classification can be seen in table 2.

2.3.2 Tree species origin and distribution

There are altogether 31 tree species growing in Finnish forests, but traditionally mainly three species have had economic importance. The two dominant species, Scots pine (*Pinus silvestris*) and Norway spruce (*Picea abies*) occupy over 80% of the forested area. In the northernmost areas over 75% of the growing stock consists of

Table 2. The classification of the forestry land areas according their productivity and the share of different classes from the total forestry land area.

Class (according to (M)ean (A)nnual (I)ncrease)	Share of total %
Forest land (MAI over 1m^3/ha)	76,2
Scrub land (MAI 0,1-1m^3/ha)	11,3
Waste land (MAI less than 0,1m^3/ha).	12,5
Total	**100**

(Finnish Forestry Association, 1997)

pine alone. The main broad-leaf species is birch (*Betula pendula* and *B. pubescens*) accounting 7,5% of the forest land (Finnish Forest Industries Federation, 1997a).

The species composition of a typical forest view changes gradually when moving across the country from the southern deciduous forests to the most extreme conditions in Lapland. The richest soils in the south-western area grow species such as oak (*Quercus robur*), ash (*Fraxinus excelsior*), elm (*Ulmus sp.*) etc. Finns refer to this group of trees with respect as "the noble broad-leaved trees". In southern Finland Norway spruce is the dominant species, whereas in eastern Finland birch thrives at old slash-and-burn sites. In western Finland, and increasingly towards north, Scotch pine is the dominant tree species. On moist sites in northern Finland one meets birch (especially *Betula pubescens*) (Forestry Centre Tapio, 1994). Scotch pine forms the northern timberline above which only fell birch (*Betula tortuosa*) can exist in the extreme living conditions.

2.3.3 Total growing stock, growth and total fellings

The current growing stock volume in Finnish forests is 1 890 million m^3 (1996). The share of non-industrial, private owned forests of the total growing stock is 69%, 8% is located in company forests and 18% in state forests. (Finnish Forest Research Institute, 1997b) The average total growing stock per hectare is $92m^3$/ha varying from 140-159m^3/ha in Southern Finland to 40-59m^3/ha in Lapland. The mean annual increment per hectare in the Finnish forests is 3,8 m^3 which accounts to a total annual increment of 77 million m^3. The annual growth has increased steadily from the 1960s. Annual fellings and natural loss are together about $60m^3$ (Finnish Forest Association, 1997).

2.3.4 Forest threats

Changing environmental conditions have started to weaken the health and sustainability of forests against the stress caused by natural factors. Pollution affects trees by increasing the soil acidity and damaging the needles. The acidic deposition from the industry causes changes in the nutrient status of the soil. As already mentioned, the soils in Finland are naturally acidic and infertile, and thus vulnerable to increased soil acidity. The increasement of acidity accelerates nutrient leaching and the dissolution of iron and aluminium compounds into the soil water.

Tree defoliation, the loss of leaves or needles, is one of the main parameters used to determine the state of the health of the forest. Often, however, the significance of other causes for defoliation, for example high tree age or fungal damage, are forgotten. (Hannelius & Kuusela, 1995) The defoliation of pines and broadleaves has slightly increased during the last few years. The degree of defoliation of coniferous forests in Finland 1992 were relatively small in the European scale. A little less than 40% of the forests were slightly defoliated of which one forth was severely defoliated (Metsätalouden ympäristötyöryhmä, 1994).

Sulphur

The sulphur depositions from the industry and traffic have decreased remarkably since the 1980s. The critical level of sulphur is 7 kg/ha/year. In 1990 the amounts of sulphut depositions in Finland were 7-10 kg in southern and 3-5 kg in northern areas. However, due to the deposition of Russian smelters, the sulphur deposition was 5-7 kg in the northern areas along the eastern boarder (Hannelius & Kuusela, 1995).

Nitrogen

The decreasing of the nitrogen deposition has been somewhat slower. The critical level being 10-20 kg/ha/year the deposition in Finland varied from 10 kg/ha/yr in the south to 2 kg/ha/yr in northern areas (Hannelius & Kuusela, 1995).

Biotic and abiotic factors

Damages caused by biotic and abiotic factors result in a loss of about 168,2 million EUR in stumpage income annually. The economically most damaging pathogenic fungi are *Heterobasidion annosum* (Annosum root rot) and *Gremmeniella abietina* (needle cast). Insect damages are caused by *Diprion sp., Tomicus sp.*

and *Hylobius abietis*. Also mole *(Microtus sp.)* and elk *(Alces alces L.)* cause damages in seedlings and young stands of pine and birch. The most common abiotic factors causing damages in Finnish forests are wind and occasional sudden changes in temperatures. (Metsätalouden ympäristötyöryhmä, 1994)

The greenhouse effect

One of the greatest environmental threats, the greenhouse effect has been predicted to have a greater effect on the climate on areas close to the North pole. In Finland the temperature during growing seasons could be 2-3°C higher and during the winter 4-6°C higher than today. The greenhouse effect could also increase the precipitation. These changes would cause the natural coniferous zone to move towards north and broad-leaved forests to replace them in Finland. The amount of damages caused by insects, fungi or wind would increase, as would also the costs of forestry. That could be partly compensated by the increase in the wood growth and yields (Hannelius & Kuusela, 1995).

2.4 Silviculture

The management of boreal forests is a long-term commitment due to the long rotation ages; at least 60-80 years is required for a forest to reach the harvesting maturity. The idea of management is based on simulation of the natural forest succession after a major disturbance (fire, wind, insects or disease). The silvicultural chain-of-custody constitutes of successional stages such as regeneration, brushing and cleaning of the young sites, thinnings (precommercial and commercial), pruning, and fertilisation.

Each year, forest regeneration takes place on 165 000 hectares which is nearly 0.8% of the whole forest land (Finnish Forest Association, 1997). The result of the regeneration should be a healthy young stand of adequate and even spacing and good quality. The Forestry Centre advises forest owners to use natural regeneration when ever the prerequisites exist. Natural regeneration methods are the seed-tree method for pine and birches and the shelter-tree method for spruce (Forestry Centre Tapio, 1994). Most of the sites are prepared by sculping or scarification. After a few decades of low interest the use of prescribed burning as site preparation method is increasing while the forest ploughing has been phased out.

If the favourable circumstances for natural regeneration do not exist, or there is a need to change the tree species, the forest owner is obliged to use artificial regeneration methods. Sowing or planting after clearcutting is used on over 70% of the regenerated areas. The distribution of the total regenerated area to different regeneration methods can be seen in table 3.

Table 3. The distribution of different regeneration method.

Regeneration Method	Share of total, %
Natural regeneration	29
Sowing, pine	16
Planting, pine	23
Planting, spruce	22
Planting, birch & others	10
Total	**100**

(Finnish Forest Association, 1997)

Stand tending, forest management of early development stages, includes chemical and mechanical cleaning of the sites. Stand tending is done to regulate the species composition and to protect the main species from competition. Guidelines for managing this stage of stand development have been revised lately; now the aim is a mixture of coniferous and deciduous species. The species mixture improves the soil characteristics, reduces possible damages and increases biodiversity. Most of the tending is nowadays carried out mechanically**,** herbicides are rarely used (Metsäteollisuus, 1998).

The neglect of stand tending is becoming a problem in Finland. In 1996 tending was done only on 154 000 hectares, which is the smallest amount since 1970 (Finnish Forest Research Institute, 1997a). The need of stand tending is urgent on 460 000 hectares of forest stands. Forestry Center Tapio has established a campaign for increased young stand tending in order to ensure the future wood supply (Nuoren metsän hoidon kampanja, 1997).

Thinnings imitate forests natural development keeping an even-aged forest structure as a goal. Damaged trees and trees of low quality are removed and the stand is opened up in order to prevent undesired competition. Thinnings are done 1-3 times during a rotation depending on the tree species and the growing conditions. The total amount of thinnings done in 1996 was about 111 000 hectares of which 82 000 hectares were first thinnings (Finnish Forest Research Institute, 1997a). According to the results of the National forest inventory there is a current need for first thinnings on 2,5 million hectares of the forests. Arrears, sites where the thinnings are already late, account up to 400 000 hectares. This neglect of management may lead to a decrease in the profitability of forests and exposes the stands to damages (Hynynen, 1998). The Forestry Center Tapio campaign refered to earlier is aimed also to eradicate these arrears.

2.4.1 Forest drainage

One third of Finland is covered by peatlands. Starting from the late 19th century peatlands have been drained for agricultural and forestry purposes accounting to 6 million hectares of drained area (Päivänen & Paavilainen, 1996). The era of ditching for forestry is coming to its end, and the annual amounts of first drainages (draining at virgin areas) has decreased. In 1996 the annual area of drained peatlands was 6300 hectares, whereas in 1969 the number was 294 100 hectares (Finnish Forest Research Institute, 1997a). The Forest and Park Service has given an example by ceasing first draining on state lands since 1994. (Forestry Centre Tapio, 1994)

Nowadays the main method of peatland managing is maintenance of drainage by drain cleaning and supplementary ditching on sites where the tree stands have already developed vigorously (Forestry Centre Tapio, 1994). In 1996 drain maintenance was performed on 68 500 hectares of peatlands (Finnish Forest Research Institute, 1997a).

As a whole peatland drainage has been successful in providing growth increments and valuable yields in otherwise poor conditions. However, about 15% of the drained area is considered to be unsuitable to maintenance (Päivänen & Paavilainen, 1996). These sites have been, or will be let to grow wild again, or in some cases even restored by cutting the trees and blocking the drainage system.

2.4.2 Fertilization

The annual quantity of forest fertilisation was at its greatest at the mid-1970s and has decreased to almost non-existent during the 1990s. In 1975 over 243 000 hectares were fertilised, but in 1995 the corresponding figure was only 8 535 hectares (Finnish Forest Research Institute, 1997a). In the 1990s the emphasis has changed from the increase of the forest growth to vitality fertilisations. The main idea is to prevent the adverse effects of nutrient deficiencies on the vitality and sustainable development of forests (Päivänen & Paavilainen, 1996).

The lack of nutrients is the limiting factor of forest growth in many poor peatlands. Fertilisation has been a method to manage these sites. The main nutrients applied are nitrogen, phosphorus and potassium. Wood ash has been used as a fertiliser on nitrogen-rich sites accounting on a mean annual growth increase of 4-8 m^3 per hectare (Päivänen & Paavilainen, 1996).

2.4.3 Recent changes in silviculture

In the 1990s many silvicultural practises have been slightly revised to better accommodate the concerns for forest ecology and biodiversity. The new recommendations advice the forest owner to consider also ecological, landscape and wildlife factors, and other multiple-use factors of the forest besides his/her economical goals. The main ideas of the new forest management recommendations include:

- natural regeneration should be used whenever feasible;
- broad-leaved trees should be fostered in stands of conifers;
- forest treatment should be proceed with caution

alongside lakes and rivers, a protection zone around them should be left untouched;
- habitats of endangered species and other key biotopes should be preserved and maintained;
- the biodiversity after clear felling should be preserved by leaving large trees, clumps of trees and diseased and decaying trees on the site.

Management of the environment has became a part of the daily actions in the forests. The Finnish Forest and Park Service started the development of the landscape ecology planning in Finland in 1994. The purpose of landscape ecology planning is to guide forestry in such a way that the typical fauna and flora to an area may remain as viable populations at all times. This is provided by observation and mapping of valuable biotopes and habitats of vast areas (hundreds of square kilometres) and by forming dispersal routes and so-called stepping stones for the indigenous wildlife. The landscape ecology planning is performed keeping in mind all the important components of multiple-use forestry (Hallman, E. & al.,1996). By the year 2000 all the state-owned land should be within the landscape ecology planning program.

2.5 Forest production

2.5.1 Harvesting systems, accessibility

On the average, felling of timber is carried out annually on 1,9% of the forest land, covering 385 480 hectares (fig. 1991-1995). The share of different felling methods from the total fellings is shown in table 4.

The mechanisation of harvesting systems has been rapid in Finland. Up until 1980s most of the wood was sawn by forest workers with a chainsaws, and in 1996 the share of mechanised fellings was already 86% of the total. About 70% of thinnings and 90% of final fellings were mechanised (Finnish Forest Research Institute, 1997a).

About 25-30% of all the wood harvested is so-called delivery wood felled by the owner and sold at the roadside. Most of the wood in private forests is sold by stumpage sale and harvested by contractors working for the buyers (Hannelius & Kuusela, 1995).

In Finland, as in all the Nordic countries, wood is harvested using the cut-to-length method; the trunks are cut into the required lengths already in the forest. The main advantage of this method, which has been proved competitive also in other countries, is that the transporting of trees out of a thinned forest can be done without damaging the standing trees. Damages are also prevented by using light and easily manoeuvrable machines in thinnings. Harvesting on a soft or boggy land is usually done during the frozen ground and snow cover (Hannelius & Kuusela, 1995).

2.5.2 Timber uses

Forests are the most important resource of raw-material in Finland. The total use of roundwood in Finland was 61,7 million m^3 of which forest industry used 56,2 million m^3. Around 8 million m^3 of roundwood were imported. The share of industry of the total use of roundwood is 91% (Finnish Forest Research Institute, 1997a).

There has been certain structural changes in the timber use. Even though the total amount of forest industry production have increased remark-

Table 4. The share of different felling methods from the total fellings.

Felling method	**Share of total fellings, %**
Thinnings	46
Clear-felling	29
Seed-tree or Shelter-wood method	13
Removal of seed-trees or shelter-trees	10
Other felling methods	2
Total	**100**

(Finnish Forest Association, 1997)

ably, only slight increases of roundwood use can be seen. The main reasons for this are the considerable reduction in the use of wood as fuel, the wood-saving methods used in forest industry and promotion of the degree of processing (less roundwood is needed per a production unit) (Finnish Forest Research Institute, 1997a).

2.5.3 Non-timber forest products and the multiple-use forestry

In addition to timber products Finnish forests offer a large variety of multiple-use products, material and non-material goods such as forest berries and mushrooms, game, possibilities for recreation, nature conservation and landscape values. These are all included into the theme of multiple-use forestry which has become an ever more important part of the Finnish forest policy. The previous forest policy program, Forest 2000, underlined the importance of multiple-use of forests, and remarked that the forests should be utilised in such a way that it in a sustainable way meets the various needs of the population, and that the material and non-material overall benefits are maximised. The importance of multiple-use of the forests is ever increasing.

Berries and mushrooms
In 1996 there were 6 718 000 kg of commercial forest berries and 377 000 kg of commercial forest mushrooms collected from the forests. The total value of these were 9,5 million EUR. It should, however, be noted that these figures exclude the household use of berries and mushrooms, which would probably increase the value manifold (Finnish Forest Research Institute, 1997a).

Hunting
The traditional way of utilising the forests, hunting, is still practised by many Finns; there are about 293 000 registered hunters in Finland. For a great majority of them hunting is a way of recreation. Elk, waterfowl, forest game birds and hare are the most important game species. Most of the bag of game goes to the household use, but the estimated value is 49,4 million EUR (Finnish Forest Research Institute, 1997a).

Lichen
In some areas with dry, lichen-rich pine forests lichen (*Cladonia alpestris*) is picked for export markets. In 1996 Finland exported a total of 254 000 kg of lichen with a value of 1,3 million EUR. Over half of the exported lichen goes to Germany.

Reindeer husbandry
In Northern parts of Finland reindeer husbandry is a locally important source of livelihood. Approximately 1,7 million hectares of forest land is grazed by reindeers producing 2,8 million kg of reindeer venison annually. Monetary value of reindeer venison production is 13,5 million EUR (Finnish Forest Association, 1997).

Recreation
Forests have also a social meaning for many Finns. Forests provide peace and quietness for relaxation, suitable sites for summer cottages, perfect terrains for hiking or skiing and supplies of forest berries, mushrooms and game. Everyman's right gives an opportunity for recreation almost everywhere in the nature, but usually Finns use actual recreation and outdoor life areas built for the use. Such areas provide outdoor people with services such as marked paths, fireplaces and huts. There are over 7000 recreation areas in Finland (Finnish Forest Research Institute, 1997a).

Landscape values
In the Finnish landscape, one can see simultaneously the effects of the last continental ice sheet, the development of the vegetation and the actions of man. An increasing interest towards landscape management has brought up the question of preserving not only the natural landscapes but also so-called cultural landscapes. Forests are an important part of the Finnish landscape, and thus forest management is also management of the landscape. The current forest management recommendations by the Forestry Centre Tapio underline the management of special landscapes such as forests near settlements and stands at the top of a hill.

Table 5 presents the amount of nature conservation areas in Finland. In addition to these, vast land areas are under restricted forest utilisation accounting the total amount of conservation areas to 4,2 million hectares. In order to be established, a conservation area should have an endangered species or ecosystem, or it should be naturally beautiful. Also cultural landscapes can be preserved due to their rarity or special value (Finnish Forest Research Institute, 1997a).

The biological diversity is not very great in the northern coniferous forest. The total number of species living in Finland is ca. 42 000. The share of endangered species is estimated to be 4%, some 1 692 species (Finnish Forest Association, 1997). About 48% of all the endangered species live in the forests or peatlands (Finnish Forest Research Institute, 1997a). Causes leading the species to be threatened can be seen in table 6.
Since most of the endangered species live in commercial forests the mere establishment of a network of conservation areas is not enough. The nature has to be taken into consideration in every stage of the forest management. This has been the main aim in the new management recommendations and in the landscape level planning.

3 Forest economics

3.1 Forest and forest industries in national economy

The importance of the forest sector in Finland's economy is great, even though its share of GDP has decreased during the last decades. In 1960 the share of forestry of GDP was 8.7%, and that of forest industries, 7,1%, while in 1996 forestry accounted to 2,4% and forest industry to 5,3% (Finnish Forest Research Institute, 1997b).

In addition to the basic forest sector, also the forest cluster has an important role in Finnish economy. The forest cluster includes the forest product industry, paper, pulp, and harvesting machine manufacturing, chemical industry and other related industries. Also services such as research and marketing, and automation technology are included in the forest cluster.

The Finnish forest industry is highly export-oriented covering 29% of Finland's total exports (Finnish Forest Industries Federation, 1997b). The share of production exported can rise up to 70-90% depending on the branch of industry (Finnish Forest Research Institute, 1997b). Paper, paperboards and converted products account to 71% of the forest industry exports in 1997.

The share of sawnwood was 14% of the forest industry exports while the share of pulp, plywood and other wood products were under 10% (Finnish Forest Industries Federation, 1997b). In 1992 the share of the whole forest cluster of Finland's export income was 41% and in net terms (supplied by domestic raw material) more than 60%.

The main markets for Finnish forest industry can be found mainly in Europe with 78% of the exports. The share of the European Union is 69% with Germany (18%) and Great Britain (17%) being the two most important partners. Other important export areas are Asia (10%) and North America (5%) (Finnish Forest Industries Federation, 1997b).

European Union has been a very important market and production area to Finnish forest indus-

Table 5. Nature conservation areas in Finland in 1996.

Type of nature conservation area	**Number of**	**ha**
Strict nature reserves	19	152 000
National parks	31	731 900
Wilderness areas	12	1 488 200
Peatland reserves	173	416 200
Protected herb-rich forests	53	1 200
Protected old-growth forests	92	9 100
Other special conservation areas	42	52 700
Conservation areas	1382	69 800
Total	**1804**	**2 921 100**

(Finnish Forest Association, 1997)

Table 6. Causes leading a species to be threatened.

Cause	Impact on reduction on numbers of threatened sp.
Changes in tree species composition	30%
Reduction in amount of decaying wood	27%
Changes in forest stand age structure	13%
Forest treatment, not specified	30%

(Finnish Forest Association, 1997)

try even before joining it. Becoming a member in 1995 improved Finland's position and offered a possibility to be involved in decision making. As a member state in EU Finland is in the future stronger also in other markets.

The European integration and the globalisation of the world economy have offered a new challenge to the forest industry. It is not only the client and the sales organisations, but also the production capacity that is located abroad. Finnish forest industry companies have 22 paper and board mills in western Europe and 5 elsewhere in the world. In 1996 34% of paper and board production capacity was located outside Finland (Metsäteollisuus, 1998).

The ownership of Finnish forest industry has greatly changed since mid-1980s. Several integrations and fusions have lead to a situation where the pulp and paper production is concentrated in three major companies owning also half of the sawnwood production in Finland. These three companies (UPM-Kymmene, Enso and Metsä-Serla) are already among the leading paper producers in the world, but there are more fusions likely to come. Current issue is the fusion of one major Finnish company Enso with a Swedish Stora pending approval from the EU.

3.2 Employment

Due to the structural change the share of the labour force employed in the forestry sector is diminishing. In the 1970s 20% of labour force were involved in forestry whereas the share in 1996 was only 6%. Immediate causes for the decline are the mechanisation of fellings, and the development of automatisation in forest industry (Finnish Forest Research Institute, 1997a).

In 1996 the total labour force in the forest sector was 97 000. Forestry employed 25 000 people whereas forest industries offered employment for 73 000 people. (Finnish Forest Research Institute, 1997b) The forest cluster employed additional 25 000 people. Following from the mentioned structural change the unemployment situation in the forestry sector is worse than in the society as a whole. Whereas the overall employment situation improved and reached the unemployment situation of 16,3% in 1996, the unemployment among forestry labour was 23%. The unemployment in the forest industry was, however, only 11,9% (Finnish Forest Research Institute, 1997a).

4 Forest and forest related policies

4.1 Legislation

Ever since the 1880s the main purpose of the Finnish private forestry legislature has been to prevent both the devastation and the inappropriate use of forest by its owner. Today, however, this is not enough. Due to the international environmental awakening, agreements made in Rio de Janeiro in 1992 and in Helsinki Ministerial conference on the protection of forests in Europe in 1993 and Finland's membership in EU, Finland has reformed the legislation concerning forestry as a whole. This has been essential for the international image of the forest sector.

The most important reformed laws concerning forestry are:
- Forest and Park Service Act 1994;
- The Act on Forestry Centres and the Forestry; Development Centre 1996;
- Forestry Act 1997;
- Act on Financing of Sustainable Forestry 1997;

- Nature Conservation Act 1997;
- Act on Forest Owner's Associations 1998.

The aims of the new Forestry Act is to promote economically, ecologically and socially sustainable management and utilisation of forests in such a way that the forests offer a sustainable satisfactory yield while the biological diversity is maintained. In order to maintain biodiversity, the Forestry Act lists certain important biotopes where the management is restricted. Such biotopes are e.g. neighbourhoods of springs and small lakes. The Act also defines standards for sustainable forestry; the minimal obligations for care and the minimal restrictions for the use of forests.

4.2 Actors in forest and forest related policies

The question of forests and forest policies has clearly became more public than it has been in earlier decades. During the 1960s, 1970s and to some degrees still in 1980s the power in the forest policies were in the hands of the few: the state, the forest industry and forest owners made the decisions. Due to the importance of forest sector to the national economy the major actors in public sector have been the Ministry of Agriculture, the Ministry of Finance and the Bank of Finland (Hyttinen & Tikkanen, 1998).

Today the group of stakeholders is much more diverse. The role of private forest owners has became ever more important due to the societal change. Environmental organisations and other non-governmental organisations are also increasingly taking part in the forest discussion. The new forest legislation is underlining the bottom-up approach and participatory planning. These are in accordance with the international principles of participatory planning approved at the Rio conference in 1992 (Hyttinen & Tikkanen, 1998).

4.3 Forest policy tools

The Act on Financing Sustainable Forestry was made to ensure the realisation of the new Forestry Act. The object of this act is to allocate government funding to measures that maintain and promote sustainable forestry. Private forest owners are entitled to receive subsidies in cases of additional costs or economic losses.

The Forest Act contains also another new instrument to promote sustainable forest management, such as the so-called regional target programmes for forestry. These programmes are targeted to identify the specific ecological, financial and social characteristics of each area including also the goals and targets for the forestry. The programme is drawn up by the Forest Centre in co-operation with all the parties representing forestry and other relevant parties in the area.

The outcomes of these national programmes are utilised in the ongoing formulation process of the National Forest Plan (NFP), the Finnish forest policy with an overall vision of "Sustainable welfare from the diversity of forests". The specific action programs defined under NFP will be targeted to five areas: forest management, nature conservation, roundwood markets, innovations, and international policy.

4.4 Forest policy in relation to other national policy areas

Forest policy is only a part of the policy group affecting the management of Finnish natural forest resources. Due to the importance of forests in Finland and its economy several other policies have a significant role on the forest sector. These are, for example, environmental, taxation, employment and economic policies.

The main focus of interpolicy co-ordination between forestry and other sectoral policies has shifted decisively due to the evolution of national and international forest policies in the 1990s. In domestic economic policy, the question of interest earlier has been replaced by environmental and international policies. For example, in 1994, the Ministry of Agriculture and Forestry and the Ministry of Environment launched together the Environment Programme for Forestry. Also authorities of environmental, nature conservation and forest issues and, some non-governmental organisations were involved in formation of this strategy for sustainable forest management in Finland (Hyttinen & Tikkanen, 1998).

Another example of the co-operation between the main ministries dealing with forest issues is a forum for discussing Finland's stands and the main lines of policies at the international arena (Hyttinen & Tikkanen, 1998).

4.5 EU forest and forest related policies

Finland became a member in the European Union in the beginning of 1995 together with such forest countries as Sweden and Austria, which increased the importance of the forest sector in EU. The forested area of the union was doubled and EU became a net exporter of forest products. At the moment EU does not have any common forest policy, but several regulations and decisions directly and indirectly connected to forests are done in other branches of policies (Hyttinen & Tikkanen, 1998).

A conversation regarding the common forest strategy in EU has risen lately. Compromising and decision making may, however, be difficult due to differences in ecological prerequisites in forests and variable interests and needs towards the forests.

The position of Finland on this matter is that instead of a common forest policy programme EU should have a general forest strategy concerning the central questions. The national decision-making should, however, be maintained. The main targets of Finland for the EU forest strategies are:

- To follow the principles of sustainable forestry;
- To take into account the forests' importance as wood producers;
- To recognise the importance of forestry in preserving the vitality of rural areas;
- To keep the forestry sector independent of the subsidies;
- To improve the operational environment of forest industry. (Hyttinen & Tikkanen, 1998).

4.6 Forest education and research

4.6.1 Education

Secondary level education in forestry and wood sciences in Finland is offered by 26 forestry schools. After the reform of the educational system in 1995 the secondary education in the forestry field constitutes of the so-called basic degree in forestry (approximately. 2 years) and a 3-year degree for a forest technician. After the secondary level forestry and wood science education may be obtained in polytechnic schools (or Fachhochscules) (Kekkonen, 1996).

Academic education in forest and wood sciences is given by the universities of Helsinki and Joensuu. Universities of technology in Helsinki and Lappeenranta and the Faculty of Chemical Engineering in Åbo Akademi are also offering education in wood science. The Faculty of Agriculture and Forestry of the University of Helsinki offers academic education in the sustainable use of natural resources in 12 of Faculty's departments. Over 30 subjects are taught. In Joensuu the Faculty of Forestry is mainly concentrating in disciplines of Environmental Management of Forests, Forest Management and Economics, Forest technology and Wood Industry. The Universities of Technologies offer higher education in e.g. pulp and paper science, mechanical wood processing, wood industry and wood science. Several other universities conduct forest-related research (Finnish Society of Forest Science, 1995).

4.6.2 Research

Besides the universities, the major research organisations in Finland are the Finnish Forest Research Institute (FFRI aka METLA), The Finnish Pulp and Paper Research Institute (KCL), The Foundation of Forest Tree Breeding, The Research and Development Department for Timber Procurement and production at the Finnish Forest Industries Federation (Metsäteho), The technical Research Centre of Finland (VTT) and The TTS-institute (Finnish Society of Forest Science, 1995).

Approximately 350 researchers study forest related questions in Finland. Over 200 of them are employed by the Finnish Forest Research Institute (METLA) founded in 1917 and funded mostly through the national budget (Finnish Forest Research Institute, brochure).

The research is provided with a network of research forests and research stations. The eleven research stations of Finnish Forest Research Institute and the Universities carry out both the national and regional research. They are also responsible for information exchanges between research and practical forestry. FFRI has also a network of research forests including over 140 000 hectares of land with over 23 000 experimental plots (Parviainen & al., 1995).

Finnish forest research is involved in international co-operation, especially with our neighbouring countries and in the European scale. The pan-European research projects have became more important after joining the EU in 1995. In 1993 Finland set up the European Forest Institute (EFI) an organisation of 106 member groups from 25 European countries, to co-ordinate and implement pan-European forest research. Finland is also supporting forest research in developing countries through FAO as well as through bilateral development projects (Palo, 1995).

The establishment of the Ministry of Environment in 1982 has promoted the research in biodiversity and forest ecosystem questions through increased funding. Also the Academy of Finland has financed research on the multidisciplinary fields (Palo, 1995).

5 Main current conflicts and challenges

5.1 Natura 2000

The Natura 2000 Network initiative has, without doubt, been one of the most difficult issues in Finnish forestry lately. The process to create the national proposition of the sites to be of Community importance (SCIs) is still not quite finished. Although 95% of the sites proposed to be attached to the Natura 2000 Network are old Nature conservation areas or otherwise earlier protected sites, the remaining 5% of new areas has caused 14 000 appeals, which delays the process. Almost 107 000 hectares of the new area is private lands and 36 200 is owned by the state. The process has been criticised of the precipitancy and the lack of an analysis of the economic and social effects of the program.

Only 50 of the 200 habitat types included in the EU Habitats Directive exist in Finland. Also flora and fauna prioritised by EU to be protected are very few in Finland. There are only 32 species of animals, 60 birds, 6 vascular plants and 6 species of moss in Finnish nature that are included in the Natura 2000 Network (Finnish Forest Research Institute, 1997b).

5.2 Forest Certification in Finland

International environmental agreements, as well as the fact that a considerable number of Finland’s forest industry markets are located in areas where the consumers react sensitively to environmental issues have brought up the question of national forest certification.

The conversation regarding the need for certification has brought up the views of the national interest groups. As a whole, certification has been seen as a cost-effective way to present both the general value goals and the strive for responsible forest management to the markets and especially to demanding customers. Certification is needed to present a good image of Finnish forestry and to promote marketing of forest products. The fact that most of the competitors to Finnish forestry are active in promoting sustainability and certification, can also be seen as a pushing factor towards certification (Ministry of Agriculture and Forestry, 1997).

The national Forest Certification Committee was appointed in April 1996, and later the same year leading environmental NGO’s (Non Governmental Organisation) together with the representatives of the organisations of forest owners and the forest industry set up a national Working Group on Forest Certification Standards. The aim has been to establish a internationally acceptable forest certification standard. The Forest Certification Standards Proposal was drafted in 1997 and has been tested in three pilot areas. The aim is to introduce the Finnish forest certification in the autumn of 1998 <HTTP://www.smy.fi/certification>.

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Additional Sources:

http://www.smy.fi/certification> Finnish Forest Association
http://www.vyh.fi>

Addresses of organisations related to forestry:

Central Union of Agricultural Producers and Forest Owners, P.O. BOX 150, 00101 Helsinki, tel. +358 9 131 151, fax +358 9 1311 5409

The European Forest Institute (EFI), Torikatu 34, 80100 Joensuu, tel. +358-13-252 010, fax +358-13-124 393, http://www.efi.fi

Finnish Forest Research, Institute (METLA), Unioninkatu 40 A, 00170 HELSINKI, tel. +358-9-857 051, fax +358-9-8570 5677, http://www.metla.fi

Forestry Centre Tapio, Soidinkuja 4, 00700 HELSINKI, tel. +358-9- 15 621, fax +358-9-156 2232

Finnish Forest Industries Federation, P.O. BOX 336, 00171 Helsinki, tel. +358-9-13 261, fax +358-9-132 4445, http://www.forestindustries.fi

The Finnish Forest and Park Service, P.O. Box 94, 01301 Vantaa, tel. +358-9-857-841, fax +358-9-85-784-219, http://www.metsa.fi

Finnish Forestry Association, Salomonkatu 17 B, 00100 HELSINKI, tel. +358-9-649-0300, fax +358-9-693-3466, http://www.smy.fi

Finnish Particle Board Association, Rickhardinkatu 1B 19, 00130 HELSINKI, tel. +358-9-657-122, fax +358-9-657-145

The Finnish Society of Forest Science, Unioninkatu 40 A, 00170 HELSINKI, tel. +358-9-8570 5235, fax +358-9-8570 5677

Finnish Sawmills, Säästöpankinranta 4 C, 00530 HELSINKI, tel. +358-9-711-088, fax. +358-9-715-275, http://www.finnishsawmills.fi/

Finnish Wood Research, P.O. Box 367, 02151 Espoo, tel. +358-9-4354-2022, fax +358-9-4354-2200

Finnish Forest Foundation, P.O. Box 336, 00171 Helsinki, tel. +358-13-261, fax +358-132-4445

Helsinki University of Technology/, Department of forest product, technology, Vuorimiehentie 1 02150 Espoo, tel. +358-9-4511, fax +358-9-451-4259, http://www.hut.fi/Units/Forest/index.html

Lusto, the Finnish Forest Museum and Forest Information Centre, 58450 Punkaharju, tel. +358-15-345-100, fax +358-15-345-1050, http://www.lusto.fi

Metsäteho, P.O. Box 194, 00131 Helsinki, tel. +358-9-135-521, fax +358-9-659-202

Ministry of Agriculture and Forestry, Hallituskatu 3A, 00170 Helsinki, tel +358-9-1601, fax +358-9-160-2190, http://www.mmm.fi

Ministry of the Environment, P.O.Box 399, 00121 Helsinki, tel. +358-9-199-11, fax +358-9-1991-9545, http://www.vyh.fi

University of Helsinki, Faculty of Agriculture and Forestry, P.O. BOX 27, 00014 HELSINGIN YLIOPISTO, tel. +358-9-70 851, fax +358-9-708 5575, http://www.honeybee.helsinki.fi

The Forest Library, Unioninkatu 40 B, 00014 HELSINGIN YLIOPISTO, tel.. +358-9-1911, fax +358-9-191 7619

The University of Joensuu, The Faculty of Forestry, P.O. BOX 111, 80101 JOENSUU, tel. +358.13-1511, fax +358-13-151 3590, http://gis.joensuu.fi

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1 The country

1.1 Natural conditions

Topography & general description
With a total of 550 000 km^2 of territory, France is the biggest European country after Russia. The French territory is divided into 95 departments plus 8 overseas departments and territories.

The average altitude is 342 m (excluding Corse) but this average does not represent the diversity found in France. Indeed, the altitudes on the territory range from 4807 meters for Mont Blanc (the highest mountain in Europe) to sea level. The presence of high mountainous ranges (the Alps, the Pyrénées), of relatively lower and older mountains (the Massif Central, the Vosges and Jura) and of plains and valleys testifies of this great diversity.

Climate
Globally, the French climate is temperate with more or less oceanic (or respectively continental) influences. The average summer temperatures range from 17 to 22° C (1 to 6° C for the winter season). As for rainfall, it is relatively well distributed throughout the year. The annual rainfall is often below 600 to 700 mm on the Mediterranean littoral coast but reaches higher values on the western littoral coast (800 to 1200 mm). While leaving the coastal influences, the annual rainfall slightly drops to values ranging from 700 to 800 mm excepted in the mountainous areas where it quickly rises with increasing altitude.

Four main types of climates are met in France:
- the temperate maritime climate met on the west coast,
- the temperate climate with a continental influence in the eastern part,
- the Mediterranean climate characterising the South eastern part,
- the mountainous climate found in the Alps and the Pyrénées.

Once more, it is interesting to note the significant diversity of climatic influences found on the territory favouring numerous different habitats and environmental conditions.

Soils
Since the end of the quaternary, the French climate has been favourable to biological activity and to a general phenomenon of soil leaching resulting in an acidification and a differentiation of two layers in the soils. This soil leaching characterises a majority of the soils met on the French territory.

The main soils found on the French metropolitan territory are :
- leached brown earth and brown earth,
- leached hydromorphic soils (gley),
- acid brown earth,
- podzolic soils and podzol,
- acid soils of high- and middle-altitude mountains,
- lime soils

Other data
- 6 000 species of plant life can be found in France (of which 200 are specific to the country)
- 340 different sorts of cheese (almost one for every day of the year).
- About 450 AOC wines
- Almost 15 million hectares of forests.

Figure 1. Administrative map of France

1.2 Society

Population

With 58.6 million inhabitants, the average density on the French territory is approximately 107 inhabitants per km^2 (INSEE, Annuaire statistique de la France, 1998). 75 % of the French population live in an urban environment ranging from great urban centres (such as Paris, Lyon …) to cities or villages.

Industry

As shown in the table 1, the tertiary sector, with 70 % of the GDP plays an important role in French economy.

France is one of the biggest agricultural producers in Europe. Agricultural production uses 55 % of the land area. The principal agricultural products in France are sugar beet (1st in the EU[1], 2nd in the world), wine (2nd in the EU, 2nd in the World), milk (2nd in the EU, 5th in

[1] Those ranks are given according to the volumes produced.

Table 1. Distribution of the GDP (Gross Domestic Product) and of the employment in 1995 (%) (in C. Albalgli, 1998).

	GDP %	Jobs %
Primary sector	2	5
Secondary sector	28	27
Tertiary sector	70	68

the world), beef (1st in the EU, 6th in the world) and cereal (1st in the EU, 8th in the world).

France also ranks first in the EU and in the world for tourism.

2 Forest resources and their uses

2.1 Forest history

Firstly, it is worth insisting on the importance of the evolution of French forestry and forests as it can explain many of the current characteristics of the French forest resource. This evolution is basically characterised by changes in terms of area, stumpage volume and stand type.

As shown in the figure 2, the general trend observed shows a regular increase of the global wooded area in France resulting in a doubled forested area since the end of the French revolution. The French revolution indeed characterised the beginning of a serious concern about the worrying level of the forest resource. It resulted in the establishment of a forest code in 1827 and the establishment of a deforestation and an afforestation act respectively in 1859 and 1860.

This historic increasing trend observed throughout the last couple of centuries can be explained by a long-standing afforestation policy but also by the improvement of agricultural productivity resulting in decreasing need for agricultural lands throughout the nineteenth and twentieth centuries.

Several evolutions also appeared in the stand types of the French forests corresponding to an evolution of the needs of the society. Many of the coppice stands were converted into coppice with standards especially after 1669. At the beginning of the nineteenth century, the validity of the coppice with standard stands to answer the needs and uses of the society started to be seriously discussed. Most of those stands were then converted into even-aged high forests. Despite this conversion, it has to be kept in mind that only half of the French forests are even-aged high forests. Other silvicultural systems, even-aged (coppice) or uneven-aged (cop-

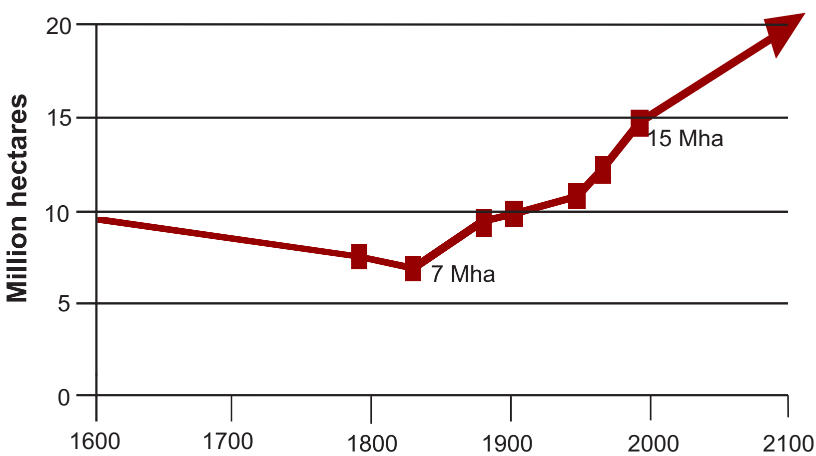

Figure 2. The evolution of the forested area on the metropolitan French territory from the end of the eighteenth century to the end of the twentieth century (J.L. Peyron, 1997).

Table 2. Importance of the different ownership categories, in terms of areas and number of owners (J.L. Peyron, 1997).

Owner categories	Areas	Number of owners	Mean area (ha)
State	10 %	1 (1514 forests)	956 ha
Communities	16 %	14 000 (11 000 communes)	163 ha
Private owners	74 %	3 700 000	2.6 ha

pice with standards, selection systems) kept a considerable share of the French forests. There is, for example, a long-lasting tradition of uneven-aged coniferous stands in some of the French mountainous regions.

This evolution of forested area and stand types, as well as the increasing proportion of coniferous trees, logically resulted in a significant increase of the standing volume of the French forests which has been multiplied by 4 between 1827 and the present day (refer to part 2.3.4).

2.2 Forest ownership

As shown in the table 2, the state and communities forests (managed by or with the support of the National Forest Office (ONF)) count for 26 % of the total forested area. The majority of the French forests (three-quarters of the forested area) indeed belongs to private owners. Those private forests vary enormously in terms of size and type. The French private owners are mainly persons (82 % of the area, 96 % of the owners) or corporations (18 % of the area, 4 % of the owners). 71 % of the private owners are individuals and household and 25 % are farmers. Retired persons also represent a significant proportion of the French private owners (21 %). Forest industries generally do not own forests in France.

2.3 Land use and forest resource

2.3.1 Global overview of the land use

As shown on the figure 3, the area and proportion of the wooded lands has increased since the last world war. It first increased relatively quickly (+75 000 ha / year from 1950 to 1970) and its expansion seems now to be more moderate with an average expansion rate of 25 000 ha / year from 1978 to 1989. The main explanations for this increasing trend observed lie in the abandonment of agricultural lands and in the afforestation of fallow and moors.

2.3.2 Extent and distribution of the forests

With more than 14 million hectares of woodland forests and poplar plantation (table 3), France is one of the most forested lands of the European Union (ranking third after Sweden and Finland)[2].

As shown on the map of the figure 4, in terms of spatial distribution, the majority of the French forests are found in the eastern part of the country (Alsace) or in the mountainous areas (Vosges, Jura, Massif Central, the Alps and the Pyrénées). Most of the western part of the country is indeed characterised by a much lower proportion of forested lands excepted for the "Landes" in the Southwest.

[2] To this forest extent must be added the French forested area overseas which is to say an area of 8.8 million hectares (8.3 of which are in French Guiana).

Table 3. The current extent and distribution of French forests

Type of land use	Area in 1993 (1000 ha)	Proportion of metropolitan land
Woodland, forests and poplar plantation	14 810	27.0 %
Heathland, groves and thickets Maquis, garrigues Hedges and scattered trees	3598	6.5 %
Total forested area	**18 408**	**33.5 %**

Source: SCEES: Teruti 1993, Agreste n°56.

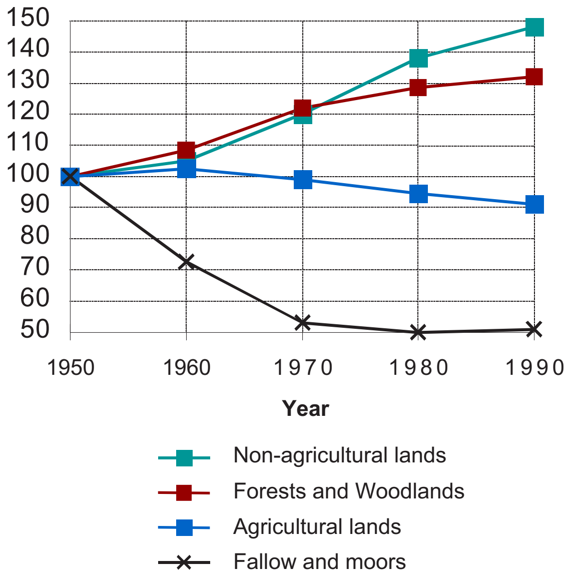

Figure 3. Overview of the types of land uses in France from 1950 to 1990 (D. Normandin, 1995).

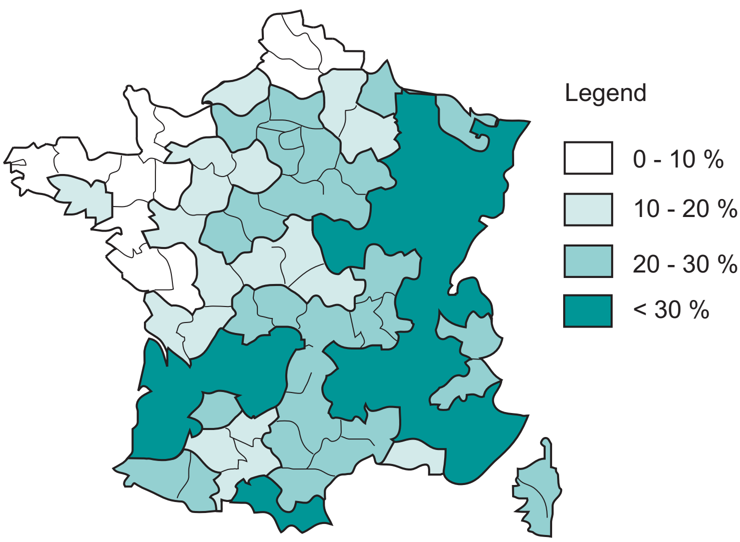

Figure 4. The current distribution of the forested area in France (J.L. Peyron, 1997)

Table 4. Native and introduced species in the French forests (in Indicators for the sustainable management of French forests - 1994).

	Trees occurring in forests			
	Native species	**Acclimatised species**	**Exotic species**	**Total**
Number of Hardwood species	57	3	16	76
Number of Softwood species	16	6	38	60
Total	**73**	**9**	**54**	**136**
Proportion of the nations land covered in 1994	94.03%	5.97%		

Table 5. Share of stand and tree species in the French forests

Species	Area (stand species) %	Standing volume (tree species) %
Quercus robur	18 %	13 %
Quercus petraea	13 %	12 %
Fagus silvatica	9 %	12 %
Quercus humilis	6 %	2 %
Castanea sativa	4 %	5 %
Quercus ilex	3 %	1 %
Fraxinus sp.	5%	2 %
Other hardwood	9 %	15 %
Pinus pinaster	11 %	10 %
Pinus silvestris	9 %	8 %
Pinus excelsa	5 %	7 %
Abies alba	4 %	8 %
Other softwood	7 %	5 %

Source: the National Forest Survey, J.L. Peyron, 1997.

2.3.3 Tree species origin and distribution

The French forest, with a total of 136 species can be said to be ecologically extraordinary rich. Table 4 shows that France's forests consist of mainly native hardwoods. Approximately 95 % of the proportion of the national forested land are covered with native species.

Oak stands are almost one third of the national forested area (one fourth of the standing volume) (table 5). Beech is also predominant which is a typical feature of France and the European temperate zone. It must be kept in mind that French forests are characterised by a noticeable heterogeneity of stands, which are often constituted of mixed species (71% of the French forests are mixed stands).

Douglas fir (*Pseudotsuga menziesii*, not mentioned in the table) and Maritime pine (*Pinus pinaster*) are the first reforestation species.

2.3.4 Total growing stock, growth and total felling

As already mentioned in the part 2.1, the total standing volume of the French forests has been multiplied by 4 since 1827. Between 1984 and 1994, as observed in many European countries, the increase in standing volume is proportionately far higher than the increase in the corresponding areas. This could be given several explanations: the use of more dynamic silvicultural practices, tree improvement (Landes) or also a possible general rise in productivity of forest ecosystems possibly linked with the growth in the level of the carbon di-

Table 6. Damage caused by pests and diseases

Forested area requiring rehabilitation after damage from pests and diseases	2 500 ha/year
Forested areas where significant growth losses can be attributed to pests and diseases	150 000 ha/year
Forested areas where significant growth losses can be attributed to pests and diseases without calling into question the future of the stands	50 000 ha/year

oxide in the atmosphere. French forests are currently in a timber capitalisation phase partly explained by the afforestation and reforestation programmes undertaken during the past 50 years. The average volume per ha is now 138 m^3 rising by 14 % since 1984.

2.3.5 Forest threats

Biotic threats:
Pests and diseases
There is a great deal of variation from year to year in the nature and intensity of the biotic agents threatening the French forests. These variations rely essentially on the actual dynamic of the threatening insect or fungi population. Nevertheless, as shown in the table 6, it can be considered that an average of 2500 ha of forested areas per year are seriously damaged by pests and diseases.

Death often results from the combination of weakening factors such as repeated drought periods, frequent defoliation or the explosion of an insect population such as bark beetles. *Scolytus sp.* and defoliating insects are responsible for 60 % of the damage observed in France. Fungi are also significant threats to the French forest resource: the Dutch elm disease, for example, caused the quasi-extinction of *Ulmus minor* on the French territory, *Armillaria obscura* seriously damages the Landes' forests and *Heterobasidium annosum* damages are quite common on *Picea abies*.

Fungi and insects are thus important threats to be taken into account. Nevertheless, they are not the only biotic threats. French forests also have to cope with serious damage due to big game (especially large herbivorous mammals during the regeneration phase). The most threatening species are roe, red deer and rabbits. In 1993, the average densities of roe and red deer were estimated to be respectively 5.98 and 0.38 head per 100 ha (source: Ministry of Environment & ONC). During the last decade, the red deer population seems to have increased by 50% while the roe deer population has been multiplied by a factor of more than 3. Approximately 12% of regeneration units receive special protection to avoid excessive damage by big game. The set up of protection systems could double or quadruple the price of a plantation respectively for roe and red deer. The costs of those regeneration protections is sometimes covered for 40% by state subsidies but they are still very difficult to manage and often require a big investment, which is not always possible.

Abiotic threats:
Fires
The intensity of the damage caused by fires in the French forests varies considerably from year to year but it can generally be said that, at the level of the metropolitan area, fires have a relatively low influence. Indeed, the average burnt area (forests and other wooded areas) generally turned to be close to 0.25% of the total forested area with an average of 5 000 outbreaks a year. Nevertheless, it should not be forgotten that 80% of those fires occur in the Mediterranean region where approximately 1% of the area is damaged by fires every year. In this region, the rapid succession of fires is a serious problem as it can result in damaging erosion or in a degradation process in plant formations culminating in guarrigue or maquis scrubland.

Storms
The global impact of storms on forests at the country level is very low even if from 1982 on, France has experienced locally a series of considerably damaging storms (Massif central, 1982; North east, 1984; Brittany, 1987; northern half of France, 1990…).

Pollution
Pollution is also responsible for part of forests decline to the extent that a special service (called DSF) was created to monitor the health of the French forest resource.

2.4 Silviculture

Despite the conversion process started 170 years ago, only 48% of the French forests are even-aged high forests. In total 32% of the French forests are still uneven-aged stands (coppice with standards or selection systems). Selection systems can traditionally be found in mountainous areas.

The French silviculture is also characterised by a preference for the use of natural regeneration. Only 20% of the French high even-aged forests are plantation forests.

2.5 Forest production

2.5.1 Harvesting systems, accessibility

As shown in the table 8, in 1994, more than two-thirds of the French forests were classified as easy to log. In fact, only 6.5% of the area (5.9% of the total standing volume) were considered as difficult to log.

There is consequently no major problems in terms of accessibility and harvesting systems on most of the French territory. Lowland and hill forests, which represent more than 60% of the inventoried area are in great majority characterised by an easy or an average access thanks to the development and introduction of more and more forest roads and tracks. Forest harvesting and accessibility is more a problem in

Table 7. Evolution in the stand structures of the French forests (EFI proceedings No 17, 1997)

Stand types	Area %
Even-aged high forest	
Hardwood mainly	
From natural regeneration	16%
From artificial regeneration	3%
Softwood mainly	
From natural regeneration	12%
From artificial regeneration	17%
Coppice (even-aged, hardwood)	20%
Coppice with standards (uneven-aged, hardwood)	26%
Selection system (uneven-aged, softwood)	6%

Table 8. Accessibility of French forests in 1994

Logging category	Area (ha)	Area (%)	Volume (thousands m^3)	Volume (%)
Easy	9 422 077	67.1	1 325 869	71.5
Average	3 103 772	22.1	418 845	22.6
Difficult	916 127	6.5	109 168	5.9
Not loggable	607 558	4.3	unknown	-
Total	14 049 534	100	1 853 882	100

Table 9. General description of the timber uses in France (source : SCEES/EAB – DERF)

	Volume (1000 m^3)	Value (million ECU)
Volume of sawlogs, veneer logs	21 494	
Volume of pulpwood and other industrial wood	10 631	
Volume of fuelwood	14 511	
Value of timber after logging (except home consumption)		1598.89

the mountainous regions especially on steep sloping terrain (which represent a little less than one quarter of France's forests).

2.5.2 Timber uses

In France, the timber harvest is lower than the biological production of forests. Indeed, French forests represent a growing stock of 1.8 billion m^3 increasing by 75 million m^3 annually and of which only 45 to 50 million m^3 are harvested per year.

Fuelwood harvested is generally not sold on the wood market. It comes from forests but also from other wooded areas such as hedges or thickets. The total volume of sawlogs, veneer logs, pulpwood and other industrial wood harvested has considerably risen in the recent years from 26 in 1982 to 32 million m^3 in 1992.

The average consumption of wood in France in 1992 was estimated to be of 61 million m^3 RE (Roundwood Equivalent) which corresponds to an average consumption of slightly more 1 m^3 per inhabitant per annum.

2.5.3 Non-timber forest products

Hunting
Hunting in forests represents in France a sum of about 150 million ECU, of which less than 15 % actually benefits private forest owners. The product of hunting has significantly increased (by a factor 2.3) over the last 20 years in the state owned forests. From 1983 to 1993, the extraction of big game increased by a factor 2 for red deer and by 2.5 for roe deer and wild boar which testifies of the rising importance of the hunting activity in France.

The forest mushrooms harvest
Mushroom picking is a traditional activity in France taking the form of professional or occasional mushroom gatherers. It is thought that the value of the annual harvest of edible mushrooms may reasonably be estimated at an average of 91.50 million ECU (up to more than 150 million ECU for good years). Most of this harvest is consumed domestically.

Other products or services
Forests can also produce a great variety of other harvestable non-timber products (such as pine resin, honey, lichens, cork …) but the harvest of most of those products is said to be on the decline.

2.5.4 Forest functions

Protective functions:
Soil and Water physical protection
More than 350 000 ha of the State owned forests are managed with a priority of protecting the physical environment in terms of soil and water. Two public forest protection series (primary and secondary physical protection series) ensure an adapted management prioritising physical protection in sensible areas. These areas are mainly mountainous areas subjected to landslides, rock falls, avalanches or gullying. Coastal dunes management is also subjected to an adapted management giving priority to protection and public access to prevent the breaking up of the Atlantic dunes.

Water quality protection
This concerns the forests located around drinking water catchment including mineral water sources.

Other socio-economic functions:
Public access and recreation
France is characterised by a proportion of 0.25 ha of forest per inhabitant. More than one fifth of the French forests are marked by a relatively high tourist's pressure, at least high enough to be considered as one of the major priorities for setting up of an adapted forest management. Private owners may try to close their forest but they often tolerate (officially or not) public access.

3 Forest economics

3.1 Forest and forest industries in national economy

The social and economic importance of the forest industries in the national economy should first be stressed. The wood sector consists of approximately 90 000 firms and it represents 1.5 % of the French Gross Domestic Product. Approximately 2.6 % of the jobs (salary earning or not) offered in France are found in the forest and wood sector.

This so-called wood chain in France includes all branches from production, logging, and transformation to the marketing of wood. These activities, without considering the fuelwood sector, currently consume approximately 61 million m^3 RE (Roundwood Equivalent) per year which is to say about 1 m^3 per year and per inhabitant. Recycling, notably of waste paper provides for a quarter of those needs (16 million m^3 RE) while the rest of it (three-quarter) comes from the transformation of raw wood (50 % corresponding to structural timber, 50 % to pulpwood).

The French forest and wood sector together present a structural deficit of about 13 million m^3 RE in volume (essentially pulps and paper boards, furniture, coniferous sawn wood) and stays one of the sector showing the most important deficit in the French trade balance.

3.2 Employment

It is very difficult to determine precisely the number of jobs offered by the forest and wood sector especially when trying to estimate the number of persons self-employed working in the silviculture or the harvesting branches. The numbers found in the table 10 are consequently just estimates useful to give an idea of the im-

Table 10. Estimated jobs in the forest and wood sector (in thousands of full-time jobs) in 1991 (D. NORMANDIN & J.L. PEYRON, 1997).

Fields of activity	Employed	Self-employed	Total number of jobs
Silviculture & forest services	16.1		16.1
Forest harvesting	7.0	21.0	28.0
Total primary sector	23.1	21.0	28
Mechanical wood working	92.0	6.5	98.5
Sawn wood	23.5	3.0	26.5
Panels, veneers, impregnation	12.5		12.5
Furniture industry	89.8	20.0	109.8
Paper and cardboard industry	105.8	0.8	106.6
Paper pulp	2.0		2.0
Total secondary sector	287.6	27.3	314.9
Wood-working industries	38.0	3.0	41.0
Wood-processing industries	249.6	24.3	273.9
Total first and secondary sectors	310.7	48.3	359
Wood-building industry	108.1	23.8	131.9
Trade in wood-based products	82.5		82.5
Total primary, secondary and tertiary sectors	501.3	72.1	573.4

portance of the forest and wood sectors in France. The number of jobs in the forest sector (excluding the work of forest owners) would be 570 000 of which 90 % are wage- or salary-earning employment.

The relevance of the wood building industries and trade in wood based products as sectors of employment offered by the forest and wood branches can sometimes be discussed. If considering only the fields more directly linked to the forest such as production, harvesting, wood working and wood processing, the number of jobs would be approximately 360 000 full-time jobs (of which 310 000 are wage- or salary-earning employment). This represents a share of 6 % of the total number of jobs offered by the primary and secondary sector in France.

As shown in the figure 5, employment in forestry (silviculture and logging/harvesting jobs) only covers 7 % of the total number of salary-earning jobs offered in the primary and secondary sectors of the forestry and lumber business.

In terms of evolution of the employment situation in the context of strong international competition, it can be said that the French forest sector is rather strong and only suffered from limited staff losses in the course of the past two decades.

3.3 Profitability

As shown in the table 11, the forests and wood sector industries represent a significant share of the total added value of the combined primary and secondary French sectors. It is also worth insisting on the fact that most of this added value is created downstream i.e. with the wood-working, wood-processing, furniture and paper industries.

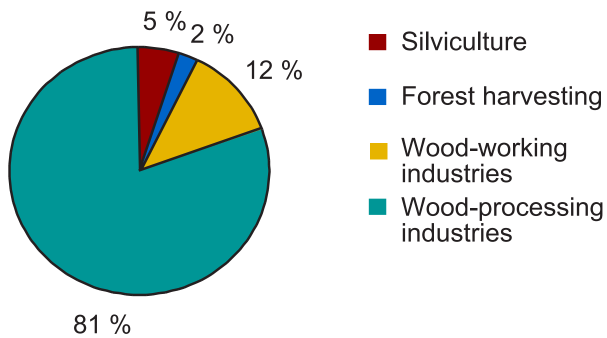

Figure 5. Salary-earning jobs of the primary and secondary sectors offered by the wood and forest sector (D. Normandin & J.L. Peyron, 1997).

Table 11. The value added by the French forests and wood sector industries.

	Added value (thousand millions ECU)
Silviculture & forest harvesting	2.5
Wood-working and processing industries	3.6
Furniture industries	3.4
Paper & cardboard industries	5.2
Total	14.7
Share in the primary and secondary sectors	5.3 %
Share in the Gross Domestic Product	1.5 %

Source: Daly-Hassen & Peyron, 1995.

Foreign trade
Forest exploitation and logging show a favourable trade balance. Nevertheless, all the other sectors either show a small deficit balance (sawing) or a worrying one (furniture, pulpwood). The deficit of the wood and paper sector for the last decade was approximately 3 thousand million ECU / year. It can then be said that the French forest sector consequently suffers from a real lack of profitability. This is due to the relative weakness of the second transformation industries compared to those of other European countries.

It is also important to stress that France is a net receiver of softwood timber while it is a net exporting country for hardwood species. The global deficit balance observed consequently results from an inadequacy between the available resource in the country (mainly broadleaved species) and the requirement of the French industries (essentially conifers).

Splitting of the forest property and lack of vertical integration in the forest sector.
The splitting of private forest property, the relatively small size of the wood processing industries and the lack of vertical integration in the forest sector result in higher "supplying costs", themselves leading to a significant loss of competitiveness of the French industries. Indeed, cutting a tree from the forest and processing it to obtain the final product sometimes necessitates the intervention of two or three intermediaries leading, for each transaction, to a multiplication of the final supplying cost and consequently reducing the competitiveness of the final product. Reducing those "supplying costs" is currently one of the challenges for the French forest industries.

4 Forest and forest related policies

4.1 Legislation

The current French policy aims to meet society's expectations in the following ways :
- by enhancing the forests potential for economic and social use,
- by preserving and improving its ecological wealth and variety of landscape,
- by increasing efforts to create a balanced rural environment.

Forest planning
The importance of forest planning in order to adapt forest management to the owner's and society's expectations was realised long ago in France. Forest management, to be effective and sustainable, necessitates planning taking long term objectives into consideration and leading to more precise, concrete and formal prescription applying to periods of 10 to 30 years.

Public and community forests (26 % of the French forests) are managed under a management plan which is written under the responsibility of the French National Forest service called O.N.F. (Office National des Forêts) created in 1966. Those management plans have to be approved by the French ministry of Agriculture representatives, who ensure that the operations planned for the forest are conformed to the general guidelines defined by the national or regional forest policy.

Forest planning is also an obligation for private forests over 25 ha (which represent 27 % of the French forests).

This is done thanks to a working plan of operations called P.S.G. (Plan Simple de Gestion). Those PSG also have to be coherent with the guidelines of the O.R.F. (Orientations Régionales Forestières) and have to be approved by the C.R.P.F. (Centre Régional de la Propriété Forestière). The CRPF are local organisations whose mission consists of translating and applying the national directive at a regional level for private forests. They are in fact a part of the public administration ruled by the forests owners themselves. Making sure that the PSG written verifies the criteria set up at the national level is one of their overriding missions. As for the ORF, they are general guidelines worked out at the regional level by regional forest and forest product committees, where all the partners concerned are represented (responsible for the national forest policy, nature protection associations).

Finally, it appears that forest planning (taking the form of either a management plan or a P.S.G) is an obligation for half of the French forests. The quality of management is not necessarily conditioned by the formalisation of a management plan. Nevertheless, the preparation of such plans, which have to be approved by professional or governmental agencies offers the opportunity to have control on the management of the French forests. It also has to be kept in mind that those management plans (for private, state or community forests) are not the only planning documents existing in France. There are lots of other regional guidelines and documents which provide the manager, who so desires, with a general framework for his silvicultural thinking and activities. Finally, it is estimated that almost all France's forested area (92.7 %) is covered by a planning or general guideline document (DERF, 1994).

Forest protection
Protecting the forest resource is a relatively long-lasting tradition in France. It started with the limitation of the clearing in 1669 and became a very serious concern after the French revolution. Indeed, a Forest Code was established in France in 1827 and was followed by the establishment of afforestation and deforestation acts.

The main legislation of the current policy in terms of afforestation and deforestation in France is the deforestation law according to which any clearing in a private woodland (which would be bigger than 4 ha) needs an official authorisation. Nevertheless, deforestation below 4 ha are not completely free as they can limited and restricted especially for woodlands with a protection or/and conservation values. Those measures, completed by a tax on clearings, have been set up more to reduce deforestation than to totally forbid them.

The set up of protection forest series, the mapping of ZNIEFF[3], ZICO[4], special zones (ZPS[5], ZSC[6]) and other sites of ecological interest are also some of the protective measures existing in France at the moment. It must be noticed that those measures influencing the national forest policy have in fact to be associated with the French land use planning policy.

Reference monitoring of the French forest resource
This is also one of the priorities in the French forest policy. This follow-up includes a permanent survey of the French territory by the IFN (Inventaire Forestier National) (evolution of the surface, standing volume, yield of the forests). There is also a more qualitative follow up trying to keep an eye on the health of the French forests. This is for example the whole network of scientists of the Forest health department (Département Santé des Forêts) or the national long term survey of forested ecosystems called RENECOFOR .

4.2 Actors in forest and forest related policies

The major current actors of the French forest policy are :
- the government, being both a forest owner and the responsible for the French forest resource sustainable use and management at the national level,
- the French national forest service (ONF),
- the communities also own part of the French woodlands and forests,
- the private forest agencies :
- regional and local agencies (CRPF, Chambre d'agriculture),
- forest owners associations,
- organisms for forest management and marketing of forest products,
- research and extension organisms (IDF,

[3] Zone d'intérêt écologique, faunistique et floristique
[4] Zone importante pour la conservation des oiseaux
[5] Zone de protection spéciale des oiseaux
[6] Zone spéciale de conservation

AFOCEL, ARMEF, FOGEFOR…)
- other actors such as :
- forest logging industries,
- wood processing industries,
- the ONC (Office National de la Chasse), standing for the French hunters,
- various environmental associations ...

4.3 Forest policy tools

There are basically three main objectives for the range of forest policy tools existing in France:
1. protection of the French forest resource,
2. to fight the splitting of properties in order to achieve larger management units,
3. to encourage long term investment.

During the last 50 years, numerous forest policy tools have been set up with a view to achieve those general objectives.

The establishment of a tax system aiming to preserve the existing forest resource was initiated as early as the 30's. The current range of taxes in France goes from income taxes to wealth, property, inheritance taxes...

Grants are also used as an inducement to forestry thanks to the FFN (Fonds Forestier National). The FFN, set up in 1946, is responsible for most of the grants allowed in France (for both private and public or community forests). The means of assistance provided from the FFN are of three forms: materials, cash grants and loans. The FFN is a fund internal to the forestry sector so that it could isolate itself from variations in government provision of money. Until 1991, the FFN was financed on deductible charges levied on all products of the wood-processing industry consumed in France but the use of this specific tax system stopped in 1991 as the European Court considered that it was not adjusted to the free EU trade. Great difficulties have then been encountered by the FFN to compensate the lack of this tax revenue. One of the solutions consisted in increasing the proportion of general public funds in the financing of the organisation. Despite these efforts, the total source mobilised by the FFN has become significantly lower than what it was before 1991: 65.9 millions ECU in 1994 compared to 123.1 millions ECU in 1990. This money is normally spent on general aims of the forest policy. It is not, for example, normally devoted to the improvement of sawmills (as it could have been in former arrangements).

The main forest grants currently existing in France are basically subsidies or exemption from taxes (complete or partial). Those grants are summarised below.

Subsidies
- forest investment of state forest revenues
- global subsidy to community forestry
- national forest fund & other national subsidies
- European subsidies and associated national funds
- regional and local subsidies

Exemption from taxes
- for plantations
- for forest sales, donations, legacies…
- for forests in the frame of wealth taxes
- for changes of value

Finally, the organisation of research, development and vulgarisation systems can also be considered as an useful instrument for the proper management of French forests.

4.4 Forest policy in relation to other national policy areas

The objectives defined for forestry in France (ranging from timber production to environmental and recreation concerns) imply that the management of the French forest resource can't be ensured just thanks to a forest policy document. The management of the French forest resource is also a concern for the land management and the environmental policies.

Forests are indeed mentioned in the building and urban land use code (Code de l'urbanisme) with, for example, the classification of forested zones as protected area (article L411.1) or as sensitive natural areas (article L130.1) on the land use plan (Plan d'Occupation des Sols).

Many areas submitted to protection measures, on behalf of the French environmental policy, are forested. This could explain the existing relation between the environmental and the forest policy in France. The legislation for the management of French natural reserves, is set up of protection series or the inventory of special interest natural habitats (such as ZNIEFF[7], ZICO[8], ZPS[9] or ZSC[10]) undertaken in the framework of the national environmental policy considerably influence the management of a significant proportion of the French forests.

4.5 EU forests and forest related policies

Common Agricultural Policy (CAP)
The CAP started relatively recently to have a direct influence on forest management in France. In 1992, the European Community proposed a grant system for the afforestation of agricultural lands (CEE n°2080/92 - 06/06/92). This system has been then slightly modified to suit the French conditions and adopted in 1995 (Prime au Boisement des Terres Agricoles (PBTA) - D94-1054 - 01/12/94).

This PBTA is only one amongst all the initiatives taken by the CAP. Its effect on afforestation rates is sometimes discussed all the more that it is challenged by lots of other CAP regulation systems such as for fallow lands for instance.

4.6 Forest education and research

The organisation of forest research in France is rather complicated due to the existence of a double system of education at the university level but also to the diffusion of semi-public organisations which are generally largely financed by different departments.

The main forest research organisation existing in France is the INRA (Institut National de Recherche Agronomique) and to a lesser extent the AFOCEL (Association Forêt Cellulose) and CEMAGREF (Centre de Machinisme Agricole et de Génie Rural des Eaux et Forêts). Research co-ordination inside the INRA is guaranteed by two joint bodies. The Higher Council of Agricultural Research (which establishes the general objectives and priorities of the organisation and maintains a close relationship with the productive sector) and the Scientific Committee (which promotes the set up of interdisciplinary research projects guiding long term activities).

A wide range of numerous small research groups also contribute to forest research in France. The ENGREF (French Institute of Forestry Environmental and Agricultural Sciences), for example, can be considered as one of those research stations.

Forest education in France is also quite complicated. It relies on different education and training systems depending on the final qualifications which are aimed for.

Skilled forest workers and technicians receive a complete formation essentially relying on fieldwork. The forest workers are generally trained in Agricultural colleges (BEPA forestier) while the technicians, qualified for middle management posts, receive a two year formation called BTS forestier (standing for Brevet de Technicien Supérieur).

As for MSc, their formation is basically ensured in France by the ENGREF (the French Institute of Forestry, Agricultural and Environ-

[7] Zone d'intérêt écologique, faunistique et floristique
[8] Zone importante pour la conservation des oiseaux
[9] Zone de protection spéciale des oiseaux
[10] Zone spéciale de conservation

mental Sciences). Indeed, there is no faculty of forestry in France.

Two different training are ensured in the ENGREF. The forest managers called IF (Ingénieurs Forestier) are qualified to supervise the work and management of technicians on an average 15 000 to 30 000 ha forest district. The GREF engineers (Génie Rural des Eaux et Forêts) tend to be trained for higher responsibility tasks.

5 Main current conflicts and challenges

Structural weakness of the French forest sector
The problems faced by the forest industries in France (mainly originating in the splitting of the private forest property and the lack of vertical integration and the resulting high supplying costs) have already been stressed in this report (refer to 3.3). Those problems considerably reduce the competitiveness of the French wood sector and are consequently considered as some of the major priorities for the forest sector welfare.

Improving the French forest industries' competitiveness could then be considered as one of the main challenge for the current French forest policy. Intensifying the relations between the forest owners, forest managers, forests harvesters and other middlemen could be one of the solutions.

Sustainable forest management and ecocertification.
Another challenge could be linked to the constantly rising environmental requirements.

There has been indeed, relatively recently, an internationalisation of all the debates about forestry. Since 1992 (UNCED conference hold in Rio) and the June 1993 Helsinki conference, the concern of a sustainable management of the forest resources has taken an international dimension. France took part in this internationalisation and especially tried to implement the decisions and principles discussed at the international level. For example, the document entitled “ The sustainable Management of French Forests ” published in April 1994 describes the commitments undertaken by the French government at the UNCED conference and at the Ministerial Conferences on the Protection of European Forests hold in Strasbourg in 1990 and in Helsinki in 1993.

Besides, this problematic of sustainable management has already been integrated in the ORF and there is currently a project to include it to the next French forest orientation law.

As for ecocertification, France took actively part in setting up the document written to adapt the ISO 14 000 standards to the forest sector. In this document, the problem of the splitting of forest property for setting up of an efficient ecocertification scheme has been seriously considered (mainly due to the French insistence). Nevertheless, there is currently no ecocertification scheme used in France and getting prepared to use one in the short term could be considered as another challenge for French forestry.

Integration in the European system.
French industries were very sensitive to the currency devaluations which occurred in 92-93 in some European countries. In this context, the set up of a single currency (which is going to be established for 11 out of the 15 current EU member countries) will probably be favourable to the French forest industry.

Reconsideration of wood as a building material
There is no true tradition of timber use in the building industry in France. Promoting the use of wood as a construction material could consequently be another challenge to be taken into account for the French forest strategy in the coming years.

The Versailles symposium
The Versailles symposium was organised on the CSFPF's initiative. It aimed at giving to all the parties involved in sustainable forest management a chance to give their opinion and resulted in a series of considerations.

The emphasis was put on the fact that long term forestry management needs to be debated by the whole community. It must also be implemented by all the forest partners and to insure that the European forestry sector remains competitive it is essential that the ecocertification procedures take into account the small forest ownership specificities. People also expressed the wish that this long term management and authentication partnership founded on the Helsinki and Lisbon conferences and based on relevant geographical negotiations be expanded.

The Bianco report

The French government entrusted Mr Bianco with the preparing of a report aiming at introducing a bill on forestry modernisation (due to be brought in front of the French parliament in 1999). In his report, Mr Bianco recommends the drawing up of a long term plan schedule and states its objectives:

- To improve the productivity of the whole industry (particularly by increasing the amount of wood harvested, improving the marketing and ecouraging industrial investments).
- To set up a sustainable forest management certification (resulting from a co-operation between all the partners).
- To draw up a plan relating to the use of wood in the construction business (by launching advertising campaigns for the use of wood as a material and systematically using wood in public buildings).

As far as the means are concerned, Mr Bianco opts for the territorial and contractual approach based on negotiations between all the partners involved.

Organisations related to forestry

ONF, 2, Avenue de St Mandé, 75 012 PARIS
Ministère de l‘ Agriculture et de la Peche, 78,rue Varenne, 75 007 PARIS
CEMAGREF, Direction générale, Parc de Tourvoie, BP 44, F 92163 Antony Cedex, Tel: 33+ (1) 40 96 61 21
INRA, Institut National de la Recherche Agronomique, 147, rue de l‘Université, 75338 Paris CEDEX 07, Tel: 01 42 75 90 00, Fax: 01 47 05 99 66
FNSPFS, Fédération Nationale des Syndicats de Propriétaires Forestiers Sylviculteur, 6, rue de la Trémaille, 75 008 PARIS, Tel: 01 47 20 36 32
FNB, Fédération Nationale du Bois, 1, Place André Malraux, 75 001 PARIS, Tel: 01 42 60 30 27
IFN, Domaine des Barres, 45 290 NOGENT sur VERNISSON, Tel: 02 38 28 18 00
ENGREF, 19, Avenue du Maine, 75 015 PARIS
FIF, 14, rue Girardet, 54 042 Nancy CEDEX
IDF, 23 Avenue Bosquet, 75 007 PARIS, Tel: 01 40 62 22 80
AFOCEL, 164, Bd Haussmann, 75 008 PARIS
ANCRPF, 34, rue Hamelin 75 116 PARIS, Tel: 01 47 20 68 15
RFF, Revue Forestière Francaise, ENGREF, 14, rue Griradet, CS4216, F54 042 Nancy
AFOCEL, Association Foret Cellulose, Domaine de l‘Etancon, 77 370 NANGIS, Tel: 01 60 67 00 30
UIB, Union des Industries du Bois, 30, avenue Marceau, 75 008 PARIS, Tel: 01 47 20 62 66

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Georgia

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1 The country

Georgia is located in the central and western parts of the Transcaucasian region. Its northern border chiefly extends along the crest of the Main water-divide ridge of the Great Caucasus (Caucasioni). Its eastern border near Mount Tinov-Rosso slopes down to the southern piedmonts of the Great Caucasus, stretches along the lower River Alazani and approaches the area where Alazani flows into the Mingechaur water reservoir. Its southern border extends along the River Iori and the watershed of the rivers Iori and Kura, intersects the rivers Kura and Debeda, stretches along the Loksky and Nialiskursky ridges, intersects the river Chorokhi and approaches the Black Sea. In the west, Georgia is washed by the Black Sea from the Psoy river mouth to Sarpi Town. The total length of the border is 1968,8 km, the land border stretching for 1660.4 km.

Georgia borders on the Russian Federation in the north, on the Republic of Azerbaijan in the east, on the Republic of Armenia in the south, and on Turkey in the southeast. Georgia's westermost and easternmost points are at 40° 05' and 46° 44' E. Its southernmost and northernmost points are at 41° 07' and 43° 35' N. Georgia extends vertically from the Black Sea level to an altitude of 5068 m (Shkhara Peak). Georgia's total area is 69.95 thousand sq. km.

1.1 Natural conditions

Georgia is a mountain land. Mountains and foothills (Kolkhida, Kartli, and Alazan plains) cover 87% of its territory. Georgia's diverse nature is due to its geographic position, relief, etc. Highlands and mountains of medium height occur along with low mountains, piedmonts, intermontane plains, lowland, and plateaus.

Georgia's basic orographic units are:
1 The Great Caucasus (Caucasioni) Mountain System;
2 The Georgian Intermontane Province;
3 The Minor Caucasus Mountain System (Meskhetian-Trialetian ridge);
4 The South Georgian Highlands.

The Likhsky ridge divides the country into West Georgia and East Georgia and is responsible for differences in landscape.

1.1.1 Geological structure

Georgia is located in the Alpian foldbelt of Eurasia. Complex geological structure, the mobile Earth's crust, and active neotectonic movements are characteristic. Georgia's geological structure is basically formed by Mesozoic and Cenozoic deposits. Older Precambrian and Palaeozoic rocks are scarce.

Georgia's reliefs are genetically diverse. Reliefs generated by tectonic and petrogenic processes, gravitation, erosion, glaciation, karst formation, human activities and other factors occur.

1.1.2 Climate

Georgia's climate is highly varied. It is affected by the fact that Georgia lies at the boundary between the moderately humid subtropical Mediterranean, the dry continental Aral-Caspian basin province, and arid Frontal Asian highlands.

Humid subtropical climate dominates in West Georgia, whereas moderately humid and dry subtropical climate with a much smaller amount of precipitation prevails in East Georgia. Continental climate is also characteristic of the South Georgian Highland. A variety of climatic zones ranging from a humid-subtropical zone to a perpetual snow-and-glacier zone occurs over a relatively small territory. The main factors affecting Georgia's climate are the Black Sea, which lies in the west, and high Caucasian ridges that protect Georgia from cold air coming from the north. The Black Sea smoothens air temperature variations and contributes to abundant precipitation, particularly in West Georgia. Mean annual precipitation varies from 400 to 4500 mm (on the Chakvian Ridge slope in the vicinity of Mount Mtirala near Batumi). Maximum precipitation zones occur at latitudes of 300-500 to 3500 m a.s.l. in West Georgia and at latitudes of 1200-3500 m a.s.l. in East Georgia.

In Georgia, air temperatures are highly contrasting. The highest mean annual air temperature is observed in Sukhumi (+15° C) and the lowest temperature (- 12.5° C) in the Caucasian Ridge at an altitude of 5000 m a. s. l. The warmest winter is on the Kolkhida Plain where mean January temperature is +5 to +7° C. In Georgia, vertical air temperature gradient varies from - 0.2 to - 0.9° C.

Owing to its geographic position, Georgia is supplied with a substantial amount of sun heat. The length of sunshine ranges from 1350 to 2520 h/year. Radiation balance is maximum in the humid subtropical zone (52-53 ccal/cm^2) and minimum in the Great Caucasus high mountain zone (25 ccal/cm^2). Because Georgia's relief is highly rugged, general air circulation is transformed and the climate is diverse. Therefore, Georgia is split into 13 markedly different climatic provinces.

1.1.3 Soils

Georgia has a variety of soil types. Almost all known soil types occur there. Each type is subdivided into zones, subzones, provinces, and subprovinces, depending on soil-forming conditions. Georgia falls into 48 soil provinces and 169 subprovinces.

Three major soil provinces are:

1) The West Georgia soil province: It is located between the Black Sea and the Likhian Ridge. Lowland bog and podzol soils, hummocky-hilly piedmont red and yellow earths occur along with mountain-forest and mountain-meadow soils.

The mountain-forest zone occupies a large territory in the medium-height mountain region dominated by brown forest soils. Podzolic burozem soils are common in the upper part of this zone, particularly in the dark coniferous forest zone formed by Nordmann fir and Oriental spruce. Podzolic brown forest soils dominantly occur under the canopy of spruce, fir, and beech stands. Forests grow on these soils over a large area.

2) The East Georgia soil province: is represented by plains, foothills and mountain ranges that lie east of the Likhian Ridge.

Chestnut and chernozem soils occur in the dry steppe and steppe zone. Brown soils are common in the Eldarian neardesert and in the southern Iorian plateau. Chestnut (grey-brown) soils are encountered in the Gardabanian, Marneulian, Rustavian, and Samgorian steppes and in the southern Iorian plateau, particularly in the Taribanian and Natbeurian steppes. Dark-chestnut, chestnut, and light-chestnut soils are differentiated.

Chernozem soils are widespread in the elevated part of the Iorian plateau and in the Samgorian, Garedgian, Azamburian and particularly Shirakian steppes.

Cinnamon brown soils are common in most piedmont and low-mountain areas.

In East Georgia, the mountain-forest zone covers a large area in the Great Caucasus, the Trialetian and Somkhitian ridges. Brown soils are widespread in the lower part of this zone, and brown forest soils are common in its middle and upper parts. Mountain-meadow soils occur in alpine and subalpine belts in the highland zone of East Georgia.

3) The South Georgia soil province: which incorporates the Javakhetian, Tsalkian-Janisian and Erushetian highlands, Nialiskurian Ridge slopes, the Alakhtsikhian basin, etc. There, mountain chernozems formed at an altitude of 1500-2200 m a.s.l. and meadow chernozem-like soils predominate and grade upwards into mountain-meadow soils. Brown forest soils are widespread in the mountain-forest zone, dark brown forest dominating in spruce and fir forests that grow on northern slopes and their thin, poorly developed varieties occurring on steep slopes. The stable structure of mountain-forest soils is due to a high percentage of humus and high absorbing capacity.

1.1.4 Vegetation cover

The diversity of Georgia's vegetation cover is due to a variety of physico-geographic and soil-climate conditions, complex relief, the contrasting pattern of altitudinal belts and the fact that the territory lies at the contact of genetically different phytolandscapes. Georgia exhibits a broad range of plant formations from neardesert types that occur at piedmonts in the most arid areas of East Georgia to exuberant forests affected by humid, almost subtropical climate in the Kolkhida mountain province and bizarre cryophilic (cold-resistant) highland vegetation.

Georgia has about 5000 wild floral plant species and some 8300 spore plant species (75 pteridophyte, about 600 moss, 600 lichen, 5000 fungus, and 2000 alga species).

A high level of local endemism is characteristic of Georgia's vegetation cover. Some relicts, such as Medvedev's birch, Pontic oak, Imeretian buckthorn, Kolkhida moonseed, wingnut, Caucasian blueberry, Caucasian laurelcherry, some rhododendron species, etc., have survived. The genus Epigea is now represented by only three species: one grows in Japan, one in North America, and one in Georgia (Adjaria).

Substantial differences in climate between East and West Georgia are responsible for differences in their vegetation cover: West Georgia has no forest-free belt formed by semi-arid and arid vegetation; forests cover plains and mountain slopes at sea level and above. Therefore, in West Georgia the simpler vertical zonation profile is represented by four major belts: a forest belt (from sea level to 1900 m), a subalpine belt (1990-2500 m a.s.l.), an alpine belt (2500-3100 m a.s.l.) and a nival belt (over 3100 m a.s.l.).

In East Georgia, the vertical zonation of vegetation is more complex. Six major belts are differentiated:

1) a neardesert, dry steppe, and arid thin forest belt (150-600 m a.s.l.);
2) a forest belt (600-1900 m a.s.l.);
3) a subalpine belt (1900-2500 m a.s.l.);
4) an alpine belt (2500-3000 m a.s.l.);
5) a subnival belt (3000-3500 m a.s.l.) and
6) a nival belt (over 3500 m a.s.l.).

Forest-free formations of semi-arid ecosystems dominated by mountain-steppe vegetation also occur locally in the forest and subalpine belts of the South Georgian Highland.

1.2 Society

1.2.1 Population

According to the 1989 census of the population, Georgia's total population was estimated at 5401000 (table 1), including 3 758 000 Georgians (69.6% of total population). Georgia is a multi-national state. Other nations and minorities are Armenians (8%), Russians (6.3%), Azerbaijanians (5.6%), Ossets (3.0%), Abkhazians (1.7%), and others (5.8%).

The diversity of native conditions is responsible for population density, economic development and the irregular distribution of population in the territories discussed. The North mountain zone located on the southern slopes of the Great Caucasus that dominantly have deep gorges and steep slopes is the least populated part of Georgia: it is inhabited by not more than 5% of total population, as compared with 8% in the South mountain zone. Most people (87%) live in the intermontane depression zone, which extends from west to east, and in the Black Sea

Table 1. Distribution of Georgia's population in big regions.

	Unit of measurement	Total	West Georgia	East Georgia
Area	1000 hectares	6950.0	3195.0	3755.0
Population	1000 people	5401.0	2324.0	3077.0
Population density	per sq. km	78	73	82

belt - the most densely populated provinces of Georgia with both rural and urban population. Population density is much higher in this zone (up to 200-250 people per sq. km) than in mountain zones.

Forty-three per cent of the popultation live in West Georgia and fifty-seven per cent in East Georgia. Average population density per sq. km in Georgia is 78 people. East Georgia is more densely populated (82 people/ sq. km) than West Georgia (73 people/sq. km) presumably because Tbilisi, the capital city of Georgia with a population in excess of 1 million, is located in East Georgia.

The areal distribution of population clearly exhibits a vertical zonation pattern: population decreases from an altitude of 600 m a.s.l. upwards, so that
- 85.1% of the total population live at an altitude below 800 m a.s.l.;
- 11.8% live at an altitude of 800 to 1600 m a.s.l.;
- 3.1% live at an altitude of 1600 to 2400 m a.s.l.

The upper boundary of the populated territory is at an altitude of 2400 m a.s.l.

1.2.2 Economy

Georgia is an agrarian and industrial country. Agriculture is a well-developed sector of Georgia's economy. Viniculture, fruit growing, horticulture, tea growing, citrus fruit growing, field husbandry, and cattle breeding are of primary importance. Georgia is recognized as a classical country famous for viniculture and fine wines. Georgia is the birthplace of the oldest wheat varieties.

Georgia's priority industries are mechanical engineering, metallurgy, power engineering, coal and manganese production, chemical, light and food industries. Tremendous volumes of oil are transported from Azerbaijan via Georgia to West Europe.

1.2.3 Political structure

Georgia is a sovereign, independent, democratic country. The legal basis of the state system is provided by Georgia's Constitution endorsed by the Parliament on 24 August, 1995. It is stated in the Constitution that the Parliament is a supreme executive body elected every 4 years by general secret ballot. The country is headed by a President who is elected every 5 years by general secret ballot. Georgia is a member of the General Assembly of the United Nations. The state language is Georgian. The City of Tbilisi is the capital of Georgia.

The Abkhazian Autonomous Republic (capital city Sukhumi) and the Adjarian Autinomous Republic (capital city Batumi) are part of Georgia.

Georgia is a developing country. However, it has a high intellectual potential, original old spiritual and material culture, a variety of natural resources and a favourable geopolitical position. It is hoped, therefore, that Georgia will soon overcome the ongoing financial and economic crisis.

Georgia is now at the initial stage of transition to a market economy. The main goals of the country are:
a) to overcome the economic crisis in the near future;
b) to speed up transition to market economy and privatization of state property;
c) to steadily supply the population and economy with energy resources;
d) to improve the social and economic insur ance of the population;
e) to develop transportation facilities;
f) to attract foreign investors and seek for for eign credits.

2 Forest resources and their use

In Georgia, forests are of national value. They markedly differ from each other in geographic distribution, biological properties and ecological characteristics, which, in turn, is primarily due to a variety of their genetic, growth, and formation patterns.

2.1 Forest history

The background of Georgia's flora, including forests, is complex and largely obscure. It is known from the literature (A. Dolukhanov, 1981) that Eocene flora substantially differed from the present flora. It is most similar to the present Indian-Australian tropical flora with its evergreen woody species. Climate, relief and vegetation have considerably changed subsequently. Thermophilic plants have died out to give way to cryophilic species that grew earlier in the mountains. It is assumed that forest-free drought-resistant plant formations have spread over large areas in the Caucasus since Myocene time, when land expansion was active enough to let them spread from the arid centres that had formed by that time in the eastern Mediterranean.

Gradual cooling of climate resulted in the complete disappearance of tropical flora (in the present sense). In Pliocene time, foothill belt vegetation was affected by humid climate. It was chiefly represented by subtropical forest ecosystems and dominated by deciduous species in the upper storey of stands. At higher latitudes, forests spread in mountains under moderately warm climate conditions. Many woody species have survived there.

The earliest evidence for Georgia's forests was provided by old Greek and Roman authors. Some well-known Greek scientists and thinkers, such as Herodotos, Hypocratos, Xenophonthos, Strabonos and others, note that the Georgian tribes that lived in the Caucasus and in Minor Asia owned forest-rich territories. They also note that ship-building timber was produced in Kolkhida. Valuable information on Georgia's nature, particularly forests, is provided in chronicles on the invasion of Mongols, Persians, Turks, etc. and in some travel notes. Italian missionary Arcanjello Lambert (18th century) and German scientist, member of the St. Petersburg Academy Anton Guldenstedt (18th century) collected valuable data on the species composition of forests in Georgia.

Georgian Medieval historic sources provide voluminous data on Georgia's forests and timber industry. For example, Forest Service was founded by the Tzar in Middle Ages for forest protection and management. Based on the type of property, forests were subdivided into state-owned, church-owned, and rural types. The Book of Laws written by Tzar Vakhtang VI contained clauses on forests. Of great value is the contribution made by well-known 18th-century Georgian scholar Vakhushti Bagrationi who presented interesting data on Georgia's forests in his book "Geographic description of Georgia". He was the first European scientist to call attention to vertical zonation in the distribution of the vegetation cover, particularly forest vegetation.

In the late 19th-early 20th centuries, wood consumption in industry, transport, and agriculture had substantially increased. Large-scale logging conducted by big timber companies caused an appreciable damage to forests. In many areas forests were thinned or completely cut. Some timber products were exported.

2.2 Forest ownership

In 1921, Soviet power was declared in Georgia, all forests were nationalized and became state property. In the early 1930s, about 20% of state-owned forests were granted to collective farms for permanent use. In 1984, collective farms were abolished and forests have been supervised ever since by governmental bodies. All forests in Georgia are now state-owned. Forests are managed by:

- the State Forestry Department (about 2,480 000 ha);
- the State Department of Protected Territories, Nature Reserves, and Game Management (ca. 54,000 ha). There are no private forests in Georgia.

2.3 Land use and forest resource

2.3.1 Land utilization

Georgia has versatile agriculture. Total agricultural land area is 3.1 M ha, including 0.8 M ha of ploughland and 1.7 mln. ha of hayland and pastures. Georgia has 0.16 ha of ploughland and 0.62 ha of agricultural land per capita. The main sectors of agriculture are grain farming, viniculture, fruit growing, subtropical cultures (tea and citrus fruit growing), potato growing, tobacco production, animal husbandry, etc.

2.3.2 Distribution and functions of forests

According to 1996 data, Georgia's total forest area is 2,988 000 ha, including 2,752.3 thousand ha of forested area. The percentage of forests is 39.8%.

For more information on Georgia's forests, see table 2.

Table 2 shows that the percentage of forests is much higher in West Georgia (52%) than in East Georgia (29%) and that forest productivity is much higher in West Georgia (average reserves per ha 173.2 m3) than in East Georgia (average reserves per ha 134.4 m3) primarily because soils and climate are mare favourable for forest vegetation in West Georgia than in East Georgia.

The highest percentage of forests estimated vertically is reported from the middle and upper forest zones.

Forests fall into mountain (98%) and plain (2%) types, the latter type being chiefly represented by Kolkhida lowland forests. Total wood (standing timber) reserves are estimated at 434 M m3. Average reserves per ha are 158 m^3 Total mean wood increment is 4.6 M m3 (1.8 m^3 per ha). Forested area per capita is 0.51 ha and wood reserves per capita are 80 m3.

The percentage of forests is higher in Georgia than in Austria, Germany, France, Italy, Greece, Spain, Poland, Armenia, Azerbaijan, Ukraine, Belarus, etc.

Forests fulfil various functions. From table 3 one can see that Georgia's forest fund is dominated by soil-protecting and water-regulating resort forests and green-zone forests that cover a total area of 2 779.1 thous. ha (over 93% of all forests).

The areal distribution of forests in Georgia is irregular. Forests occupy over 50% of some areas such as Gagra, Gulripshi, Mestia, Lentekhi, Oni, Borzhomi, Akhmeta, etc., but they are scarce (less than 10%) in other parts of the country, eg. Dedoplistskaro, Ninotsminda, Akhalkalaki, Tsalka, Kazbeki, Gardabani, etc. The distribution of forests on the basis of hillslope steepness is as follows: up to 10°-5.5%; 11-20°-16.5%; 21-30°-34.8%; 31-40°-34.8%; 41° and above - 8.4%. Most forests (78%) grow on steep (at least 21°) mountain slopes.

The distribution of forests in terms of altitude a.s.l. is irregular, too. Forests that grow at an altitude up to 500 m make up 7.3% of total forest area; those growing at an altitude of 501 to 1000 m account for 19.5%; forests that occur at an altitude of 1001 to 1500 m make up 35.5%; those occurring at an altitude of 1501 to 2000 m account for 30.7%, and those growing above 2001 m make up 7.0%. Consequently, most forests (92.7%) grow on mountain slopes from 501 m a.s.l.

Table 2. Specific information about the forests of Georgia

Indices	Total for Georgia	West Georgia	East Georgia
1. Forested area, thousand hectares	2752.3	1650.0	1102.3
2. Percentage of forests	39.8	52	29
3. Wood reserves, mln. (m3)	434.0	258.8	148.2
4. Average reserves per ha (m3)	158.0	173.2	134.4
5. Forested area per capita, (ha)	0.51	0.71	0.36
6. Wood reserves per capita, (m3)	80	123	48

Table 3. Distribution of forests based on their functions.

Function of forests	Forest area, 1000 ha	Percentage of Georgia's total forest area
1. Nature reserves	168.9	5.7
2. Forests formed by valuable woody species	4.7	-
3. Green zone of cities and industrial centres	265.7	8.9
4. Close-zone resort forests	115.1	3.9
5. Remote-zone resort forests	775.5	26.0
6. Soil-protecting and water-regulating forests	1623.1	54.3
7. Protecting and commercial plain forests	35.0	1.2
Total	**2988.0**	**100**

Such distribution of forests in terms of mountain slope steepness and altitude a.s.l. creates some farming problems in mountain forests.

In West Georgia, mixed subtropical forests formed by alder and Pterocarya species grow at sea level to an altitude of 500 m in the Kolkhida depression. Imeretian oak (*Quercus imeretina Stev*.), zelkova (*Zelkowa carpinifolia*), European chestnut (*Castanea Sativa Mell*.), oriental beech (*Fagus orientalis Lipsky*), European ash (*Fraxinus excelsior* L.), persimmon (*Diospurus Lotus* L.), box-tree (*Buxus colchica*), wingnut (*Pterocarya caucasica C*.), fig (*Ficus carica* L.), maple (*Acer platanoides* L.), Pitsunda pine (*Pinus pithyosa Stev*.), hornbeam (*Carpinus caucasica* A.), Caucasian linden (*Tilia caucasica Rupr*.), etc. occur in this belt. Shrubs are represented by Grecian laurel (*Laurus nobilis* L.), laurelcherry (*Laurocerasus officinalis Roem*.), bladder-nut (*Staphylea colchica Stev*.), Caucasian blueberry (*Vaccinium arectostafhylos* L.), Pontian and Ungerna rhododendron (*Rhodedendron ponticum and R. ungerna*), etc.

The chestnut forest belt occurs at an altitude of 500-600 to 1000-1100 m a.s.l.There, chestnut grows together with hornbeam, Gartvis oak, Caucasian linden, maple, forest pear, etc. Laurel, Pontian rhodedendron, Caucasian blueberry, etc. are encountered in the undergrowth.

In East Georgia, the arid thin or light forest belt occurs at an altitude of 300-400 to 500-600 m a.s.l. under dry climate conditions (precipitation 200-300 mm/year). Xerophytic plants, such as turkterebinth pistache (*Pistacia mutica Fisch et mey*), hackberry (*Leltis caucasica Willd*), and juniper (*Juniperus foetidissima Willd* and *J. Oblonga*), are common there. Iberian oak (*Q. iberica*) forests grow at an altitude of 500-600 to 1000-1100 m a.s.l. Oak occurs together with European ash, hedge maple, hornbeam, and Oriental hornbeam. Medlar, dogwood, and spindle-tree are encountered in the undergrowth.

In West and East Georgia, the vertical distribution of forests at altitudes above 1000-1100 m a.s.l. is as follows:

Oriental beech (*Fagus orientalis Lipsky*)-dominated forests grow on mountain slopes at altitudes of 1000-1100 to 1500-1600 m a. s. l.; both unmixed and mixed, dominantly uneven-aged, multi-storeyed beech forests mixed with Caucasian hornbeam, European ash, Caucasian linden, Norway maple, Oriental spruce, and Nordmann fir occur. Laurelcherry, Caucasian rhododendron, Pontian oak, Caucasian blueberry, etc. are encountered in the undergrowth. Biogroups of common woody species with biological and sylvicultural characteristics of their own are abundant in small to relatively large zones in beech forests and in other stands, depending on external growth conditions such as relief, soils, climate, exposure to sunlight, slope steepness, etc. This all shows the biological diversity of these forests.

Mixed and unmixed dark coniferous forests dominated by Nordmann fir and Oriental spruce chiefly grow in West Georgia at altitudes of 1400-1500 to 2100-2300 m a. s. l. Uneven-aged, multi-storeyed dark coniferous forests, particularly fir stands, have a high vertical density of canopy. Four to five independent age generations (storeys) of stands are differentiated. The soil cover is dominated by brown forest soils. Podzolic brown forest soils occur in spruce stands on plains and gentle slopes. Forest vegetation is formed by highly productive fir and spruce stands mixed with beech, aspen, linden, yew, forest pear, mountain ash, etc. Pontian rhododendron, laurelcherry, Caucasian blueberry, Caucasian rhododendron and other plants occur in the undergrowth.

The subalpine forest belt extends from 2000-2100 to 2200-2400 m a.s.l. Forest-meadow and mountain-meadow soils are common. Forest vegetation is dominated by thin forests consisting of high-mountain maple (*Acer Trautfeter*), Litvinov birch, mountain ash, goat willow, Oriental spruce, and Nordmann fir. Oriental beech is occasionally encountered. High grasses are widespread on subalpine meadows.

Depending on forest density, total forested area is distributed as follows:
- low-density (0.3-0.4) forests account for 17.5% of all forests;
- medium-density (0.5-0.7) forests - 79.1% , and
- highly dense (0.8-1.0) forests - 3.4%.

Georgia's forests are dominated by medium-density stands. A high percentage of low-density stands is due to large-scale cutting. In the past, cutting instructions were often violated, so that at least 40-50% of wood reserves were cut at a time. As a result, highly dense forests have been strongly thinned, their productivity has decreased, and the general state of the forests has deteriorated.

The age distribution of forests is irregular, too. Forests fall into the following age groups:
- young stands cover 6.3% of total forest area, and their wood reserves account for 1.5% of total wood reserves;
- medium-aged stands make up 32.9 and 17.1%, respectively;
- immature stands-17.9 and 17.1%, respectively, and;
- mature and older stands- 42.9 and 59.6%.

Depending on productivity (quality class), Georgia's forests are subdivided as follows:
- highly productive stands (classes I-II) cover 21% of total forested area;
- medium-productivity stands (class III) - 44.9% and;
- low-productivity stands (classes IV-V)-33.7%.

Consequently, highly productive and medium-productivity stands make up 2/3 (66%) of Georgia's forests primarily because the soils and climate are favourable for their growth and because major forest-forming woody species, such as beech, fir, pine, etc., have some characteristics of their own.

2.3.3 Forest composition

The woody species composition of Georgia's forests is highly diverse. About 400 woody and shrub species are known, each forming an individual plant and animal community. However, only some species form big ecosystems, whereas most trees and shrubs occur as individual biogroups in forests dominated by major forest-forming species. Therefore, Georgia's forests are biologically diverse. The composition of forests primarily depends on relief, climate, the physicochemical properties of soils, etc. that affect the genesis, growth, development, and formation of forests. However, forests are not passive. Being nature's active vital force, forests substantially affect the environment.

Although hundreds of various trees and shrubs grow in Georgia's forests, major forest-forming woody species are Oriental beech, Iberian oak, Nordmann fir, Sosnovsky pine, Caucasian hornbeam, European chestnut, alder, birch, Oriental hornbeam, etc. (table 4).

One can see from table 4 that Georgia's forests are dominated by deciduous species (83.5%).

Other valuable species that form stands and individual biogroups or grow individually are Caucasian linden, European ash, elm, Imeretian oak, high-mountain oak, daphne willow, zelkova, hop hornbeam, forest pear, wild apple, box-tree, Pitsunda pine, yew, hawthorn, bladder-nut, persimmon, dogwood, walnut, etc. Pitsunda pine, Imeretian oak, elm zelkova, box-tree, yew and other plants are in Georgia's Red Data Book.

It should be noted that in Georgia, forests are dominantly formed by native stands, which is not the case in many European countries where such forests are scarce. Artificial stands make up not more than 5% of all forests.

Primeval (virgin) beech-fir-spruce forests that are scarce in many European countries have survived in Georgia over an area of about 500 000 ha at high altitudes in narrow mountain river gorges. They are unique in composition, genesis, growth patterns, formation, and productivity.

Analysis of experimental data collected by the Institute of Mountain Silviculture, Georgian Academy of Sciences, has shown that primeval forest is a very complex living ecological system where biologically different, closely related plants and animals co-exist and collectively affect the environment. In primeval forests, organic matter is permanently exchanged, formed and destroyed in a cyclic manner; old generations of trees, shrubs, herbs and other living organisms die out to give way to new generations.

The distribution of undisturbed (primeval) forests in terms of major forest-forming species is as follows:
- Oriental beech-dominated stands – 356,100 ha;
- Nordmann fir-dominated stands – 117,000 ha;
- Oriental spruce-dominated stands – 27,400 ha.

Structurally, these are uneven-aged, multi-storeyed forests in which at least 4-5 age generations or storeys can be differentiated. Every tree or its biogroup has its own biological and phytocenotic position in a complex mosaic biogeocenologic pattern. Primeval forests exhibit the entire spectrum of biological growth and development stages from seedlings and undergrowth to big old trees. Some huge trees are 50-70 m high, 2.0-2.5 m thick and 500-700 years old. In the dark coniferous forest, where the Gagra forestry farm operates (Gaga river gorge), we cut a 668-year-old, 65.4 m high, 2.52 m thick model Caucasian fir-tree. In such stands wood reserves vary from 1,600 to 1,800 m3 and mean annual wood increment is 10-15 m^3.

Such high forest productivity indices are primarily due to optimum climate and soil conditions and the biological characteristics of genesis, growth, and formation. The nature of primeval forest is perfect, there are no unnecessary constituents (so-called "production waste"), its metabolism is closed, and all plants, animals and microorgamisms live in harmony and affect each other. In primeval stands the quantitative distribution of trees in terms of thickness and height is uneven, has several peaks and the distribution sequence is asymmetric. In primeval fir-beech forest the quantitative distribution of trees on the basis of thickness is as follows:

Trees that have a thickness up to 20 cm account for 43.5%;

24-40 cm	-	30.2%;
44-60 cm	-	11.3%;
64-80 cm	-	4.4%;
84-100 cm	-	3.6%;
104-120 cm	-	2.6%;
124-140 cm	-	1.8%;
144-160 cm	-	1.2%;
164-180 cm	-	0.9%;
184-200 cm	-	0.7%.

The structure of primeval beech, fir and spruce forests primarily depends on the height distribution of trees. The mosaic pattern, compactness or heterogeneity of these forests are caused by some native spatial distribution characteristics of trees. This heterogeneity is observed in both the upper and underground parts of stands. The root system of primeval forests is multi-storeyed, too. The amphitheatre-like distribution of trees growing on mountain slopes contributes to better lateral illumination and, consequently, provides maximum sunlight for the trees.

To illustrate the height structure of primeval uneven-aged fir stands, let us subdivide them into storeys.

1) The upper storey (storey I) is formed by trees that vary in height from 40-45 to 60-70 cm and in thickness from 120 to 250 cm. They

Table 4. Distribution of forests in terms of major forest-forming woody species.

Forest-forming woody species	Area, 1000 hectares	% relative to total forest area
coniferous		
Nordmann fir	189.8	7.0
Oriental spruce	138.6	5.0
Sosnovsky pine	122.1	4.4
Junipers	4.1	0.1
total	**454.6**	**16.5**
hardwood deciduous species		
Oriental beech	1,175.6	42.7
Iberian oak	291.0	10.5
Caucasian hornbeam	274.9	10.0
European chestnut	106.0	3.9
Oriental hornbeam	48.1	1.8
Other hardwood deciduous species	54.3	2.1
Total:	**1950.2**	**70.8**
softwood deciduous species		
Alder	200.0	7.3
Birch	73.4	2.8
Other deciduous species	**25.1**	**0.9**
Total:	298.5	10.9
Other woody species	**12.1**	**0.4**
Shrubs	36.9	1.5
Total:	**2752.3**	**100**

make up 10% of all trees in the stand.

2) The middle storey (storey II) consists of 30-40 m high, 60-120 cm thick trees that account for 18-20%.
3) The middle storey (storey III) is built up by 150 m high, 24-56 cm thick trees that make up 30%.
4) The lower storey (storey IV) is formed by 7-15 m high, 10-20 cm thick trees that account for 40%. They grow slowly in height and thickness because of poor illumination.

The genesis and growth of primeval mixed beech-fir-spruce forests in time and space are shown below.

Variant I

1) Mixed fir-spruce-beech stands.
   Stands formed under their canopy are:
2) Mixed beech-fir-spruce stands.
   Stands formed under their canopy are:
3) Fir-spruce-beech stands.

Variant II

1) Mixed beech-fir-spruce stands.
   Stands formed under their canopy are:
2) Mixed fir-spruce-beech stands.
   Stands formed under their canopy are:
3) Mixed beech-fir-spruce stands.

Studies have shown that the above succession is chiefly caused by the fact that Oriental beech is more light-demanding than Nordmann fir and Oriental spruce. Because the canopy of dark coniferous forest is more transparent than that of beech forest, it contributes to natural beech regeneration. Spruce and fir are successfully regenerated in the denser and shadier beech forest canopy. The compositional succession of these forests is a permanent process. The constituents of one forest formation penetrate another formation.

2.3.4 Growing stock

Based on 1996 data, Georgia's total wood reserves are estimated at 4,34.1 M m^3, including:
- coniferous stands - 121.9 M m^3 (28.1% of total reserves);
- hardwood deciduous stands - 290.3 M m^3 (66.9%);
- softwood stands - 20 M m^3 (4.6%);
- other woody species - 0.66 M m^3 (0.1%);
- shrubs - 1.24 M m^3 (0.3%).

The biggest wood reserves are formed by Oriental beech-dominated (224.7 mln. m^3, 51.8%) and Nordmann fir-dominated (74.7 mln. m^3, 17.2%) forests. Total mean annual wood increment is 4.6 mln. m^3. Mean annual wood increment is 1.7 m^3/ha.

2.3.5 Forest threats

Georgia's forests are heavily damaged by various entomological pests and diseases. The shrinkage of elm-trees caused by graphyosis (*Graphium ulmi*) and European chestnut cancer (*Graphynectria Endothia parasitica*) are the most harmful diseases. Forest pests are gypsy moth (*Ocnerea dispar*), brown-tail moth (*Nygmia phaeorhea*), loopermoths (*Operophthera brumata, Eranis defoliarea*), bark beetles (*Dondroctonus micans, Ips typographus, Ips sexdendatus, Ips acuminatus*), etc.

Silvicultural and biological methods (entomophags, pheromones, biopreparations, etc.) are basically used to control forest pests and diseases.

Because prophylaxis is well-organized, large-scale forest fires do not occur in Georgia.

2.4 Reforestation

Although the percentage of forests is Georgia is high (39.7%), close attention has always been paid to reforestation in forest-free areas. Reforestation started on a scientific basis in 1890. The largest-scale reforestation was carried out after the Second World War. For example, seedlings were planted over an area of 41 000 ha in 1926-1946 (including protective reforestation), 102.2 thous. ha in 1947-1970, 162.0 thous. ha in 1971-1990, and over 10.5 thous. ha in 1991-1998.

About 70 woody species and shrubs, such as pine, fir, beech, oak, ash, chestnut, Persian walnut, maple, black locust, cypress, sumac, almond, forest pear, bush cherry-plum etc., are planted. Sosnovsky pine, scrub pine, ash, black locust, are used in protective reforestation along with some introduced plants, e. g. Bolle's poplar, Eastern poplar, Japanese cryptomeria, Oriental plane tree, Italian and evergreen cypress, etc. Pine accounts for 30% and trees of the walnut family 16% of the total area covered by forest cultures. Some steps are taken to contribute to natural forest regeneration, so that it substantially exceeds the extent artificial reforestation.

2.5 Silviculture

According to final cutting instructions, voluntary-selected cutting, group cutting, and gradual cutting systems are allowed in Georgia's mountain forests and clear (strip) cutting in plain forests.

In mountain forests, felling is carried out and wood is utilized in order:
a) to retain and strengthen soil-protecting, water-protecting and other functions;
b) to prevent erosion;
c) to naturally regenerate economically valuable woody species by seeding;
d) to increase the productivity and general state of forests.

Cutting techniques are selected with regard for the biological characteristics of woody species, forest type, mountain slope steepness, the exposure of slopes to sunlight, reforestation conditions, the erodible resistance of soils, etc.

In mountain forests voluntary-selected cutting prevails.

In addition to final cutting, all types of thinning are used, depending on the composition, age and density of forest and relief.

2.5.1 Timber uses

The percentage of harvested timber generally accounts for 65.7% of the total amount of wood produced. Timber is chiefly used in industry (furniture production, woodworking, etc.), construction, transport, agriculture, etc. Firewood is used for heating. There was a pulp-and-paper plant in Zugdidi, West Georgia, but in 1992 production came to a halt because of the lack of raw material.

2.5.2 Non-timber forest products

Forests are used for other purposes, e.g. collecting wild fruit and berries such as dogwood, hazelnuts, medlar, persimmon, Caucasian sumach, currant, gooseberries, blueberries, forest pear, wild apples, bladder-nut, etc. and medicinal plants, e.g. dog rosa, raspberries, St. Johnswort, plantain, sage, celandine, etc.

2.5.3 Conservation

Being of great nature conservation value, Georgia's forests help maintain and increase the biological diversity of landscape and stabilize the environment.

3 Forest economy

3.1 Forest and forest industries in the national economy

Forests are now managed on the basis of the State Programme for the sustainable development of forest economy approved by the Government and President of Georgia in December 1997 and the Strategy for the development of forest economy elaborated together with the World Bank. These acts describe basic goals in reforestation, forest fire and pest protection, the multi-purpose utilization of forest resources, social, economic and financial issues, the expansion of the existing forest road network, the updating of technical facilities on forestry farms, etc. Special attention is paid to the development of a mechanism of transition of the forest sector to market economy and the implementation of this policy. Almost all woodworking and furniture companies had been privatized by 1996. However, they can hardly operate nowadays because there are no raw materials and their products have high cost price and are uncompetitive. Only roundwood is exported, which is economically unprofitable.

Some steps will be taken to attract foreign investors and to update the logistics of logging, timber, and woodworking companies. Some joint harvesting and woodworking companies have been founded.

3.2 Employment in the forest sector

As of 1997, 11,202 people work in the forest economy sector (including 9,697 people in the State Forest Protection Department) and 1,505 people in timber industry. By the year 2005, 20,684 people are expected to work in the forest sector (including 13,708 people in the production sector) and 6,792 people in the commercial sector of timber industry.

3.3 Profitability

Profit made by selling forest products is determined as a difference between the income achieved by selling forest products and their production and sale costs.

Companies export forest products and exclude export tariffs from the income achieved. The level of profit made by selling forest products (rate of profit, profitability) typically varies from 20 to 30%.

4 Forest policy

4.1 Forest legislation (its development and legal structures, forest-related environmental protection laws)

Before Georgia joined Russia (1801), its legislative acts had always had clauses on forest protection and rational forest management.

After joining Russia, all forest relations have been formed in accordance with Russia's forest laws. In 1921, Soviet power was established and all forests in Georgia were declared state property. In 1924, Georgia's first Forest Code was accepted, and the forests were subdivided into forests of state and local value.

In 1931, all forests in the USSR were divided into two zones: a timber industry zone and a forest-cultural zone. Georgia's forests of resort importance were incorporated in the timber industry zone. It was a mistake because forests were thinned over large areas and forest reserves were exhausted.

In accordance with the Act endorsed by the Government of the USSR in 1943, differentiated forest economy was declared, and all forests were subdivided into three groups: I, II, and III. Based on the Act approved by the Government of Georgia in 1945, Georgia's forests were split into groups I and II. Most forests (96%) were included in group I. They fulfilled water-regulating, soil-protecting, climate-controlling and other social and ecological functions.

In 1967, new final cutting rules were approved. In 1978, a new forest law developed with regard for the forest laws of the USSR was endorsed. In 1995, the Parliament of Georgia changed the law and made some supplements. A new Forest Code is now being developed. The draft project will be approved by the Parliament and President of Georgia.

In 1958, the Law on Nature Conservation in Georgia" was approved for the first time in Georgia. In 1996, the Parliament of Georgia endorsed a new law "On Protection of Georgia's External Environment" with a clause on forest protection.

4.2 Actors in forest and forest-related policies

4.2.1 Government forestry bodies

Forests are managed by the State Forestry Department in Georgia, by the State Departments in the Abkhazian Autonomuos Republic and the Adjarian Autonomous Republics and by district sylvicultural enterprises.

The forests studied by the V. Z. Gulisashvili Institute of Mountain Silviculture are managed by the Gorian and Didgorian experimental farms and the Tsitelkhidian Experimental Forest Station.

In protected territories, nature reserves and wildlife areas forests are managed by the State Department of Protected Territories, Nature Reserves and Game Management.

About 160 000 ha of forests are still being managed by the Ministry of Agriculture and Food of Georgia.

4.3 Forest policy tools

Some instructions, methods and standards, such as new final cutting and thinnng instructions (1993), new rules for selling standing timber, an instruction on responsibility for violation of forest laws (1986), schemes for planting forest cultures (1998), etc. have been worked out and approved for the implementation of forest laws.

4.4 Forest policy in relation to other national policy areas

Georgia's forest policy is pursued in accordance with national policy because all forests are declared state property and all principal and strategic forest management problems are solved by the state.

4.5 Forest education and research

The Tbilisi State University was founded in 1918. It has the Agronomy Department opened to train specialists in forestry.

In 1924, the first group of silviculturists was granted university certificates. This work was supervised by Prof. S. Z. Kurdiani who founded Georgia's first School of Forestry.

In the early 1930s, the Tbilisi Forest- Technical Institute was founded. Its Forestry Department trained forestry engineers until 1938.

In 1938, the Tbilisi Forest-Technical Institute was closed and the Forestry Department became part of the Georgian Institute of Agriculture, now the Georgian Agrarian University, which trains specialists in forestry. Every year 25 silviculturists get higher education certificates. The Borzhomi School of Forestry, now School of Construction, trained silviculturists who got secondary education certificates.

The pioneer study of Georgia's forests was conducted in the mid-19th century in the Borzhomi Estate owned by Grand Duke Mikhail,Russian tzar's brother, under the supervision of Y. Medvedev and A. Gamrekel who also worked out the first forest management project for Borzhomi Gorge forests. Subsequently, Prof. S. Z. Kurdiani and other scientists continued to study biology of forest species.

Systematic large-scale studies in silviculture, forest management, forest inventory and other fields started after opening the Tbilisi Forest Research Institute (1945), now the Institute of Mountain Forestry, Georgian Academy of Sciences, founded by Prof. V. Z. Gulisashvili.

The native characteristics of forest are also studied by the Forestry Department of the Georgian Agrarian University, the Institute of Botany (Georgian Academy of Sciences), the Tbilisi and Sukhumi Botanical Gardens (Georgian Academy of Sciences).

The Institute of Mountain Forestry is Georgia's leading research institute where silvicultural problems are studied and silvicultural practices are done on a scientific basis. It was the leading institute of mountain forestry in the former Soviet Union.

The priority fields of research done by the institute are:

a) the biological and silvicultural characteris tics of forests;
b) the genesis, growth, and evolution of major mountain forest formations;
c) the social and ecological (soil-, water-, cli mate-regulating, etc.) functions of forests;
d) development of rational and effective scien tifically-based regeneration and natural re forestation methods;
e) working out environmentally acceptable fi nal cutting and thinning rules to maintain thesustainability and inexhaustibility of forest resources; the theoretical and practical aspects of selective economy;
f) the biological and ecological characteristics of forest pests and diseases; working out integrated pest protection systems with an emphasis on biomethods.

Organisations connected with the forest sector:

The State Forestry Department of Georgia, Mindeli St., 9, Tbilisi 380086.
The State Department of Protected Territories, Nature Reserves and Game Economy, I. Chavchavadze Prospect., 84, Tbilisi 380062.
The Ministry of the Environment and Natural Resources of Georgia, M. Kostava St., 68, Tbilisi 380015.
V. Z. Gulisashvili Institute of Mountain Forestry, Georgian Academy of Sciences, Mindeli St., 9, Tbilisi 380086.
Georgian Agrarian University, 380031, 13 th kilometre on the Military Georgian Highway.
L. A. Kanchaveli Georgian Institute for Plant Protection, I. Chavchavadze Prospect, 82, Tbilisi 380062.
N. Ketskhoveli Institute of Botany, Georgian Academy of Sciences, Kodzhorskoye Shosse, 1, Tbilisi 380007.
I. Dzhavakhishvili Tbilisi State University, Botany and Ecology Chairs, Universitetskaya St., 10, Tbilisi.
Tbilisi Botanical Gardens, Botanichaskay St., 15, Tbilisi 380005.
Batumi Botanical Gardens, Georgian Academy of Sciences, 384533, Batumi, Makhindjauri.
Sukhumi Botanical Gardens, Georgian Academy of Sciences, Chavchavadze St., 2, Sukhumi 384933.
Lesproject Company, I. Chavchavadze Prospect, 84, 380062.
Georgian Project and Design Institute of Sylviculture, I. Chavchavadze Prospect, 84, 38002.
Tbilisi Forestry Research Institute, Gaprindauli St., 2, Tbilisi 380054.
Association of Georgian Foresters, Mindeli St., 9, Tbilisi 380086.
Green Association, David Stroitel Prospect, 82, Tbilisi 380082.
Association of Georgian Hunters and Fishers, I. Chavchavadze Prospect, 75, Tbilisi 380062.
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Germany

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1 The Country

1.1 Natural Conditions

Situated in the center of Europe, Germany offers a tremendous variety of natural geographic regions in a comparatively small area. Topographically, Germany can be divided into three major areas. The Northern German lowlands stretch from the coasts of the North and Baltic Seas to the foothills of the low secondary mountain ranges. The relief of this area includes the glacially influenced moraine landscapes with their characteristic hills and lakes as well as the more uniform, flat areas created by maritime and fluvial deposits. The second major topographic area contains the German low mountain ranges from the southern edge of the lowlands to the Danube river. This region is characterized by a varied relief created by mountain ranges of very different ages and origins. There are the geologically old mountains (for example the Black *(Schwarzwald)* and Bavarian Forests *(Bayerischer Wald)*), which are mainly made up of crystalline rocks. Volcanic processes during different periods formed other landscapes such as the *Vogelsberg* and parts of the *Eifel*, while mountain ranges like the southern German *Swabian Alp* consist predominantly of sedimentary rocks. The third major topographic area, south of the Danube valley, contains the small German portion of the Alps, including the broad foothills of that mountain range. Landscape and geology of this region are strongly influenced by glacial and fluvial deposits originating in the Alps. The southern boundary is marked by the abruptly rising wall of the Alps, which mainly consists of different kinds of limestone in this area.

Due to Germany's central location in Europe, the climate shows both maritime and continental characteristics. The average temperature in July lies between 15°C (coastal areas, lower mountains) to 20°C (upper Rhine Valley). During the coldest month, January, the average temperature varies between 2°C in the north-western flatlands and below - 4°C at the higher elevations. Annual precipitation in the northern lowlands and at lower elevations in the South varies between 500 to 1000 mm per year, while reaching up to 2000 mm and more in the highest mountain regions of the Alps (Statistisches Jahrbuch 1997).

Considering the complex geology and different climatic influences, soil taxonomy in Germany is too complex to be treated in a brief overview. Brown soils dominate in the low mountain ranges and in wide parts of the Alpine foothills, while lime soils are found in the Alps and in some low mountain ranges (Swabian Alp). Different kinds of Podsols and wetland soils (moor, riverain) dominate in the northern flatlands (Seydlitz 1984). A good overview of forest-relevant soils is given by Rehfuess (1990).

Before humans began to interfere with nature, more than 80% of Germany was covered by deciduous forests. Red beach (*Fagus sylvatica*) was the dominant species in most forests. Oak (*Quercus petrea*, *Q robur*) originally dominated forests in the dry and warm basins of central Germany. Conifers (mainly *Pinus sylvestris*; *Abies alba* and *Picea abies* in the mountains) could be found in certain areas at higher elevations in the mountains and in the drier parts of eastern Germany. Forest-free areas only existed in extreme sites such as moors or in the highest mountains above the tree line (Ellenberg 1996, Mantel 1990).

1.2 Society, Economics and Politics

In 1996, Germany had a population of approximately 81.8 million. At 229 people per square meter, it is one of the most densely populated countries in Europe. The distribution of the population is quite uneven. More than 70% live in cities with more than 10,000 inhabitants. Densely urbanized agglomerations like the Rhine-Rhur-area with more than 11 million inhabitants stand in stark contrast to sparsely populated areas in large parts of north-eastern Germany, northern Bavaria, or the *Eifel* region in the West (Statistisches Bundesamt 1997). Especially since Germany's reunification, there has been a tendency of migration from eastern Germany into the West, not including the fast growing metropolitan area of Berlin.

Germany is a highly industrialized nation. In terms of overall economic performance, it is the third largest in the world, and in regard to world trade, it was ranked second in 1996. In 1997, the gross domestic product reached 1,811,000 million ECU, which translates into a per capita amount of 21,890 ECU. The huge difference in economic power between the former eastern and western part of the country still represents a major problem. In the West, 66.5 million people (81% of the total population) produce 1,607.8 billion ECU (89% of the gross domestic product), while in the former GDR 15.5 million people (19%) produce only 203.4 billion ECU (11%) (Statistisches Bundesamt 1997).

The foreign trade balance is positive, with a 1996 surplus of 53 billion ECU, emphasizing Germany's self-image as an export nation. The

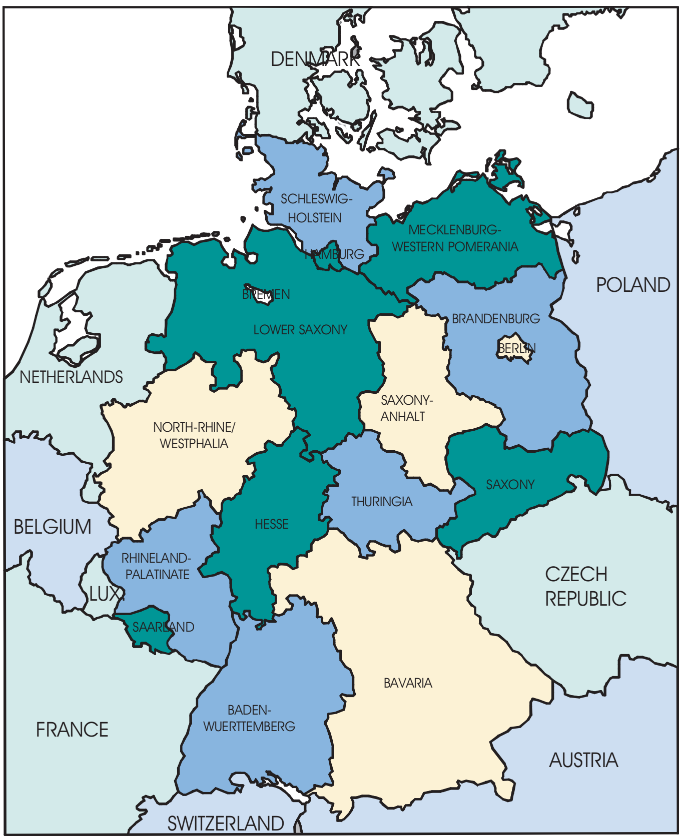

Figure 1. Germany and its Federal States *(Länder)*

most important industrial branches in 1994 included: building and construction trade (80 billion ECU), electrical engineering (48.9 billion ECU), automobile industry (46.23 billion ECU), mechanical engineering (43.4 billion ECU), and the chemical industry (36.77 billion ECU). With 655 billion ECU (36% of the gross domestic product in 1996), the service sector represents the biggest economic sector today, even surpassing the industrial sector (585 billion ECU; 32%). The agricultural sector, including fishery and forestry, produces not more than 19 billion ECU (1% of the gross domestic product) (Statistisches Bundesamt 1997).

Probably as a result of the tremendous structural changes, especially in the former GDR, and under the pressure of globalization, unemployment has become a serious problem in Germany's society. This, along with the resulting societal changes, has driven environmental concerns from a top position in the polls on society's general awareness (Schaub 1998). In early 1999, more than 4 million German people were jobless (Bundesministerium der Finanzen 1999).

Germany is a parliamentary democracy with a federalistic structure. The legislative body consists of the German parliament, the *Bundestag*, and the *Bundesrat*, an assembly of the regional governments of the German states *(Bundesländer)*. The executive is formed by a cabinet of ministers, headed by the German chancellor. The President of the Republic, albeit the highest public office, has mainly representative functions. The jurisdiction (Federal Court and Constitutional Court) is endowed with a high degree of influence and control over both the legislative body and the government (Rudzio 1996).

2 Forest Resources and their Uses

2.1 Forest History

Starting in the Neolithic and continuing during the Celtic age, humans began to have a visible impact on the nearly pristine forests of Germany. Especially in geographically favorable areas such as the Rhine Valley, the onset of agricultural land use as well as the emerging need for timber products changed the face of the landscape. While this trend continued during the Roman era, which mainly influenced the south and west of the country, most parts of Germany still contained a closed forest cover at the beginning of the early Middle Ages (Hasel 1985, Mantel 1990).

Throughout the Middle Ages, and up until 1750, periods of population growth with the ensuing settlement of formerly uninhabited areas in the mountains were followed by times of population decrease caused by wars and diseases. As a consequence, periods of clear-cutting and intensive use of the forests interchanged with periods of deserted landscapes and increasing natural reforestation. Formerly native forests (such as those owned by the German kings) were given as fiefs to feudal or clerical lords. Rural and urban communities also acquired forests.

At the end of the 18th century, the growing population and the developing industry caused a strong increase in the demand for timber as fuel and construction material, and the need for farmland and settlement areas led to a serious devastation of the remaining forests. Fearing a shortage of timber, intensive efforts gave birth to a regulated forestry. Sustainability became the major goal in timber production. Afforestation, mainly of devastated areas such as heathlands, led to a slow increase in Germany's forested area. Compelled by impoverished soils as well as (later on) influenced by the doctrine of net return, even-aged coniferous forests (mainly *Picea abies* and *Pinus sylvestris*) gained increasing importance, replacing the former, richly structured broadleaf forests (Hasel 1985).

During and especially after each of the two World Wars, the population's demand for timber as well as reparation cuttings once again decreased the growing stock of the forests. Coniferous species were still used as the predominant trees in the reforestation of clear-cut areas, and later in the afforestations induced by the agricultural crisis, leading to the present dominance of coniferous woods. In the last decades, afforestations in rural areas led to an increase in the total forest area. In western Germany, the forest area increased from 6.95 million ha in 1950 to 7.4 million ha in 1989 (BMELF und. c).

2.2 Forest Ownership

At the beginning of the 19th century, secularization of clerical property and the elimination of many small German territories led to growing state forest holdings. Some members of the nobility kept their forest property even in the times of the Republic; today, they represent an important group of forest owners. Communal forests developed in different ways from region to region. Depending on the dominance of Roman or German law, respectively, the communities—as a modern political body—kept the property, or the individual members became forest owners (Hasel 1985). After World War II, different changes in forest ownership took place in eastern Germany. Some private forests were expropriated, others were managed by the official forest service. At least about 90% of the forest area in the former GDR was managed by state institutions according to principles of uniform authority. Today, laws determine the restitution and the reprivatization of forests in the "new" Federal States (Sasse 1996, Brandenburgisches Ministerium für ELF 1998). The present distribution of forest ownership in Germany is shown in figure 2.

Almost half of the German forests are under private ownership. This includes about 600,000 ha of forest land administrated by the Federal Trusteeship Office in eastern Germany. The private forests are often split up into small parcels. An estimated number of more than 1 million Germans own less than 1 ha forest land each (Volz, Bieling 1998). The figures for forest enterprises published in the official statistics are given in table 1.

Especially in the south-western parts of the country, very small and disjunct parcels of woodland cause problems for effective forest management, leading to the reparceling of forest land. Privately owned forests dominate in *Bavaria*, *North-Rhine/Westphalia*, and in *Brandenburg*. State forests in Germany are mainly owned by the Federal States *(Länder)* (about 30 % of all forests); 4% of all forests are administrated by the federal Government (mostly used by the military). A high percentage of federal (national) forest is found in *Hesse*. Communal forests make up about 20% of the total forest area. Large ratios of such forests exist in *Baden-Wuerttemberg*, *Hesse* and *Rhineland-Palatinate*.

2.3 Land Use and Forest Resources

2.3.1 Global Overview of the Land Use

Table 2 gives an overview of the land use in Germany in 1993. Agricultural use, based on total area, represents the most important type of land use in Germany. Forests grow on about 30% of the country's land area.

2.3.2 Extent and Distribution of the Forests

107,390 km2 are covered with forests. There are tremendous differences in the distribution of forests (see table 3).

Big contiguous forests can be found in most low mountain ranges (e.g., in the Palatinate Forest

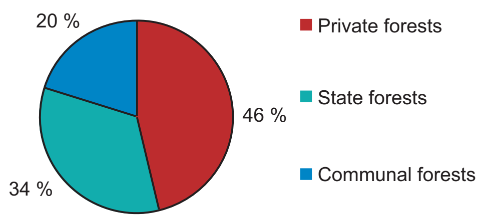

Figure 2. Forest ownership in Germany (source: BMELF und. b)

Table 1. Structure of forest property (source: BMELF 1999)

	Enterprises		Forest area of the enterprises	
	number	**1000 ha**	**area in percent**	**area per enterprise (ha)**
Farms[1]	277.224	1509,5	16	5,4
Forest enterprises[1]	156.404	8000,0	84	51,1
Total	**433.628**	**9509,5**	**100**	**21,9**

[1] Enterprises with 1ha of forest or more

(Pfälzer Wald, Rhineland-Palatinate), Bavarian Forest *(Bayerischer Wald, Bavaria)* or the northern Black Forest *(Schwarzwald, Baden-Wuerttemberg)*) as well as in the flatland regions with poor soils (e.g., in *Brandenburg*, parts of *Lower Saxony*). Contiguous forest-free areas exist mainly in parts of Northern Germany (*Schleswig-Holstein*), but also in some areas of the South (e.g., in the agriculturally used areas of *Lower Bavaria*).

2.3.3 Tree Species: Origin and Distribution

As mentioned earlier (see 2.1), present-day forests in Germany are vastly different from the natural forests of the past. As a result of 200 years of regulated forestry as well as centuries of human impact, coniferous instead of broadleaf forests are predominant in Germany today. Figure 3 gives a general impression of the distribution of tree species (dominant tree species in mixed forests) in present-day Germany.

Coniferous forests make up about two thirds of the total forest area in Germany. 39% of these forests are exclusively soft-wood forests containing a single tree species; another 25% of the soft-wood forests are also dominated by one species but include an admixture of other tree species (up to 10%). About 35% of these can be considered conifer-dominated mixed forests.

Unlike the widely dominating spruce and pine, other conifers gain importance only on a regional level. Silver fir (*Abies alba*) still is a characteristic tree in parts of the southern German mountain forests, while Douglas fir (*Pseudotsuga menziesii*) as the most commonly planted foreign conifer species is found with increasing frequency on different sites. Two species of larch (*Larix decidua* and *L. kaempferi*) also occur in different parts of Germany (Burschel, Huss 1997).

Hardwood forests are dominated by beech (*Fagus sylvatica*) and oak (*Quercus robur* and *Q. petrea*). In contrast to the soft-wood forests, 54% of these forests are mixed forests (admixture reaches more than 10% of the area). Besides beech and oak, maple (*Acer pseudoplatanus* and *A. platanoides*), ash (*Fraxinus excelsior*) and other broadleaf trees can be relevant to forestry. While hardwood forests, as the former dominant forest type, are mostly limited to their natural habitats, the distribution of coniferous forests now widely extends beyond the boundaries of their original occurrence (Ellenberg 1996, Burschel, Huss 1997).

2.3.4 Total Growing Stock, Growth and Total Fellings

The average growing stock in German forests is about 270 solid cubic meters of standing crop/

Table 2. Land Use Germany 1993 (source: Statistisches Bundesamt 1997)

	settlement area([1])	**traffic area**	**agricultural area**	**forest area**	**water areas**	**other areas**	**total area**
% area of Germany	7,1%	4,6%	54,7%	29,2%	2,2%	2,2%	356,970 km^2

[1] includes buildings, free spaces, recovering areas and cemeteries

Table 3. Forest area of the German Federal States (source: BMELF und. c)

Federal State (Bundesland)	Forest area (%)	Forest area (1000 ha)
Baden-Wuerttemberg	38	1.353
Bavaria	36	2.526
Berlin	18	16
Brandenburg	34	993
Bremen	0	0
Hamburg	4	3
Hesse	41	870
Mecklenburg-Western Pomerania	23	532
Lower Saxony	23	1.068
North-Rhine/Westphalia	26	873
Rhineland-Palatinate	41	812
Saarland	35	90
Saxony	27	502
Saxony-Anhalt	21	424
Schleswig-Holstein	10	155
Thuringia	32	522
Germany	30	10.739

ha (BMELF und. b). There exists an obvious difference between eastern Germany (the former GDR) with about 210 solid cubic meters of standing crop/ha, and the western part of the country with about 300 solid cubic meters of standing crop/ha. The average increment of the German forests is estimated at 6 m3 per year and ha. Table 4 gives an overview of the total fellings in Germany in recent years, and further subdivides the total amount according to the most important groups of tree species.

About four fifth of the total felling occurs in coniferous forests, due to their larger area percentage and higher average increment compared with hardwood forests. As the table shows, the annual average felling does not reach 40 million m3 (excluding the year 1990, with the immense effects of a major storm catastrophe). According to the results of a forest resource assessment, felling in Germany could be increased up to 57 million m3 without violating the principle of sustainability. In this regard, only about 70 percent of the increment potential is currently being used (BMELF und. b).

Figure 4 shows the development of total fellings, comparing the "old" and the "new" Federal States. The storm catastrophe of 1990 is evident, as are the reduced fellings in the new states

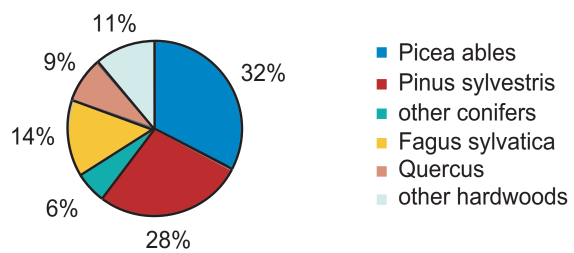

Figure 3. Tree species distribution (Source: BMELF und. c)

Table 4. Total fellings in Germany (source: BMELF 1998)

Management period	Total felling in 1000 m³	Spruce[1] in 1000 m³ and percent ( )	Pine[1] in 1000 m³ and percent ( )	Beech[1] in 1000 m³ and percent ( )	Oak[1] in 1000 m³ and percent ( )
1990	75,021	54,595 (72.8)	11,004 (14.7)	8,017 (10.7)	1,405 (1.9)
1991	31,884	19,400 (60.8)	5,540 (17.3)	5,939 (18.6)	1,005 (3.2)
1992	28,009	16,742 (59.8)	4,761 (17.0)	5,518 (19.7)	988 (3.5)
1993	28,259	17,138 (60.6)	4,782 (16.9)	5,372 (19.0)	967 (3.4)
1994	34,616	21,777 (62.6)	5,816 (16.8)	5,959 (17.2)	1,066 (3.1)
1995	39,342	22,019 (56.0)	8,477 (21.5)	7,472 (19.0)	1,374 (3.5)
1996	37,016	21,246 (57.4)	7,080 (19.1)	7,347 (19.9)	1,343 (3.6)
1997	38,207	23,035 (60.3)	8,027 (21.0)	6,081 (15.9)	1,064 (2.8)

[1] tree species groups contain: Spruce: *Picea abies, Abies alba, Pseudotsuga menziesii*; Pine: *Pinus sylvestris, Larix spec*.; Beech: *Fagus sylvatica*, other broadleaf trees without oaks; Oak: all oaks (*Quercus robur, Q. petrea, Q. rubra*)

(the former GDR) after Germany's reunification (increase of growing stock; management problems in re-privatized forests (BMELF und. c)).

2.3.5 Threats to the Forests

The forests in Germany are especially affected by harmful insects, fungi and browsing by deer. Following the severe storm damage in 1990, bark beetle populations (especially *Ips typographus* and *Pytogenes chalcographus*) increased dramatically in some regions, causing serious calamities in the coniferous forests. Butterfly mass propagation (especially *Lymantria dispar*), possibly favored by the warm summers in the mid-1990s, also had a damaging impact on broadleaf stands. Major calamities due to *Lymantria monacha* and *Panolis flammea* infestations occurred especially in eastern Germany's pure *Pinus sylvestris* forests.

As an important example of detrimental fungi, *Heterobasidion annosum* should be mentioned which causes red ring rot on *Picea abies*. Fungal infections as well as insect mass propagation often occur in the wake of major abiotic calamities which weaken the forests.

Browsing by red deer (*Cervus elaphus*) and roe deer (*Capreolus capreolus*) can lead to considerable damage in crops and young stands, although there are wide regional differences. Selective pressure due to browsing threatens the regeneration of some of the rarer conifers and broadleaf tree species in certain areas. In addition, bark-peeling by unadapted red deer populations causes serious damage, mainly in spruce stands (occurring in up to 10% of all spruce stands (BMELF und. b)).

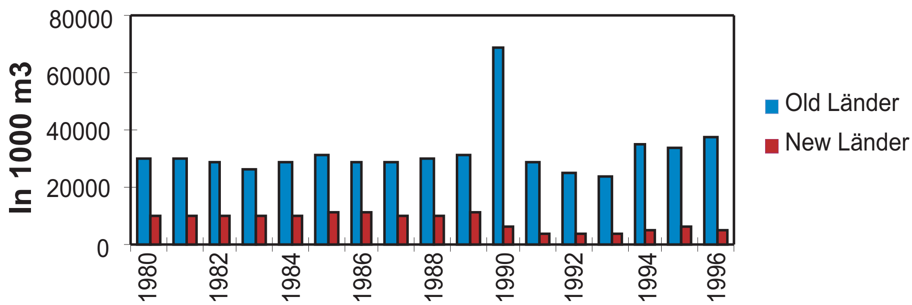

Figure 4. Development of total fellings in Germany (source: ZMP 1998; Brandenburgisches Ministerium für Ernährung, Landwirtschaft und Forsten 1998)

Without doubt, storms constitute by far the leading cause of forest damage. The dramatic winter gales of 1990, e.g., left about 75 million m3 of storm-damaged timber in their wake, which represents about twice the amount of Germany's regular annual harvest. Snow and ice breakage lead to considerable damage especially in the Alps and in the low mountain ranges, but may also occur in the flatlands. Middle-aged pure stands of *Pinus sylvestris* often are subject to serious damage by wet snow. Although forest fires occur quite frequently during dry periods in the summer and spring, they usually do not play a major role as a forest calamity. Between 1991 and 1995, forest fires damaged about 1,800 ha (0.02% of all forests), on average. The highest fire danger is encountered in the large, dry pine forests of north-eastern Germany (e.g., *Brandenburg*) (BMELF und. b).

In the 1980s, the so-called *Waldsterben* (forest die-back), a widespread thinning of the tree tops, became the first crucial topic in the ongoing discussion of the threat caused to forest ecosystems by anthropogenic atmospheric immissions. The annual state of the forests report, using top thinning as a health indicator (e.g., BMELF 1996a), shows an improvement in the overall health of the forests compared to 1995. According to the 1996 report, 20% of the trees show visible damage (1991: 25%; 1995: 22%). While coniferous forests show a continuing tendency toward improvement, broadleaf forests have remained at previous levels of damage or, in case of the oaks, even show a trend toward further loss of leaves.

2.4 Silviculture

The age-class high forest system is the dominating silvicultural system in Germany, applied to 97% of the forests. About 2% of all forests are uneven-aged forest (*Plenterwald*), while just 1% is managed as coppice or coppice with standards forest, the silvicultural systems most frequently found in former centuries.

The age-class high forest system in Germany shows a large scale of variation. On the one hand, there are even-aged pure conifer forests (mainly *Picea abies* and *Pinus sylvestris*) managed under clear-cutting or strip felling systems. On the other hand, selective cutting, shelterwood systems with long regeneration periods, or femel cuts create mixed forests with a rich vertical and horizontal structure. The *Plenterwald* system (uneven-aged forests used by selective cutting) is restricted to shade-tolerant tree species and suitable sites. This system is characteristic in farmer-owned forests of the Black Forest mountains, but it is also occasionally applied in other parts of Germany.

The wide variety of silvicultural systems which characterize the German forests has its roots in an amalgam of varied historical backgrounds and a wide range of natural sites and tree species as well as the varied concepts of how to manage nature. In the 18th century, Hartig already described shelterwood systems (Burschel, Huss 1997). Different types of strip systems were developed by C. Wagner *et al.* (Wagner 1912). As a reaction to the doctrine of net return, the *Dauerwald*-movement (”Lasting” forest movement) developed in the early 20th century (Möller 1922), which regarded the forest as a single organism from which trees should be harvested in selective cuttings. Despite the fact that natural regeneration is a commonly accepted goal of German forest administrations, only 40% of all regeneration occurs through natural regeneration (with an increasing tendency). There are also mixed systems where both artificial and natural regeneration are applied. Table 5 gives an overview of the silvicultural systems applied to the most common tree species in order to achieve natural regeneration.

Due to the historic and legal background as well as the goal of harvesting stems of big diameters, rotation periods in Germany are long, reaching between 100 and 140 years in most coniferous forests and up to 200 years or more in valuable oak forests. For the most part, the achievement of forest goals (dimension, quality) determines the time for stem harvest in today's forests, resulting in more flexible rotation lengths.

Table 5. Silvicultural systems applied to the most common tree species in order to achieve natural regeneration (source: Burschel, Huss 1997)

Tree species	Silvicultural system	Importance of natural regeneration
Picea abies	strip fellings, Femel, shelterwood; Plenter	common at higher elevations; increasing trend at low elevations, too
Pinus sylvestris	small clearcuts, strip fellings (possibly Shelterwood with a short regeneration period (5 to 10 years))	mainly used on poor sites (costs)
Fagus sylvatica	shelterwood, Femel, relatively long regeneration periods (10 to 20 years)	very common
Quercus spec.	Shelterwood system, short regeneration period (5years)	rare, mostly planting, sowing

2.5 Forest Production

2.5.1 Harvesting Systems and Accessibility

The density of transportation routes varies greatly between eastern and western Germany. In the West, it reaches an average of 54.4 m/ha (source: Federal Forest Inventory 1986 - 1990, BMELF und. b). Half of those roads are narrower than 3 meters, which means limited accessibility for trucks. Skidding track density reaches 64 m/ha. All in all, the accessibility of western German forests meets the requirements by the forest management. Nevertheless, there are regional deficits in accessibility, especially in mostly privately owned small forests.

In 1991, the road density in eastern Germany lay at about 24m/ha (BMELF und. b). Since only about one third of the forest roads are in decent repair, accessibility for trucks is critical, especially in the winter. Moreover, at 31m/ha the skidding trail density is lower in the East.

Since German forestry is varied and makes use of different silviculture methods, a number of different harvesting systems are applied, depending further on topography and accessibility. Much of the timber harvest is still done manually, with chain saws. As a consequence of the major storm calamities of 1990 and the ensuing immense amount of storm-damaged timber, harvesting machines became established in Germany. Today, they play an important role in the small-diameter timber harvest (especially for thinning in pure conifer stands). Due to the current tendency toward selective cuttings, mixed stands and the large target dimensions of trees, harvesting machines are unlikely to reach the overall importance in Germany which they have attained in northern Europe, e.g.

2.5.2 Timber Uses

Figure 5 shows the distribution of timber (including fellings, waste paper and import) in Germany,

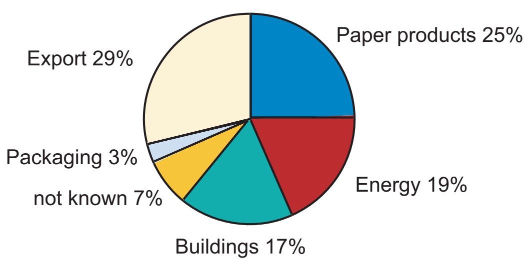

Figure 5. Distribution of timber and timber-based products in Germany, 1995
Source**:** Forstabsatzfond 1998

based on the results of an extensive timber distribution analysis (Forstabsatzfond 1998).

The overall consumption of timber in 1995 lay at about 89.5 million m3 roundwood equivalents (ZMP 1998). An overview about the total timber balance of Germany in 1995 is given in table 11. Tables 6 and 7 give an overview of stemwood and industrial timber use in Germany in 1993. Imported timber is also included in the table.

As indicated in table 6, sawmills are the most important timber users in Germany. Other important stemwood users include the veneer (non-coniferous logs) and plywood industries (coniferous logs). Export is also of importance, with an increasing tendency. In regard to industrial wood, particle board production and wood pulp are the most important users in Germany. Overall, fuelwood does not play an important role, although it attains local importance, especially in rural regions.

2.5.3 Non-timber Forest Products

Non-timber forest products do not reach high economical importance (between 2 and 3% of the total output of forestry (BMELF und. c)) in Germany. The gathering of mushrooms and berries mostly occurs on a non-commercial level, and the use of pine resin, formerly practiced in eastern Germany, is discontinued today. The production of Christmas trees and boughs is only of limited regional importance. Christmas tree plantations, especially on formerly farmed private land, are on the rise in rural regions close to metropolitan areas, where they attain some economic importance. Hunting occurs in a regulated fashion under a hunting district system. Owners of a contiguous area (forest, farmland and/or fishing areas) of more than 75 ha have the hunting rights on their property, while game tenants are required to lease a contiguous area at least 150 ha in size, or 250 ha in some of the Federal States. Hunting and forest utilization lead to conflicts in many regions (Deutscher Jagdschutz-Verband 1998, Schraml 1998, Syrer 1987).

2.5.4 Forest Functions

Forest functions can be divided into three major complexes (Nießlein 1985). Economical use (in Germany, mainly timber production) is treated in chapters 2.5.2 and 3. Protective and recreational functions of forests are of high and still increasing importance in densely populated, highly industrialized Germany. Relevant protective functions include water protection (filter and retention effects); immission protection against air pollution and noise; climate protection (Global CO2 reservoir and local climate protection); soil protection, including erosion control; landscape protection; and the protection of biotopes and species (BMELF und. b, Böswald 1998, Enquete-Kommission 1994).

The recreational use of forests is perhaps the most important forest function in metropolitan

Table 6. Timber (stemwood) uses in Germany, 1993 (source: NABU 1996)

	Coniferous logs(1)		**Non-coniferous logs(1)**	
User	**1980**	**1993**	**1980**	**1993**
Sawmills	12.3	16.98	2.81	1.69
Veneer mills	0.03	0.03	0.33	0.19
Plywood industry	0.23	0.23	0.32	0.36
Poles	0.11	0.02	-	-
Pitprops	0.38	0.08	0.18	0.11
Export	0.89	2.62	0.21	0.23
Other	1.52	-	0.9	-
Railroad Ties	-	-	0.24	0.04
Total	**15.46**	**19.96**	**4.99**	**2.62**

(1) in million m^3

Table 7. Timber uses (industrial wood) in Germany (source: NABU 1996)

	Coniferous industrial wood [I]		Non-coniferous industrial wood [I]	
User	**1980**	**1993**	**1980**	**1993**
Wood pulp	2.4	2.33	0.01	0.02
Chemical pulp	0.54	0.43	1.12	0.76
Particle boards	2.68	2.03	2.27	0.94
Fiber boards	0.08	0.29	0.16	-
Lightweight boards	0.55	0.03	-	-
Charcoal	-	-	0.06	-
Export	1.46	2.94	0.12	0.46
Storekeeping and fuel	0.17	-	1.34	-
Total	**7.88**	**8.05**	**5.08**	**2.18**

([I]) in million m^3

and touristically used areas. By law, all forests are subject to general access by the population for the purpose of recreation (Federal and State Forest laws). According to some studies, an average 168 people/ha annually enter the forests for recreation, while in metropolitan areas that number may increase to 1,000 visitors/year/ha and more (BMELF und. c).

The goal of ”multiple use forestry” is the careful utilization of forests, ensuring the fulfillment of economic, protective and recreational functions within the same area (Dietrich 1953, Nießlein 1985). This objective is stated in all forest laws. In special forest function maps, most forests are classified according to their importance in terms of environmental protection and recreational use. Besides the high importance of ”forest functions” in forest policy, the theoretical concept of ”forest functions” has been discussed in detail in Germany’s forest science circles in recent years (see Burschel 1994, Blum et al. 1996, Mantau 1997).

3 Forest Economics

3.1 Forests and Forest Industries in the National Economy

Measured against the overall gross domestic product of Germany, forestry plays a minor role in the national economy, e.g. accounting for only 0.2 to 0.3 percent in Baden-Wuerttemberg (Lückge, Nain 1997). On the other hand, Germany’s timber production is able to cover two thirds of the demands of the timber and paper industry (BMELF und. c). The forest industry contains 39,050 individual enterprises which produced a turnover of about 54.7 billion ECU in 1994 (see table 8). In 1991, the share of the forest industries reaches 1.2% of the German net domestic product. Table 8 gives an overview of the West German forest industries.

The degree of concentration in the forest industry sector is comparatively low. Small and medium sized enterprises, located mainly in densely wooded areas, are important supporters of rural development. Large enterprises have become established in capital-intensive areas such as the paper industry or wood-based paneling. In those sectors, international competition has led to cooperation with other EU-countries.

The development of the eastern German forest industry, impacted by the break-down of the unprofitable production plants in 1990/91, is still undergoing rapid changes. This offers a rare chance to gather data on the rebuilding process of a modern industry. Table 9 shows the relations between eastern and western forest industries in 1991.

Table 10 gives an overview of the amounts and values of some forest industry products.

Germany’s timber market is traditionally characterized by a net import overhang. In 1995, this overhang amounted to about 20 million m3. Table 11 shows the overall timber balance in 1995.

Table 8. Forest industries: enterprises, workers, turnover in the forest and paper industry 1994 in West Germany

Branch	Enterprises	Workers	Turnover (million ECU)
Wood working*	2,634	46,904	6,773
Wood processing*	11,986	283,012	28,057
Small craft business**	22,500	77,421	4,147
Timber trade	1,774	23,830	6,652
Pulp, wood pulp, paper, and cardboard	147	44,544	9,057
Total 39,050	**475,711**	**54,686**	

*Large-scale enterprises of the manufacturing industry and industrial small-scale businesses
**Enterprises or firms with less than 20 workers
Source**:** BMELF und. b**,** Statistisches Bundesamt 1997

Table 9. Production of selected semi-finished wood products in the old (former FRG) and new (former GDR) Federal States in 1991.

	Old Länder (in 1000m3)	New Länder (in 1000m3)
Saw timber	12526	795
Veneer	425	16
Particle board	7441	26
all semi-finished wood products	23167	841

Source: BMELF und. c

Table 10. Saw wood and fiber products in 1995*

Timber product	Amount in 1000 m^3/ m^2	Value in million ECU
Saw timber	13,242 m^3	2,581
Plywood	456 m^3	355**
Particle board	8,157 m^3	2,041
Fiber board	153,177 m^2	327

*only enterprises with more than 20 workers
**in 1996
Source: Statistisches Bundesamt 1997

Table 11. Total timber balance in Germany, 1995 (in million cubic meters converted to roundwood equivalents)

	Wood availability	Wood disposition	
Removals (Calendar year)	40.0*	Stock Increase	1.0
Waste Paper	30.5		
Non-energy use of waste wood	0.9**	Consumption	89.5
Import	83.6	Export	64.5
Total timber availability	**155.0**	**Total timber disposition**	**155.0**

* partly estimated
** estimated
Source: BMELF und. b

Figure 6 shows the development of import and export of timber and timber-based products in relation to the calculated consumption. The timber import figures do not reveal a clear trend in the past years. A declining tendency in roundwood imports is reported, while the import of processed timber products, especially from the Central and Eastern European states, has increased during recent years. This trend may be caused by the involvement of German companies in these countries. Total timber exports (compare also roundwood) have increased in recent years and show an ongoing upward trend (BMELF und. b).

3.2 Employment

In 1992, between 90,000 and 100,000 people were employed in the German forestry sector (only former Western Germany), representing about 0.3 % of all employees in West Germany. On the other hand, about 600,000 to 800,000 people each year work in temporary jobs of varying duration in the forests (Löffler 1992). On a regional level, the forestry employment sector reaches a higher importance in economically less developed rural areas, where a larger percentage of forestry jobs occur. This also increases the importance of the forest industry, which employed 476,000 workers in 1994 (BMELF und. b). Table 8 shows the distribution of workplaces in the forest industry.

3.3 Profitability

Table 12 shows the data from the Federal Ministry of Agriculture's test network of forestry enterprises (BMELF und. b), subdivided according to the three main types of forest ownership in Germany. Profitability in the test network is defined through the difference between income and expenses (net return). State subsidies are excluded from the table calculations, but state assistance on the forest office level, both free of charge or at reduced fees, is included.

The data illustrate the critical profit situation of the forestry enterprises despite the continuing upward trend in the past years. The reasons for this situation are the continually increasing expenses of the forestry enterprises in relation to stagnating income. Despite the increase in productivity of forest workers (1960: 8; 1990: 1.7 productive working hours / cubic meter wood harvested / year (Löffler 1992)), the harvesting costs per cubic meter have increased (considering inflation). On the other hand, timber proceeds as the major income of the forestry enter-

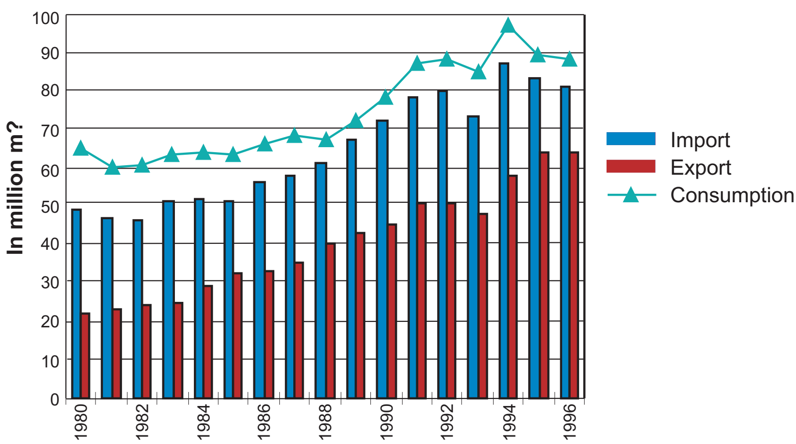

Figure 6. Import, export and consumption of timber and timber-based products, converted to roundwood equivalents source: ZMP 1998

prises have decreased during the past decades, if inflation is considered.

There are obvious differences in profitability among the different types of forest ownership. These differences are in part due to a further cause of the critical situation, called social function or burden of the forestry. According to one study, in 1991 32 ECU/year/ha were expended for the improvement of infrastructure (communal forests 42, state forests 33, private forests 24 ECU/ha/year) (BMELF 1991). Legal restrictions (for example the far-reaching prohibition of clearcuts) as well as increasing incentives by the federal government (e.g., the promotion of hardwood plantations) influence the forest management and restrict the possibilities of optimal economic action. The growing importance of promotion by the government is shown in figure 7.

4 Forest and Forest-related Policy

4.1 Legislation

The basic legal standards for German forestry are set by the Federal Act on Conservation of Forests and Promotion of Forestry, enacted in 1975 (in the following referred to as Federal Forest Act). This act outlines basic guidelines which are specified, elaborated and, if needed, supplemented by the 16 Federal States (*Länder*). While federal and state legislations are competitive concerning the promotion of the forest production (*Art*. 74, *Abs.* 17 Constitution), the Federal Government is restricted to drafting a framework for the legislation dealing with nature conservation and landscape management (Klose and Orf 1998; Wagner 1996).

The important elements for the conservation and sustainable management of forests are outlined in the Federal Forest Act. They include 1) the obligation to manage the forests in a proper and sustainable fashion; 2) the forest owners' duty to replant cut-over stands; 3) the definition of regulations for precautionary action in regard to environmental protection, limited clear-cut areas, protection of immature stands, the duty of tending and forest opening, and adequate forest management planning; 4) conversion of forests into another form of land-use requires approval by the responsible authority; 5) promotion is provided jointly by the Federal Government and the federal states; 6) forestry framework planning serves the regulation and improvement of forest structures and is geared toward safeguarding the forest functions; 7) protection and recreation forests with specially regulated management procedures and measures are to be designated for the avoidance of dangers and disadvantages to the population.

Furthermore, there are several acts covering special issues of forests and forestry, e.g., the Forest Seed and Seedlings Act, the Act for the Compensation of Forest Damage, and the Forestry Sales Fund Act. In addition to these legal bases, a number of regulations can be found in other acts which partly relate to forests and forest management, e.g., 1) Nature Conservation Act (Federal Government and *Länder*); 2) Federal Hunting Act (Federal Government and *Länder)*; 3) Federal Immission Control Act (*Länder*); 4) Federal Regional Planning Act and Regional and Landscape Planning Act (*Länder*); 5) Act on Environmental Impact Assessments (Federal Government).

Table 12. Development of the economical situation of the forest sector (in ECU/ha)

Year	State forest			Communal forest			Private forest (> 200 ha)		
	income	expenses	net return	income	expenses	net return	income	expenses	net return
1981	345	325	20	397	278	119	380	283	97
1989	359	392	-33	346	332	14	438	343	95
1993	217	415	-198	246	322	-76	323	339	-16
1995	344	412	-68	332	323	9	373	339	34

Source: BMELF und. b, data from the ministries network of forestry enterprises

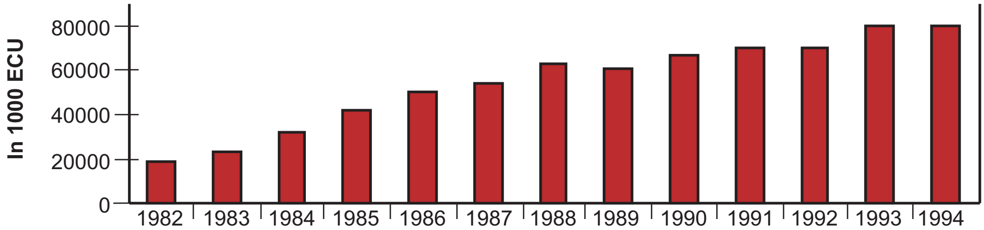

Figure 7. Development of financial support in forestry as part of the joint task ”Improvement of Agricultural Structures and Coastal Protection”

Source: BMELF und. b

4.2 Agents in Forest Policy and Related Fields

In Germany, a large number of organizations and associations are concerned with forestry, including scientific, professional and commercial groups. Until now, the organizations concerned with forest policy were often considered part of the forestry sector if their names contained the word ”forest” (e.g., Zundel, Schwartz 1996). A few years ago, in addition to the traditional agents, a number of ”new” organizations—such as environmental groups—began to focus their activities on the forest sector (Volz 1997). Endowed with high public credibility, many environmental groups developed their own forest programmes. Until now, the governmental departments and forest associations have played a leading role in the decision-making within the political process, followed by politicians, scientists and the media (Weber 1993).

The development and the implementation of specific programs for the forestry sector is mainly carried out by the Ministry of Food, Agriculture and Forestry. However, in some policy areas other ministries are also concerned, e.g., the Ministries of Economics, the Environment, and Developmental Aid (Hofmann 1997).

The federal states each have their own Departments of Forestry. Traditionally, these are often connected with the agricultural sector, and—in recent times—increasingly with the Departments of the Environment (Zundel, Schwartz 1996). As a result of the combination of different duties, the State Departments of Forestry are very influential. They are responsible for the formulation and the implementation of programs, they manage the state forests, and they are in charge of timber supply and non-timber benefits. Finally, the forest services influence the management in community and private forests by way of extension as well as financial and technical support (Krott 1996).

Prior to the German reunification in 1990, the estimated number of associations concerned with forestry was about 60 (Weinberg 1989). Not all of these held political importance on a supra-regional level. Two types of associations can be distinguished: organizations with a mainly economic objective (forest owner’s interests, employee’s interests), and those supporting idealistic values (education of members and the public, battling forest decline) (Nembach 1993, Weinberg 1989, Mantau 1996).

The German Forestry Council (*Deutscher Forstwirtschaftsrat, DFWR*) aims at integrating the entire forest sector (DFWR 1996). The organization has a particular position in the development of policy since it provides a forum for discussions for representatives of all ownership types, including professional associations and scientists. The results of the council’s deliberations are usually passed on to the government for implementation. However, the joint preparation of statements and the resulting constant struggle for compromises partly paralyzes the work of the DFWR.

The most powerful member (based on the number of votes) is the Working Group of German Associations of Forest Owners (*Arbeitsgemeinschaft Deutscher Waldbesitzerverbände AGDW*), representing the interests of both private and community forest owners. While the representatives of private and community forest owners are regarded as powerful as the state forest administrations, associations which support idealistic goals (e.g., the Protective Association for the German Forest, SDW) occupy a less powerful position (Mann 1998). The influence of trade unions (e.g., the Trade Union for Horticulture, Agriculture and Forestry, former GGLF, now IG BAU) and other professional associations (e.g., Association of German Foresters, BDF) lies somewhere between the two extremes (Mann 1998).

4.3 Forest Policy Tools

The legal framework represents an influential forest policy tool, containing important restrictions of the forest owners' scope of action. An overview of the legal handicaps can be found in section 4.1. General and forest-specific planning is another important tool of forest policy, influencing the field of forest management (Nießlein 1985). Forest Framework Planning as an integrative approach is covered in section 4.4. Forest inventories as the major basis for local forest planning are obligatory in state or community-owned forests every 10 to 20 years. They are also usually carried out in larger private forests, as they are supported by the government and represent an important basis for tax write-offs in case of calamities (BMELF und. b). Policy tools in Germany's state forest policy are based on the three major goals: 1) strengthening forest enterprise capacities; 2) promotion of the competitiveness of timber; 3) increasing the stability of forests (BMELF und. b).

4.4 Forest Policy in Relation to Other Areas of National Policy

There is an urgent demand for cooperation of forestry with other sectors. However, as forestry has more or less clearly defined boundaries separating it from other sectors within society, communication on an everyday level is often insufficient (Krott 1995). Although cooperation between forestry and other sectors is considered ill-developed, forestry and its counterparts do realize the importance of inter-sectoral communication and cooperation in the fields of rural development (agriculture), environment, and industry (economy).

Due to the close connection between forestry and agriculture in private entities, the relationship of the two sectors is often described as symbiotic. Hence, "agri- and silviculture" (*Land- und Forstwirtschaft*) has become a well-established expression. As a rule, one would expect the coordination of both sectors to be successful, since forestry and agriculture are combined under one ministry at the federal level and in most of the federal states. Nevertheless, the goals of the sector policies and the utilization of instruments differ (Hachenberg 1985, Thoroe 1986), and the programs formulated for each sector usually do not promote coordination (e.g. BMELF 1996b).

Based on the long tradition of sustainability, German forest owners and forest administrations see themselves in an environmentalist role. Therefore, protection of the environment and environmental policy are considered a substantial part of forest policy (Nießlein 1985). The competence of governmental organization in the implementation of environmental policy is subject to specific regulations. However, the fact that the forest owners' right to manage their own forests is considered more important than environmental issues frequently leads to a conflict of interest between the authorities and their clients, which impedes cooperation (Wagner 1996).

The cooperation of forestry and timber industry has led to the establishment of a certain institutional basis. Joint councils, committees and organizations—paid and supervised by both forest owners and the timber industry—were founded, e.g., the Committee for Development and Cooperation of Forestry and Timber Industry *(Ausschuß für Entwicklung und Zusammenarbeit der Forst- und Holzwirtschaft beim BMELF)*, the Special Agency for Renewable Resources *(Fachagentur Nachwachsende Rohstoffe e.V.)*, and the Timber Working Group *(Arbeitsgemeinschaft Holz e.V.)*

(Mantau 1996). Another example is the campaign to promote the image of timber (*Forstabsatzfonds-Imagekampagne*). Moreover, an exchange of information between forest owners and the timber industry is guaranteed through a joint publication (*Holz-Zentralblatt*) and symposia with representatives of both sectors (e.g. Bartelheimer, Volz 1991).

While no inter-sectoral cooperation exists between institutions and different interest groups, a certain level of cooperation is realized in the forest planning process. In general, the Federal Forest Act stipulates for forestry framework planning to improve the forest structure and to aid in the attainmment of the goals of the Federal Forest Act. Therefore, forest agencies contribute to forest-related matters in the land-use planning process (Wrede 1993). Forestry framework planning is expected to become part of the management plans of forest enterprises and to be incorporated in the overall planning process of the federal states. Until now, only four states have completed a forest framework plan (BMELF und. c). This is due to a lack of well-defined goals, and to unspecified target groups, a dominance of natural and economic matters in the planning process, and inadequate cooperation of forest authorities with other sectors (Nießlein 1985).

4.5 EU Forest Policy

The competence and the involvement of EU agencies in the field of forest policy are being watched very carefully in Germany (Halpap, Zundel 1993; Wagner, Flasche 1999). A number of policies are actually beneficial, although they mean restrictions to the development of national forestry.

Since the control of air pollution represents a goal of supra-national character, the German Federal Government strongly emphasizes this particular part of European environmental policy (BMELF und. b). The implementation of certain regulations concerning the protection of forests against atmospheric pollution has been achieved through Germany’s participation in a European forest health monitoring system (Europäische Kommission 1996a, 1996b). The monitoring is organized on state level (e.g., Bayerische Staatsforstverwaltung 1995). German federalism is also an important factor in the implementation of the EU’s Natura 2000-concept, too. The expected restrictions for the forestry sector are one reason for the ongoing opposition in some of the federal states against a high number of protected areas (Damó 1999, Europäische Kommission 1998).

The incentives for afforestation offered by the EU under the Common Agricultural Policy have led to an overall increase in afforestation areas in Germany (1985: 1312 ha; 1990: 2447 ha; 1992: 6156 ha; all data concerning West Germany (BMLEF und. c)). However, the expected effects on the agricultural use of the landscape (e.g. Philipp 1987) were not reached (Europäisches Parlament 1998). In Germany, afforestation is often criticized by environmentalists, who point out that afforestation takes place especially on marginal soil sites without agricultural attraction but of high ecological importance (NABU 1996).

The goals of the EU Regional Policy also touch the national and state forest policy. Eastern Germany is placed in a position to be able to resort to EU funds, with the resulting possibilities for improvement in the forestry sector (BMELF und. b). Some rural areas of western Germany were included in Objective 5b-promotion. Local initiatives as well as some of the Leader II-projects can lead to benefits for forestry enterprises (BMELF 1996c).

4.6 Forest Education and Research

Forest education and research have a broad basis in Germany. Opportunities for the training of well-educated personnel are provided by four universities in Germany: *Freiburg (Baden-Wuerttemberg)*, *Göttingen (Lower Saxony)*, *Munich (Bavaria)*, and *Tharandt (Saxony)*. All universities are involved in national and international research programs. A specialized technical education can be gained at so-called ”*Fachhochschulen”* (non-university higher education). There are five facilities which offer education on this level: *Weihenstephan (Munich)*, *Hildesheim/Holzminden (Göttingen)*, *Rottenburg*, *Schwarzburg* and *Eberswalde*. The federal government and the state forest administrations maintain forest research institutions with the purpose of ensuring a close connection between practical experience and research. Moreover, there are several schools for forest workers in Germany.

5 The Main Current Conflicts and Challenges in Germany

An overview over the actual relationships between different agents within the forestry sector is given in chapter 4.4. Moreover, figure 8 offers a view on some traditional parties of conflict.

However, this view is somewhat outdated since new actors have entered the political arena. In the last decades, forest owners, agencies, and forestry associations have agreed upon common ideologies and management concepts, which helped to avoid conflicts. Examples are the Forest Function Theory of Victor Dietrich (1953) and the term ”appropriate forest management”. These concepts were important preconditions for the fostering of cooperation and coexistence of different forestry agents. Thus, they were integrated in nearly all regulations under German forest law, to promote not only the interests of the forest owners but also the demands of society.

Today more than ever, the relationship between the different agents of forest and environmental policies is rife with conflict. Moreover, competition exists between forest authorities and other state organizations that are responsible for environmental concerns. Examples include 1) the mapping of biotopes; 2) the management of protected areas; 3) the interpretation and implementation of specific laws; and 4) increasingly important, the overall goals of forest management. A closer look at these conflicts is given by Helstöm and Welp (1996).

A current example of a conflict and the possibility of new alliances is the ongoing discussion of certification/labeling of timber. Environmental groups demand the introduction of international certificates in Germany as part of a worldwide process to ensure sustainable forestry. Especially the Forest Stewardship Council (FSC) has become an important agent in the field of certification in Germany. Most of the ”traditional” agents have reacted with reservations to the demand and have outright rejected it, with the following arguments: 1) a tried and tested national forest legislation ensures sustainability and proper forest management; 2) the difficult economic situation of forest enterprises and the ownership structure (see table 1) speak against the introduction of the new financial ”burden” of certification (Firnhaber 1996, Institut für Forstpolitik 1996, BMLEF b). Today, some agents, mainly environmentalists, trade unions and some forest owners, support the FSC-process (Institut für Forstpolitik 1996**,** Gemeinde und Städtebund Rheinland-Pfalz 1998) while others, such as the German Forestry Council (*DFWR*), have presented alternative concepts to certification.

The current debate over the goals of forestry is mainly fueled by the difficult situation of forest enterprises due to unfavorable economic conditions and the low budget of the public sector.

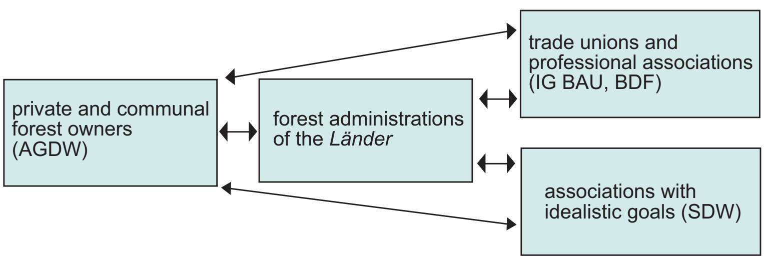

Figure 8. Traditional conflicts in the forest sector (source: Mann 1998)

Consequences can be observed in many areas: 1) Forest enterprises aim to improve their economic situation; therefore, forestry intensifies timber cuttings. This may cause conflicts with the demands of the public (Weber, Mann 1997). 2) Forestry attempts to inform the public about its non-timber benefits and to commercialize the corresponding services. 3) The reduction of employees leads to a decreasing number of members in associations and unions, and therefore to a loss of influence. 4) In recent times, forest authorities have been losing financial and personnel resources. This reduction of financial grants and technical aid diminishes the possibilities for consulting and thus the state agencies' influence on forest management in private (Krott 1996a) and community forests (Dinkelaker 1999). 5) There is an ongoing discussion about privatization of the state forest management, which is expected by some to result in increasing levels of innovation and profitability in Germany's state forestry (Borchers 1996).

In summary, important agents within German forest policy fear being ”ruled from outside” (Krott 1996b). ”Economic and structural crises” of the sector (Oesten 1995, Nießlein 1995, Mann 1998), and the promotion of the participation of various social groups in decision-making processes through international agreements, such as Agenda 21 (Weber 1998), create main challenges for the future.

Further sources of Information (National Forest Inventory)

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BMELF (undated) Federal Ministry of Food, Agriculture and Forestry, Germany. Bundeswaldinventur -eineWertung. Bonn.

Organizations related to Forestry:

Federal Ministry

Bundesministerium für Ernährung, Landwirtschaft und Forsten (Federal Ministry of Food, Agriculture and Forestry), Rochusstr. 1, 53123 Bonn

Representatives of different interests

Deutscher Holzwirtschaftsrat (German Forest Industries Council) Bahnstraße 4, 65205 Wiesbaden

Deutscher Forstwirtschaftsrat (German Forestry Council) Münstereifeler Straße 19, 53349 Rheinbach

Arbeitsgemeinschaft Deutscher Waldbesitzerverbände (Working Group of German Associations of Forest Owners), Meckenheimer Allee 77, 53115 Bonn

Industriegewerkschaft Bauen-Agrar-Umwelt (Union for Building-Agrarian-Environment) Bockenheimer Landstraße 73-77, 60325 Frankfurt a. M.

Deutscher Forstverein (German Forestry Association) Konrad-Schwarz-Straße 2, 34305 Niedenstein

Bund Deutscher Forstleute (Association of German Foresters) Lohmühlenstaße 9, 50422 Wirges

Schutzgemeinschaft Deutscher Wald (Protective Association for the German Forest) Meckenheimer Alle 79, 53115 Bonn

Stiftung ”Wald in Not” (Foundation ”Forests in Danger”) Godesberger Allee 142-148, 53175 Bonn

Naturschutzbund Deutschland (NABU) (Nature Conservancy Federation of Germany) Herbert-Rabius-Straße 26, 53225 Bonn

Organizations for techniques, marketing and information

Kuratorium für Waldarbeit und Forsttechnik (Committee for Forest Operations and Forest Technology), Spremberger Straße 1, 64823 Groß Umstadt

Absatzförderungsfond der Deutschen Forstwirtschaft (Foundation for Increasing Sales of German Forestry), Godesberger Allee 142-148, 53175 Bonn

Zentrale Marketinggesellschaft der Deutschen Agrarwirtschaft mbH (CMA) (Marketing-Society of German Agricultural Industries), Koblenzer Straße 148, 53177 Bonn.

Auswertungs- und Informationsdienst für Ernährung, Landwirtschaft und Forsten e.V. (AID) (Information Service for Food, Agriculture and Forestry), Konstantinstraße 124, 53179 Bonn

Fachinformationssystem Ernährung, Land- und Forstwirtschaft (FIS-ELF) Postfach: 20 14 15, 53144 Bonn

Scientific and educational organizations

Deutsche Gesellschaft für Holzforschung (German Society for Timber Research) Bayerstraße 57-59, 80335 München

Bundesforschungsanstalt für Forst- und Holzwirtschaft (BFH) Leuschnerstraße 91, 21031 Hamburg

Bayerische Landesanstalt für Wald und Forstwirtschaft (LWF) Am Hochanger 11, 85354 Freising

Landesanstalt für Wald und Forstwirtschaft (Thüringen) Jägerstraße 1, 99867 Gotha

Fachhochschule für Forstwirtschaft Schwarzburg 07427 Schwarzburg

Fachhochschule Rottenburg, Hochschule für Forstwirtschaft, Schadenweilerhof, 72108 Rottenburg

Fachhochschule Weihenstephan, Fachbereich Forstwirtschaft 85350 Freising

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Useful Internet Addresses

Forestry education and sciences

University of Freiburg http://www.forst.uni-freiburg.de/

University of Göttingen http://www.uni-goettingen.de/fb/Forst/

University of Dresden (Tharandt) http://www.forst.tu-dresden.de/

University of Munchen (Freising) http://www.forst.uni-muenchen.de/

Forest Research Institute of Baden-Wuerttemberg http://fva.forst.uni-freiburg.de/

Forest Research Institute of Bavaria http://www.lwf.uni-muenchen.de/

Popular forestry journals

Allgemeine Forstzeitschrift/Der Wald http://www.blv.de/afz

Forst und Holz http://www.forst-und-holz.de/

Databases

Information about Food, Agriculture and Forestry http://www.dainet.de/fiself/

Information about Food, Agriculture and Forestry http://aid@aid-online.de/

Ministries responsible for forestry

Germany http://www.bml.de

Baden-Wuerttemberg http://www.mlr.baden-wuerttemberg.de/

Bavaria http://www.stmelf.bayern.de/

Brandenburg http://www.brandenburg.de/land/melf/

Lower Saxony http://www.niedersachsen.de/ML1.htm

Mecklenburg-Western Pomerania http://www.mv-regierung.de/lm/index.html

Rhineland-Palatinate http://www.rheinland-pfalz.de/index2.htm

Saxony-Anhalt http://www.ml.sachsen-anhalt.de/

Thuringia http://www.thueringen.de/tmlnu/index.html

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1 The country

1.1 Natural conditions of the Hellenic area

Prof. Dr. Dr. Dimitrios Kotoulas, Head of the Department of Forestry and Natural Environment

The natural environment which the trees of the forest are born into, and in which they grow and die, is formed by three natural factors: the earth's relief, its climate and its geology. Only where the combination of these three factors is favourable can a forest develop.

The Hellenic area, whose main natural factors are described below, stretches to the southern point of the Balkan peninsula and displays complex horizontal and vertical fluctuations. Its total surface (131,957 square kilometres) is divided into that of the mainland (82%) and of the islands (18%). The sea which surrounds it from three sides; the interrelationship towards the North by means of the mainland highland districts of the Balkan peninsula; and its main land connection from North to South, amounting to a total of 791,8 km, hold a significant effect over the formation of its ecological environment.

Table 1 shows that 65,42% of Greece's total surface area has an altitude of more than 200 metres, in other words it displays mountainous characteristics. The remaining landscape, although under 200 metres, is, however, mainly hilly and barren in nature. Flat land, suitable for farming, constitutes 25% of the total area. Consequently, Greece, although mountainous in character, is in fact an undulating landscape of moderate elevation.

The favourable position Greece holds as far as its latitude is concerned, the fact that all three of its sides are surrounded by seas, and the intense fluctuation of its relief at altitudes rang-

Table 1. Distribution of the steps of altitude in the Hellenic area

Steps of altitude (m)	Area	Surface (%)	Mean slope of soil (%)
200	flat	34,58	3
201 - 600	hilly	34,83	8
601 - 1000	semi-mountainous	19,61	9 – 15
1001 - 1500	mountainous	6,93	16 – 30
1501 - 2000	very mountainous	3,55	30 – 40
2001 - 2500	sub alpine	0,35	41 – 65
2501 - 3000	trans alpine	0,15	65

ing up to 2.917 metres, form within its area a variety of climatic variations.

The Greek climate generally appears to have Mediterranean-type features: rainfall during winter, spring and autumn and drought in conjunction with high temperatures during summer, as well as a significant amount of sunshine. At the coasts and islands, especially in the southern parts of the country a marine climatic type is predominant, while in the north and interior of the country a continental-type climate is prevalent.

Distribution of the most significant meteorological factors in the Hellenic area, with regards to vegetation are as follows:

As for air temperature, significant changes are noticed from place to place. The annual range of temperatures (the difference between the largest and the smallest temperature of the year) ranges from 13°C (islands of the Southeastern Aegean) to 23°C and over (North and Central Macedonia). The Greek climate is influenced by isotherms of 19,5 °C and 14,5 °C.

The annual average of relative air humidity ranges between 60% and 70% and is important. The more humid areas are in the Northwestern districts, Central Macedonia, Corfu and the Aegean islands near the coasts of Asia Minor, while less humid are the areas of Attiki, Argolida, Corinth, Laconia, as well as the Cyclades. Generally, humidity decreases from the Ionian towards the Aegean sea.

Annual precipitation, found in the Hellenic area, is not negligible. In the flat areas it ranges from 400 to about 1,200 mm, while it increases with altitude, exceeding 2000mm in the mountainous parts of Western Greece. Its distribution during the year is uneven. Rainfall appears during spring, autumn and especially winter, while the summer months are generally dry. In the mountainous regions, especially towards the northern districts of the country, most of the precipitation falls as snow. Table 2 shows that rainfall is heavier in the mountainous regions. From the distribution of amounts of the mean annual precipitation in the Hellenic area, presented in table 3, it arises that in Greece most of the areal coverage receives an annual amount of precipitation from between 1001 to 1400mm (22,32%). Consequently, although Greece gives the impression of being a dry country, due to its summer drought, it does in fact receive a substantial amount of rainfall.

Due to the variety of rock formations which make up the Hellenic area, and through the dynamic nature of earth-forming processes, the geological structure of Greece is complex. As seen in table 4, showing the extent of the various petrological formations, it is evident that in the Hellenic area the most recent sedimentary rocks are the most prevalent - by area - followed by limestone and slate.

Thus, the various land formations, all suitable for the development of forests, are dependent upon the geological structure and climate associated with each of our areas.

Table 2. Fluctuation of various climatic factors in Greece in connection to the altitude

Altitude (m)	**Mean annual precipitation (mm)**	**Mean annual number of days with of at least 10 mm of precipitation**	**Mean annual air temperature (°C)**	**Mean annual temperature range (°C)**
<200	<760	<23	<16,2	<29,0
201 - 600	761 - 1050	23 - 30	16,1 – 13,6	29,0 – 30,0
601 - 1000	1051 - 1320	31 - 37	13,5 – 10,8	30,0 – 30,7
1001 - 1500	1321 - 1680	38 - 46	10,7 – 7,6	30,7 – 31,8
1501 - 2000	1681 - 2020	47 - 55	7,5 – 4,3	31,8 – 33,0
2001<	2021<	55<	4,3<	33,0<

Table 3. Distribution of annual precipitation of the Hellenic area

Steps of mean annual precipitation	Surface (%)
<400	1,72
401 - 600	21,76
601 - 800	32,74
801 - 1000	17,84
1001 - 1400	22,32
1401<	3,62

Table 4. Distribution of petrological formations in Greece

Petrological formation	Surface (%)
Limestone rocks	19,50
Flysch rocks	8,48
Slate rocks	18,35
Sedimentary rocks	24,00
Igneous rocks	12,58
Alluvium	15,87
Various	1,22

Formation of the Hellenic area with its climate, relief and geological structure is favourable for the development of forests. In Greece there are no deserts, nor are there spaces that are covered permanently or for long periods of time, by snow and ice. Greece has the natural privilege that forests are able to prosper over almost all of the country up to an altitude of 1800 till 2000 metres (ASL) (tree line), in other words on 99,5% of its surface, and this tree cover can offer opportunities for many benefits.

2 Forest resources and their uses

Assoc.Prof. Dr.Paulos Smiris

2.1 Forest history

A forest is a group of trees and bushes that live together on a large piece of land in such close relation to one another and at such a distance from each other that their canopy create a distinctive environment – a forest environment – and when together with other members of the plant and animal kingdoms, they create a distinct ecosystem.

When the Achaeans settled in Greece, the Greek mainland was covered from its coastlands up to the sub-alpine zone with thick forests, in which lived numerous species of wild animals and birds (Homer, Plato et al.). As the population gradually increased and civilisation developed, the demand for timber and arable land grew, and this was by necessity satisfied through reckless and destructive tree-felling and clearing of the forests. As early as the 4th and 5th centuries B.C. according to Plato, the mountains of Hymettos and Parnitha were already bare. During the Roman and Byzantine eras, as well as the period of Turkish rule, destruction of the forests continued, especially in the coastal regions.

After Greece gained its independence from the Ottoman Empire the first serious attempts to exploit the forests in a rational way were made by Bavarian foresters, who came to the country with King Otto.

- 1836: Enactment of the first basic legislation and establishment of the first forestry administration.
- 1877: Dissolution of the forestry administration and assumption of its duties by the gendarmerie.
- 1896: Establishment of the Forestry School at Vitina with the aim of providing professional training for forestry staff.
- 1911: Foundation of the Forestry Department at the Ministry of National Finance.
- 1917: Establishment of the Forestry School at the National Metsovio Polytechnic in Athens.
- 1920: Enactment of Law 1687 regarding local Forestry Service staff and Law 2036 regarding the administration of forests and taxation fo forestry products.
- 1921: Forestry Service split up between the Police Force and the Ministry of Finance.
- 1924: Codification of forestry legislation and division of the country into 14 Inspectorates, 55 Forest Districts and 65 Forest Periphery offices.

The period 1931-1940 can be described as a decade of organisation and progress since a series of laws improved the Forestry Service and set out the aims for the exploitation and protection of the forests. During the period 1941-50, on account of the war, no significant work was carried out in connection with the forests.

From 1951 up to the present day continuous efforts have been made to restore and improve the forests, to prevent soil erosion and flooding, to develop game-keeping and fish-farming, to increase the number of national parks, to carry out recreational and mountain tourism projects, and also to establish and improve urban forests.

2.2 Forest ownership and land use

The total land area of Greece is 13,195 740 ha of which 25.4% (3,359 186 ha) consists of productive forests, 23.9% (3,153 882 ha) non-productive forests, and the remainder other forms of land use (range lands 13.7%; crop lands 33.6%; industrial land 1.1%; and areas of water 0.7%). As for the ownership of forested land, 65.4% belongs to the state, 12.0% is communal, 9.8% is owned by co-operatives, 4.8% is monastic and 8% is privately owned.

2.3 Forest distribution and forest growth

Table 5 shows the distribution of forests in Greece according to tree species in ha. Beech, fir, black and Scots pine usually occupy the cool, moist levels of the country’s mountain ranges.

The main types of soil are brown forest soils, acidic forest soils and soil of the Rendzina type, on which grow, Quercus sp., Castanea sativa, Miller., Pinus halepensis, Mill. and Pinus brutia Ten. forest-types usually occupy the dry to moderately cool levels of the lower mountain ranges. The predominant types of soil are the brown and reddish-brown forest soils.

Table 5. Distribution of forests in Greece according to tree species and forest production.

Name	**Area (ha)**	**(%)**	**Merchantable volume (m^3)**
Softwoods			
Ab. Bor. Regis, Matt	543,308	8.34	43,133 020
P. halepensis,Mill and *P. brutia*, Ten	567,731	8.72	13,634 886
Pinus nigra, Arm	281,692	4.33	13,892 819
P. sylvestris, L	20,955	0.32	2,341 835
P.leucodermis,Ant	8,300	0.13	2,029 000
Pinus pinea, L	108	-	117,736
Ab.bor.regis,Matt and *P. nigra*, Arm	4,762	0.07	
P. excelsa, Lint	2,754	0.04	856,395
Total	*1,429 610*	*21. 95*	*77,349,481*
Hardwoods			
F. sylvatica, *L-F. moesiaca*, Maly	336,640	5. 17	27,693 914
C. sativa, Mill	33,081	0.51	0.5124,145 321
Quercus sp.	1,471 839	22.60	1,925 067
Pl. Orientalis, l	86,579	1.33	231 525
B. pendula, Zoth	1.437	0.02	5,067 467
Evergreen trees			60,757 651
Total	*1,929 576*	*29.63*	
Productive forests	3,359 186	51.58	138,107 132
Non productive forests	3,153 882	48.42	2,755 829

The principal types of silvicultural system in Greece's forests are as follows: high forests 36.4%; coppice 46.8%; and coppice with standards 16.8%. The average growing stock amounts to 62.4 m^3/ha; more specifically, 80 m^3/ha for conifers and 48 m^3/ha for broad-leaved trees. The mean annual increment is 2.76 cubic m (2.48% for conifers and 3.12% for broad-leaved trees). The mean annual timber cut is 1.6 m^3/ha.

2.4 Silviculture

From the above one may conclude that Greece is poor in forests and that its forests are poor in terms of growing stock, with a low to average timber quality. This, of course is not a result of the way it has so far been managed by the forestry services, but due to the impact on forests from grazing and other activities.

Furthermore, it is a fact that virtually half the Greek forests are coppice and need to be converted. In silvicultural terms, it is possible, through cultivating the forests and reafforestation, both to increase the proportion of forest coverage from 25 to about 35% and also to improve productivity, quality and growth.

On this last point, in Greece, the demand for recreation, in recent years, has risen in both the forests near towns and also those in more remote mountain areas. Likewise, the increase in demand for water has rendered it necessary to manage forest ecosystems in such a way as to ameliorate the water budget problems in watersheds and produce a correct water balance.

Finally, public sensitivity towards protection of the environment has greatly increased, to the extent that, to date, 10 areas have been designated national parks, 1 virgin forest and a large number of forests aesthetic areas. To purely designate a virgin forest, however, may not be possible in the present day.

2.5 Forest threats

Prof. Dr. Stephanos Markalas

Abiotic factors

The climate of Greece is characterised by low precipitation during the warm months of the year. Thus, drought is a very important environmental factor, responsible for many direct or indirect tree damages, especially in years with a prologed dry period or during periods of successive dry years. For example, drought (in combination with unfavourable soil conditions) causes remarkable losses in young afforested stands. Other abiotic factors such as high or low temperatures, strong winds, snowfalls, etc., cause from time to time some damage in forest stands.

Pollution

In recent years, some research results indicate the existence of air pollution in forest ecosystems, but so far it has not been correlated with specific tree health problems. The fact that almost all Greek forests consist of native tree species, in combination with the dry climate and the prevalence of calcareous forest soils, indicates that the problem due to air pollution will be insignificant, also in the near future.

Forest fires

During the last decade we had, annually in Greece, about 1,500 forest fires affecting an area of about 48,000 ha. From these fires, 550 burned in woodlands and 950 in brushlands and grasslands, which affected 17,000 and 31,000 ha respectively. The most fire-endangered forest species are *Pinus halepensis* Mill and *Pinus brutia Tenn*, which constitute the coastal forests in the lowest and southernmost part of the country. Causes of the fires are mainly attributed to indirect or direct human activities (negligence 32%, accidents 3%, arsons 29%), since only 3% of the total number are lightning-caused fires; the rest 33% are attributed to unknown reasons.

Diseases

The diseases occuring in Greek forests are practically the same as those found in other European countries, but due to the existing dry climatic conditions they are not as important. During this century, three introduced diseases, which have spread nearly all over the country, are of great economic importance, because they threaten the existence of their host plants. These are: the Chestnut blight (*Cryphonectria parasitica*), the Dutch elm disease (*Ceratocystis ulmi*), and the cancer of cypress (*Seiridium cardinale*).

Insects

From the great number of insects attacking forest trees in Greece, there are some species which attain significant numbers to cause serious economic losses. The most important group are the bark boring insects (especially Scolytids). They are secondary in their attack, preferring stands suffering from other stress factors, causing death of the attacked trees. As mentioned above, drought is the primary stress factor resulting in weakened trees of low resistance, and susceptible to insect attack. Outbreaks of bark boring insects are common in coniferous stands (mainly fir and pine stands) during or after dry periods. From the numerous foliage feeding insects, it is worth mentioning the pine processionary moth (*Thaumetopoea pityocampa*), which causes sustained outbreaks mostly in pine afforestations, and the gypsy moth (*Lymantria dispar*), exhibiting periodic outbreaks in oak stands (mostly *Quercus coccifera L*).

2.6 Forest production

Dr. Elias VOULGARIDIS, Professor

Greece is a Mediterranean country and, through its long and turbulent history, its land has been subjected to large-scale deforestation and environmental destruction. As a result, nowadays, the percentage of forest area is low and the greatest part of the forests are in need of rehabilitation. According to the last census, forest land covers 25.4% of the land-total of Greece but forest productivity is low. A significant part of the country (23,9%) is covered by forest areas that are mostly evergreen hardwoods and many of them are used as grazing areas.

The annual production of wood from state forests is only 2,707,000 m^3 which corresponds to 786,000 m^3 wood for technical use and 1,921,000 m^3 for fuelwood (table 6). The main species producing wood for technical use are pine (mostly black pine), fir, spruce, beech, poplar and, to a small extent, oak and chestnut. Most of the wood produced by the Greek forests is of a small dimension (<25 cm in diameter). Such wood, amounting to 40% of the total production (i.e. 1,200,000 m^3), is produced by coppice oak forests and used mostly as fuelwood. Other significant quantities of small-dimension wood are produced by coppice chestnut and beech forests as well as evergreen hardwoods. The quality of such wood is relatively low due to the presence of a high proportion of growth abnormalities (juvenile and reaction wood, poor stem forms, etc.), that results in some negative effects on the quality of final products and on processing costs. The

Table 6. Annual production of wood from Greek state forests.

Wood category	Hardwoods		Softwoods		Total	
	m^3	%	m^3	%	m^3	%
Industrial wood* (wood of technical use)	380,000	48.3	406,000	51.7	786,000	29
Fuelwood	1,615,000	84.1	306,000	15.9	1,921,000	71
Total**	1,995,000	73.7	712,000	26.3	2,707,000	100

* Includes sawlogs, poles, mine timber, veneer logs and wood utilized for particleboards, fiberboards and pulpwood.

** At least other 300,000 m^3 of wood are produced from private, communal, monasterial and other forests.

Table 7. Annual Imports of wood and wood products.

Category of products	**Quantity, m^3**
Round wood, m^3	200,000
Sawn wood, m^3	400,000
Veneers, m^3	2,000
Pulpwood (equivalent round wood volume)	1,200,000
Others	50,000
Total	1,852,000

proper use of small-dimension wood, that constitutes most of the production from the forests, is for biomass utilisation. In Greece, however this is still a problem because of a large wood deficit of wood. The deficiency of wood results in imports of wood and wood products reaching an amount of 1,852,000 m^3 annually (table 7). Thus, demands for the successful conversion of small-dimension wood into technically and economically high-value wood products are expected to increase in the future.

2.6.1 Harvesting systems, accessibility

Harvesting of wood in Greece is based on the "sustained yield" principle. This is employed in combination with natural or artificial regeneration and secures the continuous production of wood and conservation of forest ecosystems. A management plan which determines the yearly yield and the silvicultural system is a prerequisite before harvest.

Selection system is the principal method applied to productive forests of pine, fir, spruce and beech. For coppice forests of oak, chestnut and evergreen hardwoods clear cutting on small areas is performed.

The forests in Greece are mostly found in more or less remote and not easily accessible mountains. The road density for the productive forests is now about 20-25 m/ha with an optimum of 27-30 m/ha.

Harvesting operations are not extensively mechanised due mainly a) to the fact that the productive forests are in the mountains and ground topography (slopes over 35%) does not allow use of mechanised vehicles and b) to silvicultural practices which take into account natural regeneration aspects, protection of forest ecosystems, and aesthetic and recreational demands.

A characteristic of the harvesting system applied (shortwood system) is the complete processing of felled trees to logs at the felling site or stump area. This processing includes topping, delimbing, bucking and (crosscutting into logs), and debarking (for conifers only). Then the logs are transported to storage yards, or lay-bys at forest roadsides. They serve as temporary depots for the storage of harvested wood awaiting sale or shipment and the eventual transportation of timber to forest industries for further processing.

Felling, bucking and topping are accomplished by a chain saw. Delimbing is done by a chain saw and, to a small extent, by axe. Debarking of conifer logs is performed in the forest by an axe and, rarely, by spud. Skidding is done mostly by animals (horses, mules) and to a very small extent by wheeled or crawler-type skidders, cable systems and forwarders.

Forest workers are trained mostly on-the-job, and by short courses. They are seasonal and payment is based on units of volume produced.

Harvesting of timber in state forests (65% of total) is done by a) hiring worker co-operatives or independent crews, direct supervision of works and selling the wood from the Forest Service and b) by worker cooperatives that pay a fee to the state to acquire the right to harvest wood under specific regulations and supervision from the Forest Service and sell it. No wood is sold on the stump. In private forests, supervision by the Forest Service is indirect. The manner of sale is by auction.

2.6.2 Timber uses

The woodworking industry in Greece showed a rapid development in the 1960s and 1970s. Today it consists of 2,482 factories or small wood processing units in the primary processing and 20,838 factories mostly small units in the secondary processing, sectors and employs about 75,000 people.

Products from, and type of wood industries, include poles and posts, sawmills, flooring (parquet), railroad ties, veneer and plywood, particleboard, fiberboard (MDF), thermomechanical pulp, paper, boxes and crates, match, preservation, furniture, oleoresin distillation and a great number of small enterprises. The wood working industries in Greece are shown in tables 8 and 9. Part of the sawnwood, plywood, veneers and paper and paper boards are produced from imported forest products. In particle board production about 40% of its raw material consists of wood residues and fuelwood. Exports are limited to small quantities of certain products (oleoresin, gum rosin, turpentine, plywood, particleboard, etc.). Most of the wood industries are small and medium-sized enterprises.

Table 8. Wood working industries (1990)

Type of factories	Number of factories	Number of workers	Workers/plant	Degree of Utilization capacity (%)
Sawing and other Mechanical Processing				
Sawmills	463	3,660	6	40
Floor-parquet mills	45	605	14	46
Box-mills	210	1,799	9	47
Other small enterprises	1,680	4,624	3	22
Sub-total	2,398	10,688	4.5	33
Wood Panel – Industry				
Plywood plants	7	1,050	150	45
Particleboard plants	7	665	95	80
Veneer plants	6	350	29	36
Fiberboard plants	1	120	120	80
Sub-total	21	2,185	104	62
Chemical - Processing Industry				
Woodpulp	1	800	800	45
Oleoresin	12	180	15	35
Charcoal	50	200	4	10
Sub-total	63	1,180	19	42
Total	2,482	14,053	5.7	37

Table 9. Secondary and tertiary processing industry

Type of factories	Number of factories	Number of Workers	Workers/plant
Paper-paperboard	410	10,200	28
Wood working shops	9,910	21,800	2.2
Furniture	10,518	28,550	2.7
Total	20,838	60,550	2.9

2.6.3 Non-timber forest products.

Additonal forest products are oleoresin (from Aleppo pine trees), briarwood (from *Erica arborea L*), Christmas trees, basket - weaving (willow) coppice, fruits, ornamental, pharmaceutical, and aromatic plants, and organic soil (humus), etc.

Regarding pine resin, yearly production is now about 5.000 tons- down from about 30.000 tons in the 1960´s. The decline is mainly attributed to the diminishing interest of workers due to low income. Resin is produced by tapping Aleppo pine (Pinus halepensis Mill), and is collected after debarking the limbs and treating with sulfuric acid paste. Most resin is exported mainly in the form of rosin.

Other exudates (excretions) include mastick from *Pistacia lentiscus var. chia* or *latifolia* and styrax (storax) from *Liquidambar orientalis* L. . Organic substances like tannins and colouring materials are extracted from wood, bark, foliage, and fruits and flowers of certain forest species and used in leather- making (tannins), for dyeing textiles (coloring materials) and for production of other products.

Briarwood is commonly used in making the bowls of tobacco smoking pipes. It comes from tumor-like outgrowths that develop between the root and stem of white heath (Erica arborea L), an evergreen shrub. Preference for these tumors is attributed to fire resistance, lack of odor when heated at high temperatures, fine grain, good polish, and attractive figure.

In addition, forests contribute to animal production by providing food for wildlife and grazing livestock, production of honey, etc.

3 Forest economics

Assist. Prof. Dr. Athanasios Christodoulou, Assist. Prof. Dr.Vaios Blioumis, Prof. Dr. Nikolaos Stamou.

3.1 Forest and Forest Industries in national economy

3.1.1 General

The contribution of forestry to the national economy is small if the wood production sector is only considered. This contribution (in current prices) is 0.17% on average of the GDP (min 0.14 and max 0.19%) for the period 1990-1994 and 2.04% (min 0.86 and max 1.22%) of the GDP of the primary production sector.

Some of the important forest service activities are shown in table 10. Total expenditure in the forestry sector is shown in table 11.

Furthermore, some economic features of Greek forests which are expressed in indices, are quoted: size of forest per capita of population 0.25 Ha, average annual cut 2.5 million m^3, number of employed people 35,000 , number of working days/year 2.1 million, employment in forestry/total employment 1.19%, and added value 0.1 billion ECU.

Table 10. Selected forest service activities

Year	Reforestation Ha	Forest road construction Km	Hunting licenses
1990	4657	921	327255
1991	4140	1092	331210
1992	4592	1118	290436
1993	4653	1193	290960
1994	4406	1408	273784
1995	3320	1077	272203
1996	1963	1017	252524

Table 11. Total expenditure in the forestry sector (in million ECU, current prices)

Year	Forest protection	Reforestation	Road construction	Miscellaneous	Managerial expenses	Total
1990	16.79	12.70	11.17	40.63	49.61	130.91
1991	27.93	12.68	12.00	43.20	45.00	140.81
1992	27.95	14.88	13.00	49.70	44.60	150.12
1993	29.99	15.72	11.14	52.10	47.17	156.13
1994	44.98	16.66	11.34	45.21	52.50	170.68
1995	38.71	13.13	10.83	47.58	52.89	163.14
1996	37.27	11.85	12.71	54.76	80.56	197.15

3.1.2 Forest industries

The Greek industry of wood and furniture is a sector of economy which utilises not only indigenous but also imported raw materials. In general, these firms, are characterised by: a relatively small size per firm, technological underdevelopment, under-utilisation of the established equipment, a lack of standardisation and quality control , low productivity, and a small degree of vertical integration.

Specifically, the following observations may apply:
- The Greek industry of wood and furniture is characterised by a large diversity in size from firms being small saw-logging factories up to organised industrial units.
- There is a broad scale of capacity utilisation both within and between the diverse size classes of the industry. On average only 45% of the established capacity is utilised. This fact denotes the amount of waste within the productive force and indicates possibilities to encourage full employment and capacity-utilisation through better organisation and management of the firm.
- When looking at the raw material being used, with the exception of the small-scale factories, it comes from local production in fluctuating proportions depending on the kind of firm (e.g. sawn wood factories 85%, boxing wood factories 55%, parquet factories 80%, plywood factories 10%, particle board factories 100%, and veneer factories 5%).
- The geographical distribution of industrial wood firms within Greece is characterised by the biggest rate of accumulation of first degree manufacturing units in northern Greece and mostly in Macedonia.

Wooden furniture enterprises
- In general, a characteristic of the enterprises is their small comparative size, seen when looking at furniture factories, both nationally and at the community level, (based on the number of employed people).
- Raw materials used by the Greek furniture industry are largely imported from overseas, meaning that the industry is strongly dependent on them.
- The greatest accumulation rate, of these enterprises is in the area of the capital, followed by northern Greece.
- Most of the entrepreneurs used to be wood craftsmen before they become furniture businessmen.
- The trade in furniture exports is at low levels and characteristically in negative balance. The imports are mainly from E.U. countries, whereas exports are made to the Middle East.

Wood trade enterprises
Problems occurring within the wood trade enterprises are related to:
1) The countries characteristic trait in importing large amounts of timber and timber products and
2) the contemporary particularities of the Greek, European, and world wood market which are the following:
- Rapid rate in the reduction of forests and forest lands at a global level;
- A decline in the production of tropical timber and its availability outside the developing countries.

- The restriction imposed by wood-producing countries in regulating the amount of wood annually harvested, in order to establish sufficient stocks and ensure the future availability of primary material for their own wood industry.
- The merchandising of products from the major Greek wood industries in order to compete with the European wood industries, along with the constantly increasing production costs within Greece.
- The standardisation of wood production from the Greek forests is rarely systematic and is unlikely to serve the demands of the wood industries.
- The trend of the Greek consumer towards imported products is greatly enforced by the high prices and low quality of Greek wood-furniture products.

3.2. Market

As already mentioned, our country is strongly dependent on imports of timber and timber products resulting in a big gap in the wood trade balance. Our needs are not met by domestic production except in only a very few products such as fuelwood, particle board, veneer sheets, and plywood (sawlogs 24%, sawnwood 50%, fiberboard 14%, paper-paperboard 50%, pulp 78%).

Regarding Greek imports, taking into account the period 1985-91, the following remarks are stressed:

- The value of timber and timber product imports for this period is 4.72% of the value of the country's total imports (for the years 1995 and 1996 the respective rates are 5.14% and 4.2%). The total value of the country's annual imports is changing from year to year at an average annual rate of 18.6% whereas the respective value of timber products is changing at an average rate of 24.2%.
- Timber imports, compared with the imports of such basic products as crude oil, iron, and meat, from the viewpoint of overcharging the trade balance of Greece, occupy second place after crude oil and its products.
- The value of timber imports and every kind of timber product consists of 36.12% of wood and wood products, 12.98% of pulp and 50.90% of paper with increase rates of 24.3%, 13.8% and 27.0% respectively.
- When looking at the share in value of annual imports among unprocessed, semi-processed and its final products (paper is not included) the semi-processed wood comes first with a geometric mean rate of 67.44% against 15.90% and 15.09% of the unprocessed and final products, respectively.
- When looking at the global share in value of imports (paper excluded), Europe comes first with a rate of 67.73%, America with 16.88%, Africa with 14.56% and Asia 0.77%.

Regarding the period 1992-96, table 12 shows the import and export of timber and timber products.

Table 12. Imports and Exports of Timber and Timber products for the period 1992-1996 (value in million ECU, current prices)

Year	Wood and cork		Pulp and waste paper		Cork and wood manufactures (except furniture)		Paper, paperboard, etc.		Total	
	Imports	Exports	Imports	Exports	Imports	Exports	Imports	Exports	Imports	Exports
1992	153.06	21.18	42.87	0.89	92.27	30.20	363.34	44.97	651.55	97.24
1993	134.59	27.73	33.27	2.07	79.76	31.13	410.62	44.24	658.24	105.17
1994	168.54	19.83	49.67	2.38	96.44	34.92	447.74	47.58	762.39	104.71
1995	169.08	13.10	98.28	1.98	120.70	38.93	608.32	67.83	996.37	121.85
1996*	168.08	9.07	62.06	1.92	97.71	32.17	553.84	76.22	881.69	119.39

*Temporary data

Share in the value of imported paper and pulp to total imports into the country from timber and timber products during the seven-year period 1971-77 was equal to 58.7% while in 1995 it amounted to 70.9%.

Theoretically, we should consume more than 3/4 of the average annual production in roundwood of the Greek forests in order to cover our annual needs of imported pulp and paper.

3.3 Employment

In the mountainous area of Greece, three basic forms of soil exploitation co-exist (forestry, stock breeding and agriculture) in which forestry employs about 35,000 people. However, the absence of any care and policy for the development of this specific area, as well as the un-planned development of big cities has led to the mountain areas having a low-level quality of life and to desertification with severe migration inland and overseas, especially during the period 1945-75.

In addition to the above number of employed people consideration should also be given to additional sources of employment, which take: a) 13 million working days/year (due to grazing of the forest lands), b) 400,000 working days/year from the production of honey and c) 400,000 working days/year for the collection of products such as fuel material, tobaccosticks etc.; in other words a sum of 14 million days/year.

The employment of workers in the wood, cork, furniture and paper and paper products enterprises is shown in table 13. The 73,423 employed people in these sectors cover 10.3% of the total number of employed in the manufacturing sector.

However, if we also take into account the associated networks of handicraft factories and industries (glued substances, fabrics etc.) as well as the commercial shops, then in the above number of 74,000 employed people we should add another 100,000 workers.

3.4 Profitability

Profitability is the existing relationship between the annual profit gained by the enterprise and its investment capital (own capital or/and foreign).

Based on the broader meaning of the term profitability some of the indices being used for its determination are as follows: Net Present Value (NPV), Equivalent Annual Income (EAI), Soil Expectation Value (SEV), Benefit/Cost ratio (B/C), Payback Period (PP), Real Internal Rate of Return (RIRR), and these terms have been used for the estimation of the efficiency in various sectors.

In general, concerning Forestry in Greece, profitability indices are not estimated for two basic reasons:

a) because Forestry has a strong social dimension in the Greek mountainous and semi-mountainous areas.
b) because outputs from Greek Forestry focus less on wood production and more on the environmental role of the forests under specific

Table 13. Number of manufacturing establishments and average annual employment by branch (Census,1988)

Branches	**Establishments**		**Average annual employment**	
	Number	**%**	**Number**	**%**
Wood and cork	12720	53.4	30947	42.1
Furniture and fixtures	10484	44.1	30476	41.5
Paper and paper products	594	2.5	12000	16.4
Total	23798	100	73423	100

Greek conditions (protection against soil erosion, enforcement of water reserves, protection against streams and floods, protection of biodiversity and genetic reserves etc.). However, this role for methodological reasons was not quantified yet and was not included in the profitability indices.

4 Forests and forest related policies

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Forests and forest lands in our country, constitute a national wealth, because they provide goods and services that contribute to an improvement in the quality of life, hence, they are protected by the Constitution of the year 1975 and current Forest Legislation.

The increasing needs of our society, as they depend on forests, justifies the enacting of a dynamic forest policy, which will be realised based on forest legislation. Analysis of the Forest Policy objectives should be acquired through three basic general guidelines, which are goals, formation and means.

The goals are defined, based on the needs of our country, which should be served by forest resources, after considering previously analysed problems that confront an organised society.

Policy formation ordinarily involves many decisions made by different people. It is usually a continuing process of further modifying policies which already exist. So this forest policy (which is not unique but a set of policies) can be more effective to achieve the goals defined with specific criteria, especially when the general conditions (social, economic, technological, biological, etc.) differentiate within time. Hence, the differentiation of the above conditions and the presentation of forests not only as an economic, but as environmental and social good, impose to respect the principles of sustainable forest benefits, multiple-use of forests and forest lands, finances in a wide socio-economic meaning and sensitivity, and total quality, with sustainable development effort.

4.1 Legislation

The Constitution of the year 1975, has characterised the natural and cultural environment of Greece as a subject of great interest and special adaptations. That fact is an important stage in the constitutional history of the country.

However, by article 24, paragraph 1, of the Greek Constitution, it is prohibited to change land use in State forests and forest areas. That prohibition is not valid when agricultural exploitation is excelled or other use that is imposed by the public interest.

Also, in article 117, paragraph 3, of the Greek Constitution, it is not allowed by the legislator the possibility of setting any kind of time or other restrictions or exceptions in the compulsory reforestation of state and private forests and forest lands, which are destroyed by fire or any other cause.

Forest legislation used many protective measures such as: implementation of a forest ownership survey and forest cadastral survey, protection of flora and fauna, proclamation of areas to in danger from fires, the special character of allowable interventions into the forests, the inaction of punishments for law violators of forest legislation, the characterization of forests and forest lands as natural parks, monuments of nature and declared protected areas for greater protection.

4.2 Actors in forest and forest related policies

The actors involved with forests are:
a) ownership actors,

such as 1) the State; 2) physical persons: i) owners, ii) co-owners; 3) corporate bodies: i) corporate bodies under public law, ii) corporate bodies under private law, and

b) exploitation actors,
such as 1) state forests: i) the state itself, ii) private owners, iii) free forest work cooperatives, and; 2) private forests, i) private owners, ii) free forest work cooperatives and iii) other actors (ecological organizations, hunting societies, cattlebreeders e.t.c.)

Forest policy, is a set of policies (wood production, recreation-tourism, national parks, wildlife and fishery, wetlands, watershed protection and soil conservation, grazing and soil conservation, grazing and livestock, mining, special uses, conservation of the environment and maintenance of the aesthetic values) that is enacted uniquely by the State, who is the major owner of forests and forest lands, through the Forest Service, in the state forests and through forest policy supervision in private forests.

4.3 Forest policy tools

The protection and development of forestry was always done through five-year development project plans, which were created by the Ministry of Agriculture and were indispensable based on the previsions mentioned goals.

Now, our country has adopted the policy of the total development and exploitation of forests and the natural environment. This policy started in the year 1985 and until today co-funds programs from the E.U. with a duration of 5 to 7 years.

These programs are : functional programs of forest measurements, programs within the Regulation 867/90, programs about Regulations 2157/92, 2158/92, the program INTERREG II, the regional programs and the program about Regulation 2080/92.

The restrictions, that appear during the realisation of projects about protection and development of forest and forest lands, refer to: lack of great forest complexes, lack of integrated development projects, existence of property rights into forests, the relief and difficult ecological conditions, the defective organization of Forest Service, lack of environmental studies, lack of effective design and, mainly, the lack of adequate funds.

The motives for the private sector to try and carry out development projects are: a) economic motives, mainly co-funding from E.U., b) management motives, that is the extra money per kilo of resin for resin-collectors, the free supply of resin-collection tools from the Forest Service, the improvement of their income with their participation in other works and the motives for forest cooperatives to acquire the exploitation of cut, and c) the motives for infrastructure works in the private sector, that contribute in the improvement of wild life, and result from Regulation 2328/91 and project Leader II of the E.U. The motives for the advancement of recreation activities inside private forests, are derived from supplementary State-funds, while for the public forests, are usually, derived from the Forest Service by signing contracts for projects with Local Authorities. These projects are funded by LEADER II or by the Regional Development Programs (RDP).

4.4 Forest policy in relation to other national policy areas

Forest policy is connected with other national policy areas, such as: agricultural, urban, economic and economic development policy.

Concerning the relationship between forest policy to agricultural policy, reference is made to the occupation of forest workers from the agricultural areas, improvement of agricultural income, and mainly the adjustment of watershed equilibrium. In parallel, the relationship of forest policy with urban policy deals with the expansion of cities (sprawl) with respect to the natural environment and conservation of ecological equilibrium, the development of recreation areas, suburb green zones, etc. The relationship of forest policy with economic policy refers to the wood, that is used in forest industries and as a raw material which has huge consequences in the commercial-equilibrium (imports-exports) and in the payment-equilibrium. Finally, the relationship of forest policy and economic development policy deals with the management, improvement of forests (aesthetic forests, hygienic forests) and the natural resources, that consist of tourist attraction poles, with the proper infrastructure. These policies contribute to the regional development of these mountain areas which need a better quality of life.

4.5 E.U. forest and forest related policies

The E.U. interacts in the area of forest policy and refers to: protection of forests, research and professional training, wood commerce and its products, and the development of enterprises (Brussels 1959). An integrated forest policy was never applied by the E.U. Mainly, the E.U. provided the member-countries with forest projects for reforestation, road-openings, protection of fires, special measurements for the improvement of degraded Greek forests, torrent rearrangement and with various regulations. Within the framework of the international conference SILVA (1986) is recognized the great economic, ecological and social value of forests and has to be autonomously protected as an ecosystem.

4.6 Forest education and research

Forest education, at university level, takes place solely at the Department of Forestry and Natural Environment at the Aristotle University of Thessaloniki. The course lasts five years. In parallel, there are three Technological Educational Institutes (T.E.I.) in Drama, Karditsa and Karpenisi, that in three years give a technical and applied oriented degree.

There are also Institutes for Professional Training, after basic education (Lykion) for several areas of Forestry (forest protection, natural parks guides, etc.). There are also forest-guards and forest-workers who are respectively trained in action, before they start to work in the Forest Service.

In Greece, research is taking place in Universities and Forest Research Institutes. The teaching personnel in the Department of Forestry and Natural Environment intensively deals with research in all the separate fields of Forestry. The research is funded by Ministries and the E.E.. There are also many postgraduate students who practice research for their Ph.D. thesis.

There are also two university forests in Pertouli Trikala (3.300 ha) and Taxiarchi Chalkidiki (6000 ha), where several research projects and methods are applied.

The two Research Institutes deal with current forestry problems and focus in the forestry fields of biology, ecology and less technical or economic subjects.

5 Main current conflicts and challenges

Relationships between different actors
It is a fact, that there are many conflicts of interest between the different goals of forest policy, mentioned above, which are directly related to the various uses, as they are mentioned in the set of policies, which are transformed from non-compatible to compatible with the adoption of the principle of equal priority and dominating uses. Hence, private forest owners aim to change the character of forest lands when there is an economic value, while in parallel, the authorities officially establish the policy for conservation and increase of forest lands and resources. On the other hand, legislative interventions appear continually, that de-characterise forest lands.

From the exploitation actors, the private merchants and free forest co-operatives have as a unique target the increase of produced wood and disregard the sustainability of the forests. However, these relationships are in harmony, because the forest policy is individually enacted by a powerful, high actor, who is the Greek State.

Issues arising from the UN Conference
The Rio Conference imposes in the Countries which participated and signed, the conservation of biodiversity and the sustainable use of its elements and the precise division of advantages from the exploitation of genetic resources.

Especially, in Rio, there were adopted three important agreements, which are also adopted from Forest Service and refer to:

a) the Agenda 21, which consists of a global action program for the advancement of sustainable development. As it concerns forests, in chapter 11 of the Agenda 21 about confrontation of deforestation, sets the foundations for conservation, management and development of forest resources.

Hence, it urges countries to develop a common forest policy in order to confront successfully the phenomenon of deforestation,

b) the Declaration of Rio, for the Environment and Development, that defines the rights and obligations of countries in relation to the principles for the environment and development, and

c) Statement of Principles for Forests, a legally non obligatory document, that consists the "first international common conscience" about forests. In parallel, it constitutes principles for an international agreement over management, conservation and sustainable ecological exploitation and development of all types of forests.

Changes in the relative importance of different forest functions
During the last years, important changes are observed in the various forest roles, which refer to the sector of watershed protection, water production, development of wildlife and fishery, development of aesthetic values of landscape and the protection of the environment, recreation inside forests, the development of mountain tourism and the protection of biodiversity (fauna-flora).

During the coming years, the State should move in multiple use levels, in order to achieve its targets. The State should proceed in solving ownership problem together with other various rights (grazing, fuel, wood, e.t.c.) that create continuous problems, with implementation of the forest cadastral survey.

It is also intended to enact a new and more severe regulation which aims at the protection of forests and the parallel correct application of older regulations. The financial reinforcement through projects, the lessening of forest taxes and a more effective organisation of the Forest Service, will also solve some of the problems of Greek Forestry.

Forest education and research have become very intense during the last decades. It is necessary to exist a direct and constant feed-back relation between theory, research and forestry in action in order to achieve better results.

Role of the State
The State will play a very important role in the protection, extension and sustainable development of forests and the natural environment in the coming decades, and that is the conservation of forests as public ownership (status quo), the harmonization of forest legislation to the modern needs of society with parallel law-coding, the continual co-fund from the E.U. and the organizational and functional changes of Forest Service towards the direction of decentralization with a powerful Central Administration.

Hungary

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1 The country

1.1 Nature

Hungary is in the middle of the Carpatian Basin. The territory of the country is about 93.000 km^2 . The country can be divided into six main geographical regions, which more or less coincide with the main forestry regions. The main data of these regions is given in table 1.

1.1.1 Soils

Though the territory of the country is relatively small there is a wide variety in different soil types, ranging from rough sand and chernosyom in the Great Plain to very productive forest soils in the mountains and in Southern Transdanubia.

1.1.2 Vegetation

Roughly 7-8 % of the Hungarian forest are composed of stands of beech. These stands need an annual precipitation of 700-800 mm, while the average relative humidity in June at 2 pm should exceed 60 %. Within beech stands other species can either be mixed on a large rate, or their slight presence in a scattered way may also be tolerated. Among them certain species of maples (*Acer platanoides, Acer pseudoplatanus*), a basswood species (*Tilia cordata*) and in the southern Transdanubian region the silver lime tree (*Tilia argentea*) a few sessile oaks (*Quercus petraea*) and some elms (*Ulmus spp.*) can be found. On more stony sites for beech the European ash (*Fraxinus excelsior*) may also occur.

Table 1. Area and climatic data of the main geographical and forestry regions of Hungary (Country report on Hungary by K. Mészáros)

Area	Annual precipitation mm	Annual mean temperature C	Territory ha	Forested land %
West Transdanubia	750	8.5-10.5	721,110	28
Southern Transdanubia	600-800	9.5-10.5	1,284,485	23
The Little Plain (Kisalföld)	550-650	9.8-10.6	500,810	15
Transdanubian Mountains	550-800	8.5-10.5	835,554	30
Northern Mountains	500-1000	6.0-10.0	1,146,607	35
The Great Plain	500-700	9.0-11.0	4,814,488	10

On terrains at lower level where annual precipitation is more than 650 mm and the mean temperature is higher than 10 degrees C and the relative humidity is about 50-55 % there are mixed stands of oak and hornbeam. These trees prefer the various types of brown forest soils. These stands have usually two canopy layers. The upper layer is mainly composed of sessile oak (*Quercus petraea*), while the lower canopy contains shade tolerant species, such as hornbeam (*Carpinus betulus*) and more rarely the small leaf lime tree (*Tilia cordata*). Typical mixing species is the mazzard cherry (*Prunus avium*), in Western Transdanubia the Spanish chestnut (*Castanea sativa*) and in Southern Transdanubia the silver lime tree (*Tilia argentea*).

On lower hilly lands, in dryer climatic conditions single-storey oak stands dominate. The most characteristic species is the sessile oak (*Quercus petraea*) and the turkey oak (*Quercus cerris*). Typical accompanying trees are species of mountain ashes (*Sorbus* spp.), the wild service tree (*Sorbus torminalis*) and the English field maple (*Acer campestre*). Occasionally the ash (*Fraxinus ornus*) and some wild fruit species can be found.

The lands on the plain can be characterized by the vegetation of forest steppe. The climate is so dry that without supplementary water the grass lands formed there have a varying and incomplete density. For the survival of forest additional ground water or flood is needed. The main species of natural forests is European oak (*Quercus robur*) with some white poplar (*Populus alba*).

Black locust (*Robinia pseudoacacia*) stands make up about one sixth of the Hungarian forests. The species was introduced in the country several hundred years ago.

The plantations of hybrid poplars are very useful, especially in flood areas. These poplars require rich soil and a certain amount of ground water obtainable by the roots.

1.2 Society

The population of the country is 10.246.000, the population density is 110,1 inhabitants/km^2. The population is annually decreasing by 50.000 people, which is the population of a small town, despite of the fact that Hungary became a target land for immigration for citizens of Hungarian origin of the neighboring countries and citizens of other countries as well.

After the change of the political system in 1989 Hungary changed its economical system from the centrally planned system to the market economy, and the transition process is still on the way. According to its economical indicators Hungary is an industrial country with developed agriculture. The per capita GDP was 537.000 forints, thus 4.273 USD in 1996.

In the former systems aiming at full employment the number of employed was about 5 Million. By now this value decreased to 4 Million. The number of unemployed is 500.000 (this means an unemployment rate of 11 %) The remaining 500.000 from the active population belongs to those already not under unemployment support and those with early retirement. The latter increased the number of retired to the 3.200.000 of today, which was originally unproportional as well.

The foreign debt of more than 20 Billion USD and its interests meant a considerable, nearly unsolvable problem to the nations economy. In 1996 the proportion of the private economy is over 70%. The total amount of export was 12,5 billion USD, and the import was 15,1 billion USD. Out of the 40 million people coming to Hungary there were 21 million tourists.

2 Forest resources and their uses

2.1 Forest history

Hungarian people have been living since 1100 years in the Carpathian Basin where half of the area had been covered by forest at the time of the settlement. With growing population, the forest area has decreased. At the turn of the century, immense treeless plains characterized the consequence of unrestrained deforestation. This situation turned to even worse following the first world war when the wood supply of the country became an insoluble task as most of the forest area was annexed to neighboring countries. The area of Hungary decreased in 1919 from 28.3 million to 9.3 million hectares, the population from 18 millions to 7.6 millions. The forest area decreased from the pre-war 7.4 million to 1.2 million hectares. The remaining forests were on the least productive lowland and hilly areas. Previous wood wealth and flourishing wood export was quickly followed by wood shortage and the necessary timber could only be imported.

On a proposal of foresters a forest policy has been accepted which prescribed to increase the forest area, first of all on the treeless lowland area, to increase the productivity of existing forests and to economize on produced and imported wood.

2.2 Forest ownership

During the last century ownership and management conditions changed several times considerably, which influenced the productivity and the aims of forestry. The ownership structure changed after World War I because of the decrease of the Hungarian territory, and after World War II because of nationalization and the establishment of cooperatives and the large scale afforestation on agricultural land. The social, economic transition had the last and basic influence on the branch, at the beginning of which two sectors were typical. 69 percent of forests were state owned (Forest Companies, State Farm Companies, Forest Companies controlled by the Ministry of Defense or by the Water Conservancy), 30 percent were owned and utilized by agricultural cooperatives. The compensation and privatization processes changed this status, when 730.000 ha forests (39-40 percent of the total forest area) were privatized.

State property was privatized in the compensation process, implemented in two steps. The first allocations were done on forest areas managed by state owned forest companies until spring 1993. As the demands were not satisfied completely by the first allocations, after assessing the supplementary demands, additional allocations were made in 1994-95. By 1995 the first stage of compensation auctions finished, and since 1995 the additionally allocated forest areas can be privatized. Presently we are in the stage of consolidation aiming at starting forest management activities on these forest lands.

Another procedure of the ownership change was, when the ownership rights of the land of the former co-operatives was given to individuals in the compensation process. By the end of the eighties about 1300 agricultural co-operatives had bits and smaller and greater fragments of forests. By this time co-operative forest management developed mostly with additional wood processing as well. The individual ownership rights of property proportions were assigned by the land delivery committees, which were formed out of the owners. The land delivery committees ceased to exist by 31 December 1996, remaining matters were assigned to the county Agricultural Offices. According to the 1992 Act II. owners could obtain forests (or grazing land) in one piece, undivided. Thus in case of property proportion ownership there are many owners on one area. On 32.7 percent of the forest area which was expected to be privatized, ownership changes were registered by forest authorities, and an efficient owner circle can start their economic activities. One of the consequences of the forest ownership changes on such an unprecedented scale is that members of the society have become directly interested in matters concerning forest management, as the number of private forest owners is about 252.000. The ownership changes include a considerable increase in the number of smallholders. In 1996 there were 52,640 smallholders. The specific managed area is 3.14 ha/piece in case of individual smallholders and 173.37 ha/piece in case of associated smallholders. One owner acquired property rights at an average of 1.4

places, thus the average parcel size is 1.2 ha, the specific forest area is 1.3 ha/person. This property structure has mainly developed through the compensation process. In case of property proportion ownership of former co-operative forests there is one owner for every 3 ha. The forest area belonging to a smallholder circle who are unable to operate is significant: 366,899 ha, partly because of the uncleared ownership conditions and partly because of lacking the means for starting the operation. It is very dangerous for the forest stand that parts of forest area are temporarily unowned. There is a risk involved in the fact, that the new owners do not have appropriate forestry traditions, as the proportion of small private forest properties was even before World War II relatively low, and the descendants of former forest owners form only a small part of the developing new private owner circle. One of the reasons for this is the privatization of the areas which were afforested within the scope of the large scale state afforestation program.

2.3 Land use and forest resources

2.3.1 Global overview of the land use

The area proportions of land use categories are in table 2.

Table 2. Main land use categories in Hungary. National Statistics 1996

Land use category	**%**
Agriculture	65,4
Forest area	18,7
Other (settlements, industry, transportation)	15,9

2.3.2 Tree species origin and distribution

The distribution of the forest area by species and ownership is shown in table 3.

2.3.3 Total growing stock, growth and total fellings

The growing stock is 317 million m^3. During the period from 1945 up to now the growing stock of 150 million m^3 in 1945 has more than doubled. The main cause of the increase of growing stock is the large scale afforestation program, and the forest structure transformation implemented as a forest policy principle of great importance, the aim of which was to diminish the broadleaved hardwood stands from sprouting. The growing stock also increased from 1990 to 1998, to which also contributed harvesting, which was left out during the transformation period, besides affor-estation done in this period. 85 percent of the growing stock (m^3) is composed of broadleaved

Table 3. Distribution of forest area by species and main ownership categories. State Forest Service, 01.01.1996

Species	**State owned**		**Private owned**		**Total**	
	1000 ha	**%**	**1000 ha**	**%**	**1000 ha**	**%**
Oak	268	28	90	14	358	22
Turkey oak	143	15	41	6	184	11
Beach	87	9	16	3	103	6
Acacia	109	11	214	33	323	20
Other hardwoods	114	12	47	7	161	10
Poplar	54	5	98	15	152	10
Other softwood	39	4	51	8	90	6
Conifers	154	16	92	14	246	15
Total	968	100	649	100	1617	100
%		60		40		100

species, where the 26 percent ratio of oak is significant. The further order is: conifers 15 percent, turkey oak 13 percent, beech and black locust 12-12 percent, poplar 6 percent. The great extent of afforestation is the main reason for the great proportion of the age groups 0-20 years (31 percent) and 20-40 years (29 percent).

Annual harvesting was 6.604.000 gross m^3 in 1996 compared to 8,0-8,6 Million in the 80s and to the increment of 11,4 Million m^3. Mainly final cuts were less than the allowable cut (only 80% of the possible final cuts according to forest management plans was utilized!).

Clearcuts form still an overwhelming part of the cutting, their proportion is about 78%. The 22% proportion of regeneration cuts includes coppice regenerations. The proportion of regeneration from seeds is only 1/3 within this proportion.

2.3.4 Forest threats

In Hungary, within the frameworks of the complex forest protection program, there is forest health monitoring system based on a 4 by 4 km grid, which is part of the forest health monitoring system ICP Forests covering the whole Europe.

The health status of the Hungarian forests shows a considerable decline in the last two decades. Since 1988, based on the Hungarian observations, which are totally compatible with the European data acquisition system, the proportion of the healthy trees dropped from 79% of 1988 to 43% in 1996. Defoliation struck mainly oak and acacia, while beach, hornbeam and other softwoods remained relatively healthy. The proportion of the dead sample trees also increased, the 2% proportion of the previous periods increased to 3.1%.

Damages affect most often the crown, but the proportion of stem damages is also considerable. Amongst the latter we have to mention damages attributed to humans, which is one of the most avoidable form of damages. Not negligible is damage on the stump and damage caused by wildlife.

2.4 Silviculture

The basic principles of the close-to-nature forest management and silviculture on an ecological basis are those internationally accepted. According to these preference is given to close-to-nature stands with mixed structure and multiple canopy layers. Clearcuts are avoided, and preference is given to natural regeneration, wherever possible.

The results of research work in the established net of forest reserves help to understand the undergoing processes in the natural forests, and these experiences improve close-to-nature forest management. Stands kept for gene-reserves can be sources of propagation of native species. The increasing importance of mixture species and stand edges can help to maintain biodiversity.

The management principles outlined above are suitable for the desired prevention in forest protection. Even in case of damages the use of chemicals should be avoided (or selective chemicals can be used) and biological means of protection should be preferred.

2.5 Forest production

2.5.1 Harvesting system, accessibility

The importance of the species in harvesting is presented in table 4.

Reducing the gross values by 20% loss we get the amount of utilized forestry assortments, 4.840 m^3 (table 5).

70-80 % of the harvesting operations - formerly done with own machines and workers - are carried out by entrepreneurs even in the state owned forest companies as a result of the privatization.

The mechanization of harvesting operations is influenced by the changes mentioned above and by the hard economical situation. Instead of modern, special big machines, formerly used by the companies, the use of cheap equipment is

Table 4. Gross volume of felling by species. State Forest Service, 01.01.1996

Species	Gross volume harvested (1000 m^3)	Proportion %
Oak	980	15,3
Turkey oak	724	11,7
Beach	550	7,9
Acacia	1370	18,8
Poplar	1500	21,6
Other broadleaved	613	11,5
Conifers	867	13,2
Total	**6604**	**100**

Table 5. Net volume of felling by assortments. State Forest Service, 01.01.1996

Assortment	Proportion %
Veneer and sawlog	24,7
Other sawn wood	5,1
Pitprops	0,8
Pulp wood	20,4
Misc. industrial wood	4,0
Total industrial wood	55,0
Fuelwood	45,0

typical (chain saws, tractors with adapters, carriage, hand equipment, etc.). Because of this there is a decrease in the level of mechanization.

As a result of the socio-economic changes the central control of the technical development disappeared. The forest companies use their financial resources unconcentrated. Despite of this there is a need for elaboration of the principles of mechanization both on national and regional level. From the market side the purchase of small machines which are gentle to the forest stand and soil are encouraged.

60% of the harvesting is carried out with whole trunk method, and 40% with assortment method.

The pace of building forestry roads, belonging to the infrastructure of harvesting decreased considerably. The overall length of forestry roads with pavement is 3000 km, the length of built roads is 2700 km. The opening up of the forests is 9,5 km/ha, considering the non-forestry roads in forest areas as well.

Road construction is subsidized by the state. This subsidy applies to the maintenance of forestry railroads as well, because these operate with loss (total length is about 150 km).

The specific cost of harvesting done by the forest companies themselves is about 4,5-8 Euro/ m^3 (including transportation costs). Having entrepreneurs do the work the owner has to pay a price lower by 30-40%.

2.5.2 Timber uses

The different timber uses by species are shown in table 6.

2.5.3 Non-timber forest products

The non-timber forest products are not significant in Hungarian forests. As an example honey production in black locust land can be mentioned.

2.5.4 Forest functions

The social functions of the forests have become more and more important for the society, the official forest policy has acknowledged them, when multipurpose forestry has become general. The first afforestation efforts on the Great Plain in Hungary were also justified by the favourable effects of the forests on public health. Our first forest law of 1879 highlights the protective effects of the forest. The proposal of the

Table 6. Timber uses by species. Hungarian forestry, 1995 by Prof. J. Rumpf

	Assortment structure of the species, species groups (%)							
Assortments	**Oaks**	**Turkey oak**	**Beach**	**Acacia**	**Poplar**	**Other broadl.**	**Conifers**	**Total**
Sawlog	26,7	11,9	43,0	13,9	57,1	15,0	32,6	28,7
Mining wood	0,4	0,9	-	4,8	-	0,1	0,7	1,0
Paper wood	0,2	3,5	10,3	0,4	15,8	4,7	25,9	8,5
Pulp wood	5,5	14,3	5,4	1,9	12,4	19,2	22,2	11,5
Other industrial	1,7	1,3	0,9	9,4	6,6	1,9	5,8	4,0
Fuelwood	65,5	68,1	40,4	69,6	8,1	59,1	12,8	46,3
Total	100,0	100,0	100,0	100,0	100,0	100,0	100,0	100,0

Hungarian delegation at the 7th World Forestry Congress of Buenos Aires (Madas, A. 1972) determined the basic functions of forestry, namely wood production, protection and social functions which can appear together, but not to an equal extent. Forest function distribution of Hungarian forests is shown in the table 7.

3 Forest economics

3.1 Forest and forest industries in national economy

The Hungarian economy turns to a course of growth nowadays; the basic economic structures have already been formed, the privatisation has finished and 75% of the GDP comes from the private sector. The agriculture has survived one of the most serious crisis in this century. The crisis is indicated by the GDP share of agriculture, forestry and fishery, and the indexes of the gross agricultural products. The stagnation period prior to the change of the economic structure, the change in the ownership, and the transition of the production structures caused a difficult situation in the Hungarian agriculture.

Table 7. Area distribution of forests by primary functions. State Forest Service, 01.01.1996

Primary function	Area proportion
Wood production	79,3%
Protection	15,1%
Recreation	2,4%
Other (e.g. experiments)	3,2%

On the other hand the favourable natural conditions (soil, climate) provide a remarkable comparative benefit in the region.

The share of forestry inside gross agriculture is not remarkable, the GDP share is almost 1%. In the past few years forestry production has declined, only 70-80% of the allowable cut was utilised. The amount of reserves given in allowable cut area and volume has increased. The performance of the state forest management was 88-89% and that of the private forest management was 74-80% in 1995 and 1996. These data show that the weaker performance of private sector gradually disappear. The production in private forestry has started, but the unclear ownership relations are still an obstacle to the forest management in the private forests.

3.2 Employment

There is virtually no data available on the emplyment situation in private forests. It can be assumed, that the planned afforestation program will positively contribute to solving employment problems in areas with high unemployment rates.

State forest companies used to have their own labor force for solving their forest management tasks. The number of employees in these companies decreased by about 60% compared to that before the political change. The companies solve their labour force problem by employing independent enterpreneurs.

The employment of entrepreneurs instead of own workers and production means started already in the last decade, and became more important after the change of political system. The proportion of their employment is high especially in harvesting, and is already more than 80% and over 50% in transportation. Some forest estates and companies employ only entrepreneurs in harvesting and transport. There is a tendency towards employing entrepreneurs in the biological part of the production (soil preparation, afforestation, tending, nurseries)

Despite of the full employment of entrepreneurs there is no price-rising monopoly effect, they are rather underpaid. Because of this they use all their income for living, and cannot establish funds for amortization, which represents a problem in solving future problems.

The initial problems with the quality and properness of the work are disappearing even with the newest entrepreneurs, but it is worthwhile to have the companies own workers do the most complicated tasks if the quality of the work is to be guaranteed. This is because the low entrepreneur prices force even those people to do low quality work who would otherwise provide good quality of work.

For the entrepreneurs who are not in the position to acquire big machines and have only little capital simple, such effective and safe working systems were elaborated that can easily be managed and deliver acceptable results with low costs. Instead of the previous solutions with big machines and lots of personnel new technologies are being developed based on spatial system, and these are proposed to the entrepreneurs.

4 Forest and forest related policies

4.1 Legislation

The regulation of the Hungarian forest management started by forest maintenance (1426, 1565, 1770, 1838). The regulatory enactment since the last century were a concomitant symptom of the major social and economical changes. So after the Austrian- Hungarian compromise (1867), in 1897; after the end of the first Word War (1918) in 1935; after the second Word War the forest Act that fitted to the Communist economical structure born in 1961; and after the last political and economical changes (1990) the new forest Act was born in 1996. We would like to emphasise the still valid provisions of the first Hungarian forest Act (Act NoXXXI of 1879): designation of shelter forests, prohibition of grazing; obligatory and systematic use of the management plans in forest management; and establishing the forestry authority of first and second instance.

The Forestry and Environmental Protection Act (Act No. IV of 1935) was our first Environmental Protection Act. The paragraphs on the state forests management and the association of the forest possessors formed the primary conditions of the high level and trouble-free forest management. The Act No. VII of 1961 extended the use of the forest management plans to all forest stands. The Act No. LIV of 1996. handles the forest as a complex ecosystem, where the maintenance of forest serves the interest of the whole society, therefore forests should be managed only in harmony with the common interest. The primary conditions of the sustainable forestry activities are detailed regulations of rights and liabilities. Very important part of the Act is the determination of the functions of each forest stand, where the rules of the forestry are in harmony with its functions. The Act initiates the regional forest planning and keeps the obligatory forest management planning. It is an important point of the Act that obligatory introduces the Domestic Forest Stand Database. Hungary did internationally a pioneer work in the creation of this database. Further paragraph of the Act deals with the environmental protection, hunting and game management. These regulations have important influence on forestry.

4.2 Actors in forest and forest related policies

The social basis of the forest policy has substantially changed in the past 8 years with the appearance of private forestry, and through the ownership relations the society's interest in forestry has increased. Considering the approximately 250.000 owners, nearly 10% of the population came into contact with forestry. Within these owners there is a distinction between forest owners living in towns and in rural areas. The members of the society became more sensitive to environmental problems such as forest health. The use of the infrastructural services of the forests became common in the last decades, and the new users and the new owners are in many cases refusing to allow people visit their forests. The economical crisis was disadvantageous for the protection of the private ownership, and with the decreasing living standard the so call "social crime", crime in order to make a living appeared, especially in the case of forests.

Besides the traditional special associations (Association of Hungarian Foresters, Union of Forestry Workers) both the state owners and private owners have their organizations for protection of their interests. The Union of Forest Companies represents the interest of forest companies in the Forestry Board of Representatives of Interest, in which other organizations such as the Agricultural Chamber, the Association of Agricultural companies and the Association of Common Forest Owners and other organizations of private forest owners take part.

The interest of the "professional" environmental protection organizations and the different "green" organizations turned also towards forest management. The nature protection movements have a serious criticism towards forest management, but also towards the "professional" nature protection.

These factors altogether imposed an improvement in the public relations activity of forestry. Organizations protecting interests developed a marketing program with the slogan "natural wood" to promote forest management. The Forestry Office of the Ministry of Agriculture published materials aimed at the young generations. The state owned forest companies also spend considerable amounts of money on projects popularizing forest management. In 1997 they launched the program "The Week of the Forests" where foresters gave information about forestry to the students mainly in rural elementary schools.

4.3 Forest policy tools

The system of aims of the Hungarian forest management are determined within the frame of the National Agricultural Program. Within its aims, forest management accepted a separate part of the program. The aims of the national forest management are:

- preservation of the characteristics of the Hungarian forest management,
- building on the Strasbourg, Helsinki and Lisbon decisions of ministers, responsible for forests, safe and expanding satisfaction of the complex economical and social claim to forest in a long term,
- in harmony with protection of environment and nature, land utilization and soil protection.

Afforestation should be considered as a national task. The forest area relative to the productive land has to reach 25-27% in the future. The afforestation rate should reach 20,000 hectares/year after the year 2000. Resources for the new afforestations should be both national and EU funds.

Forest management is financed by the so called "Forest production fund". This is a special financial fund managed by the State Forest service, and finances reforestations and precommercial thinnings on a unit price (per hectare) basis. The sources of the fund are payments of the forest owners and companies after each felled m^3 of timber.

4.4 Forest policy in relation to other national policy areas

Forest policy is in strongly related to agricultural policy and was defined in 1997 as a part of the National Agrar Programme. In this programme the role of the forest management was to take part in the programme of rational land use and environmental-friendly technologies. The rational use of agricultural areas through afforestations is one of the main elements of the National Agrar Programme.

The role of the forests in the National Programme on Environmental Protection is also very important, where the advantages of close-to-nature forest management are stressed.

4.5 EU forest and forest related policies

Forestry aspects of the connection to the EU. The EU summit in Madrid in 1995 suggested to the countries the development of an agricultural structural program, to be financed by the European Union. According to this suggestion the Ministry of Agriculture developed a package of measures in accordance with the Agricultural Strategic Plan of the EU and the Modernization Program of the Hungarian Government. In the above mentioned document there is a special emphasis on new afforestation as a measure for the development of the ownership structure. In the plan for measures elaborated by the Ministry of Agriculture there is a separate chapter dealing with afforestation. The material has been handed to Brussels in 1996.

We consider forest management as an essential part of agriculture, and in this system forest can play a unique role in the rural development, alternative land use and nature protection.

Production of environment friendly wood is not under any preference or restriction in the EU, so in this area the marketing according to quality can be accomplished in harmony with the European conventions.

4.6 Forest education and research

The main and only institution of academic level forestry education in Hungary is the Faculty of Forestry of the University of Sopron (formerly the University of Forestry and Wood Sciences). The average annual number of forestry graduates is 50 forest engineers, 40 engineers for the wood industry.

The secondary school level forestry education takes place in four towns, and annually 200 foresters graduate from these schools.

The main state institute for forestry research is the Forest Research Institute, which celebrated it's 100 year anniversary in 1999. The research institute was founded in Selmecbánya, where the higher forestry education also started. The institute has several research stations in the country, and each station has its own main research topic.

5 Main current conflicts and challanges in each country

Agrar sector
Within forest management the connection of agriculture and forestry play an important role in terms of land use. Afforestation of about 700.000 ha former agricultural land is anticipated.

Wildlife management
Due to its beneficial natural conditions Hungary has an excellent quality wildlife population, which represents a considerable natural value. Both on areas of agriculture and forest management the too high density of game population leads to conflicts, where the population density is not in accordance with the natural capacity of the habitat.

The number of hunting districts increased with the new law on hunting to 1145 compared to the number of 875 in March 1997, the average district size decreased from 9180 ha to 7020 ha, which means that with hunting right assigned to land ownership more and smaller hunting districts were formed. The number of leased districts increased from 757 to 779, beside 120 forest company owned and 366 owner owned districts. In Hungary there are 50.000-55.000 Hungarian and some 20.000-22.000 foreign hunters. In addition to this there are 3.000 "professional" hunters.

The interest in protection of capability of the "hunting society" is very strong. In forest policy making this group has a stressed importance, because in the past years we saw considerable conflicts of interest especially in the sometimes severe damages caused by wildlife to forest stands.

Nature protection in Hungarian forests

Source of conflict is the primary function and the art of regeneration of the protected areas after passing the law on nature protection and the prohibition of clearcuts on some areas. Sources of local conflicts could be:

- limitation on the areas of clearcuts (max. 3 ha) and regeneration cuts (max 5 ha)
- on protected areas monocultures should be avoided where possible
- final cuts are allowed only near the biological rotation age (or close to this age). The definition of biological rotation age allows for a wide range of ages for agreement.

Because the law on nature protection extends the definition of the protected forests to the areas of National Parks, nature protection areas and landscape protection areas which represent nearly half of the forest covered area of the country, forest management in these areas is a serious task for the Hungarian forest management, and requires considerable financial resources.

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Note: This report is largely based on: Growing for the Future, A Strategic Plan for the Development of the Forestry Sector in Ireland, Department of the Marine and Natural Resources (Anonymous. 1996).

1 The Country

This report deals with the Republic of Ireland. However, some of the general statistics are presented for both the whole of the island of Ireland and for the Republic.

1.1 Natural Conditions

Ireland is an island of approximately 8.44 million hectares of which 7.03 million hectares in the Republic of Ireland and 1.41 million hectares in Northern Ireland, situated in North Western Europe (51.5^0N to 55.5^0N and 5.5^0W to 10^0W). No part of the country lies more than 113 kilometres from the sea. As a result the climate is distinctly maritime in nature. The North Atlantic drift brings with it ever changing frontal systems and depressions, giving Ireland mild, damp winters and cool cloudy summers. Rainfall may vary from 3,000 millimetres in mountainous parts along the west coast to 750 millimetres in the Dublin region on the east coast. The absence of extremes in temperature is favourable to the growth of a wide range of agricultural and forest species.

The centre of the country is a low, limestone-floored plain surrounded by an almost continuous rim of higher ground. Through occasionally hilly, this central plain rarely exceeds 100 meters in elevation. The coastal mountains are extraordinary in their geological diversity. The main features are the basaltic plateau's in the north east, the granite mass of the Wicklow mountains in the east, the parallel, old red sandstone ridges of the south, the bare limestone pavements of the west and the quartzite peaks of the north west. Although these mountains have been reduced in height by weathering and denudation, they still dominate the landscape of the country. Superimposed on this landscape is abundant evidence of the glaciations of the Pleistocene. These glaciations were responsible for a variety of hill, mound and ridge deposits, such as eskers, kames, moraines, drumlins and deltas, which occur in large numbers across the countryside. Many lakes dot the central plain and many peat bogs now fill ancient lake basins.

Much of the country is covered with glacial till deposits, from which most of the soils have been developed. The composition of the till material for the most part reflects the composition of the underlying rock formations. However, variation in soils is also the result of climatic, ecological and topographic factors.

An excess of precipitation over evapotranspiration over large areas of the country has resulted in a tendency towards podzolisation where drainage is free, while gleying and peat formation are common where drainage is impeded. The predominant soil types are podzols, brown earths, gleys and peats.

1.2 Society

Politically, the island of Ireland is divided into the Republic of Ireland and Northern Ireland, which is part of the United Kingdom. Internally there are twenty-six counties in the Republic and six in Northern Ireland. The country is also divided into four ancient provinces: Ulster in the north, Leinster in the east, Munster in the south and Connacht in the west. Of these, the last three are wholly within the Republic while Ulster is divided, three of its nine counties being in the Republic and six in Northern Ireland.

The population of the island is currently about 5 million people, of whom 1.5 million live in Northern Ireland and 3.5 million in the Republic. Before the Great Famine of 1846-48 the population of the island was 8.5 million. During the famine over a million people died and a further million emigrated. Emigration became a cure for rural distress. As a result, the population continued to decline for the remainder of the nineteenth century and by 1900 the figure was down to 4.5 million.

In the Republic of Ireland more than 1/3 of the entire population live in the 'Dublin area', while the population density in parts of western Ireland may be as low as 23 people per square kilometre. The average population density is 60 people per square kilometre. With increasing industrialisation and migration to urban areas, the proportion of the population deriving a living from agriculture and other land related enterprises is declining.

2 Forest Resources and their Uses

No legal definition of the terms 'forest' and 'forestry' exist in the Republic of Ireland. In practical terms, a forest has been defined as an area of at least 0.5 ha (sometimes reduced to 0.2 ha in the case of broadleaves) with a minimum width of 40m over no more than 2/3 of its length, with at least 50% canopy cover by trees (sometimes subjectively reduced to 20% during the recently completed national forest inventory).

The term 'forestry' covers the theory and practice of the whole constitution and management of forests, and the utilisation of their (merchantable and non-merchantable) products.

2.1 Forest History

When man first arrived in Ireland about 9,000 years ago, the country was covered in mixed broadleaf forest, mainly oak, with pine and birch on higher ground and on poorer soil. The early inhabitants cleared small local areas, but over the centuries forest clearance increased as a result of pressure from population increases, settlements, pasture, tillage, and later colonisation and commercial exploitation.

By the 1600s it is estimated that only about 12% of Ireland was covered in forest, and the exploitation intensified as the use of wood became increasingly important. It was used for ships, buildings, barrels and as firewood and charcoal for iron smelting and glass making. Oak bark was also used in large quantities for leather tanning. By the early 1700s Ireland had become a timber importing country.

During the relative political stability from the 1700s to the late 1800s, some owners of the great estates began to improve their land and plant trees. The forests again declined, however, with the passing of the Land Acts in the late 1800s and the transfer of ownership to the tenant farmers. By 1905 the area under forest was just over 100,000 hectares, or about 1% of the land area, while fuel and timber shortages during the First World War further reduced the forest cover.

State forestry began in 1903, with the acquisition of Avondale House in County Wicklow as a forestry training centre and with the acquisition of the woodland areas of some estates. Acquisition and planting of other land by the State followed over subsequent decades, to the extent that public forests now total about 390,000 hectares, which is over 5% of the land area and almost 70% of all forests in Ireland today.

Afforestation by the private sector remained at a very low level until the end of the 1980s, when improved grants became available. Afforestation increased since then to the extent that in 1995 it amounted to 23,460 hectares. Of this figure, 74% was carried out by farmers. Total forest cover (public and private) in Ireland is now about 570,000 hectares, or 8% of the country's land area.

2.2 Forest Ownership

Today only 27% (or 143,000 hectares) of Irish forests are in private ownership. This gives Ireland the second lowest percentage of private ownership in the EU. Particularly noteworthy is the rate at which private forest ownership is increasing. The ratio between State and private afforestation has changed considerably in recent years. During the period 1985-95 private forestry increased its share of the total annual afforestation from 14% to 60% (Figure 1).

The largest single landowner and forest owner in Ireland is Coillte Teoranta, the state-owned commercial forest company. By the end of 1995 its estate comprised 427,000 ha of which 390,000 ha are productive forests. There are 9,300 private forest owners, who on average own circa 10 ha of forest. Twenty farm forestry co-operatives have recently been set up in 14 counties. The purpose of these co-operatives is to provide a planned approach for farm forestry development and to maximise its benefits (commercial, social and environmental) for the farmer and local communities.

2.3 Land Use and Forest Resources

2.3.1 Global Overview of the Land Use

Of the total land area of 7.03 million hectares in the Republic of Ireland, 8.2% is covered with forests. Agriculture is the land-use on 80.2% of this total area and the remaining 11.6% is used for other purposes, such as roads, towns and industry.

2.3.2 Extent and Distribution of the Forests

The Republic of Ireland's forests of 570,000 hectares are stocked to varying intensities and reflect varying levels of silvicultural management and treatment. Forestry is essentially concerned with wood production and in this regard economic and strategic analyses focus on what is known as the 'Productive or Planted Forest Area'. In Ireland's case, this now amounts to 464,000 hectares. In addition to the aforementioned Productive or Planted Forest Area, the following features of the national estate require to be acknowledged, not least because of the increasing international emphasis on the non-wood benefits of forestry:
- broadleaf scrub / undeveloped woodland;
- unstocked woodlands;
- privately-owned woodlands not regularly managed;
- areas reserved for the preservation of wildlife habitat.

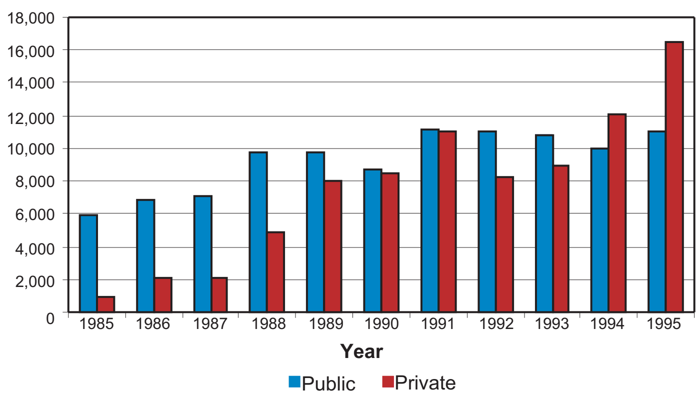

Figure 1. Public and private planting (including reforestation)1985 - 1995.

These areas cover in excess of 100, 000 hectares and while they would not tend to generate significant wood production benefits, they can provide other benefits such as recreation and amenity. There are certain constraints on the availability of data, notably for older privately owned woodlands. A national inventory of forests is currently being carried out.

2.3.3 Tree Species

Native Species
Ireland's native woodlands comprise mixed broadleaves such as oak (*Quercus petraea* (Mattuschka) and *Quercus robur* L.), elm (*Ulmus procera* Salis.), ash (*Fraxinus excelsior* L.), alder (*Alnus glutinosa* (L.) Gaertn.), hazel (*Corylus avellana* L.) and birch (*Betula pendula* Roth). The existing broadleaf woodlands include the remnants of the indigenous forest (about 5,200 ha of which is protected in national parks and nature reserves) and old woodland and scrub.

Commercial Species
The main species used for commercial forestry are 'exotic' or non-native conifers, which grow particularly well here. The main species used are Sitka spruce (*Picea sitchensis* (Bong.) Carr.), Lodgepole pine (*Pinus contorta* Dougl. var. *latifolia* Wats.) and Douglas fir (*Pseudotsuga menziesii* (Mirb.) Franco) from the north-west coast of North America and Norway spruce (*Picea abies* (L.) Karst.) from northern Europe.

Sitka spruce is the most attractive commercial species because it grows particularly well in Ireland, having a growth rate well in excess of the EU average, and because it is suitable for most sites. The afforestation programme has therefore concentrated almost exclusively on this species, to the extent that it currently accounts for about 60% of the productive forest estate and 65% of current annual afforestation. The predominance of this non-native species has been the subject of criticism, particularly for environmental reasons, in recent years. As Ireland has no indigenous conifers, the alternatives on the peat soils are limited to birch. On the better mineral soils, oak and ash are possible indigenous alternatives. However, these alternatives will not produce the same financial returns as the exotic conifers.

The level of broadleaf afforestation was very low up to the early 1980s, averaging less than 500 hectares per annum or 3-4% of total annual afforestation. As a result of the positive differential in favour of broadleaf species in both the afforestation grant and premium schemes of recent years, the level of broadleaf afforestation has increased to 4,500 ha or about 20% of total afforestation in 1995 (25% of private afforestation, 3% of Coillte afforestation). Oak is particularly suitable to a range of sites. Broadleaf species are, however, expensive to establish and maintain and take much longer to reach maturity.

Future Species Mix
The overall species mix and in particular the proportion of Sitka spruce within the afforestation programme will determine the date by which the required critical mass of timber output can be achieved (see section 5). The lower the proportion of Sitka spruce, the longer delayed will be the achievement of critical mass. On the other hand, broadleaves can offer high value-added end-uses and often have a high labour content in the specialist furniture and woodcraft areas. They can also replace imports of tropical timber. A reliable supply of suitable raw material is essential to the development of an indigenous broadleaf processing capacity.

Taking site suitability and the need for diversification into account, the following species proportions, on a national basis, are consistent with the achievement of critical mass by 2035:
- 60% of sites - Sitka spruce is the best financial option;
- 20% of sites - Sitka spruce could be replaced by other conifers without substantial yield loss and
with timber quality benefits;
- 20% of sites - best suited to broadleaves.

2.3.4 Growing Stock, Increment and Removals

The growing stock in 1995 was 45.0 million m^3 and the annual increment 3.3 million m^3. Sixty two percent of the growing stock consists of

Sitka spruce, Lodgepole pine takes up 21%, Norway spruce 5%, Scots pine (*Pinus sylvestris* L.) 3%, other conifers 6% and broadleaves 3%. The average growing stock is low, at around 100 m^3 ha^{-1}, as a result of the age class structure of the forests (see Figure 2). Just over 50% of the productive forest estate is under 25 years of age.

The forest estate is highly productive, the overall average yield is 8.5 m^3 ha^{-1} an^{-1}, while the average yield class for all conifers is 14 m^3 ha^{-1} an^{-1}. However, there are significant differences between species. Most of the new plantings in the last five years have shown yield classes in excess of 20 m^3 ha^{-1} an^{-1}.

At present roundwood removals come almost solely from fellings on Coillte owned lands. In 1995, Coillte sold 2.1 million m^3 of timber, of which 1.4 million m^3 was sawlog and 700,000 m^3 pulpwood, and in 1996 over 2.4 million m^3 were sold, 1.5 million m^3 of sawlog and 900,000 m^3 of pulpwood. In the same year the timber flow from private forests was only approximately 200,000 m^3. By the year 2015, annual timber production is expected to reach 4.5 million m^3.

2.3.5 Forest Threats

Pests and Diseases

Ireland is fortunate in having relatively few forest pests and diseases, a low risk of forest fires and little evidence of damage from air pollution. Ireland as an island and by reason of its isolated geographic location is uniquely protected from exotic forest disease and dangerous pests. However all forests, especially those in which one species predominates, are at risk from insect and fungal attack. Indigenous pests and diseases such as Fomes can be controlled through timely intervention during forest operations.

The importance of protecting the forest resource is recognised, and Ireland participates in EU forest health surveys and has developed a forest health contingency plan which includes regular surveying of the forest estate and nurseries and the application of strict plant and timber import controls. The various EU Directives on plant health and forest condition are being applied.

Wind Damage

At present, the only real damage to Irish forests is caused by wind. Both endemic and catastrophic windthrow result in the premature felling and salvaging of significant areas annually. However, the recent move towards more productive and less exposed sites for afforestation, combined with better afforestation and management techniques, will result in a reduction of the percentage of total harvest volume coming from wind-damaged stands.

Deer Damage

Until recently, deer management was not considered essential. This has resulted in restrictions in species selection and excessive amounts of deer damage in certain parts of the country. However, this problem is being addressed

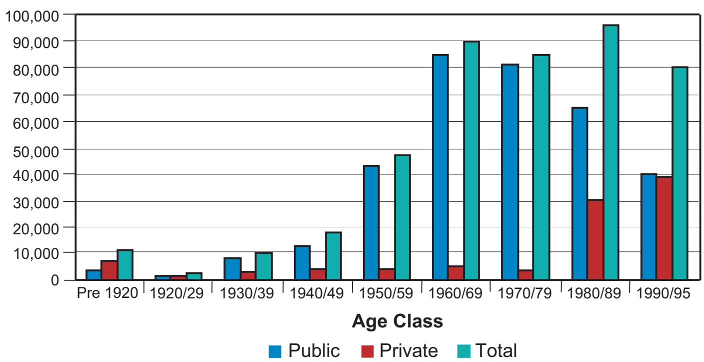

Figure 2. Age distribution of Ireland's forests.

through the integration of deer management with forest management.

2.4 Silviculture

The tree species planted depends on the site and soil potential. Establishment operations include fertilisation (where required), cultivation, drainage, fencing and weed control and, where necessary, access roads and fire protection measures. Sufficient trees must be planted to ensure a viable crop of satisfactory timber quality. At present this indicates the planting of 2,500 trees per hectare for conifers and more for broadleaves. After planting, maintenance operations include drain maintenance, protection against browsing by animals and vegetation control.

Thinning operations can commence as early as 15 years with the purpose of transferring growth to the better trees. Pruning operations, which may commence shortly thereafter, reduce branching and consequent knotting in the timber. Bud pruning may be needed for broadleaves to produce good tree shape. Thinning can be undertaken either mechanically or motor-manually (chainsaws). In addition to transferring growth to the better trees, thinning represents cash flow for the owner. There are usually 3 to 5 thinnings in a conifer rotation which remove about 50% of the crop yield over the rotation. Usually a crop is finally removed by clearfelling although in some cases a shelterwood system is used. Reforestation is predominantly carried out by planting, although natural regeneration of Sitka spruce has been successfully used in several parts of the country.

In Ireland, the rotation period for conifers is typically 40 to 50 years while the rotation period for broadleaves ranges from about 55 years in the case of ash to over 100 years in the case of oak.

Both herbicides and pesticides are currently being used, especially during afforestation and, to a lesser extent, during reforestation. In addition, fertilisers are applied where site quality and species requirements demand this. It is envisaged, that the use of these materials will be significantly reduced, if not eliminated, during the next 10 years, as we move away from first rotation forestry and more sustainable forest management practices are implemented.

2.5 Forest Production

2.5.1 Harvesting and Transport

Wood production from the existing forest estate is projected to increase from 2.2 million m^3 in 1995 to 2.8 million m^3 by 2000 and 5 million m^3 by 2035. Harvesting is carried out on a variety of site types. It is important that the machinery used is suitable to the individual site, the nature of the forest operation and the protection of forest soils and trees and crop stability. This applies particularly to thinnings. A full assessment of mechanised harvesting needs by capacity and type in relation to anticipated forest output has yet to be carried out.

Harvesting and transport are significant cost elements of timber production, which can range from 30% to 80% of the mill gate price depending on the timber category.

Harvesting Operations

Most harvesting is currently carried out on Coillte's forest estate, as privately owned forests are in general young and immature. An increase in the harvesting and transport of timber from small and dispersed plantations is in prospect as privately owned forests mature. There is a general lack of skills in, and knowledge of, harvesting among private forest owners which will become more critical. Training courses in harvesting operations, which include safety elements, are provided with the support of the Forest Service.

There is an increasing trend towards mechanisation in forest harvesting. The ratio between motor-manual and mechanised harvesting is currently (1996) estimated at 40:60. This tend reflects greater concentration on cost efficiencies, problems with availability of labour, technological development and increasing demands for quality and precision in felling, measurement and presentation. For large harvesting areas, chainsaw operations present difficulties in relation to manpower availability, productivity, safety and reliability.

Most harvesting is now carried out by private sector contractors, working either for the timber producer (i.e. Coillte) or for the purchaser of the timber (i.e. sawmills or the panel board industry). Circa half of Coillte's annual harvest volume is sold standing, the remainder is sold at road side or at mill gate. The majority of timber is sold by electronic auction.

The dominant harvesting system is the shortwood system, with felling by chainsaw or mechanised harvester and extraction by forwarder. A scheme has been in place since 1989 which assists the development of mechanised harvesting capacity by providing grant assistance towards the cost of purchasing harvesting machinery. In the period 1991 to 1996, a total investment of ECU 27.5 million in machines has been supported, at a total grant cost of ECU 10.75 million. There is a high dependence on imported machines. Imported machines are usually developed in other countries by reference to their particular sites and conditions. The development or adaptation of machinery for difficult Irish sites and of small-scale harvesting equipment has not achieved its full potential.

Timber Transport
All substantial forest properties require internal forest roads and tracks for access and internal transport. Coillte alone constructs around 150 to 200 km of new roads annually (Anonymous. 1997a). A grant scheme, supported by the EU, has been in place since the early 1980s to assist in their construction. To date the scheme has supported the construction of over 1,500 km of forest roads involving grant assistance of some ECU 11.6 million. Once removed from the forest, timber has to be transported for processing. Because of the location of forests in remote areas, non-national (county) roads are often subjected to heavy forest traffic for which they were not designed. This is a source of concern in many areas. It has been estimated by Coillte that up to 2,000 km of non-national roads are sub-standard for forest transport. Of these, 600 km have been identified as priorities and limited funding for improvement was provided by the Department of the Environment in 1995. It is expected that further funding will be committed for this purpose by that Department in the remaining years of the current Structural Funds round. The Department of the Environment has estimated the cost of upgrading the 2,000 km of non-national roads already mentioned at ECU 62.5 million.

Coillte has recently begun to transport timber by rail for the purposes of supplying raw material to the new OSB plant in Waterford Port.

Environmental Impacts
In the context of growing concern about the environment generally it is acknowledged that harvesting and transport can have adverse effects on the landscape, cause soil erosion, threaten wildlife habitats and give rise to site damage, road damage and contamination of watercourses. It is necessary to reconcile this concern with the prospective marked increase in timber harvesting and transport operations which will reflect the increasing output from Ireland's forests and to provide adequate assurance that safeguards for the environment are in place. As yet there are no national comprehensive codes of practice or standards applicable to harvesting and transport. However, the Forest Service is in the process of drawing up a code of 'best forest practice' which will include the harvesting and transport sectors.

2.5.2 Timber Uses

Sitka spruce timber is suitable for a wide variety of end-uses such as structural timber, fencing, palletwood and pulpwood and is the mainstay of the current wood processing industry. Its fast growth rate does, however, result in a lower level of timber quality than for other conifers (e.g. Norway spruce, Douglas fir) and the species is not generally suitable for use as a finishing timber for interior applications.

Timber output is classified according to size as follows:
- pulpwood (the smallest logs): 7-14 cm diameter - these logs are used for stakewood and also as raw material for panel boards;
- small sawlog: 14-20 cm diameter - these are

used for the production of pallets, crates and light construction timber;
- large sawlog: 20 cm+ diameter - the primary product is structural lumber.

Other forest based outputs include, for example, foliage, bark, nursery plants, Christmas trees, transmission poles etc. Timber production in 1995 totalled some 2.2 million m^3, of which 1.4 million m^3 was sawlog and 0.8 million m^3 was pulpwood. Coillte as the largest producer accounted for 2.1 million m^3. Residue material in the form of chips and sawdust is used for panel boards or for energy, and bark can be used in horticulture.

In the industrial processing sector (sawmills and panelboard mills), the supply of timber is fully utilised by existing and planned processing capacity. This situation is expected to continue into the second decade of the next century.

There are about 100 sawmills in Ireland, although the 10 largest process approximately 80% of sawlog production. These mills are small by international standards and employ between 50 and 250 people. Total direct employment in the mills is approximately 1,500. Sawmills in Ireland are mostly family owned businesses which were originally developed to service local markets. Sawmills currently process some 1.4 million m^3 of sawlog per annum with resultant sawnwood output of approximately 700,000 m^3. Current production capacity far exceeds supply.

There are four panel board mills in Ireland - Finsa Ltd. in Scariff which produces chipboard, Willamette Ltd in Clonmel which produces Medium Density Fibreboard (MDF), Louisiana Pacific Coillte Ireland Ltd which produces Oriented Strand Board (OSB) at Waterford Port and Masonite in Carrick-on-Shannon which produces moulded door facings.

There are about 400 firms in the Irish furniture industry, which is made up of a large number of small and dual-purpose (furniture and joinery) firms and relatively few medium sized commercial firms. There is no dominant product category. While the industry uses wood as a raw material, it is not fully integrated with the existing forest resource or other forest industries, and only a very small amount of its timber is sourced in Ireland.

2.5.3 Non-timber Forest Products

Christmas tree and foliage production are the two most important non-timber forest products. The four largest Christmas tree growers all have farms over 400 ha. In addition, there are about 20 medium-sized growers (8-20 ha) and several small growers. The main species is Noble fir (*Abies procera* Rehd.), but Coillte is also growing pine, spruce, Douglas fir and a small quantity of Nordmann fir (*Abies nordmanniana* (Stev.) Spach). In 1996 Coillte put 100,000 Christmas trees on the market and a further 100,000-200,000 were produced by private growers. The Irish home market absorbed about 250,000 trees, the rest were exported, mainly to the UK. Major growth potential in the production of Christmas trees has been identified, with ready markets in continental Europe where annually an estimated 60 million trees are bought.

In 1997, Coillte, by far the largest producer of foliage in Ireland, exported 200 tonnes of Noble fir foliage out of a total production of 500 tonnes.

2.5.4 Forest Functions

Conservation
Historical events have left Ireland with a small area of indigenous forest, much of which is now protected by conservation measures. About 5,200 hectares of semi-natural forests are protected in national parks and nature reserves. In addition, the proposed Natural Heritage Areas (NHA's) and Special Conservation Areas (SCA's) listed by the National Parks and Wildlife Service include other important woodland ecosystems.

Amenity and Recreation
There is a substantial and growing interest by the public generally and a wide variety of interest groups in the use of forests for recreation and education. While there is no formal right of access to forests, State-owned forests have in

general been open to the public since the early 1970s, when the Forest Service began to develop the 'open forest policy' through the creation of forest walks, nature trails, forest parks and other specialised facilities. Access to these forests has been maintained by Coillte Teoranta since it was established in 1989. Access to privately owned forests is at the discretion of the owner. A Planned Recreational Forestry Scheme was introduced in 1992 by the Forest Service which supported a limited number of planting projects and the provision of facilities. Two new grant schemes, the Urban Woodland Scheme and the Amenity Woodland Scheme were launched in March 1996. The former aims to promote and support woodland development by local authorities, with community involvement, for amenity and recreational purposes. The latter scheme is aimed at encouraging other landowners to bring forward projects covering a wide range of recreational, sporting and leisure pursuits which have the potential for positive economic and social impact at local level. Both new schemes place particular emphasis on the improvement and use of old woodlands.

Benefits and Costs
Environmental costs and benefits can be significant in the case of forestry but quantifying them is a difficult task, as the methodologies used are relatively new and are not yet widely accepted. There has not been a full treatment of this issue, which would include an estimation of the value placed on environmental costs, in relation for example to afforestation on peatlands and changes in landscapes. Two recent assessments considered the issue of environmental benefits in relation to afforestation in Ireland (Ni Dhubhain and Gardiner, 1994; Anonymous. 1996). The most obvious and easily measurable external benefit of forests is the opportunity for recreational activities and the studies have estimated an annual value of ECU 2.8 - ECU 3.6 million in this regard. The median figure of ECU 3.1 million is equal to approximately 9% of the current stumpage (sale of standing timber) income from forests. More tentative estimates of the benefits of carbon sequestration, tourism and 'preservation value' are ECU 4.9 million, ECU 16.25 million and ECU 3.4 million respectively, giving a total estimate of the annual indirect benefit of existing forests of ECU 27.65 million.

One of these studies has also estimated the benefits which would arise from additional afforestation to be worth ECU 36.25 million, in relation to a 20% increase in the area under forest when the additional afforestation is on marginal land. This is based on the contingent valuation method and it is of interest that about 75% of the additional value arises from the first 10% increase in the forest area, which suggest that there are high but diminishing environmental returns from afforestation.

Public Access
Continuing public support for forestry development, particularly in the context of increasing afforestation levels, will depend to a large extent on an active policy of encouraging the use, wherever possible, of forests for amenity and recreation purposes, as well as for the production of timber. Forests are seen to have benefited from a large public investment in the past and there is a high expectation that publicly-owned forests, at least, will be open to the public.

3 Forest Economics

3.1 Forest and Forest Industries in the National Economy

It is estimated that in 1993 the sawnwood and panel board sub-sectors alone contributed ECU 108.75 million to GNP (i.e. 0.3% of GNP). The value added to industrial input timber and wooden furniture is estimated at ECU 207.5 million.

At present Ireland supplies over 50% of the domestic requirement for structural or construction grade timber (approximately 550,000 m^3). Exports, chiefly to the UK, consist mainly of palletwood and amount to approximately 250,000 m^3. The outlook for the European and world markets for timber is positive, with significant growth projected over the coming years. The UK has a high net import requirement and has been the main market for Irish timber. Irish

MDF has established itself as a quality leader in Europe, and the OSB mill at Waterford Port will make Ireland the largest producer of this product in Europe.

3.2 Employment

Direct employment in forestry is estimated to be approximately 7,000 (management, harvest/ haulage, primary processing, distribution, and administration and support). While direct employment is relatively small, it represents an important source of employment in areas where relatively few alternative employment prospects exist. Total direct and indirect employment has been estimated at 16,000. It is anticipated that over 11,000 new jobs could be created in forestry from now to the year 2020. The biggest increase will occur in harvesting and haulage, followed by the primary processing industry. More than half of all new jobs created are expected to arise in the period 2000 to 2010 as increased processing capacity comes on stream.

While it is likely that some jobs will be lost in the sawmill sub-sector in the short term as the industry moves towards rationalisation, these losses will be more than compensated for over time by job creation in the new paper and pulp processing sub-sectors and by additional jobs in the sawmill sub-sector in the longer term as timber volumes increase. However, this situation is likely to change as more agricultural land is planted. The amount of agricultural employment displaced is very difficult to calculate, since it involves making assumptions about several different variables.

It should be noted that the type of employment being created is very different to that being replaced. Agricultural employment is often poorly paid and many farmers are under-employed. By contrast, forestry would create reasonable well-paid, permanent, full-time and part-time jobs. This type of employment could have a regenerative effect on rural areas. Young people are much more likely to remain in rural areas to take up a job in forestry, which would be on a par with alternative jobs in urban areas, than to take over a farm. Furthermore, jobs created in forestry will utilise best available technology, whereas the agricultural employment displaced is likely to use out-of-date technology. It can therefore be assumed that the new forestry jobs would be more sustainable in the long term than the displaced agricultural employment.

3.3 Profitability

The estimated real rate of return on investment in forestry (Sitka spruce) is 5%, including land costs and exclusive of grants and subsidies, based on industry assumptions on costs, prices and yield models (see section 4.3 for information on taxation). At higher cost levels (as used by the Forest Service) a rate of return of 4.3% is achieved. This rate is satisfactory, given the relatively high current cost of land. However, the very long period before payback is achieved would, in the normal course, make investment unattractive to investors, private landowners and farmers. Investment in broadleaf forestry yields lower returns because of the long rotation periods.

The fundamental financial arguments for transferring agricultural land to forestry are strong. If subsidies and price support did not exist, forestry would offer a better return than the average return from conventional cattle and sheep enterprises, assuming current technologies, costs and world prices for output. The trend in the Common Agricultural Policy (CAP) reform is to move away from price support towards direct income support for farmers, which may be increasingly de-coupled from agricultural production. In these circumstances, forestry would become increasingly attractive from both a national and individual point of view. However, the estimated annualised income from forestry without subsidy is purely notional and is unlikely to attract farmers.

If subsidies are included, the evidence shows that forestry is reasonably competitive with cattle and sheep enterprises, even though these activities are currently more heavily subsidised. Forestry should be attractive to part-time farmers with lower than average incomes per hectare from drystock enterprises.

4 Forest and Forest Related Policies

4.1 Legislation

Current forestry legislation consists of:
- the Forestry Act, 1946, which sets out the Minister's functions in relation to forestry, establishes the felling licence procedure and provides for the compulsory acquisition of land for forestry;
- the Forestry Act, 1956, which amended the provisions in relation to the compulsory acquisition of land;
- the Wildlife Act, 1976, sections 53 and 55, which permits some of the Minister's powers under the Forestry Acts to be used for wildlife purposes;
- the Forestry Act, 1988, which established Coillte Teoranta and increased the penalties for offences under the 1946 Act.

Other legislation of relevance to forestry is:
- the Local Government (Planning and Development) Acts, 1963 to 1992, in relation to the making of Tree Preservation Orders by local authorities and general planning permission legislation;
- the European Communities (Environmental Impact Assessment) Regulations, which, inter alia, provide for environmental impact assessment (within the context of planning permission) for initial afforestation and for the conversion of broadleaf high forest to conifers.

The Forestry Acts, 1946 and 1956, require review as they reflect the prevailing circumstances at a time when:
- the forest estate was much smaller;
- timber shortages following the Second World War required strict control of felling;
- afforestation was in the main a State operation requiring the acquisition of land;
- the concerns of the Minister with responsibility for forestry were concentrated on silvicultural and wood supply issues and did not encompass issues such as the environment, amenity and multi-purpose forestry.

In addition, the current felling licence procedure is proving cumbersome in the context of the increasing volume of timber being harvested as the forest estate matures.

4.2 Actors in Forest and Forest-related Policies

The Forest Service, which is a Division of the Department of the Marine and Natural Resources, has overall responsibility for forestry development in Ireland. The Department's responsibilities include national forestry strategy, development of public and private forestry, administration of forestry grant and premium schemes, forest protection (plant health matters), control of tree felling, forestry awareness and promotion, support of research in forestry and forest products and the encouragement of multiple-use forestry. The Department is also responsible for relations with the European Commission and a variety of international bodies on forestry and for expenditure in Ireland of EU financial support for forestry development.

Coillte Teoranta is the State-owned commercial forestry company, established in 1989, which now owns most public forests. At the end of 1995 it owned a forest estate covering some 390,000 hectares, valued at about ECU 1.2 billion. Some 70% of Ireland's total forest area is in Coillte ownership, reflecting the hitherto dominant role of the State in forest establishment. Coillte's principal objectives (as set out in the Forestry Act, 1988) are to:
- carry on the business of forestry and related activities on a commercial basis and in accordance with efficient silvicultural practices;
- establish and carry on woodland industries;
- participate with others in forestry and related activities consistent with its objects, designed to enhance the effective and profitable operation of the company;
- utilise and manage the resources available to it in a manner consistent with the above objects.

Complimentary activities of Coillte include the sale of nursery stock and Christmas trees, sawmilling, provision of comprehensive forestry and arboricultural services including tree surgery, planting and landscaping, engineering, forest research, as well as the development of leisure facilities and amenity parks.

The Society of Irish Foresters, founded in 1942, promotes forestry and the forestry profession by organising field days, study tours, seminars and other events, as well as through its publications. This society also represents the professional concerns of Irish foresters.

The Tree Council of Ireland, founded in 1985, is a voluntary organisation composed of the representatives of all voluntary and professional associations, institutes with environmental concerns, government departments, local authorities and educational and research institutes. As such it embodies a great diversity of tree-related interests. Its aims are to promote the propagation, management and conservation of trees, and to disseminate knowledge about trees and their care.

Forbairt, the national development agency under the Department of Enterprise, Trade and Employment, is involved in the development of standards relevant to forest products. It also offers business advice and administers grant schemes to assist in the promotion and development of the forestry industry. In addition, the Forbairt Forest Products Department provides strategic and operational support for the expanding timber processing sector.

The Irish Timber Growers Association (ITGA) was established in 1997. It has over 600 members and is the representative body of the private woodland growers. Its objectives are the development and expansion of the private forestry sector, and the commercial development of the wood chain in co-operation with State and other agencies. It provides advice, education and training to the private estate owners.

The Irish Timber Trade Association represents Irish timber traders and works closely with the other sectors of the forest industry. Its concerns include the raising of standards and quality of timber products.

The Irish Forestry Contractors Association (IFCA) is the representative body for contractors working in all sectors of the forest industry from plantation establishment to timber harvesting and haulage.

The Irish Timber Council (ITC) was founded in 1918. It represents the Irish sawmill owners. Its 16 members (who own 20 mills) represent 80% of the Irish sawmilling industry's processing capacity.

The Faculty of Agriculture, University College Dublin is the only educational establishment in the country offering degree (Graduate and Post-Graduate) courses in Forestry and is heavily involved in research related to silviculture, forest management and forest harvesting.

Crann, which has as its main objectives: to heighten the appreciation of trees in the community; to encourage local involvement in forestry projects; to conserve and develop the broadleaf woodland resource; and increase the planting of broadleaves.

4.3 Forest Policy Tools

Since 1981, a number of important forestry development programmes have been supported financially by the EU and have resulted in a significant increase in afforestation in recent years.

The Western Package Scheme: This scheme was introduced in 1981 to provide grant aid to farmers in disadvantaged areas for the afforestation of marginal agricultural land suitable for forestry. The take-up under the scheme was low because of adherence to traditional farming methods in the target area, the older age profile of the potential participants and the lack of income for 15 years until first thinning age.

The Compensatory Allowances Scheme: This was introduced in 1987 to compensate farmers who afforested all or part of their land, to encourage alternative land use as part of a policy to reduce agricultural surpluses. The response to the scheme was again poor.

Forestry Operational Programme (FOP) and the Operational Programme for Rural Development (OPRD): Both of these programmes were introduced in 1989 and ran until 1993. They included a variety of measures to support afforestation, woodland improvement, reconstitution of woodlands, forest road development, forest harvesting, recreational forestry, nurseries, forest training, awareness campaigns and back-up measures such as assistance for research. Under the 1989-1993 programme a total of just over 80,000 hectares was afforested, by the private sector and Coillte Teoranta.

The Forest Premium Scheme: This was launched in 1990 and provided an important new incentive for forestry development by means of annual payments to farmers. The payment structure was designed to favour the planting of better quality land.

Operational programme for Agriculture, Rural Development and Forestry (OPARDF- Forestry Sub-Programme) 1994-1999 and the CAP Forestry Accompanying Measure: Both the OPARDF and the Forestry Accompanying Measure to the Common Agricultural Policy (CAP) were introduced in 1994. The latter was one of three measures which accompanied the CAP reform; the others relate to farmer retirement and agri-environment. The Rural Environment Protection Scheme (REPS) was introduced in 1994 under the latter measure. The Forestry Accompanying Measure is designed to encourage alternative use of agricultural land through a range of grant aid for afforestation and premium payments. The grant differentials favour the afforestation of diverse species and broadleaves in particular. The highest premium levels are payable to farmers. The main element of the current forestry programme is an annual afforestation target of 25,000 hectares, supported by grants and premiums. Grants are available for afforestation, woodland improvement or reconstitution, urban and amenity woodlands, forest roads, forest harvesting machinery, forest nurseries and forestry training. Provision is also included to support development measures such as feasibility studies, pilot projects, publicity programmes and farm forestry services.

In order to qualify for the afforestation grant, the landowner has to present a forest management plan drawn up by a professional qualified forester.

Another important policy tool in relation to forestry is the approach to taxation adopted by the government. A summary of the relevant taxation schemes follows.

Income Tax and Corporation Tax: the profits accruing to an individual or a company from the occupation of woodlands managed on a commercial basis and with a view to the realisation of profits are exempt from both income tax and corporation tax. Company distributions out of exempt profits in respect of woodlands are exempt from tax.

Capital Gains Tax: gains arising on the disposal of felled timber are not chargeable to capital gains tax. In a case where an individual disposes of woodlands, capital gains tax is chargeable on the lands only and not on the trees growing on the lands. Capital sums received by an individual under a policy of insurance in respect of the destruction of trees or damage to them are free from capital gains tax.

Value Added Tax (VAT): forestry is regarded for VAT purposes as an agricultural activity. A person engaged in forestry and whose sales consist exclusively of his/her own forest produce is therefore not required to register for VAT, although he/she may elect to do so.

Gift Tax and Inheritance Tax Relief: gift tax and inheritance tax are payable on gratuitous benefits of property taken by a beneficiary from a benefactor during a benefactor’s lifetime or on his death. Generally speaking, tax is payable on the market value of the property taken. A privately owned forest is liable to gift and inheritance tax where taken as a benefit under a gift or inheritance. However, where the beneficiary is an ‘Irish’ farmer as defined, the taxable value of the woodland is the open market value less 55% or ECU 250,000, whichever is the lesser. In the case of other beneficiaries, the 55% relief applies to the market value of the growing plantation but not to the lands on which it is growing.

Stamp Duty: any deed executed under seal is subject to stamp duty, so a licence to enter and cut timber is liable to ECU 12.50 stamp duty. The Finance Act, 1990 introduced an exemption from stamp duty on the value of trees, where the instrument transferring the lands on which the trees are growing contains a certificate confirming that commercial woodlands are growing on a substantial part of those lands.

4.4 Forest Policy in Relation to Other National Policy Areas

4.4.1 Nature Conservation

As the forestry programme is based on planted forests and still relies to a great extent on the afforestation of previously unplanted areas, the changes in local environments which this alternative land use involves are the major environmental concerns of the forestry programme. It is a specific provision of the Government's current programme that forestry development will be compatible with the protection of the environment.

Certain sites are explicitly excluded from the afforestation programme, i.e. area which are protected or qualify for protection under EU Directives 79/409 and 92/43 on the protection of Wild Birds and the Protection of Habitats.

Large scale afforestation has hitherto been subject to a requirement for planning permission and Environmental Impact Assessment (EIA) at a level of 200 hectares for initial afforestation and 10 hectares for the replacement of broadleaf high forest with conifers. Recent adjustments have reduced the 200 ha threshold to 70 ha, and a new provision for incremental or add-on forestry at a threshold of 70 ha of aggregate afforestation within a three year period by a single owner has been introduced. Grant-assisted afforestation below those thresholds is controlled by means of conditions attached by the Forest Service to grand approvals. In particular instances, the formulation of such conditions may involve referral of cases to the relevant State agencies and local authorities in relation to important landscape areas, proposed NHA's, archaeological sites and sensitive fisheries sites. In addition, standard guidelines have been developed in consultation with relevant State agencies in relation to forestry development and the landscape, archaeology and fisheries, with which compliance is a condition of grant aid. Procedures are also being put in place for notification to local authorities of afforestation proposals greater than 25 ha and for the designation by local authorities of areas of particular environmental sensitivity.

4.4.2 Agriculture

A series of agri-environmental measures were introduced in Ireland as a result of the Agri-Environmental Programme agreed by the Council of Agriculture Ministers in May 1992. As a result of these measures , the Rural Environmental Protection Scheme (REPS) was launched in Ireland in 1994. The scheme is designed to provide farmers with an incentive to farm in accordance with environmental protection and conservation measures. The REPS scheme is a five year scheme, whereby a farmer enters into a contract with the Department of Agriculture to farm in accordance with an agri-environmental plan drawn up by an approved planning agency. Since the introduction of the scheme, a third of Irish farmers and almost a third of the agricultural land have become part of REPS. Afforested land is not eligible for REPS payments. However, a REPS farmer who wished to afforest part of his/her land may do so once a revised plan for the farm is produced, excluding the afforested land from further REPS payments.

A second scheme, introduced in Ireland in 1993, is the extensification scheme. Farmers are paid additional headage payments if their stocking density is below 1.4 livestock units per hectare. The impact of the introduction of this scheme has been that land which had little agricultural value (and might have been afforested) in the past, could now play an important role in ensuring that farmers stayed within the stocking density limits set in the extensification scheme. Heretofore, farmers had afforested their land of poorest quality without having any adverse impact on their agricultural income.

The net result of the introduction of both these schemes is that competition for land, especially marginal agricultural land, has increased. The impact on afforestation rates has been significant. Afforestation rates fell substantially in 1997 and there is little evidence of a recovery in 1998.

4.5 EU Forest and Forest-related Policies

Ireland is one of the European countries to have signed and is committed to the Helsinki Process, and is also a signatory of the Statement of Forest Principles adopted at United Nations Conference on Environment and Development (UNCED). However the forestry sector in Ireland is unique in the European context, in that it is based primarily on plantation forests. This presents some challenges in responding to these commitments. The "Forestry Principles" adopted at the UNCED conference in 1992 reiterated the importance of plantation forests:

"The role of planted forests…as sustainable and environmentally sound sources of renewable energy and industrial raw materials should be recognised, enhanced and promoted. Their contribution to the maintenance of ecological processes, to offsetting pressure on primary/old growth forests, to providing employment and development should be recognised and enhanced."

The Sustainable Development Strategy for Ireland refers to the need to adopt a Sustainable Forest Management framework (Anonymous. 1997b). The framework is expected to be set out in the National Sustainable Forestry Plan. The current and proposed initiatives for sustainable forestry at a national level, listed in the Sustainable Development Strategy include:

- requiring, in certain circumstances, environmental assessment of some afforestation proposals;
- requiring planning permission for some afforestation proposals;
- reviewing forestry legislation to reflect sustainable forest development;
- developing a code of best forest practice (currently being completed by the Forest Service);
- implementing the strategic plan for forestry;
- identifying areas sensitive to afforestation; and
- reviewing and developing environmental guidelines for forestry.

In addition, Coillte Teoranta is currently consulting with a wide range of stakeholders, including the general public and special interest groups, in order to develop its own principles, criteria and indicators for the sustainable management of its estate (Anonymous. 1998).

4.6 Forest Education and Research

4.6.1 Education and Training

Third level forestry education is provided in University College Dublin. The 4-year Graduate degree programme is a wide-ranging course which covers subjects such as silviculture, forest economics, management, protection, harvesting, computing and data handling as well as wood science issues, and includes a practical 6 months work experience period. UCD also provides Post-Graduate (Higher Diploma, Masters and Ph.D.) programmes. The University of Limerick provides a Bachelor of Technology degree in Wood Science and Technology. A Diploma in Science, specialising in Forestry, has commenced in the Waterford Institute of Technology. In addition, a Diploma in Technology specialising in Forest Management will commence in the Galway Institute of Technology in 1998. This institute also offers full-time courses in furniture making and design.

Teagasc, in conjunction with the Department of the Marine and Natural Resources, provides forestry training courses for farmers. The basic Certificate in Farming, provided by Teagasc and known as the 'Green Cert', contains two modules on forestry. There is a substantial forestry content in the one-year, full-time course at Ballyhaise Agriculture College, Co. Cavan. Coillte provide training for both its own staff and others in forest management skills and operations in their training centre.

4.6.2 Research

Forestry research has been carried out since the 1950s by the Forest Service of the Department for the Marine and Natural Resources. Since the establishment of Coillte in 1989, such research in now undertaken by Coillte, Forbairt and third level institutions, with a small input from the industry.

On the wood growing side, the key R&D entities are Coillte and University College Dublin. Timber technology R&D is currently carried out by Forbairt and a small number of centres associated with third level colleges. The Department of the Marine and Natural Resources directly funds a number of research projects in Coillte and Forbairt which are closely related to the Operational Programme for Agriculture, Rural Development and Forestry 1994-99. Research is also undertaken with EU support through Programmes which are generally under the aegis of Directorate XI of the European Commission.

Current R&D activity ranges from nursery techniques to end-product development of sawmill and wood-based industries. Total expenditure on forestry research in 1995 was approximately ECU 2.0 million. ECU 1.25 million of this was provided by the Department of the Marine and Natural Resources with EU support.

A EU STRIDE initiative was adopted in 1989 to co-ordinate R&D projects on a national basis and to develop a strategic planning process. The STRIDE Forestry Sub-programme came into operation in 1992 and the Council for Forest Research and Development (COFORD) was established in 1993, on a non-statutory basis, to reflect the broad vocational base of industrial need and research competence. A variety of interests in the forestry sector are represented on COFORD, including Teagasc, Forbairt, Coillte, forestry representative organisations, the Irish Timber Council, the Irish Farmers' Association, universities and the Forest Service.

A programme of forestry R&D was produced by COFORD in 1994 (Anonymous. 1994). The programme identified research needs in the areas of reproductive material, silviculture and forest management, harvesting and transport, wood processing, and the socio-economic area. One of its recommendations was a phased increase in expenditure on forestry research to 3% of the gross value of forest output.

5 Main Current Conflicts and Challenges

Recognising the importance and potential of the forestry sector, the Government, in September 1993, directed the Minister to bring forward a strategic plan for forestry-related development to the year 2015. As a result, in July 1996 the Irish Government published 'Growing for the Future', a Strategic Plan for the Development of the Forestry Sector in Ireland. The overall aim of the Strategic Plan is: To develop forestry to a scale and in a manner which maximises its contribution to national economic and social well-being on a sustainable basis and which is compatible with the protection of the environment.

There is an interdependence between forestry, agriculture, rural development, tourism, industrial policy and the environment. This means that forestry development cannot be considered from a narrow or sectorial point of view or on a strictly economic basis. Its typically long time scales also mean that the benefits of investment in forestry are themselves long-term. The case for forestry is made on the basis of its economic, social and environmental benefit. The optimum scale and rate of development of the sector must be balanced with issues such as the availability of land, the production potential of the species and sites planted, and the effect of accelerated and concentrated forestry development on rural areas.

5.1 Critical Mass

While a plan could be developed which would maximise the economic, social and environmental benefits which are possible within the limits of the present forest estate and which would require no further afforestation, such an approach would fall far short of delivering the range of benefits which forestry can generate if developed to a larger scale. There is a point of development at which positive economic, social and environmental impacts are optimised. Of fundamental importance in determining this point is an assessment of the ideal or target scale of the forest estate which will be of greatest national benefit.

The development of an indigenous sustainable forestry resource is also important in the context of the international timber trade, particularly in relation to tropical timber, which accounted for ECU 46.25 million out of a total of ECU 180 million of timber imports in 1994. Increasing concerns about sustainable management of tropical forests point to the wisdom of developing indigenous timber resources, particularly of hardwoods (broadleaves).

The ideal scale of the forest estate must be related to its principal function, which in Ireland is timber production. Ireland's annual timber production is currently about 2.2 million m^3. If there were to be no further afforestation beyond 1995, this would rise to nearly 4 million m^3 of sustainable fellings by 2015 and 5 million m^3 by the year 2035 as the existing forest matures. This is below the required production level or critical mass recommended, i.e. approximately 10 million m^3 an^{-1} and preferably in the range 12-15 million m^3 an^{-1}.

Such a scale of timber production is required to make true competition and the operation of market forces possible and to support a range of processing industries. This will permit specialisation so that every element of forest output is capable of being processed on an internationally competitive scale, giving maximum added-value to the national economy.

The level of production needed to produce efficiencies of scale to permit competition and the operation of market forces is in excess of domestic market demand and success on export markets is therefore a necessity for the development of the Irish forestry sector.

5.2 Change of Land Use

An increase in timber production will require a larger forest area, and the Strategic Plan proposes a sustained programme of afforestation to increase the forest estate to almost 1.2 million hectares (or 17% of the land area of the country). An increase in the forest area means a change in some land use, particularly agricultural land which is suitable for growing a variety of forest tree species. There are almost 1 million hectares of wet mineral soils in Ireland. These soils are particularly suitable for forestry as they are of limited use for agriculture but are capable of producing high yield spruce crops. There is also potential on the drier soils for other conifers and broadleaves.

The actual availability of land suitable for forestry is limited by environmental restrictions, such as listed NHA's, Areas of Outstanding Landscapes or High Scenic Amenity Areas and the existence of archaeological sites. These restrictions may affect up to 10% of land which might otherwise be available for forestry. The actual impact over the period of the Strategic Plan on ultimate timber output is difficult to determine, given the offsetting effect of afforestation, most notably broadleaves, on better quality lands.

Afforestation on cutaway bogs is a particular case necessitating a new approach to the 50,000 hectares identified as being suitable for afforestation. Pilot trials will be needed to determine suitable species related to peat depth, type, cultivation and location. The replacement of Sitka spruce with frost tolerant species such as Norway spruce and pine will have to be evaluated. A large co-operative research project, in which UCD, Coillte, Bord na Mona (the Irish Peat Board) and the Forest Service are participating, dealing with all aspects of cutaway peatland afforestation, has just commenced.

5.3 Forestry versus Agriculture

Studies on forestry in Ireland have generally tended to assume that no agricultural activity is displaced by forestry, i.e. that afforestation only takes place on land which is unsuitable for agricultural enterprises and that the opportunity cost of displaced agriculture is therefore zero. While this may have been true when only a small proportion of the country was afforested, it is likely that a sustained afforestation programme would displace some agricultural activity. There is little evidence on the types of enterprises and value of agricultural activity most likely to be displaced.

5.4 Environment, Recreation and Amenity

Afforestation can give rise to environmental problems. Forests are highly visible in the countryside and are such an obvious change of land use that they frequently attract public attention and in some instances provoke a degree of public reaction. This reaction may be rooted in a simple dislike of any changes in a familiar landscape or may in some instances be founded on a fear of isolation of homes and farms. It may be based on concern as to the possible effects of forestry on wildlife, watercourses, local cultural, historical or archaeological areas. There is also an understandable desire to ensure that forests are accessible to local people for recreation and leisure. Public confidence in, and support for, forestry development is particularly important where a programme contemplates sustained and significant levels of afforestation over a number of decades. An additional means of addressing the question of public confidence will be to increase the degree of public involvement in forestry planning and practice. The Urban Woodland Scheme, introduced in 1996, is open to all local authorities, and provides grant aid for woodland improvement and/or the establishment of new woodland on land owned or managed by local authorities, and for the provision of public recreational and amenity facilities in these woodlands. Inter-disciplinary management and community involvement are two of the principal objectives of this scheme.

Environmental controls on forestry development must be effective and compliance must be enforced. If they are to act as a deterrent, sanctions must be applied to breaches of the general or specific environmental protection conditions attaching to grant assistance for any forestry project. Ireland has committed itself internationally to the development of a sustainable forest policy and national criteria and indicators by which it can be measured. This is also relevant in the context of the international certification of timber and the possible advantages for Irish timber in international trade.

5.5 Forest Planning

The continued absence of a national forest inventory and planning system is an impediment to securing optimum economic and social benefit from the development of the sector as a whole. As part of the Strategic Plan, a comprehensive inventory and planning system to provide forest resource, geographical and environmental data for management, control and planning purposes will be developed.

5.6 Species Selection

The policy on species adopted in the Strategic Plan is to increase (with due regard to site suitability and the attainment of the identified critical mass) the diversity of species in Irish forests. The objectives are to produce better timber quality, to extend the range of potential end-uses, to reduce risks associated with monocultures, and for environmental and landscape purposes. A recent study on bird populations in different forest types has produced remarkable high values for avian bio-diversity in commercial coniferous forest plantations (O'Halloran *et al.*, 1998).

The recent increase in broadleaf planting has made it necessary to expand silvicultural and management expertise in this area. The publication of 'Growing Broadleaves - Silvicultural Guidelines for Ash, Sycamore, Wild Cherry, Beech and Oak in Ireland (Joyce, 1998) is a first step in redressing the virtual absence of an indigenous broadleaved culture in the country.

Organisations Related to Forestry

COFORD - The National Council for Forest Research and Development. Agriculture Building, University College Dublin, Belfield, Dublin 4. Tel: 01-7067700, Fax: 01-7061180, Email: coford@agriculture.ucd.ie, Web site: http://www.coford.ie/

Coillte Teoranta, The Irish Forestry Board. Leeson Lane, Dublin 2. Tel: 01-6615666, Fax: 01-6789527 / 6768598.

Crann, Crann House, Banagher, County Offaly. Tel: 0509-51718, Fax: 0509-51718.

Forestry Section, Department of Crop Science, Horticulture and Forestry, University College Dublin. Agriculture Building, Belfield, Dublin 4. Tel: 01-7067756, Fax: 01-7061104, Email: valerie.guilfoyle@ucd.ie. Web site: http://www.ucd.ie

Forest Service, Department of the Marine and Natural Resources. Leeson Lane, Dublin 2. Tel: 01-6072000, Fax: 01-6611326 / 6768980.

Forbairt. Glasnevin, Dublin 9. Tel: 01-8082000, Fax: 01-8082500.

Irish Christmas Tree Growers Association. Knockranny, Kilmacanogue, Co. Wicklow. Tel: 01-2863681, Fax: 01-2861499.

Irish Forest Industry Chain. Confederation House, 84/86 Lower Baggot Street, Dublin 2. Tel: 01-6601011, Fax: 01-6601717.

Irish Forestry Contractors Association. Clonroad Business Park, Ennis, Co. Clare. Tel: 065-22313 / 086-2416574, Fax: 065-22744.

Irish Timber Council. 7 Mount Street Crescent, Dublin 2. Tel: 01-6785733, Fax: 01-6785976.

Irish Timber Growers Association. Plankett House, 84 Merrion Square, Dublin 2. Tel: 01-6764783, Fax: 01-6624502.

Society of Irish Foresters. 2 Lower Kilmacud Road, Stillorgan, Co. Dublin. Tel: 01-2781874, Fax: 01-2835890.

Teagasc Headquarters. 19 Sandymount Avenue, Ballsbridge, Dublin 4. Tel: 01-6688188, Fax: 01-6688023.

The Tree Council of Ireland. 2nd Floor, Royal Hospital Kilmainham, Dublin 8. Tel: 01-6790699.

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Italy

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1 The Country

1.1 Nature

Geology
The collision between Europe and Africa in the Cenozooic era has generated two main range systems: the Alps and the Apennines, the oldest areas of Italy. The rest of the country is much younger and formed mainly by sedimentation material.

Main geological groups are: Holocene alluvial deposits, Pleistocene mixed deposits, Pliocene clays, Cenozooic Flysch, limestone and dolomite, Quaternary lava and tuffs, Apennines ophiolites, metamorphic and igneous rocks.

Topography
Italy is located in the Mediterranean Sea between 36° and 47° N of latitude and 8-18° E of longitude. It is formed by a boot-shaped peninsula, two large islands (Sardinia and Sicily) and several groups of small islands, for a total of 8000 km of coastal line. The land area is 301.000 km^2 35.2% of which are mountain, 41.6 % hills (up to 600-700 m a.s.l.) and only 23.2 % are plain land. Two important mountain ranges dominate Italian territory: the Alps (direction E-W) with steep slopes and high altitudes (M. Bianco: 4810 m) and the Apennines (NW-SE) (M. Gran Sasso: 2912 m). The main plain is formed around the Po, the longest and largest Italian river (652 km) flowing from West to East, whose watershed covers over 25% of the national land area. Important natural lakes of different origin (i.e. glacial, volcanic) are present in northern (Maggiore, Garda, Como, Iseo) and central (Trasimeno, Bolsena) Italy.

Climate
Classical literature, throughout the centuries, has always celebrated Italy for its mild, Mediterranean climate. However the peculiar geographic position and the extreme variability of physical features determine conditions for diverse climatic regimes. Mean annual temperatures, measured between 2500 and 0 m of altitude, can range between 0 (in the Alps) and 17°C (Sicily). Annual precipitation vary between 200-300 mm (in the south and the main islands) and 3200-3300 mm (north eastern Alps and northern Apennines). According to Köppen climate classification the following main temperature and precipitation regimes can be found in Italy:

- Temperature*:* continental (cold winter and warm summer); maritime (mild winter and warm summer); montane-Alpine (cold winter and cool summer); montane-Apennine (cold winter and mild/warm summer).
- Precipitation*:* continental (summer precipitation); mediterranean (winter precipitation); intermediate (equinoctial precipitation); transition.

Soils
Land units are extremely fragmented due to the young geological age of the country. Soils are very diverse but never very acid. According to the FAO/UNESCO classification system the most widespread groups of soil types are:

- *Eutric* and *Dystric regosols*, *Dystric* and *Eutric cambisols*, *Haplic phaeozems*, in the

external alpine region;
- *Eutric* and *Dystric Regosol, Haplic phaeozems, Rendzinas, Podzols, Orthic luvisols* in the internal part.
- *Eutric, Dystric* and *Calcic cambisols, Eutric fluvisols* in the Padanian and main alluvial plains
- *Eutric* and *Calcic cambisols, Eutric regosols, Rendzinas* in the northern Apennines
- *Calcaric Regosols, Calcic* and *Eutric cambisol* in central and southern Apennines.

Vegetation
Zonal vegetation in Italy can be attributed to two main large regions: the Eurosiberian and the Mediterranean both belonging to the Holoartic realm. The limit between the regions is at around 44° N of latitude. In each region altitude zoning can be envisaged.

The Eurosiberian include the following zones:
- hilly, with deciduous mixed meso-xeric forests (*Quercus* spp. *Acer* spp., *Fraxinus* spp., *Ostrya carpinifolia*, *Carpinus betulus*, etc.);
- montane, with mixed mesic deciduous and coniferous forests (*Fagus sylvatica, Abies alba, Picea abies, Pinus sylvestris*);
- subalpine, with coniferous forests (*Picea abies, Larix decidua, Pinus cembra, Pinus uncinata, Pinus mugo*);
- alpine, with natural prairies.

The Mediterranean is subdivided in the following zones:
- thermo- and meso-mediterranean, with maquis, evergreen sclerophyllous forests, coniferous forests (*Quercus ilex, Quercus suber, Pinus pinaster*);
- supra-mediterranean, with deciduous mixed xeric-mesic forests (*Quercus* spp., *Acer* spp., *Fraxinus* spp., *Ostrya carpinifolia, Carpinus betulus*);
- oro-mediterranean, mixed mesic deciduous and coniferous forests (*Fagus sylvatica, Abies alba, Pinus laricio, Pinus leucodermis*);
- crio-oro-mediterranean, with natural prairies.

Azonal vegetation includes non-climatic vegetation and can be subdivided in the following main types: riparian forests, marsh forests, peat bogs, marshes, lake vegetation, brackish lagoon vegetation, coastal (dunes and cliffs) vegetation, man induced (synanthropic) vegetation.

Italian flora includes over 5800 species (5300 herbaceous and 500 woody species). There are 930 endemic species (16% of the total). 307 species (5%) are non-native but became spontaneous; 463 are endangered species at different risk of extinction.

1.2 Society

Political structure and institutional organisation of the forestry sector
Italy is a parliamentary republic and is composed of 20 regions (4 with administrative autonomy). The chief of the government is the Prime Minister nominated by the President of the Republic, who is elected by the Parliament (composed by the House of Deputies and the House of Senate).

The administrative power in the agro-forestry sector has been transferred to the Regional and Local authorities (see section 4). Some other important constitutional changes should take place in the coming years to complete the decentralisation process (Pettenella, 1994).

Population distribution and density
With population of 57.5 M and population density of 191 inhabitant's km^{-2} Italy is among the most densely populated countries in Europe. In recent years Italy has experienced successive in-migration waves especially from North Africa (Morocco and Tunisia), Eastern Europe (Albania, Bosnia, Poland, Romania), Central-West Africa (Senegal, Nigeria), Asia (Philippines, China), South America (Peru).

Over 70% of the entire population live in metropolitan and urban areas located in the plain and coastal areas. In the 1950 rural population was almost 50% of the total. There are several high-density areas spread throughout the country: in northeast (Venice, Padua, Verona), northwest (Turin, Milan), eastern Tuscany (Florence, Pisa, Livorno), gulf of Naples and northeastern Sicily.

Economy

As in many other western countries Italian economy has strongly shifted from primary and secondary to tertiary activities. Only 7% of the labour force is employed in agriculture, 32% in industry and over 61% in other activities, contributing respectively to GDP for 3.5%, 29.2%, 67.3% (table 1). On the basis of the Italian national accounting system, GNP from forest related activities (wood and non-wood forest products) represents only 1.3% of the primary sector GNP and 0.05 % of total GNP, while the GNP of the wood working sector is about 4.5% of total GDP[1].

Tourism is a very important industry for the Italian economy. In 1995 almost 28 millions international visitors came to Italy and spent about 20 billions EUR.

2 Forest resources and their uses

2.1 Forest history

Forest vegetation has been present in Italy since geological eras. In the Mesozoic it was mainly a tropical flora and besides the ongoing development of Angiosperms, this feature was maintained for most of the Tertiary period. The forest structure and composition was comparable with the one present today in tropical, monsoon woodlands. The climate warming, which affected the whole Mediterranean basin about six millions of years ago, induced a desert-type vegetation and bounded forests (where taxa such as *Pinus*, *Taxus* and *Ilex* were prevalent) to the mountain areas. The shifting back to a moist climate allowed the spreading of sub-tropical vegetation again, with evergreen forests and savannahs. In the closing phase of the Tertiary period, the Pliocene (about 2-3 millions years ago), vegetation in Italy was very similar, in some respects (evergreen scrub, deciduous forest) to the present one. Later, the climate cooling due to the succeeding ice ages bounded the cold intolerant flora to shelter areas (i.e., Iberian Peninsula or the Balkans), from which it could expand again during the interglacial phases, until today.

Since pre-roman times Italian forests have been a timber reservoir for different populations. First the Phoenicians and then the ancient Greeks cleared the rich forests of Sicily transformed into a cropland. First the Etruscans and later the Romans issued the first forest laws and regulations throughout the country. However, in order to provide adequate timber for naval and building construction and to create

Table 1. Contribution to GDP by industrial sectors

Sectors	**% GDP**
Agriculture, Forestry and Fisheries	3.5%
Mining and quarrying	2.2%
Electricity, gas and water	4.5%
Manufacturing	22.0%
Constructions	5.1%
Wholesale and retail, restaurants and hotels	18.2%
Transports and communications	6.5%
Financial, real estate and business activities	24.3%
Public administration (health, education, etc.)	11.5%
Other services	2.5%

[1] As normal in the national accounting systems, Italian GDP does not take into account any non-market public service provided by the forest sector, like erosion control, water conservation, landscape and biodiversity protection, etc.

agricultural land, they have cleared large forested areas, like in the Padanian plain and the central Apennines (river Tiber valley).

After the Roman Empire fall, the barbaric invasions and natural catastrophes created the conditions of for land abandonment and massive forest recolonization occurred up to year 1000. The socio-economic standards improved during Renaissance and forests were cleared again for crops, pastures and urban settlements. A stronger impulse to timber use came from the expansion of overseas commercial activities. A great example is the Republic of Venice that controlled forest and economic resources of a large part of northeastern Italy from the XIV to the XVIII century.

Nonetheless the numerous invasions experienced throughout the centuries and the fragmentation of the peninsula in many different states, often governed by foreign families, enhanced the exploitation of forest resources. Only sixty years after the Italian unity (1861) the central government was finally able to conceive a forest policy and the publication of important laws, still in force today.

2.2 Forest types and their distribution

Among the several factors that account for the great diversity and abundance of vegetation in Italy, two can be considered of primary importance: the climatic changes occurred along geological eras and the actual climate heterogeneity of the country. The latter is due i) to the broad latitudinal extension of the peninsula, ii) to the great sea influence and iii) the high mountain ranges (the Alps, primarily and the Apennines).

Italian forests, according the syntaxonomical classification system, can be grouped within the following main types:
- Mediterranean evergreen forest (*Quercetea ilicis*);
- Mixed Oak woods and other mesic forests (*Querco-Fagetea, Alnetea glutinosae, Salicetea purpureae*);
- Montane Beech woods (*Querco-Fagetea*);
- Alps and Apennines Pine woods (*Erico-Pinetea, Junipero-Pinetea*);
- Boreal coniferous forests (*Vaccinio-Piceetea*).

Potential vegetation of Italy envisages forest distribution from coastal and plain zones up to the higher elevations. However, the actual types prevalent in the Mediterranean region are scrub forests subjected, along the history, to various kinds of disturbances and degradations (i.e. intensive grazing and fire). Moreover, plain mesic deciduous forests, once abundant in the northern river valleys (i.e. the Po Valley, from Turin to Venice), have been cleared a long time ago and replaced by agriculture, industry and heavy urban settlements. Most of the wooded areas are therefore left on hills and mountain slopes.

In the Alps (especially in the inner, continental regions) subalpine pure or mixed forests composed by Norway spruce (*Picea abies* Karst), European larch (*Larix decidua* Mill) and Stone pine (*Pinus cembra* L) form also timberlines reaching 2100-2300 m of altitude. In the Apennines open beech woods (*Fagus sylvatica* L) are the last stands (1800-2000 m) before transition to high altitude prairies.

2.3 Forest resources: extension, ownership and main species

Two main sources of information on the forest cover structure and distribution are available in Italy:
- the National Forest Inventory carried out in 1985-86 that adopted a broad definition of forest land including land covered by shrubs and scattered trees (total forest land extension is 8.6 M ha);
- the National Institute of Statistics publishing annual data on forest land extension (the most recent data is of 6.7 M ha) including only the forestland within non-abandoned public and private farms.

However, natural forest conversion in abandoned agricultural and range land is by large the most relevant change in land use in Italy, as confirmed by other sources of information (i.e. CORINE[2] where total Forest Land Cover is 7.2 M ha, 9.4 M ha considering also shrubs and scattered trees).

Making reference to more detailed source of information (the National Forest Inventory) forests in Italy extend over 8,675,100 ha, corresponding to 29% of the total land area. High forests make about 25% of this surface, coppices more than 40%. The remaining 35% are both "*specialised production forests*" (i.e., plantations for timber or wood paste production, tree farming, or non timber products woods: cork, chestnuts, etc.) and "*other forests*" such as scrubs, maquis, rocky or riparian woods, all rarely managed (table 2).

Most of the species present are native or spontaneous; the few exotic ones are generally used for industrial forestry ("special forest crops" category).

In high forests conifers are dominant, both for extension (56.3%) and timber volume (63.1%). The most important species is Norway spruce (*Picea abies* Karst); also mountain pines (*Pinus sylvestris* L., *Pinus nigra* Arnold, *P. laricio* Poiret) and European larch (*Larix decidua* Mill.) are well widespread. Most coniferous forests are located in the Alps (montane and subalpine spruce, fir, larch forests), but some important ones can be found also in the Southern Apennines (*Pinus laricio* Poiret). Broadleaved high forests are mostly beech woods (*Fagus sylvatica* L.), but also oak woods (especially *Quercus cerris* L.) (table 3).

Among coppice woods, the most widespread species in hilly zone are chestnut (*Castanea sativa* Miller), hornbeam and hophornbeam (*Carpinus betulus* L. and *Ostrya carpinifolia* Scopoli) and oaks (*Quercus* spp.), often in mixed composition. In montane zone, beech (*Fagus sylvatica* L.) is the most important species, both on the Alps and on the Apennines (table 4).

2.4 Total growing stock, growth and yield

Growing stocks for high forests and for coppices are reported respectively in tables 3 and 4 for the main species.

The national growing stock of high forests is about 405 millions of m^3 (about 211 m^3 ha^{-1}), with a total annual increment of 15.127.900

Table 2. Forestland categories and their extension

Category	Surface (ha)	%	Type	Surface (ha)	%
High forest	2178900	25.1	- even-aged	1176300	54.0
			- uneven-aged	554400	25.4
			- irregular	377100	17.3
			- transitory (in conversion)	71100	3.3
Coppice forests	3673800	42.3	- simple	2751300	74.9
			- with standards	922500	25.1
Specialised production forests	288900	3.3	- timber	134100	46.4
			- non-timber products	154800	53.6
Other forests			- rocky	575100	26.6
	2160900	24.9	- riparian	110700	5.1
			- shrubs	1475100	68.3
Non-wooded inclusions	372600	4.3			
Total	**8675100**	**100.0**			

Source: ISAFA, 1985.

[2] CORINE is an European Commission project to collect environmental data in all EU member countries.

Table 3. High-forests: main species, surface, volume and growth

Species	Total area (ha)	%	Total volume m^3	%	$m^3\ ha^{-1}$	Increment ($m^3\ ha^{-1} yr^{-1}$)
Norway spruce	380493	19.8	117543379	29.0	309	9.4
Silver fir	63606	3.3	23245024	5.7	365	9.2
European larch	241402	12.5	49017886	12.1	203	5.7
Mountain pines	267832	13.9	49974017	12.3	187	8.0
Mediterranean pines	108627	5.6	13365769	3.3	123	7.1
Other conifers	23431	1.2	3021422	0.7	129	13.6
European beech	287992	15.0	70243581	17.3	244	8.5
Turkey oak	96452	5.0	16443298	4.1	170	6.7
Other oaks	176465	9.2	20587540	5.1	117	4.6
Other hardwoods	277779	14.4	42278552	10.4	152	8.8

Source: ISAFA, 1985.

m^3 (on average, 7.9 $m^3\ ha^{-1}\ yr^{-1}$). Including only the trees with d.b.h. >17.5 cm, the total growing stock lowers to 341 millions of m^3 and the current annual increment is 5.1 m^3. Among spontaneous species, Spruce and Beech have the greater averaged increments (9.4 $m^3\ ha^{-1}\ yr^{-1}$ and 8.5 $m^3\ ha^{-1}\ yr^{-1}$ respectively).

Currently, the annual yield in high forests rarely exceeds 50% of the annual growth and harvesting, on average, is 35% of the current increment. This led to a general increase of the growing stocks in the last decades.

2.5 Silviculture

In the part of Italy (mainly in northern regions) where forestry practices have a high standard the silvicultural systems in use nowadays are based on the principles of a sustainable, "near-to-nature" forestry. Forest operations are carefully controlled and restricted, aiming both to timber production and to forest natural regeneration.

Clearcutting is forbidden by law in about 95% of the high-forests, which are subjected to restricted use, in order to enforce soil and water conservation.

Currently the most common silvicultural systems applied in alpine high forests (especially in coniferous forests) are *selection system* and *shelterwood system* (mainly group, stripe or edge systems). This kind of treatments has determined the shifting of many even-aged forests (developed from past clearcutting or afforestation) to uneven-aged or irregular forests. In Beech high forests the most common practice is the *uniform system*. The opening of gaps or stripes by clearcutting is allowed only in stands composed by light-demanding species (larch and pines), in order to meet the ecologi-

Table 4. Coppices: main species, extensions and volumes

Species	Total surface ha	%	Total volume m^3	%	$m^3\ ha^{-1}$
Beech	402800	14.8	60939254	19.5	151
Chestnut	493535	18.1	74612238	23.9	151
Hornbeam	324701	11.9	28940076	9.3	89
Turkey oak	346285	12.7	36594099	11.7	106
Other deciduous oaks	390037	14.3	33857781	10.9	87
Evergreen oaks	152948	5.6	16446998	5.3	108
Other broadleaves	612859	22.5	60591673	19.4	99

Source: ISAFA, 1985.

cal requirements of these species and guarantee the stand natural regeneration.

Coppice is largely widespread, especially with private owners. The most common system is clearcut, but for many species the law prescribes to leave some standards to favour seed production and sprouts regeneration in old stumps. The selection system is applied in many beech coppices, a lot of which are of public property (often mountain municipalities).

Coppice with standards is a practice used sometimes only in some areas of central Italy for pure or mixed oak stands.

Although still common in Italy, coppice is currently considered an outdated silvicultural system. The reasons are that its products are largely surrogated by other manufactured items and especially it doesn't guarantee, as well as high forests, the multiple functions that public opinion expect from forests (soil-erosion control, landscape amenity and recreation).

More and more old coppiced stands in Italy are subjected to conversion operations leading to high forest. Generally conversion begins with thinnings in coppices that are by large older than their usual rotation age. When stems are relatively old, soil has improved and seed production is abundant the shelterwood system can then be adopted.

Another important aim of Italian forestry is to foster natural diversity and evolution in forests; therefore mixed forests are promoted and the spontaneous recolonization of broadleaved species in coniferous plantations is today strongly encouraged.

2.6 Forest functions

The National Forest Survey of 1985 divides Italian forests on the basis of the prevailing function as shown in table 5.

Indeed, soil-erosion control is a very important goal in Italian forest management due to the very irregular morphological features of the country and it is desirable the protective function would be extended to most of the forested land. It is also important to keep in mind that people's demand for recreational use, as well as its consciousness of the ecological role of forests, are very strong today.

It is true, however, that these functions can be played also by many of the woods classified as productive (i.e., where production is prevailing) in table 5. In Alpine forests, for example, where tourism is an important economic activity, both in summer and winter, the silviculture practices, following the sustainability principles, permit together timber production, soil conservation and recreational uses.

2.7 Forest production: harvesting systems, accessibility

Some important features of harvesting in the forest are summarised in the following table 6. Motor-manual felling is the most common felling method both in the coniferous and the broadleaved forests. Logging is based on agricultural 4WD tractors equipped with winch and on cable crane where the land slope does not allow the use of wheeled vehicles. Cable crane logging is more common in the eastern regions of the Alps. Winch sledge is used as well as

Table 5. Woodland categories and prevailing functions

Category	Prevailing function			
	production	protection	ecological	recreational
high forests	72.7	18.6	8.5	0.3
coppices	82.2	14.3	3.5	0.1
plantations	100.0	0.0	0.0	0.0
other forests	4.8	89.3	5.7	0.2

Source: ISAFA, 1985.

mobile cable yarder. In some case animal logging (mules and horses) are still performed in steep slopes, especially for fuelwood.

The accessibility varies depending on the yield of forests. In the most productive forests the accessibility ranges from 25 to 35 m/ha.

3 Forest economics

3.1 Forest and forestry industries in national economy

In Italy the two components of the forestry sector (forest activities and wood working industries) are separate entities acting rather independently. The lack of integration between the two sectors is due to different policies and patterns of development. Forest activities seem more oriented towards the production of non-market public services than to an increase in the internal supply of wood products. While the wood industry is strictly oriented towards production and competition in the international market by giving as much added value as possible to the raw material imported.

In the following pages we try to explain the different economic role of the two components of the forestry sector by describing the main elements characterising forest activities and the organisation of the wood industry.

3.2 Organisation of forest activities

Italian forests cover 6.4 million ha[3], which is equivalent to 21.3% of the land surface of 30.1 million ha. The distribution of forest types by categories of ownership and management regime is presented in table 7. Only 23.2% of the Italian territory is flat land, where intensive agricultural production systems and urban land uses are predominant. About 60% of the forests are situated in mountain areas, 35% in the hills and only 5% in the plains. Soil and water conservation is the main goal and constraint of forest management. Strict regulations (i.e. only light selective felling and silvicultural systems based on natural regeneration, prohibition of clearcutting, limitations in forest road construction) are imposed on 92.4% of the forest land (ISAFA, 1985).

According to the 1990 Agricultural Census, State and regional forests have an average size of about 850 ha, communal forests of 150 ha and private farm forests only 3.2 ha. No private industrial forest exists. Hence, woodlands are highly scattered and therefore wood harvesting is more difficult and costly. Timber quality, moreover, is not always meeting the demand requirements. High management costs and reduced wood production per surface unit are limiting private, and even public, financial interests in active forest management (Gios and Pollini, 1986).

Table 6. Distribution of wood harvest methods in forest

Average annual harvest (1990-1997)	**8917125 m^3**
share of standing sales	70%
share of roadside or transported to mill sales	30%
share of motor-manual felling	99%*
share of mechanised felling	1%*
share of log-length harvesting system	95%*
share of tree-length harvesting system	5%*
share of road as a long-distance transport mode	98%*
share of rail as a long-distance transport mode	2%*

* estimated

[3] Reminder: there are two sources of information on forest statistics (see section 2.3.).

Table 7. Italian forests by categories of ownership and management regime (1000 ha)

	State and Regions	Communes	Other public	Private	Total
high forest	198	1019	193	1379	2789
- coniferous	111	636	103	588	1438
- broad-leaved	87	383	90	791	1351
(of which poplar)	4	4	5	105	118
coppice	148	600	167	1932	2847
coppice with standards	30	157	32	548	767
Total	**376**	**1776**	**392**	**3859**	**6403**

3.3 Organisation of wood industry

In Italy all wood-related economic sectors operate in a highly disconnected forestry-wood system, whose main features seem to be:

- a fragmented and limited internal supply (table 8), due to the above-mentioned economic and environmental constraints; moreover the internal supply is not homogeneously distributed (table 9). Most of the productive high forests (mainly coniferous) are in the north-eastern regions[4] while coppices predominate in the centre of the country. The only relevant examples of forest plantations are the poplar stands in the northern plain areas of the river Po valley. On the other hand with the overall situation of wood productivity in Italy, poplar plantations probably represent financially the most productive investment in the forest sector in Europe[5];
- a consequent low self-sufficiency rate (i.e. around 36% for semi-finished products, as shown in the last column of table 8). Part of the reason for this, beside the economic and environmental constraints, is the fact that Italy's geographical position and international location is such that importing from neighbour markets (mainly Austria, France, Switzerland, Slovenia and Croatia) is easier and faster than purchasing on local markets. For example, in the softwood market the commercial flow between Austria and Italy is, quantity-wise, exceeded only by that between Canada and the USA. Furthermore, due to the size of production, the wood, furniture and pulp and paper industries need continuous, homogeneous and reliable timber provisions, which can only be guaranteed by foreign supply.

The lack of integration between domestic forest activities and the wood working industry is therefore one of the basic problem and at the same time one of the main challenge of the Italian forestry sector. The bulk of industrial activities is based on import of rough and semi-finished products (table 10), while internal supply is able only to cover small niches of the market (poplar logs used for plywood and mechanical pulp production, coniferous timber used in building activities in some mountainous areas, etc.).

In this context logging enterprises and the sawmills play a strategic role for the future development of forest activities. Italian sawmills have structural lacks (working yards, plants and equipment), very well reflected, in turn, on low labour productivity rates. Small size sawmills are undoubtedly the most widespread (on the average about 3,100 m^3 worked/year), together with a predominant family-management; this

[4] The North-east of the country is made up of three Regions (Veneto, Trentino Alto-Adige and Friuli-Venezia Giulia) on the total of 20 Italian Regions.
[5] With a net annual increment of 20-25 m3/ha, rotation periods of 8-10 years and with the predominant use of the final harvest for high-quality plywood production, poplars plantation investments can reach an Internal Rate of Return of 7-10%, being competitive with corn production (in the irrigated areas of the Po valley normally corn production is over 10 tons/ha, one of the highest productivity rates in the world).

Table 8. Italian forest products market in 1985, 1990 and 1996 (1000 cubic metres in equivalent volume of rough wood)[6]

a. rough wood

Years	Domestic production (1)	Import (2)	(1)+(2) (3)	Export (4)	Apparent consumption (5)	(4)-(2) (6)	(1)/(5) % (7)
1985	9448	5496	14944	12	14932	-5484	63.3
1990	8038	7150	15188	19	15169	-7131	53.0
1996	8876	7118	15994	308	15686	-6810	56.6

b. semi-finished wood products*

Years	Domestic production (1)	Import (2)	(1)+(2) (3)	Export (4)	Apparent consumption (5)	(4)-(2) (6)	(1)/(5) % (7)
1985	10222	18081	28303	888	27415	-17193	37.3
1990	11931	21769	33699	1120	32579	-20684	36.6
1996	12608	24388	36996	2225	34771	-22163	36.3

*: sawnwood, particle- and fibre-boards, woodpulp, plywood, veneer sheets, sleepers.

Sources: 1985 and 1990: FAO, Yearbook of Forest Products, Rome; 1996: ECE/FAO, Timber Bulletin and estimates.

Table 9. Wood domestic removals (1000 m^3 - 1997)

	From forest land	From other land*	Total	% of total removals	% of industrial roundwood removals
Total removals	8379	1350	9729	100.0	-
* fuelwood	4928	587	5515	57.9	-
* industrial roundwood	3451	763	4214	42.1	100.0
- Coniferous	1341	81	1422	14.6	33.7
(of which in north-east)	997	5	1002	10.3	23.8
- Broadleaved	2110	682	2792	28.7	66.3
(of which poplar)	958	651	1609	16.5	38.1

*: mainly single trees, windbreaks, small wood plots in agricultural areas.

Sources: ECE/FAO, Timber Bulletin; ISTAT, Bollettino Mensile di Statistica and estimates.

limits, or at least affects, investments on technical and managerial innovations. Occupying specific market niches, which allow limited productions designed for specific clients, is the other key factor for the survival of small-medium size sawmills (Cesaro and Merlo, 1990; Gios *et al*. 1991). The possibility for these niches to endure is linked to technical constraints preventing large-size specialised enterprises entering some specific markets.

3.4 The role of non-wood forest products

As in other Mediterranean countries, the social and economic role of the non-wood forest products (NWFP) is traditionally of high importance in many local communities. Market demand for chestnuts, hazelnuts, mushrooms, truffles, berries is so high that almost all the Regional Administrations have introduced property right regulations to control the collection of NWFP. These products are no more a public, free-access good, but products that can

[6] For more recent data look at the WEB site: http://www.unece.org/trade/timber/tim-fact/ita.htm.

Table 10. Main indicators of the wood-based industry structure (1997)

	Firms no.	Employ. no.	Turnover 1 M EURO	Import 1 M EURO	Import 1000 ton	Export 1 M EURO	Export 1000 ton	Balance 1 M EURO
a. Wood in the rough, chips and residuals	10830	37034	7070	7019	5041	2939	71	-4080
b. Semi-finished products	44873	149469	155552	20224	5105	7571	654	-12653
- sawnwood	4081	17943	24392	12917	3812	785	72	-12132
- panels	369	12999	48785	5196	1020	4622	438	-573
- building material	38520	103672	69928	1653	124	1684	51	31
- packaging	1903	14855	12447	460	150	480	93	21
c. Wood furniture	31807	162107	116719	4586	155	68926	1572	64340
Total (a+b+c)	87510	348610	279341	31829	10300	79436	2297	47607

Sources: ISTAT

offer remarkable source of income to the forest owners and their association.

For example, in the Alba area (Piedmont region) every year some 12 tons of truffles are officially collected (though a similar amount is collected “on the side” and sold unofficially), at an average price of 3,000,000 lire/kg (1,500 EUR). Thanks to collection and processing of the truffles (along with other typical agricultural products, particularly wine), Alba appears to be one of the boroughs in Italy with the highest percentage of agricultural workers, and at the same time, with one of the highest average income rates. However, what counts is not so much picking the truffles as the economy that revolves around this activity (food processing industries, restaurants and on-farm tourism, etc.) which is growing very quickly. According to a number of estimates, the value of the food production connected to truffles in the Alba area alone is around 25 Millions EUR, half of this deriving from exports (Japan and Northern Europe).

Both the Alba truffle and the mushrooms (*Boletus edulis*) from Borgo Val di Taro in the Emilia Romagna region have been recognised by the Italian Ministry of Agriculture and Forestry with a official trade mark.

The high profits deriving from NWFP collection might bring about a modification in the criteria adopted in woodland management (coppices are generally more productive than high forests as far as mushrooms are concerned) which have traditionally been oriented towards timber production.

4 Forest policies and main current conflicts and challenges

Italy is a country of contrasts and contradictions, also in the forestry sector: it has plenty of coppices and overstocked plantations which need to be thinned, but it is the one of the largest world importer of wood residues and fuelwood. Italian forests are an essential part of the countryside and tourism represents one of the most important sources of national income, but one-two million ha of forest land is totally abandoned and each year fires destroy thousands of hectares of Mediterranean forests. The technological level of Italian forest enterprises is extremely low and, as a logical consequence, harvesting costs are not competitive with neighbouring countries, but Italian woodworking machinery and equipment industry has a leading position world-wide[7].

[7] Italy is world leader in terms of production and export of some wood-working machines like those for panel sizing, sanding, boring, and plywood, chairs, windows manufacturing.

Marketing capabilities of forest owners are behind the average European standards, but the first case of ecocertification of a forest property in the Alps is that one of an Italian community forests (Pettenella, 1998). Italy is the country with the richest and more diversified semi-natural forests in Europe, but the capability of representing the problems and interests of the forest actors in the decision making processes at European level is extremely low[8].

Few sectors in Italian economy have such a high development rate as the wood working industry, but in the last 30 years self-sufficiency for industrial roundwood has constantly decreased. The Italian furniture industry is growing at a fast rate, consolidating its leadership in the international market, thanks also to his strong territorial specialisation (Merlo and Fodde, 1996), but internally Italy still maintains weak distribution channels. A contrasting situation is also characterising the activities in the field of forest education and professional training. While there are only few professional schools providing a practical training for the foresters to be employed in the field, five-years university courses are organised by 9 Faculties of Agriculture (Schmidt *et al*., 1998): 2 in the North (Torino and Padova), 2 in the Centre (Florence and Viterbo) and 5 in the Islands and Southern part of the country (Bari, Potenza, Reggio Calabria, Palermo and Nuoro). Of course for each of these apparent contrasts there are economic and institutional explanations, even if sometimes they do not seem so evident.

As mentioned in section 1.2, in the forestry sector a strong decentralisation process of State competencies to the 16 not autonomous Regions has been carried out in the last years. While some Regional Authorities (mainly in the North) have taken advantage of the new autonomy granted them by the State and have organised regional forest services, other (mainly in the South) are still making use of the *Corpo Forestale dello Stato*[9] for the implementation of their forest policies. A third alternative organisational model (quite common in Central Italy) is based on a remarkable decentralisation of the competencies in the forestry sector from the Regional to the local authorities (Provinces or *Comunità Montane*, associations of Municipalities in mountain areas).

As a result of this differentiated and still changing situation it is extremely difficult to find common patterns in forest related policies implemented by public authorities. While some Regions seem more concerned about the problems of expanding the forest area (see the application of EC Reg. 2080/92), protecting the forest environment from external disturbances (fires, illegal grazing, etc.), other Regions are paying more attention to the economic role of the forest sector through programmes of assistance to forest owners and forest enterprises or through direct investments based on public works for mitigating unemployment problems in marginal areas. Also as a consequence of the reduced public spending in the sector, regional forest policies tend to favour one or few single objectives. What appears to be lacking in the decision making process in Italy is identification of a clear long-term objective function which would steer short term choices according to a coherent integrated approach.

To understand these problems it is important to remind that, not only Italian public institutions are under a process of radical change, but also market demands are rapidly changing. The most evident market change in the recent past has been the increase in demand for public forest services: recreational areas and hunting, landscape amelioration, biodiversity conservation, global climate

[8] The only forest owners association without any representative in the Confederation of European Forest Owners is the Italian one.

[9] The *Corpo Forestale dello Stato* (State Forest Service) is a police force directly depending from the Ministry of Agricultural Policies, the former Ministry of Agriculture and Forests.

stabilisation, etc. The growth in such demands has often lead to the imposition, on the part of public authorities, of further limits to forestry activities undertaken by private owners.

The present problem in Italian forestry may thus be summarised as one of decreasing financial productivity as opposed to increasing social demands for public goods:
- many services having social purposes are combined products deriving from an active management of forests and have traditionally been supplied with or without limited restrictions to public access (recreation and hunting, for example);
- markets for many of the social services provided by the forest are non-competitive (i.e. the services are public goods),
- external (and generally positive) impacts of forest activities are not evaluated by private owners and adequate mechanisms of internalisation have not been set up.

One of the fundamental reasons for this kind of market failure is the system of property rights which is not suited to present-day demands. The tenure system "was designed to serve objectives which are increasingly out of tune with changing public attitudes towards resource use. In particular, while it depends heavily on public resources, it fails to provide the private tenants with the security they need to invest in future production" (Pearse, 1993, p.77). The decreasing interest on the part of private forest owners in the management of forestry resources as such could be dealt with by two policy instruments, excluding the possibility of encouraging a change in the ownership structure with public bodies buying the land itself.

i) Private forest owners could be encouraged to internalise some services of public interest (perhaps through a revision of the legislation on property rights) which in Mediterranean areas are generally supplied at no cost: rights of access to natural parks, to forest paths and roads, permits to collect mushrooms and other woodland by-products, hunting and fishing rights, renting of sites and infrastructures for sports purposes, farm tourism, etc. Such payments should obviously correspond to the supply of specific services and systems should be devised whereby the costs of fees collection would not be higher than the income. It is therefore necessary to create 'markets' where transactions would be made between those who enjoy the benefits and those who bear the costs of managing the forests. Specific payments for each individual service, apart from timber production, would help to make the models of forest management more transparent, thus avoiding 'free rider' behaviour with regard to the resources.

ii) The supply of many services of social interest, as well as industrial roundwood, calls for the establishment of large-scale management units. In a situation affected by rigid land ownership structures, active management of small private holdings could be encouraged by means of voluntary agreements between the forest landowner and a contractor. Thanks to such agreements, when necessary forest ownership could be separated from the responsibility of management, leaving such responsibility to *ad hoc* contractor firms. Direct compensation could be provided for positive externalities supplied after negotiations between the small forest owners, contractors and public authorities interested in forest investment.

In all these cases the full-time farmer would no longer be the prevailing subject of a policy of forest development, but public decision makers have to take account of other economic operators as well. In particular, the problem of absentee landlords should be considered, paying more attention to contractor firms for forest management and marketing of forestry products and services and to local administrative structures. To attain these objectives it is a priority to promote the reform of administrative structures, simplifying the procedures, stressing the functions of technical assistance, rather than policing, and creating the means to control the efficiency of public spending in the sector.

Acknowledgements

Section 1 was written by C. Urbinati, section 2 by C. Colpi. D. Pettenella wrote sections 3 and 4 and edited the text. The authors are most grateful to P. Piussi who reviewed the text and provided some essential information. Thanks are also due to R. Cavalli who wrote section 2.7.

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The Republic of Latvia

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1 The Country

The Republic of Latvia lies on the Eastern coast of the Baltic Sea. Latvia is not big: it covers 64,589 square kilometers, the distance between the farthermost points from East to West is 442 km, from North to South - 210 km. The population of Latvia totals 2.5 million; the capital Riga (with a population 800,000) is an old city founded in 1201. Latvia is bordered by Estonia (on the North), Lithuania (on the South), Russia (on the East) and Belorussia (on the South-East). Since ancient times, with its coastline exceeding 480 km and easily accessible ports, Latvia has been a significant link between the states surrounding the Baltic Sea and Russia. The Baltic Sea has always been of great importance in political, economic and cultural life of the country.

1.1 Nature

1.1.1 Topography

Much of Latvia is a flat coastal plain. Nearly 45% of its surface area is covered with forest, interspersed with small rivers and lakes. 3.7% of the country is covered by inland waters: there are 145,400 rivers in Latvia although only 777 rivers are over 10 km in length, 140 lakes are larger than 1 km^2. The average elevation of the land surface is 87 m above the sea level, and the highest point Gaizinkalns rises to 312 m. Latvia is not rich in useful minerals. Of combustible minerals only peat has certain industrial significance. The most important for the economy are raw building materials such as limestone, gypsum, dolomite, clay, sand and gravel.

1.1.2 Climate

Average annual rainfall is about 680 mm and sufficient. The wettest months are April through September, coinciding with the highest demand for moisture. Severe droughts, like the one in 1992 are rare. Mean annual temperatures (5.4 degrees Celsius) are relatively mild for the country's latitude, due to the moderating influence of the Baltic Sea. The annual mean air temperature in Riga, the capital, is +6.0^{o}C; in January -4.9^{o}C and in July +16.9^{o}C.

1.1.3 Soil

While Latvia's overall climatic conditions and topography are both sufficient and are enough to ensure good production and variety within the agricultural and forestry sectors, the soil quality is less than ideal. Podzolized soils - relatively infertile soils typically found in forests - constitute 54.5% and deep, fertile organic loam soils account for about 7% of total agricultural land with the rest belonging to less fertile categories. Average soil quality is 4 on a scale of 10 points, with 7% falling in the highest quality. Thus overall soil quality is relatively low, and so is soil humus content, averaging no more than about 1.7%. Widespread soil compaction and deteriorating drainage systems are amplifying the impact of relatively low soil quality on soil productivity.

1.2 Society

1.2.1 History

Until the middle of the 16th century Latvia was dominated by the German Empire, later its separated parts were directly ruled by other states:

Vidzeme - by Poland and Sweden, *Latgale* - by Poland, but *Kurzeme* and *Zemgale* were in the Duchy of Kurzeme (Courland), which were not so dependent on other countries. In the 18th century the above-mentioned parts of Latvia were incorporated into the Russian Empire. In 1918 Latvia obtained independence and a new state - the Republic of Latvia was established. It took several years before the war ended with a Peace Treaty between Latvia and Russia in 1920 and the formation process of the Latvia State could start. It was interrupted by the developments in 1940 - Latvia's incorporation into the USSR, the establishment of the Soviet power and the ensuing "*socialist transformations*", and World War II, immediately after. The 50 years under the socialist system left a deep imprint in the fate of both: the nation and many of its people. On May 4, 1990, the Supreme Council of the Republic adopted the Declaration on Renewal of the Independence of the Republic of Latvia. In September 1991 the Republic of Latvia was granted full membership in the UN; on February 1995 Latvia was granted membership in the Council of Europe becoming the 34th member of the body. In 1998 Latvia was the first of the Baltic States to enter the World Trade Organisation (WTO).

1.2.2 Population

As comparable to other European nations (except for Estonia), the increase in population during the post World War II years had been dominated by an increase in the rate of immigration. Until 1989, due to migration, Latvia had the highest population growth in Europe. Throughout the years, the main flow of migration has been from the nearest regions of the Russian SFSR, the Byelorussian SSR and the Ukrainian SSR (figure 1); the majority of the immigrants concentrated in the cities. The growth of cities was especially intensive in 60-70´s, when there was a drive for industrial development. From 1940 to 1959 the rural population diminished 1.3 times. This was a direct consequence of the war and deportations. The rural population continued to shrink at a rate of 3.5% per year till 1979, after which it stabilized (table 1).

Basic facts about the Latvian population (year 1996):
- estimated population 2.5 million, population growth -0.9%;
- population density 36.8 persons per km^2;
- rural population 31%, urban population 69%;
- average life expectancy 69.2 years (men 63.9, women 75.6).

1.2.3 Economy

The development of Latvia's national economy has been greatly influenced both by its geographical position and political, social and economic situation. The advantageous geographical location of Latvia on the eastern shores of the Baltic Sea and the crossing of ancient trade routes from Russia to Western Europe has determined the development of a significant transport network. Limited natural resources on the one hand and considerably well-developed infrastructure on

Table 1. Dynamics of population in Latvia

Year	Total population	Urban population, %	Rural population, %
1914	2,493,000		
1920	1,596,000		
1935	1,905,000	37.2	68.2
1940	1,886,000		
1959	2,093,000	53.2	46.8
1979	2,521,000	68.5	31.5
1989	2,680,000	71.1	28.9
1996	2,500,000	69.0	31.0

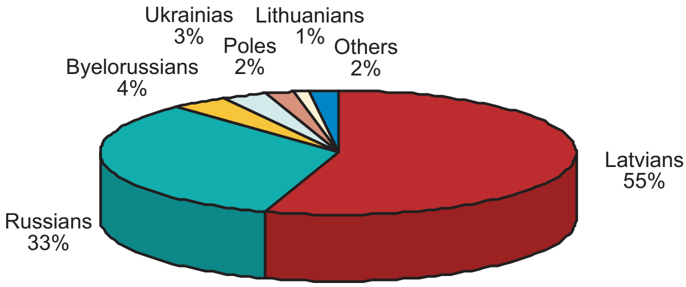

Figure 1. Ethnic distribution of Latvian population.

the other hand facilitated the creation and speedy progress of processing industries. After the collapse of the former USSR, the situation in the Baltic region has changed dramatically. During the transition period from a socialist to free market economy the Gross Domestic Product (GDP) decreased sharply. In the autumn of 1991, when Latvia regained independence, the Government started transforming the centrally planned economy into a market economy. The process of economic reforms took place in a very difficult environment. The Latvian economy was closely linked to the republics of the former Soviet Union through the specific system of specialization and division in labour.

The main weaknesses of the economy are:
- ineffectiveness of the industry regarding labour productivity;
- raw material consumption, technologies and quality of products;
- high interest rates for credits;
- lack of business culture and tradition of entrepreneurship;
- political risks related with vulnerable relations with Russia. A political conflict based on the ethnic issue can very easily lead to a blockade;
- organized criminality is also a serious problem. Many levels of society may be involved in this.

The main means for Latvia to achieve a growth rate in GDP are the monetary, fiscal, taxation and legislative measures, which will be targeted to:
- increase of domestic and foreign investments;
- considerably lower credit rates;
- structural reforms;
- further liberation of prices;
- accelerated privatization;
- lower inflation;
- equilibrium of the state budget;
- stability of the national currency.

All reforms in Latvia, to a great extent, have the same motivation - a wish to join the European Union and NATO. Latvia’s joining to these organizations will depend on whether it can meet all the criteria, to achieve the necessary level.

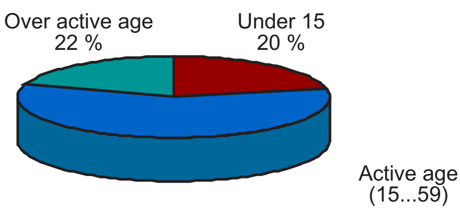

Figure 2. Age distribution of Latvian population.

2 Forest resources and their uses

Forests are of great importance for the Latvian economy, environment, landscape, flora and fauna; for many Latvians the forest also means a place for leisure activities, recreation and hunting. After the regaining independence the Latvian economy is highly dependent on renewable forest resources as well as on forest industry; in 1997 the foreign exchange of forest-based export made up 35.7% of the national total.

2.1 Forest history

In the territory of present Latvia the forest has, already for more than ten millennia, been the prevailing ecosystem which follows its own rules. The distribution of forest lands as it exists now takes its origins in the history of the country and has especially been affected by two factors, the diversity of natural conditions and man's economic activities, farming in particular. At first man's impact on the forest was insignificant, but it increased with time. The forest was used as a source of timber and firewood, tar, resin, wood charcoal, bast, game, mushrooms, berries, honey and a number of other products. In ancient times it was a common practice to burn out forest lands to revert them to fields and pasture lands instead. After repeated burning, a part of the areas under similar management practices paludified, while on another part the substrate lost its fertility and could no longer be used for farming. This situation evolved mans‘ thinking on how to manage the forest.

The earliest attempts to introduce some kind of forest administration and management date back to the early 17th century. The first laws concerning forest management were passed at that time. In Latvia the first ever published papers and books on forest management, predominantly codes of directions and pieces of advice to foresters, appeared already at the end of the 18th and the beginning of the 19th centuries. The activities of the German-origin foresters A. Leviss and A. Bode in the early 19th century are to be considered an important landmark in the history of Latvia's forestry; they provided information on forest tree species, seed production, reforestation, basics of forest management planning, and modern methods for stock volume evaluation by using sample stems.

2.2 Forest ownership

In Latvia there is a process going on towards a more market-oriented situation. The Government policy is to privatize land and other production units; this process is in its final stage. Forest ownership has been largely influenced by historical conditions and, as a result, the forms of forest ownership, in Latvia, have been changing repeatedly and radically during this century. In 1935 total area of the cadastral forests was 1.747 million ha; 79.6% of the forests belonged to the state, 17.5% belonged to the farmsteads and 2.9% were owned by the towns, industrial enterprises etc. (table 2). Actually, however, the area of the farmsteads' land where forest was growing, was considerably larger as such areas as haylandforests, pastureforests, brushwoods etc. were not all included in the cadastral forests category.

After the incorporation of Latvia into the Soviet Union in 1940, the state became the sole owner of forests and during the next 50 years about 2/3 of the forests were managed by the state forest enterprises and almost all the remaining forests were managed by the collective farms and the state farms. For example, in 1988 63.3% of the forests were managed by the state forest enterprises and 33.2% by the collective and the state farms, 3.5% belonged to the army, towns etc. (figure 3).

Since the time when Latvia regained its independence and after the land reform process was started, Latvia's forest ownership model is facing essential changes. The forest may be owned by the state, local governments and natural or legal persons. Legally, the ownership is regulated by the Law of the Republic of Latvia, assuring to all owners equal rights and equal obligations, non-violation of ownership rights and independence in carrying out their manage-

Table 2. Forest ownership structure in Latvia, 1000 ha

Year	1935	1988	1994	1995	1996	1997
Owner						
State	1390.3	1744.9	1606.3	1626.2	1626.2	1493.0
Private	306.4	-	440.3	642.9	1137.8	1275.5
Agriculture enterprises	-	916.4	215.2	46.1	20.0	18.0
Others	50.5	96.2	557.8	566.5	97.7	97.5
Total		**2757.5**	**2819.6**	**2881.7**	**2881.7**	**2884.0**

ment activities. After the land reform and the restitution of land (and also forest) ownership rights an essential part of Latvia‘s forests will be privately owned forests:

- According to the Law on Land reform, land which was in private ownership up until 21.06.1940 will be returned to previous owners or their inheritors.
- Considering the forest ownership structure before 21.06.1940 and essential increase of forest covered area since that time it is forecast that 51-52 % or 1.5 million ha of the forest will be under state ownership.
- The rest or about 45% is and will be dispersed among many small private owners.
- Municipalities are playing a minor role as forest owners in Latvia, except in the capital of Riga.
- Up until now more than 50.000 private forest management plans have already been issued.

At present 44.2% of Latvian forests are privately owned - up to 120.000 estates, average area 10-12 ha. To date the average area of holdings is too small, and the shape and location of some is unsuitable for effective forest management, utilization and protection. Further, the fragmentation of forest estates, including splitting the estate between heirs, is unavoidable. The problem is also, that a big share of private forest owners do not live near their own forests, and they do not have enough knowledge, financial resources and equipment to manage their own forests. Private forest owners’ organizations, supervision service and the forest extension and consultancy structures are developing, but many farmers are not active and this system is in the initial stage of establishment.

In conformity with the Forest Policy of Latvia, “...the public forest property is the official capital, a guarantor of realizing the nation’s ecological and social interests, while the forest property in its totality guarantees the economic interests of its owners. Irrespective of the ownership category, the forest is a national asset, with free access to it for the general public, while restrictions in the interests of forest owners are placed on the forest products utilization.” The Law gives the owner long-term and safe guarantees of management and economic independence within his estate.

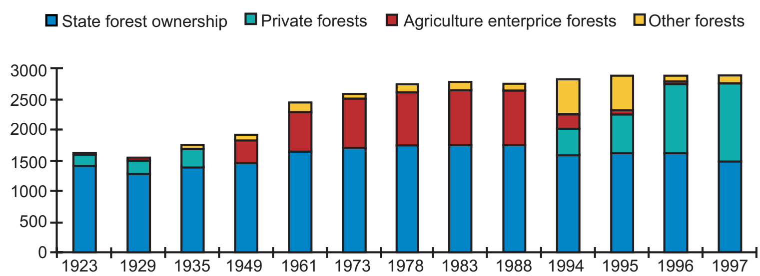

Figure 3. Dynamics of the forest ownership structure in Latvia, years 1923-1997 (1000 ha)

2.3 Land use and forest resource

2.3.1 Global overview of the land use

The forest covers 2.88 million ha or 44.6% of the total land area (table 3). 2.5 million ha or 38.8% of the territory of country is under agricultural production, 1.7 million hectares is arable, and the remainder is in pasture and meadows. In the land reform process in Latvia large areas of agricultural lands were abandoned and the process of afforestation of these lands is promoted. It is foreseen that approximately 350 000 ha could be overgrown during a 10-year period increasing the total forest coverage up to 49%.

2.3.2 Extent and distribution of the forests

Since the early 1920's the forest area of Latvia has increased from 24.7% in the year 1923 to 44.7% in 1997 presently constituting 2.884 million ha of productive forest lands. The territorial distribution of woodlands in Latvia is not even. Areas with higher forest coverage are the Central part (Riga region), the South-East area (Cesis and Madona regions) as well as the Western (Ventspils, Liepaja, Talsi regions) part of the republic. The highest forest coverage is in the Ventspils region - 60%, the lowest in the Dobele region - 26%. The age structure of Latvian forests is shown in table 4.

There are various forest growing conditions and forest ecosystems in Latvia. The adoption of Latvia's forest management practices to the demands of particular forest ecosystem-a forest site type classification was elaborated. This classification comprises groups of forest-site types. They are subdivided into five sectors: woodland with dry mineral (54.5%), wet mineral (10.4%), wet peat (12.0%), drained mineral (9.6%) and drained peat (13.5%) soils.

2.3.3 Tree species origin and distribution

Around 60% of the forest are dominated by softwoods, where 2/3 are represented by pine forests and about 1/3 by spruce forests. The main hardwood species is birch representing about 72% of the hardwood forests or 28% of all forests. Other important species are white alder, aspen and black alder. Oak and ash are represented on small areas of about 0.5% each (table 5).

2.3.4 Total growing stock, growth and total fellings

In the Latvian forests the entire standing volume is 502 million m^3 (figure 4). Mean volume of the stands is 174 m^3/ha. Trend of the average volume of all stands as well as the average volume of mature stands (mean volume - 258 m^3/ha) is ascending. Latvia's forests total current annual increment is 16.5 million m^3 (6.2 m^3 per ha annually (figure5).

Changes in the mean volume during this century display also changes in forest management. Latvia's forest resources are greater now than in the first half of the century. The higher standing volumes are in state-owned forests as a result of

Table 3. Land use in Latvia (January 1, 1997)

	Area, 1000 ha	**%**
1. Actual forest land	2881.7	44.6
2. Agricultural land	2502.7	38.8
3. Bogs, swamps	315.9	4.9
4. Roads, building site	263.3	4.1
5. Inland waters	237.2	3.7
6. Scrubland	111.7	1.7
7. Bogs for peat production	47.9	0.7
8. Waste land	10.7	0.2
9. Other	84.8	1.3
Total area	**6458.9**	**100.0**

Table 4. Age structure of Latvian forests

Age group	Coniferous 1000 ha	%	Soft deciduous 1000 ha	%	Hard deciduous 1000 ha	%	Total 1000 ha	%
Unstocked	98	5.7	29	2.6	3	9.8	130	4.6
Young stands	340	20.0	52	4.8	9	29.0	401	14.2
Middle aged	732	43.1	624	57.3	9	29.0	1365	48.4
Premature	285	16.8	151	13.9	5	16.1	441	15.7
Mature + overaged	245	14.4	233	21.4	5	16.1	483	17.1
Total	**1700**	**100**	**1089**	**100,0**	**31**	**100,0**	**2820**	**100,0**

Table 5. Species composition in Latvian forests

Species	Area %	Volume %
Pine	39.7	40.5
Spruce	20.6	19.8
Birch	28.4	24.5
Black Alder	2.4	3.5
Aspen	2.5	6.1
White Alder	5.3	4.6
Oak	0.3	0.4
Ash	0.8	0.6
Total	**100.0**	**100.0**

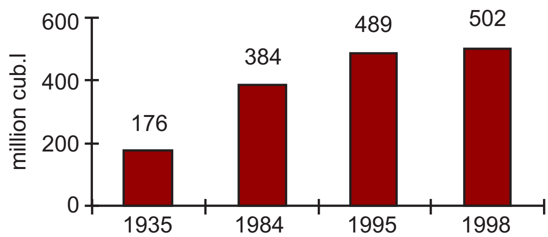

Figure 4. Total growing stock in Latvian forests.

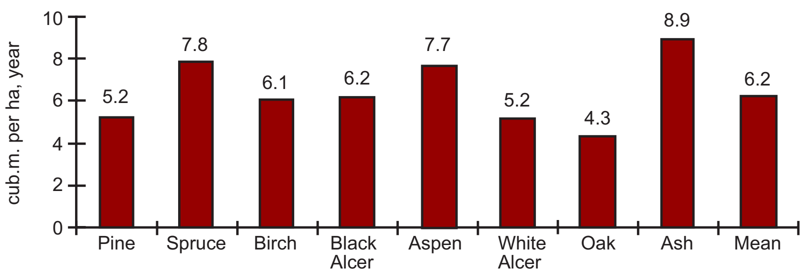

Figure 5. Current annual increment of dominant species.

better silvicultural treatment. Natural die-off is estimated to be 2.4 million m^3 per year including 1.4 million m^3 in conifer stands. The accumulation of dead and fallen stems in stands provide habitats for number of dead timber related species and serves as a forest ecosystem component maintaining forest biodiversity. Previous forest health regulations enforced the removal of all dead trees from the stand. New regulations prescribe sanitary cuttings only after the onset of forest pests; it helps to maintain a balance between both the productivity and ecological goals.

Basic information to estimate allowable cut is taken from the Latvian forest inventory system. The volumes for final and intermediate cuttings are specified in the forest management plans both nationally and at operational level. They are based on the protection status of the respective stands, the age structure and the dominant tree species. Current planning methods ensure sustainable management of forest resources. In Latvia the volume of present cut in final felling is estimated to be 5.675 million m^3, plus 2,674 million m^3 in intermediate cut, thus totaling 8.349 million m^3.

2.3.5 Damages and risks

Nowadays. as a product, the forest is Latvia's most important natural resource, constituting the highest input into the nations economy. The forests are managed and utilized primarily for timber. However, timber is not the only wealth the forest offers. Latvia contains a unique series of forest habitats, including internationally important swamp forests with a rich and endangered wildlife population. Shaped by the German and Russian school of forestry and further developed by local scholars, the Latvian system of forest management appears to be more nature-oriented than that of the majority of European countries. Low-intensity management and the intricate system of forest protection typical of the Soviet period are yet another reason for the preservation of woodland values in Latvia. Changes in the country after regaining independence, as well as in forestry and land ownership all put extra pressure on the natural resources. Forestry in Latvia is becoming more intensive. Today the goal is how to combine management efficiency with preservation of the distinguished biodiversity level. Further development is impossible without the balanced utilization of forests' wealth following the principles of sustainability.

To understand the damages and risks in the forestry sector, a SWOT analysis of the sector was carried out. The main results of forestry sector SWOT analysis are the following:

I Strengths:

- *persistent macroeconomic and political background*: integration process into the EU – progressive development and participation; finished property reforms – forest land is returned to previous owners or their inheritors, all logging and wood processing enterprises are private or share companies; ratification of the most significant international conventions on environment protection and signing the resolutions of the Ministerial Conference on the Protection of Forests in Europe; participation of Latvia in the World Trade Organisation;

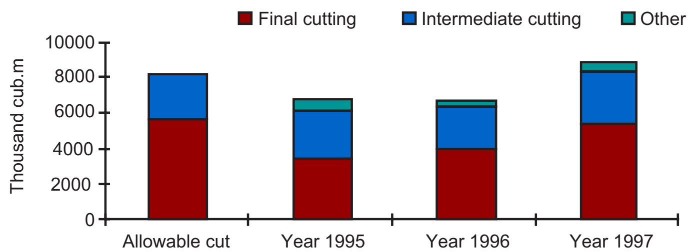

Figure 6. Forest harvesting volumes.

expected development of macroeconomic rates;
- *long term traditions and experience within the sector*;
- *the basic legal documents regulating forest management and utilization have been revised or renewed*. To comply with the principles of sustainability, provisions for biodiversity conservation, mandatory for all stakeholders in forest management, are worked into these legal documents;
- *well developed raw material accessibility*: increasing trend of forest growth and forecastability; the common roundwood market for all forest owners is functioning; experience in the raw material Eastern market, advantages in communication and mutual understanding with partners from Russia, Byelorussia and other CIS countries;
- *favourable geographical location and transport network*: strategic position – easy access to markets in Eastern and Western Europe, effective bridge between the CIS and Europe; well developed transport network, good transports links with Russia, Byelorussia and the Baltic states; three strategic all-year-round ports (Liepaja, Ventspils, Riga) and seven small ports equipped for timber and wood products handling;
- *relatively well-qualified and cost effective labour*: professional forestry and wood processing education is available at different levels and in corresponding fields, integration process of academic education - with Scandinavian and Western Europe universities is continuing; average labour cost is lower compared to EU;
- *development of an associative and consulting framework within the forestry sector*.

II Weaknesses:
- *undeveloped private forest management*: lack of experience in private forest management, including lack of knowledge in sustainable forest management; weak communication with a huge number of very small private forest estates; suspicious attitudes of forest owners towards any co-operative action, only few forest owners are the members of Forest Owners Association;
- *economy imperfections*: income from the privately owned forests is the only income for a lot of farmers in the country-side; lack of liquidity, credit facilities with reasonable conditions are not available; uneven competition with companies from other countries with better lending conditions; faults in the State taxation system leads to unfair competition due to non-payment of tax;
- *money flow in the frames of forestry sector is not regulated*: there are problems in the financing of maintenance and development of a forest infrastructure;
- *roundwood market imperfections*: insufficient information flow from roundwood market to private forest owners; resources are fragmented, insufficient logistical channels for concentration of huge volume of uniform raw material; fluctuation in roundwood market supply within 10-15 years after land reform;
- *problems of forest estate and enterprise management on the part of companies*: lack of experience in personal and business management; unsatisfactory level of Western business culture and traditions of entrepreneurship;
- *company problems in forest industry*: out-of-date technology in majority of companies; low labour productivity in some companies, which leads to low competitiveness of the industry; production capacities are away from resources, location and concentration of production capacities does not always meet optimal raw material procurement and logistical demands;
- *low value production*: share of the '*deeply processed*' wood to overall exports of wood from Latvia is still very small; during the transition period the furniture industry suffered from a lack of customer oriented strategies and a change in the market situation.

III Opportunities:
- *raw material sustainable availability*: guaranteed sustainable forest management; afforestation possibilities of abandoned agricultural lands; privatisation in Russia all increases raw material availability;
- *economic in general*: expansion of local market, domestic demand for wood products is growing slowly but steadily; special economic zones in Latvia, are attracting investment;
- *optimal utilisation of raw material*: concentration of production capacities; complex utilisation of wood – wood residues for energy

(heating, sawn timber drying, electrical power cogeneration etc., agricultural applications; utilisation of low quality timber and sawmilling residues in board industry (OSB, MDF) and pulp mill;
- *promotion of more value added processing*: modernisation of technology and machinery; product development and diversification, with a possibility to reach more market segments; promotion of furniture production – chance of application of available high quality raw material at competitive price and trained labour with know-how in the furniture business to facilitate the improvement in furniture design and architecture.

IV Threats:
- *decrease of forest* value: value of private forests in future can decrease due to incorrect management and insufficient long term sustainability; low investment level in forest infrastructure will cause difficulties in raw material procurement and decrease in forest value;
- *political and economic crisis in Russia*: raw material supply from the East is unpredictable and connected with political risks; delayed privatisation in Russia can cause shifting of large, high developed and interrelated EU timber companies from the Russian roundwood market to the Baltic Sea region.

2.4 Silviculture

Silvicultural activities create the most potential to increase forest productivity. Silvicultural treatment on a commercial basis is carried out in both exploitable and restricted management forests, except for some especially protected areas. The treatments practiced are thinning, conversion and sanitary felling, aimed at improving the tree species composition in the stand, obtaining higher yields, better quality and health of the remaining stand. This also includes the tending of newly established young stands and reforested areas. Research based on thinning models will help to achieve best results in stand productivity while simultaneously taking care of ecological values.

Woodland drainage is seen as a potential source for increasing forest productivity. Nevertheless, the best balance between forestry interests and environmental conservation still is a challenge for foresters and specialists in forest ecology. Besides, the bigger the area already drained, the greater the demand for the maintenance and reconstruction of the existing drainage systems; up to 50.000 ha of forest land once drained is now in need of maintenance. Proper management and exploitation of forest resources is impossible without a system of forest roads satisfying the defined requirements. At present the overall length of forest roads amounts to 13.100 km or 7,5 m/ha of forest, which does not comply with an optimum of 10 m/ha for forests (A.Ozols, 1995).

Reforestation after harvesting is mandatory in Latvia. About 70% of the cutting areas are reforested artificially and 30%, usually on dry sand, wet mineral and wet peat soils is regenerated naturally with pine, spruce, hard and soft deciduous species according to particular site conditions. To provide for artificial reforestation by using genetically enhanced seed and planting stock, forest seed orchards have been planted over a total area of 1077 ha. The main forest tree species are represented as follows (year 1997): pine - 826 ha (first generation - 672 ha, second generation - 154 ha), spruce - 160 ha, aspen - 11 ha, birch - 5 ha, others - 75 ha. In 1997, the total area for artifical reforestation was 28,170 ha: pine - 42.2%, spruce - 57.1%, and other species - 0.7%. Share in species of the naturally reforestated area: pine - 8.4%, spruce - 8.7%, birch - 53.1%, ash - 7.8%, aspen - 10.5%, other species - 11.5%.

Our society as well as the EU-markets has been interested in the impact of forest management on nature. In Latvia the preparatory process to carry out forest certification in the country's socio-economic and ecological conditions started some years ago. The aim of forest management is that the utilization of forest resources today does not reduce future possibilities for forest utilization and does not destroy the ecological values of forest, thus preserving them for future generations. The main principle of Latvian National Forest

Policy - state-owned and private forests- are the valuable national resources, which should be managed sustainably, including environmentally, economically and socially sound principles and techniques, to increase the welfare level of the inhabitants. Forests are of great importance for the Latvian economy, environment, landscape, flora and fauna; for many Latvians the forest also means a place for leisure activities, recreation and hunting.

Sustainable forest management and sustainable use of forest resources is one of the priority forest issues at national and international levels. The UN conference on Environment and Development, held in Rio de Janeiro in 1992, proposed a large number of activities and new projects for the promotion of sustainable forestry, either through national, intergovernmental or market-driven certification processes. In the preparation process for EU membership the Latvian Society, legislators and Government, new forest owners and producers must better understand the environmental, economic and social concerns in forestry and forest industries. The Latvian forestry and wood-processing industries are export-oriented and have faced pressure in the certification of sustainable forest management. Our society as well as the EU-markets has been interested in the impact of forest management on nature. Forest certification has emerged as a potential tool to promote forest management and Latvian exports in the major markets.

2.5 Forest production

2.5.1 Harvesting systems, accessibility

The aim of forest management is that the utilization of the forest resources today does not reduce future possibilities for forest utilization and does not destroy the ecological values of forest thus preserving them for future generations:
- Latvia's forest resources serve as a basis for fast developing forest industries and are providing opportunities for even more ambitious growth in the future.
- all State-owned forestry companies were privatized up to 1996 and large numbers of new private companies created.
- about 300 private companies are working in state forests according to long term agreements.
- most of the forestry companies are small, but only about 25 can be considered as middle size, with harvesting volumes of more than 30 000 m^3 per year.

Forest management is planned for all forested areas. Normally, the following 5 management regimes are applied:
- following the accepted management practices;
- without clearfelling;
- without final felling;
- without final and intermediate felling;
- without any management intervention.

All major harvesting operations are performed by smaller or bigger logging companies or private farmers. Some 300 companies are registered and have long term cutting contracts in the state forest. These contracts or cutting rights have normally a duration of 10-20 years. The long-term contracted volume for the 10 largest companies amounts close to 1 million m^3 annually. New cutting licences are issued with due consideration to the Latvian Government's intention to promote the development of the forest industry. About 55% of the total annual cut on state forest land is covered by long-term contracts and about 25% is sold by auctions. So called social cuttings and sanitary cuttings make up the remaining quantity.

The State Forest Service, the logging industry and environmental organisations are in favour of a system with long-term management contracts (up to a duration of 100 years). Such contracts would cover all forestry activities, harvesting and silviculture as well as infrastructural investments and maintenance.

Logging costs, as reported by the logging industry for 1996, are as follows:
- felling, delimbing and crosscutting; EUR 3.50-7.00 per m^3
- forwarding (300-400 m); EUR 3.75-6.00 per m^3
- road transport (100 km); EUR 1.50-3.05 per m^3.

The total cost will be in the range of EUR 9-16 per m^3. The variation in cost is largely due to factors such as operations in young forests (thinning), old forests (clear felling), different ground/soil conditions, and variations in dimensions and different species.

2.5.2 Timber uses

Implementation of the privatization programs increased the amount of roundwood and processed timber for sale, especially for export. Annually accepted amounts of logging fully ensured a supply of domestic raw materials for the wood processing enterprises. In Latvia the possible allowable cut would be increased up to 10-12 million m^3 in the near future (Figure 7).

The Latvian forestry and wood-processing industries are export-oriented; in 1997 the foreign exchange of forest based export made up 35.7% of the national total. Forestry and the wood processing industries play an important role in rural areas by supplying employment opportunities and by facilitating development of basic services, hence promoting regional development. This is why forestry-related activities are so important to Latvia, as in the Nordic countries (Finland, Sweden), and relatively more important than in the rest of the European countries.

At present, the forestry sector is limited by low utilization of forest resources, low quality production in certain areas, a lack of investment, and inappropriate institutional arrangements. In order to achieve its economic and social objectives, Latvia needs to encourage and promote a modern, market-led industry. It requires the Government to develop an integrated and long-term strategy. joining policy and institutional frameworks in such areas as environmental management, natural resources (forest) management, economic and industrial policy, as well as the social and political sphere with the technical potential of the forest industry. The current forest industry is dependent on long-term, stable linkages with a natural resource base (forests). On the other hand, sustained and environmentally sound forest management and utilization depends on a viable forest industry able to sell wood-based products and profitably pay for the market-value for wood.

Latvia of course is in a great need of finding ways to exploit its natural resources, and to earn foreign currency desperately needed for the development of all sectors of the countries economy. It may be tempting to export saw logs and pulpwood as this is seen as a “short-cut” to foreign currency earnings. This may, however, be a dangerous way eventually making Latvia a country which only exports raw materials, instead of the highly industrialized country it is. The export of logs should only be done if there is no practical possibilities to process the logs in Latvia and thus add more value to the raw material before it is exported. Thus it may be wise to export pulp logs, as there is no practical means of processing this part of the raw material in Latvia. If the export of sawlogs and plywood logs (blocks for peeling) are considered it is obviously quite another situation.

The main forest industries in Latvia are sawmilling, wood panel production and furniture industry. The pulp and paper industry is outdated and isn’t covering local consumption needs. There are also a number of companies specializing in some particular wood products and services. Output from sawmills has reached nearly the limits of Latvian sawlog resources while there is still opportunity to improve quality and added value of sawmilling products and production efficiency of sawmills. Main problems to be addressed in sawmilling development are: *debarking*; *sorting of logs, sawn timber and quality control*; *drying*; and a *market for sawmilling residues*. Consequently this will influence size and technology patterns in the sawmilling industry. There are three groups of panel products produced in Latvia - particleboard, fibreboard and plywood. Particleboard and fibreboard production needs an additional value to be competitive in the future; investments here are welcome. The furniture industry was and still is an important branch within the Latvian woodworking industries. Main development problems during the transition period after regaining independence were lack of customer-oriented strategies and a complete change in the market situation. Privatization is mostly completed and is considered as an important precondition to attract investment. A number of privatized and newly established private companies have successfully found their new market

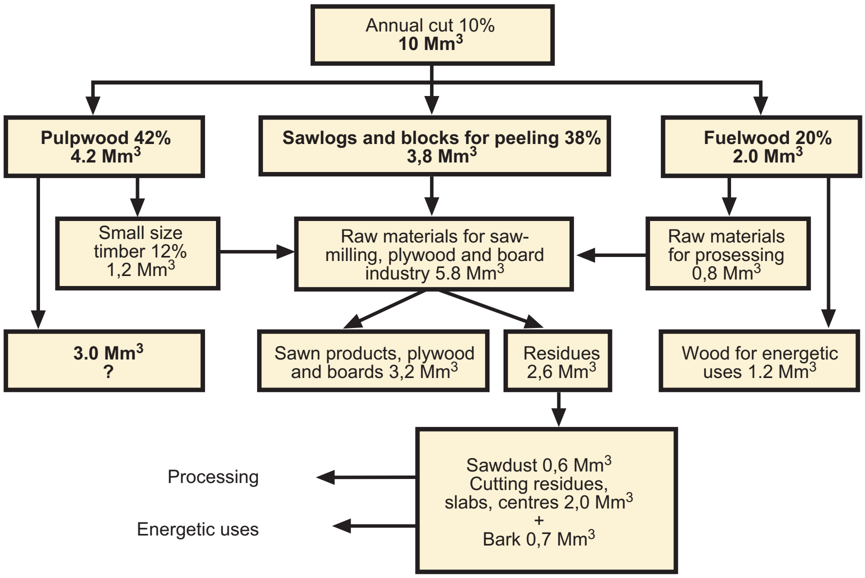

Figure 7. Possible model of wood utilization in Latvia (possible annual cut - 10 Mm^3).

niches and reoriented their production towards Western markets, local consumers or the new Eastern market situation. Currently there are slightly more than 300 companies in Latvia producing furniture or furniture components. Among them are 10 companies that can be considered as being medium sized. Now furniture or furniture components exports to Western markets have reached about 35 million EUR (year 1997) and there is definite potential for growth. Latvian furniture producers are familiar with traditions and demands in potentially huge Eastern (namely CIS) markets but risks there are still high. Investments in customer-oriented furniture design, technology and marketing are needed. The furniture industry has all the possibilities for successful development due to:

- availability of high quality raw material at competitive prices;
- good furniture making traditions in Latvia;
- trained labour and good wood processing education traditions;
- existing capacities with development potential.

Main opportunities for development and investment in the Latvian forest industry are:

- investment in technology and technology training;
- introduction of international quality control and certification systems;
- improvement of customer oriented furniture design;
- green-field chemical kraft pulp mill in Latvia (recommended capacity level - 600 000 tons annually). The new pulp mill offers new opportunities for the utilization of Latvian forests (about 3.0 million m^3 of wood annually); the wood is available in Latvia, but neighbouring countries also supply it. There is a potential to increase the utilization of sawmill residues as raw material for the pulp mill, but this potential is hampered by the present sawmill structure with general lack of debarking facilities. The project will directly and indirectly involve 13 000 to 18 000 people. Lowest possible environmental impact would be achieved through modern technology and efficient control systems. Latvian Government is fully supporting project implementation and ready to provide various incentives and assistance to facilitate its further development.

2.5.3 Non-timber forest products

Economically important forest by-products in Latvia are resin, sap, branches, Christmas trees and boughs for decoration. Also of interest are herbs, buds, bast, birch-boughs etc. Forests provide also possibilities for hay-making, cattle grazing, placing of apiaries, collection of berries, fruits, nuts, mushrooms, and other raw materials found in the wild. Latvia's forests are rich in game animals (table 6). Populations of animals particularly important in the European context for wildlife protection, such as wolves, lynx, otters and beavers show a permanent increase in numbers while wolves and beavers are nearly reaching the limits of biological capacity in our forest area.

2.5.4 Forest functions

The overall targets of Latvian forest policy are to balance possibilities in fulfilling society´s interests in maintaining ecological values of Latvia's forests and securing the implementation of social functions of forest. The forest is an important component of Latvia's environment. Therefore the aim of forestry is also to preserve the diversity of nature. Latvian forests have high environmental value. The rich flora and fauna of forests need to be conserved for future generations. There are long traditions for nature conservation in Latvia. A certain part of Latvian land area is subject to some form of nature protection. To monitor the condition of Latvia's forests a system of forest health monitoring was established and is in service. A number of sub groups of forests with different environmental values is defined and different protection and management systems applied within each of the forest protection categories. All forests are divided into three forest categories, according to their function and importance in terms of ecological, economic or other special functions (table 7).

Sections of the forest with restricted management and commercial forests (in total 248.200 ha or 8,6% of all forests) are classified as especially protected forest areas with special regulations of management. The most important ones are the following:

Table 6. Hunting animals and birds

Animals and birds	**Number (x1000), March 1**		**Hunted (x1000)**	
	1995	**1996**	**in 1995/1996**	**in 1996/1997**
Animals				
Elks	7.2	6.6	1.16	0.89
Stags	24.9	21.8	4.26	2.78
Roes	69.6	55.3	12.19	1.77
Wild boars	19.7	17.6	7.42	3.96
Wolfs	0.93	0.93	0.32	0.39
Lynx	0.70	0.70	0.10	0.07
Foxes	18.5	18.5	4.05	4.38
Otters	4.8	4.8	0.003	. . .
Beavers	26.3	26.3	1.16	2.01
Bears	0.010	0.010	-	-
Birds				
Wood-grouses	3.3	3.3	0.05	0.04
Black-grouses	17.5	17.5	0.14	0.13
Hazel-grouses	28.5	28.5	0.04	0.09
Partridge	16.7	16.7	-	-
Eagles	0.24	0.24	-	-
Wild ducks	. . .	. . .	37.73	33.3
Wild geese	. . .	. . ..	0.94	1.5
Crows	. . .	. . ..	1.66	2.1

Table 7. Forest categories in Latvia

Forest category	Area, 1000 ha	%
Class I - Protected forests. The aim of these forests is to preserve the diversity of nature: strict nature reserves, National parks, nature parks, nature reserves, suburban parks, anti-erosion forests etc. Some restricted management activities are carried out in these forests in conformity with special regulations.	330	11.4
Class II - Restricted Management forests. These forests are significant to environmental protection: protected landscape forests, suburban forests, forests for environmental protection.	525	18.2
Class III - Commercial forests - all other forests.	2029	70.4
Total	**2884**	**100.0**

- forests along rivers and lakes; 138.700 ha
- forests along roads and railways; 44.400 ha
- forests around rutting sites for cock-capercaillie; 20.500 ha
- reserved forest compartments; 11.800 ha
- forests as cultural monuments; 5.400 ha
- protected landscape forests; 4.300 ha
- sites for scientific research; 3.800 ha
- forests around protected water reservoirs; 3.800 ha
- parks and dendrological plantations; 3.600 ha
- protected margin and edge stands;3.400 ha.

To follow the condition of Latvia's forests, a system of forest health monitoring was established and is in service. The Latvia Forest Inventory Institute carries out the monitoring of forest health in Latvia. Starting in 1990 the assessment of tree crown defoliation and dechromation was carried out on 398 permanent observation plots, as well as chemical composition of foliage and vegetation. The forest monitoring is performed according to the European forest monitoring methodology. At the same time observations are done on the sample plots to monitor sources of air pollution (industrial plants, factories, etc.). Starting in 1994, introduction of the American monitoring system is continuing.

During the last few years special attention was paid in ensuring the stability and development of the ecological functions in forests. Two basic approaches were used:
- all Latvia's natural biotopes must be preserved. This means that we must also update our system of protected forest areas to match that principle;
- in Latvia, with its long-standing forestry traditions and where nearly all the forests have experienced some impact by man, it is impossible to distinguish between forest management and forest conservation. We are looking towards integrated forest functioning and goal-oriented forest management systems, where the goal determines forest management means ensuring a balance between all forest functions
- economical, ecological and social.

The goals of the national Forest Policy, related to social issues, are reached by implementing the following principles:
- general public enjoys the right of free access to the forest, irrespective of the form of ownership, with the exception of restrictions stipulated by the Law and legitimate acts;
- accounting for management practices for the forest's cultural and historical values and landscape protection;
- hunting is regulated by the Law with due regard for the owner's interests.

3 Forest economics

The economic goal of Latvia's Forest Policy is to guarantee, with ecological and social concerns in mind, sustainable development and efficiency of the country's forest sector, while providing for the maximum possible increase in additional value created via resource utilization. In view of its specific public functions, the state-owned forest should be treated as an official capital. The state as the owner of this capital has two basic interests here:

- the value of this capital (forest) must not decrease, it should increase;
- the owner (the State) is interested to draw income from its capital (forest).

The economic goals set by the forest sector are reached by implementing the following principles:
- introducing the market economy and free competition in the forest sector by creating the related legal framework, comprising a system of legitimate acts and laws on economic activities, targeted at the state deregulation in economy;
- state regulation in respect to the principles in forest utilization is intended to ensure the long-term availabilityof wood resources on a sustained basis, resulting in a predictable environment for the sector of forest products processing;
- providing for the forest sector's economic efficiency following the laws in force on entrepreneurship and legitimate acts, applicable irrespective of the form of ownership;
- the cash flow to sustain forest management is to be created by the market;
-direct state budget subsidies provide for realizing the state's public functions: regulatory, supervisory and, partly, also support;
- Management of the state-owned forest implies exercising the state's private rights in respect to its property, in so far it does not infringe on the state's public functions - environment and social concerns; the state-owned forest is covered by management activities with a required level of efficiency.

The direct contribution of forestry and forest industries to the Gross Domestic Product is calculated as 10-15%. These figures do not reflect the true economic importance of the forestry sector in Latvia. The indirect effects of the development of forestry and forest transportation, power generation, services and other sectors would be greater than the primary effects. It is estimated that about 60,000 employees are working in the forestry sector or 4.8% of the economically active population.

In developing forest industry sectors the Government is faced with several critical strategic choices concerning the overall structure of the sectors and the choice of institutional and management frameworks for the required transition enabling and promoting sustainable and environmentally sound growth. Sources, mechanisms and incentives for financing the implementation of this strategy are a major concern. In Latvia there is a long and widespread tradition in wood processing, including sawmilling. This tradition should be nurtured and exploited. Additionally, relatively small investments are required to convert a sawlog into sawn timber. Furthermore there is a large process capacity already in Latvia. This existing capacity may be utilized at a relatively low cost in the short run as the production capital is already there. As there are a large number of people who have been employed by the sawmill and wood processing industry, it is of great importance to utilize as many as possible of these people in the industry also in the future.

Latvia's forest products are going mainly for export - about 70% of the production, and the value of exported wood and wood products is growing continuously (figure 8). One of the reasons is the still limited local market. The foreign market of timber was characterized by further liberalization of the requirements to export. In 1997 the value of exported forest industry products amounted to 495 million EUR in FOB prices (figure 12). Total value of the foreign exchange of forest based export reached 532.5 million EUR, including export of woodpulp, paper and paperboard (37.5 million EUR). Main export commodities are sawn timber, plywood, pulpwood, particleboard and fibreboard. A particular increase can be seen in sawn timber exports (figure 10), where the UK is the main recipient.

Forest products trade:
- Weak domestic market for forest and wood processing products - main reason is low average income and low level of private long-term investments such as construction.
- Exports accounting for about 70% of all sales.
- Completely changed sales direction - from East to West, mainly EU (figure 13).
- Relatively high amount of exported unprocessed wood (year 1995 - 3.452 million m^3 of roundwood, year 1997 - 2.12 million m^3 of roundwood and 1.031 million tons of fuelwood).

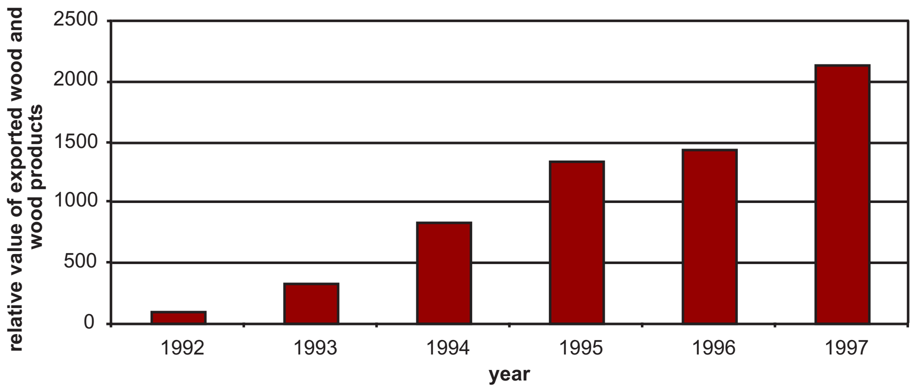

Figure 8. Growth of the value of exported wood and wood products from Latvia (relative value for the year 1992 - 100).

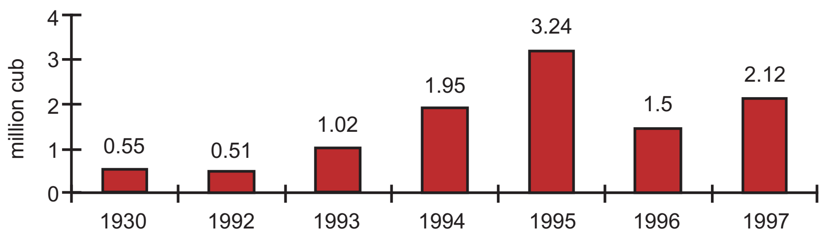

Figure 9. Dynamics of the roundwood export from Latvia.

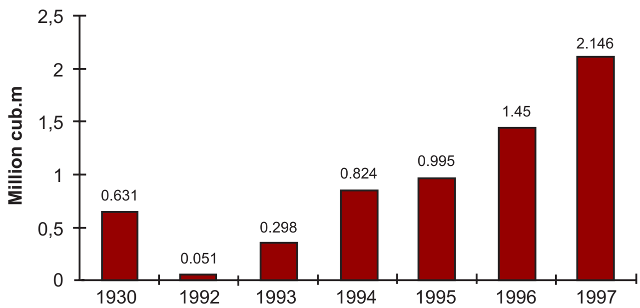

Figure 10. Dynamics of the sawn wood export from Latvia.

- High and rising environmental awareness of consumers of Latvian forest products in main importing countries as UK, Germany.

It is more effective to export timber which has been subject to a higher degree of processing. Unfortunately, during 1992 - 1997, the main product of export was roundwood (Figure 9) and in 1995, 3.24 million m^3 (47% of the forest harvesting volume), was exported. 1996 and 1997 saw a rapid growth of exported sawn wood (Figure 10). In 1997 roundwood and fuel wood export value was 17.4% of the total wood and wood products export value; sawn wood export

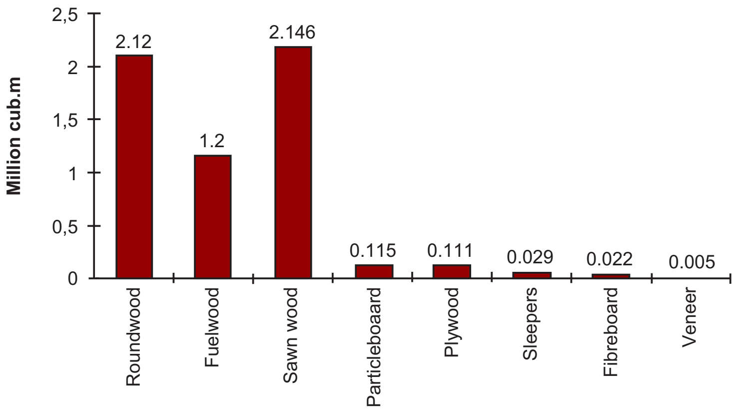

Figure 11. Structure of the wood and wood products export from Latvia (year 1997).

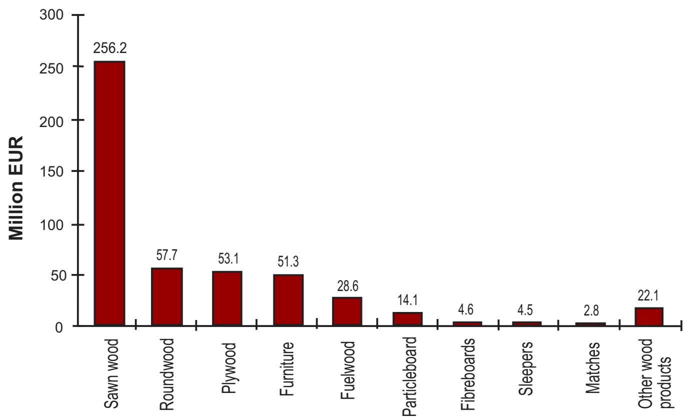

Figure 12. Structure of the value of wood and wood products exported from Latvia (year 1997).

value - 51.8% of the total, plywood export value - 10.7%, and furniture export value - 10.4% of the total value.

The average FOB price of wood and wood products exported from Latvia in 1997 was EUR 86.5/m^3. Changes in the average price of wood and wood products exported from Latvia (year 1995 - EUR 58.2/ m^3, year 1996 - approximately EUR 87.5/ m^3) are dependent on the amount of roundwood exported; once more, average price dynamics show that it is very effective to export timber subject to a higher degree of processing.

Latvian forestry is very dependent on the export markets. Sawn timber, particle and fibreboards are exported mainly to the United Kingdom and Germany, which are environmentally sensitive market areas (figure 13). The results of a representative survey, carried out by the Institute of Forest Sector Policy and Economics, Universität für Bodenkultur Wien (*E.Rametsteiner*), show, that the respondents in UK and Germany are quite satisfied with the sustainability of forest management in Scandinavian countries and in Central Europe, but they are a little or not at all satisfied with the sustainability in the Eastern European countries and that evaluation is only a little higher than shown for the tropical countries.

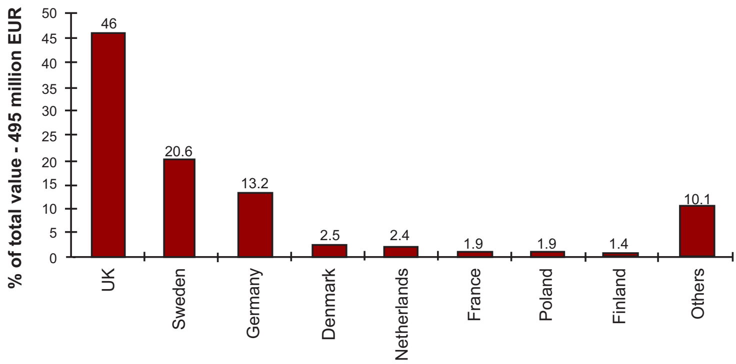

Figure 13. Wood and wood products export from Latvia (year 1997).

4 Forest and forest related policies

It is quite evident that the process of Forest Policy development and legislation formation is going along with other processes in Latvia's society and is far from completed. At the same time Latvia is following the developments in forest policy in Europe trying to harmonize our progress with an overall trend towards sustainable forest management. Major steps have been taken to adjust forestry legislation and state and public organizations to meet the present demands in forest sector.

- During the summer of 1996, new Forest Policy discussions were initiated. The main reason for this was that the existing regulatory framework did not match with the current stage of societies development, ownership structure and relations of interest groups in Latvia's forest sector, particularly private forest owners and private forestry companies.
- The main targets for Latvia's new forest Policy development was to define general goals for forest sector's development and the means and activities to achieve these goals.
- The Forest Policy of Latvia was approved by the Government (April 29, 1998).

4.1 Legislation

- Forestry related legislation has been revised or renewed in the 90's and it provides means for practising sustainable forestry in the country.
- Forestry Act defines the general principles of forest protection and management, as well as the responsible organizations, parties and main procedures of forest protection, utilization and reforestation.
- There are many legal acts issued by the Government. Most of them regulate the forest protection system, utilization, procedures used, reforestation, and forest health maintenance.
- Regulations for all forest owners including the State are equal. There are insufficient regulations to implement forest legislation principles in private forest estates. The forest act is too much instructive as opposed to restrictive.

The basic legal documents regulating forest management and utilization are as follows:
- Law on Forest Management and Utilization;
- Regulations for Final Felling;
- Guidelines for Final Felling;
- Regulations for Intermediate Felling;
- Guidelines for Intermediate Felling.

The prime intention of these documents, while ensuring the functioning of the forest as an ecosystem, is to meet the international commitments of Latvia in sustainable forest management, increase the yield of timber on a per-unit of wooded area and achieve a unified procedure in forest management and utilization. The objective is to ensure the conservation of forests' ecological values and, by promoting their regeneration by target or admissible composition stands, achieve sustainability-focused management.

4.2 Actors in forest and forest related policies

There are a number of interest organizations representing actors in the forest sector and parties interested in the environmental protection and development strategies of the sector.

- Forest owners are represented by several small initiative groups. These are still developing and currently few forest owners are represented. *Latvian Forest Owners Association* is the interest organization for private forest owners but its operations are still in an initial phase. This is due to the ongoing land reform and quite suspicious attitudes towards any form of co-operative action after 50 years of enforced collectivization. However, these groups may become more important in future.
- Forest industry is represented by Union *of Forest Logging Companies*, which looks after the interests of the private logging companies that carry out most of the harvesting, and *WWF Forest Club*. The goal of Club members (5 Latvian logging companies, who are covering 5% of the state annual harvesting volume) is to promote the development of environmentally appropriate, economically viable and socially beneficial forestry, to improve companies' performance through development and implementation policies. There are two wood processing company associations in Latvia - *Latvijas Koks* (Latvian Timber) as a representative of large and medium-size enterprises in the timber industry and *Latvian Association of Wood Processing Entrepreneurs and Exporters*, which promotes the interests of small scale mechanical wood industry, with special emphasis in quality matters and marketing.
- Environmental NGO's are represented by *Latvian Fund for Nature*, *WWF* and *Latvian Environment Club* and a number of smaller organizations.

4.3 Forest education and research

In the second half of the 19th century Latvia experienced a rapid growth of economy. Following expansion of the timber trade, greater attention was paid to forestry and timber processing. Therefore, a need for qualified specialists was created. The earliest opportunities for obtaining professional education in forestry in present-day Latvia date back to 1835, when a forestry class was opened at the Jelgava Classical School, where A.Bode worked as a teacher. The first ever Baltic School for forest rangers was started in 1898 in Vijciems, in the North of Latvia, and continued until 1929. Between 1929 and 1957 there were a number of Forest Schools in Latvia (Raiskums, Cirava, Vilaka, Lubana) training forest rangers, senior rangers, timber inspectors, assistants of tractor operators, and partly also forest technicians to work in the capacity of heads of forest districts. Right now there is only one specialized school (Ranka) training the specialists of the elementary level of qualification in forestry. There is an urgent need for well-qualified forest workers well-versed in the basics of both forest biology and technologies, including the skills to operate forest machinery. An annual demand for forest workers of high professional standards is estimated to amount to 150-200 persons at least. At the moment, there are possibilities to take some courses in forestry in the regional agricultural schools; enrolment conditions in these schools require a compulsory 9-year education. The training of workers in furniture joinery and carpentry is quite adequate - there are some 15 vocational secondary schools in this field, distributed all over the country. At present, the mid-career training of forest workers and workers of the wood processing industry (1 to 12 week-long courses) takes place at the Ogre Forest Training and Education Centre, catering for the needs of forestry sector.

Medium-level educational establishments (secondary technical schools - colleges of forestry) were started in the post War period. Until 1958, there were two technical colleges of forestry in Latvia, one in Ogre (oriented to wood processing), the other in Aizupe (forestry oriented). At present there is only one technical college of forestry in Ogre. The College is training medium-level specialists in forestry and forest operation. The medium-level process technicians in wood processing are trained at the Riga State Technical College (Technicum). The qualification level of graduates in the above fields is believed to be adequate. The improvements needed refer mainly to practical training, process engineering and economic subjects.

Specialists with a university level of qualification in forestry are trained at the Forest Faculty of the Latvia University of Agriculture (LUA). In Latvia higher agricultural and forestry education started to develop in the middle of the previous century in the Riga Polytechnical School founded in 1863. During the years of the first independent Latvian State there was a Faculty of Agriculture and Forestry at Latvia University (1919-1939). In 1939, on the basis of that Faculty, the Jelgava Agricultural Academy was founded, consisting of two independent faculties - that of Agriculture and Forestry. In 1944 the academy was renamed as the Latvia Academy of Agriculture. Its present status, as the Latvia University of Agriculture (LUA) has been since 1991.

The training of university-level specialists in forestry can be traced back to 1920, when the Forestry Department of the Faculty of Agriculture and Forestry of the Latvia Higher School (a university since 1921) was established. The programs of forest engineering and wood processing have existed at the Forest Faculty since 1949. Presently, there are three study programs at the Forest faculty at undergraduate level - Forestry (annual enrollment for full-time studies 25-30 students and for part time studies 50-75 students, too), Forest Engineering or Logging (25 full-time students) and Wood Processing (50-60 full time students and 50-75 part-time students). At graduate level (M.Sc. studies) the program in Forest Economics and Policy is offered, also. The Ph.D. studies in forestry and wood processing are organised at the LUA, also.

Forest science in Latvia was drawn from both the German and Russian traditions, as in the field of forestry until the post World War I period, there were no higher educational establishments in the Baltics. The Handbook of Forestry in Vidzeme by A.Leviss published in 1814 may be regarded as the first manual in silviculture. Regular research work in the field of forestry may be said to have started in 1867 when the Baltic Foresters' Society was founded. Eizens Ostvalds could be mentioned as one of the most eminent foresters and forest scientists of Latvia, who was the first to publish research data supporting forest land drainage as well as worked out the theory of ground rent as applied to forestry. The first research organization, the Latvian Forest Research Station, was set up in 1928, headed by the prominent Latvian scholar Kriss Melderis (1889-1942). The leading researchers were dealing with the most topical problems of practical forestry of that period: reforestation of sandy and low-fertility sites, promotion of natural forest regeneration, thinning, as well as introduction of exotic tree species and rational methods of timber harvesting.

A new period in the development of forestry and forest science in Latvia started after the incorporation of Latvia into the Soviet Union in 1940. The establishment of the Latvian Academy of Sciences in 1946 was set up alongside the organization of the Institute of Forestry Problems. Since 1953, with the Forest Research Station "Kalsnava" set up at Jaunkalsnava (the Madona region in the central upland part of Latvia), the Institute, namely its silvicultural divisions, has a permanent research base. In 1963, as a result of the restructuring of the Academy of Science, a number of institutes, mainly those oriented to applied research, were transferred under the administration of the respective branch of economy. On the basis of wood chemistry laboratories the Institute of Wood Chemistry was founded; in 1966 it was turned into a centre for coordinating research activities all over the Soviet Union in the field of wood chemistry and related branches. The forestry-orientated divisions as well as the Forest Research Station "Kalsnava" were merged to form the Latvian Research Institute of Forestry Problems "Silava".

After the regaining of independence by Latvia in 1991, along with the fundamental changes in the political and economic life of the country, a turn to privatization and market economy broke down the organizational framework of science created by socialism. At present the Latvian Forestry Research Institute "Silava" and the Forest Faculty of the LUA still remains at the hub of research and development work in the forestry sector, regardless of the difficult situation, of a limited material and technical base. Unfortunately, Latvia, a country rich in forest resources, experienced the collapse of a number of institutions within the organizational set-up of the forestry sector, with the scope of research reduced accordingly. However, forest science was successful enough to win legal recognition. The brainpower within this branch of science amounts to 110 Dr. of science and 15 persons conferred to the title of Dr. Habilitus.

In the course of time Latvia's forest science has, in all the principal spheres of research, shaped standing traditions of its own:

4.3.1 forest environment and silviculture

The forest typology, in line with local; natural and climatic conditions, is the cornerstone of silviculture in Latvia. The conclusions inferred in the studies on forest typology and hydrology enable us to evaluate forest ecosystems as being self-regulatory. In the domain of forest environment and silviculture, the problems identified and dealt with are as follows: structural model for the prospective forests of Latvia, hydrotechnical amelioration of forest lands and their appropriate management, ecologically sound and economically feasible fertilization of forest stands, forest vitality and the ground vegetation as bioindicator, game management as a part and parcel of forest management;

4.3.2 forest plants and forest protection

Latvia's forests are made up predominantly of indigenous tree species. In the sphere of forest tree species and forest protection, the problems identified and studied are as follows: exploration and protection of the indigenous forest tree gene pool, seed production of pine and spruce, selection of larch species for perspective cultivation in Latvia, cultivating forest tree varieties, a model for natural forest regeneration, tree nursery technologies, soil microflora and agrochemical characteristics of non-forest land in connection with prospective afforestation of abandoned farmlands, vegetative and microclonal propagation of trees, phytopathological and entomological inspection of forests and phermone application in pest control, dynamics of forest pests and forecasts of outbursts, the problems of forest monitoring;

4.3.3 forest operations and techniques

In spite of tough command policies concerning the mechanization of forest operations in the former Soviet Union, the Latvian scientists dealing with these issues, nevertheless, managed to develop and implement technologies and machinery suitable for Latvian conditions, including the methods of rational evaluation of timber felled by applying either tree-length or assortment technology. In the sphere of forest operations and machinery, the following problems are under investigation: diverse modern methods in timber harvesting, their evaluation and testing; operational availability and feasibility of diverse type of forest machinery, evaluation of the test results in terms of silvicultural constraints, impact of the machine and the related technology on stand performance in the future; mechanization of operations for stimulating the natural regeneration under conditions prevailing in Latvia; operating efficiency of different groups of forest workers and the methods for protecting and improving their status of health;

4.3.4 forest inventory, growth, yield, quantitative and management sciences

Forest management in Latvia was completed already before World War II. Now it is repeated on a regular basis by specialists of the Latvian Forest Inventory Institute. The inventory work resulted in the construction of a forest management plan, making provisions for thinnings, final felling and regeneration. The planning of game management is done along with the inventory work by a separate group of experts. In forest inventory and growth and yield studies the following problems are dealt with: shaping the forest stands and a follow-up of their course of growth, forest inventory and forest management, evaluation of feed resources;

4.3.5 forest products

Wood processing and conversion in a variety of ways has so far been investigated by a number of organizations (the LUA, the Riga Technical University, the one-time Research and Production Association “Gauja” as well as by the Institute “Silava” and the Institute of Wood chemistry). Developments of the post war period gave rebirth to wood chemistry in Latvia, with the main achievements as follows: the Riga method in wood hydrolysis, preservation of wood, delignification of wood, utilization of pentosanes, structure and utilization of lignin, etc. In the sphere of forest products utilization the following problems are identified and dealt with: evaluation of wood and timber quality, seasoning of wood, chemical composition of tree foliage and bark, utilization opportunities of plant protection agents (fungicides and insecticides) derived from tree biomass components, multicomponent antioxidant protective paints and the related technologies to prevent decay of wood; delignification, cellulose chemistry, wood chemistry;

4.3.6 social, economic information and policy science

The first studies of forest economics and policy problems were carried out by Prof.E.Ostwald (*Theory of Forest Land Rent*) and Doc. K.Teikmanis (late 20s). Unfortunately, after Latvia was occupied by the Soviet Union, any research in forest economics and policy ceased, and it was only in 1967 when the Laboratory of Forest Economics was set up in the framework of the Institute “Silava”. The research of that period had a completely different orientation, mainly in line with the demands of a centrally planned economy: working out norms, economic validation of new projects, forecasts of the forestry complex etc. After 1990 a reorientation in economic studies had to be undertaken with a 50-year long gap between the situation as of now and the forest economics as existed in the 30s. The content and main directions of the research projects in forest economics and policy now making headway are as follows: place and role of the forestry complex in the country’s macroeconomics, developing a flexible forest policy in Latvia and forestry legislation; forest and environment; updating the problems of forest economics typical for Latvia and developing the related system of economic studies for the forest sector; land use and forestry, socio-economic and management studies of private forestry; timber processing and conversion, marketing of forest products, etc.

The given problems, in compliance with the international commitments Latvia has undertaken, require both fundamental and applied research. In dealing with the research problems identified, the Latvian forestry scientific community is looking forward to a mutually advantageous cooperation on an international scale.

5 Main current conflicts and challenges in the country

5.1 Role of the State in the coming decades

Distribution of the State functions among different institutions where appropriate from a professional and economic point of view:
- Separation of the main functions - policy development, law enforcement and owner function in different institutions (the institutional framework is in development).
- Improving the awareness and skills of the private forest owners to manage their forests in a sustainable way, etc.

The State’s role in ensuring Sustainable Forest management is to create, by the instruments at its disposal, favourable conditions for achieving the common goals of the Forest Policy, i.e. the integrated development of the ecological, economic and social functions of the forest. In the forest sector, the State performs four basic functions:

I *Policy and normative function*:
- Formulation of the Forest Policy and its coordination with other policies.
- Development of legal (normative) means to implement the Forest Policy.

- Involvement of interest groups in the development of the Forest Policy and legal means.

II *Law enforcement and supervision*:
Developing an institutional system to ensure an equal environment for all forest owners and actors in the forest sector while implementing the Forest Policy and its legal means, including the control of Law observance in all the forest estates irrespective of their ownership status.

III *Management of the state owned forests*:
Implementation of the state forest management system to ensure:
- the development and stability of ecological and social values of state forest and to provide income (if possible) to the owner - the state;
- create a stable business climate in state forests where business is possible in compliance with the principles of Sustainable Forest Management.

IV *Support functions*:
- Academic and professional education, forest research.
- National forest inventory and management planning
- Extension
- Forest fire control
- Control of forest reproductive material

Addresses of organizations related to forestry in Latvia

Ministry of Agriculture, Forest Department, 13.Janvara iela 14, Riga, LV-1932, Latvia; tel.: +371 7228873; fax.: +371 7211176

State Forest Service, 13.Janvara iela 14, Riga, LV-1932, Latvia; tel.: +371 7226600; fax.: +371 7211176

Latvian Foresters Society, Kristapa iela 30, Riga, LV-1046, Latvia; tel.: +371 7611874

Latvian Trade Union of Forest Workers, Bruninieku iela 29/31, Riga, LV-1113, Latvia; tel.: +371 7272818; fax.: +371 2276720

Latvian Forest Owners Association, Upes prospekts 16, Ogre, LV-5001, Latvia; tel.: +371 5044388; fax.: +371 5047270

Latvian Union of Forest Logging Companies, Meistaru iela 10, Riga, LV-1050, Latvia; tel.: +371 7216799; fax.: +371 7220238

Latvian Association of Wood Processing Enterprises “Latvijas Koks”, Skaistkalnes iela 1, Riga, LV-1004, Latvia; tel.: +371 7228374; fax.: +371 7860268

Latvian Association of Wood Processing Enterpreneurs and Exporters, Brivibas iela 91, Riga, LV-1001, Latvia; tel.: +371 2372876; fax.: +371 7311075

Association of Latvia Wood Products Quality Inspectors, Dzerbenes iela 27, Riga, LV-1006, Latvia; tel.: +371 2558024

Latvian Fund for Nature, Kronvalda bulv.4, Riga, LV-1842, Latvia; tel.+371 7322852; fax.: +371 7830291

WWF Latvia, Kr.Barona iela 64, Riga, LV-1011, Latvia; tel.: +371 7311488; fax.: +371 7311939

Latvian Ornithological Society, P.O.Box 1010, Riga, LV-1050, Latvia; tel.and fax.: +371 7221580

Forest Faculty, Latvia University of Agriculture, Akademijas iela 11, Jelgava, LV-3001, Latvia; tel.and fax.: +371 3021619

Latvian State Forestry Research Institute “Silava”, Rigas iela 111, Salaspils, LV-2169, Latvia; tel.: +371 2942555; fax.: +371 7901359

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The Netherlands

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1 The Country

1.1 Natural Conditions

The Netherlands are situated in the Northwest corner of the European main land, between 50.45° and 53.32° Northern latitude and 3.19° and 7.11° Eastern longitude. Its area is about 36.000 km², or 41.000 km² if the IJsselmeer and Waddensea, both under water, are included. Its height ranges from 322 m above to -6 m below sea level. About 40 % of the Netherlands would be under water if the Dutch had not taken protective measurements, i.e. had not built dikes.

1.1.1 Geology

The land surface consists mainly of quaternary deposits on a tertiary basis. The latter lies around 600 m deep in the Northwest, and comes to the surface in the East and South of the Netherlands. The older quaternary deposits (Pleistocene) are partly marine; by rivers Rhine and Meuse in the Eastern part, by the sea in the coastal region. During the middle and late Pleistocene glacials these first sediments were pushed into ridges, which still are a striking feature of this landscape. Afterwards during the cold period in the late Pleistocene aeolic sediments covered large areas with cover sand and, only in the South, with loess.

In the Western and Northern part of the Netherlands the Pleistocene deposits are covered by Holocenic material, mainly clay. Due to a sinking basin and rising of the sea level, the sea repeatedly encroached behind the dunes where peat was formed afterwards. Of course along the rivers in the areas where Pleistocene sediments are still on the surface, Holocene clay has been deposited.

1.1.2 Climate

The climate of the Netherlands is a Cf climate according to Köppen; a humid temperate and mild climate, owing to the proximity of the North Sea and the warm Gulf Stream. The mean annual temperature varies from 9.5° C to 11.2° C, depending on the place. Severe cold and severe heat are rare, but night frost may occur as late as May/June and can cause severe damage. On average about 805 mm of rain falls each year, with a relatively dry period in February - May and a wet period in July - November. A precipitation deficit in summer and a residue in winter results, however, in an annual precipitation residue. The prevailing winds are Southwest and West. Gales occur once per decade.

Regional differences in climate, although slight, are important to plant growth. In a flat country differences in altitude have only minor influences, although the effect of the coastal dunes and the inland hills is notable. The proximity of the sea is of more importance and differences between a more maritime and a more continental climate are felt within the narrow strip of land the Netherlands is (150 km between the beach and the border with Germany).

1.1.3 Soils

Depending on its geological origin, the higher Pleistocene areas have sandy soils, with a low nutrient and water availability. Due to a precipitation excess, these soils are mainly brown podzolic soils, quite often impoverished by man (heather!). Most older (i.e. established before the second half of this century) forests in the Netherlands are growing on this kind of soils. Good river clay soils occur along the rivers and are mainly used for animal husbandry. Marine clay soils along the coast and peat soils in the same regions are used for agriculture and animal husbandry.

1.1.4 Natural vegetation

According to Noirfalise (1987), the Netherlands are covered by the following vegetation types/ ecological zones:

- Coastal dunes in a small band along the North Sea;
- Maritime polders in a broader band east of these coastal dunes;
- Fresh-water marshes in a smaller and shorter band, east of the middle and northern part of maritime polders;
- Fluvial plains along the big rivers;
- A mixture of Oak-Birch forest of the North Sea Plane and Subatlantic Oak-Beech forest south of these big rivers;
- A mixture of Oak-Birch forest of the North Sea Plane and Subatlantic Oak-Beech forest in the middle part of the Netherlands
- A mixture of humid Oak-Beech forest of the North Sea Plane (humid sand) and Subatlantic Oak-Beech forest in the eastern part;
- Raised bogs in the small peaty areas on the Pleistocene deposits.

1.1.5 Man-made landscape

A special characteristic of the Netherlands is that most of its landscape is man made. It was already mentioned that about half of the Netherlands is below sea level and would be inundated without protective dikes. Polders were recovered from the sea already during the Middle Ages, and during the 17th century large lakes behind the dunes were reclaimed and turned into agricultural land. The same was done before and after the World War II in the IJsselmeer. In the 19th and 20th century peat was used as fuel at a large scale: peat was dug and removed and the remaining land used for agriculture. Large areas of drifting sands (due to overexploitation) and heath lands have been put into use through afforestation by private landowners and by the state. An undisturbed soil profile is rare in the Netherlands.

1.1.6 Land use types

The Netherlands is a densely populated country (Chapter 1.2.1) and the lack of space makes that the countryside is almost permanently under pressure. People wish to live, work and recreate there. Also economic production and transportation have to take place. In addition, valuable nature and landscape has to be guarded for future generations. Not surprisingly, one of the most important issue in the Netherlands is to find a fitting balance between the different functions of the countryside (Ministerie LNV, 1998).

Agriculture has traditionally been the major type of land use in the Netherlands. During the 20th century its land cover increased from 64% in 1900 to 73 % around 1980 (Table 1). However, since 1980 its importance declined somewhat. During the same period the forest cover increased, as did - but more rapidly - the area covered by houses, towns, industrial plants etc. Other types of land uses, connected to the societal developments (infrastructure, air ports, rubbish dumps, etc.), increased as quickly. These developments were at the expenses of more natural areas like, heather and peat moors, water (new polders !), which declined in this period from nearly 25 % to a paltry 6 %. At present this decline has stopped and new efforts are undertaken to enlarge forest and nature areas.

1.2 Society

1.2.1 Population

With an area of 4.15 mln ha the Netherlands belong to the smaller West European countries, such as Denmark and Belgium. With 15.65 mln inhabitants and a population density of 460 persons per km^2 it is one of the most densely populated countries in the world. The population is still growing with 6.8%, amongst others due to immigration. The highest concentration of in-

Table 1. Distribution of different forms of land use in the Netherlands in the 20th century

Land use	**1900**	**1950**	**1980**	**1990**
Forest	8.2	7.6	9.0	9.7
Heather/peat moor	13.1	3.4	1.4	1.3
Moor, beach[I], land outside dikes	5.0	3.7	2.9	2.6
Water	6.6	3.4	2.2	2.4
Agricultural land	63.7	73.1	72.9	70.8
Built-on area's	1.6	2.9	5.9	7.5
Other[II]	1.8	5.9	5.7	5.7

[I]) including dunes, moving sand etc.
[II]) including open water, infrastructure, recreation areas, airports, rubbish dumps, etc.
Source: Dijkstra, 1997

habitants is in the 'Randstad' in the western part of the country bordered by the cities of Amsterdam, Haarlem, The Hague, Rotterdam and Utrecht. The Netherlands is traditionally open for foreigners and the international population contains ethnic groups from different parts of the world, with main groups from North African, Indonesian, Surinam and Antillan origin.

1.2.2 Political structure

The Kingdom of the Netherlands is a constitutional monarchy. The head of the kingdom is Her Majesty Queen Beatrix. For a governmental structure the Netherlands use the parliamental democracy. The parliament has two 'Chambers': the 'Tweede Kamer' (150 members) is directly elected by the people and the 'Eerste Kamer' is indirectly elected by the Provincial Councils. There are three governmental levels: the State, the 12 Provinces and around 600 Municipalities.

The citizens of the Netherlands are politically active. They are not only active on the level of the municipality, but also on the state level there are many small parties in the Netherlands. At this moment (1999) the land is governed by a 'purple' coalition of three parties with a social-democratic, liberal, and conservative background. Another characteristic of the political involvement of many Dutch citizens is the high degree of organisation: almost every opinion or policy issue is supported by a finely detailed network of associations and societies acting either as lobby groups or being involved with the implementation of specific policies.

1.2.3 Economy

The Gross National Product of 304 milliard ECU or 1,960 ECU per head of the population (1996) makes the Netherlands one of the prosperous countries in the world. The economy is very internationally oriented, with Rotterdam as the largest harbour in the world and a central distribution point for the mainland and Schiphol as a large international airport. The services sector is the most important, income and job generating economic sector before industry and agriculture. The agricultural sector employs less than 5% of the population, but makes up for 10% of the international trade of the EU in agriculture products and nutrition (Ministerie LNV, 1998). The contribution of forestry to the GNP is only minor (Chapter 3).

1.2.4 Societal changes

After the second World War the main social preoccupation in the Netherlands was with the rebuilding of the productive economic structure. Since the early 1950s this emphasis has gradually been augmented by several other social concerns. Several major societal changes have taken place, i.e

- Population growth and urbanization;
- Growing amount of leisure time and increased mobility resulting in growing importance of recreation and tourism;
- Development of increased environmental consciousness coupled with increased appreciation of nature;

- Increased democratic decision making and decentralisation of governmental action.

The consequences of these changes for forestry will be discussed in Chapter 5.

2 Forest resources and their uses

2.1 Definitions

According to the fourth Forest Statistics (CBS, 1985) forest (*bos*) is a land area covered with trees or bushes with an area of at least 0.5 ha and a minimum width of 30 m (Anonymous 1995). Two classes are distinguished: closed forest (> 60 % canopy cover) and open forest (< 60 % canopy cover). Besides forests, road site plantations (mainly a single line of trees, sometimes two or more) play an important role. Although forests are officially defined as having a minimum area of 0.5 ha, for practical policy purposes their minimum size is considered as 5 ha. For instance, all forest above 5 ha must be registered with the Forestry board. Forest(plot)s between 0.5 and 5 ha comprise about 17% of the Dutch forest area and they fulfil important landscape functions, but they are hardly considered in the official forestry policies.

Forestry (*bosbouw*) is defined as all resolute human activities aimed at sustainable fulfilment of all forest functions for (different groups in) the society.

Forest management is defined as the preparation, taking and execution and implementation of decisions including the evaluation of the results, regarding use and preservation of forests to achieve the objectives of the owner.

Silviculture can be defined as the resolute manipulating of forests based on a coherent set of - on ecological knowledge based - measures aiming at a fulfilment of given functions in a sustainable way.

2.2 Forest resources and their uses

2.2.1 Forest history

Around 2000 years ago, the Netherlands were nearly completely covered by forests, only too wet (lakes, marshes) and too dry sites (dune tops) were not covered by forests. Around that time the local population started shifting cultivation, diminishing the forested area. Since then, with changing intensity forests were destroyed by (over)exploitation until at the start of the 19th century only about 2 % (70 000 ha) of the land area was still covered by forests. These were mainly situated on the poorer soils in the eastern part of the country, and - in fewer cases - on better soils around country houses for the noble and or rich people. Since then first private landowners (first half of the 19th century), later also the state (second half of the century) afforested larger areas of land. Mostly the so-called wastelands situated on the poorer soils were used for this afforestation. During the 20th century afforestation continued, first to procure employment, later as part of the landscaping of the new polders. The growing importance attributed to forests is well-illustrated by the afforestation policy in the new IJsselmeer-polders (table 2). In the oldest of these polders (Wieringermeer, Noordoostpolder) only an small percentage of the area was allotted to forestry, this concerned soils not suitable for agriculture. This policy changed around 1975, and in the more recently established Flevoland polders a larger area of land was afforested, also on the better soils. This change reflects the gradual decline of the importance of agriculture which occurred in the 1970s. As a result since that time also agricultural lands became available for afforestation under the set-aside arrangements. Moreover, increased attention is also given to establish new forests in the densely populated western part of the Netherlands as a means to provide recreation opportunities for the urban people. As a result of all these developments the forest cover increased from 270 000 ha in 1900 to 340 000 ha in 1993. At the same time nature areas decreased rapidly from 620 000 ha in 1900 to 220 000 ha in 1950 and more slowly to 140 000 ha in 1993 (figure 1).

Table 2. Year of establishment and land use of IJsselmeerpolders.

Polder	Establishment	Forest & nature	Agriculture	Towns & infra-structure
Wieringermeer	1930-1940	3	87	10
Noordoostpolder	1942-1962	5	87	8
Oost Flevoland	1957-1980	11	75	14
Zuid Flevoland	1968-1995	35	48	17

Source: Reyer Knol, pers. comm

2.2.2 Present forest cover

According to the most up to date, i.e. fourth, Forest Statistics, published in 1985 (CBS, 1985), The Netherlands has 334 026 ha of forests; this means that forests cover 9.8% of the land area. The average area of forest per caput is only 235 m^2. The distribution over the Netherlands is unequal (figure 2), in the more densely populated provinces in the Western part of the country (Holland[1]) and the agricultural provinces in the North and Southwest forest cover is about 1 to 4 % with less than 100 m2 of forest per inhabitant, in the other provinces forest cover ranges between 10 and 20 % and between 200 and 1300 (Flevoland) m^2 per inhabitant.

The government aims to expand the area of forest still further to 400,000 ha in 2020. This expansion policy focuses on establishing new forests on low-value agricultural lands which are taken out of production (which are situated mostly in the northern part of the country) and on creating forest near areas with a high population density, like the 'Randstad', where the recreational function will be most eminent. In addition, these forests act as landscape buffers against unplanned extension of urban areas (Ministerie LNV, 1993).

2.2.3 Forest ownership

In the Netherlands forest ownership is rather diverse. Forests are owned either by private owners (41 %), the state (31%), local authorities and other public bodies (16%) and nature conservation organisations (11%).

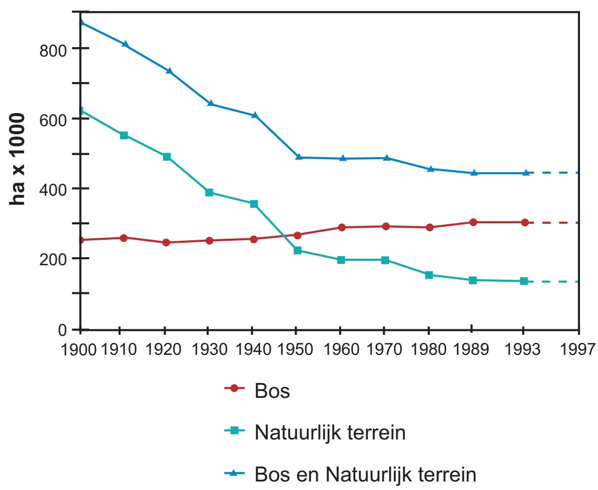

Figure 1. The development of the area forest and nature in the Netherlands between 1900 and 2000. Source: van Duuren and Lengkeek, 1997.

[1] Holland is derived from Holtland, meaning wooded land.

Figure 2. Forest in the Netherlands.
Source: Anonymous 1995

At present almost 50% of all Dutch forests are publicly owned. Most of these public forests (62%) are owned by the state, about 30% by municipalities, and the remainder by provinces and public organisations such as water supply companies. Around 1940 the areas of forests owned by municipalities and the state were more or less equal, but since that time the state forest area has increased considerably (table 3). This reflects the opinion which prevailed during most of the 20th century, that due to the long production cycles as well as the multiple functions of forests of which many cannot be financially rewarded through market mechanisms, the state holds a major responsibility to maintain forests. Thus, during much of the 20th century, the state has taken over many of the private forests being sold by their owners. The State Forest Service is in charge of managing these forests.

The area of non-public forests is owned either privately or by nature conservation organisations. In contrast to the relatively large tracts of state owned forest, the forest plots owned by private persons are characterized by their small size. About 45% of the private forests are between 0.5 - 5 ha in size; only 18 private owners have a forest area of over 500 ha. For most private owners forestry is not their main means of livelihood, rather forests are kept as part of estates, as ancestral lands, or outdoor recreation area for the family. Especially for small private landowners the motives to maintain forests are mostly amenity and conservation reasons rather than productive and financial reasons. Consequently, forest owners tend to be rather individualistic and many are not professionally oriented at forestry.

The financial results of private forest enterprises were mostly negative during the last decades. Notwithstanding the fact that for many forest owners financial gains from forestry are not the major motive for maintaining forests, the continuous financial losses in maintaining forests and the relatively high inheritance tax to be paid

Table 3. Forest ownership in 1983 and 1997

Owner	1980-1983([I])	1997([II])	
	ha	ha	number
State	104 323	101 818	133
Provinces	2 472	1 742	12
Municipalities	50 258	43 812	326
Other public owners	2 345	5 717	53
Nature conservation agencies	37 486	55 489	164
Private owners	136 385	51 314	1311
Total	**334 026**	**260 092**	**1999**

[I]) Inclusive area's < 5 ha. Source CBS, 1985, Anonymous, 1995.

[II]) Exclusive area's < 5 ha. Source Bosschap 1998, exclusive area's < 5 ha.

after the death of an owner have forced several private forest owners to sell their forests. Consequently, during the last fifty years the area of private forest ownership has decreased by 25%. Up till the 1970s these forests were mainly bought by the state. But since that time forests have increasingly also been bought by nature conservation organizations, in many cases with financial support of the government. Recently private forestry is again increasing somewhat, especially due to the afforestation of farm lands.

Traditionally, forest managers exercised a relatively strong influence on forestry policy, especially due to the fact that the State Forest Service originally had a triple role: managing state forests, giving extension to private forest owners, and forest policy development and implementation. In 1988 this service became a semi-autonomous forest management agency without responsibility for forestry extension and policy development. With respect to the owners of non-public forests the nature conservation organisations have a much stronger political profile than the private forest owners.

2.2.4 Forest functions

In the beginning of this century forests served a limited number of functions: wood production, stabilisation of sand dunes and soil improvement, and (for a small group of wealthy estate owners) prestige and hunting. Since the 1950s forest functions have gradually diversified and at present the forests have a multiplicity of functions for Dutch society (Van Vliet, 1993; Oosterveld, 1997). The 1984 Long-term Forestry Plan officially recognizes the following functions: outdoor recreation, timber production, natural values and landscape quality; in the 1993 Forest Policy Plan environmental functions were added.

Obviously, wood production is one of the functions of the Dutch forests. Annually around 1.3 million m^3 of wood is harvested. About 50 thousand people are employed in forestry and wood production and processing (including that of imported wood); the annual value of wood trade and processing is approximately Dfl 14 billion (Schouten, 1995). However, this wood production function is not considered as being the most important function. This is caused by the fact that the local wood production supplies only 7% of the domestic wood consumption, with the remainder being imported from other European (mostly Scandinavian) and tropical countries. Moreover, with the Netherlands being urbanised about 85% (Wiersum and van Vliet, 1998 *ex* OECD) the recreational and nature functions of the forest are highly valued. Annually about 200 million visits to forests are made; the average number of visits is 600 persons/ha/year, but this number may increase to 10,000 /ha/year for the most intensively visited forests. And over 1 million persons are a member of the Dutch nature conservation organisations; these own around 11% of the forests. The inhabitants have a profound impact on the nature conservation and forestry policy through these NGO's.

Also the environmental functions of forests are increasingly acknowledged and sometimes also financially rewarded. For instance, recently electricity companies are occasionally funding afforestation as a means to sequester carbon-dioxide. Similarly, a water supply company has started a trial to compensate forest owners for switching from coniferous to deciduous species in order to decrease evaporation and thus to reduce parching (Filius & Roosenschoon, 1998). Another function of increasing importance is the improvement of the living environment of housing areas. In some areas, the vicinity of forests adds up to 10% to the value of real estate property, amounting to billions of guilders in total.

The multiple functions of forests are usually reflected in forest management. Nonetheless, due to the diversity in forest owners, each having its own specific objectives for maintaining forests (Chapter 2.2.3), there exist quite some variation in the degree to which specific forest areas fulfil specific forest functions. Table 4 illustrates this with regards to the main management function as reported by various categories of forest owners.

2.3 Forest resources

2.3.1 Forest types

The most widely used classification of Dutch forests is the one developed by van der Werf (1991). Based on the potential natural vegetation, he described 33 forest types divided over 5 classes and 10 orders. An overview of the most important alliances and associations is given in table 5.

2.3.2 Main trees species

In view of the history and prevailing location of the Dutch forests, it is easy to understand that *Pinus sylvestris* is the main species in Dutch forestry (Table 6). Until 1970 even more than half of the Dutch forests consisted of Scots pine, but their dominance has declined to 35%. This decline has a number of reasons:

- The ripening (ageing) of the forest ecosystems (soils), making them suitable for other species (*Betula*, *Quercus*);
- The fading away of the timber market for pine wood (till 1965 pitprops, till 1975 pulp and paper wood);
- The afforestation with broad-leaved species on better soils such as in the new polders;
- Changes in forest management objectives (Chapter 2.4).

It is still disputed whether *P. sylvestris* is an autochthonous species, surviving along the borders of peat moors. Already in the 14th century imports from seeds were recorded. However, trees which are considered as Dutch provenance's are better suited to the local growing conditions (climate, resistance against *Lophodermium seditiosum*) than trees from foreign provenances. The other main coniferous species (*Pseudotsuga menziesii*, *Larix* spp., *Picea* spp. and *Pinus* spp.) predominate in about 25 % of the forests; these species were planted in the past mainly for timber production. In response to the changing objectives in forest management, there is a tendency to converse spruce plantations. Douglas fir will be maintained as a timber tree, but as an

Table 4. Main forest management objectives by owners in K ha in 1985

	Timber	Nature	Land-scape	Tourism	Hunting	Others	Total
State	56.4	24.2	7.8	6.0		7.4	101.8
Provinces		1.9	0.5				2.4
Municipalities	12.1	10.2	7.6	15.4		3.8	49.1
Other public owned	0.8	0.1	0.4	0.8		0.2	2.3
Nature conservation agency	0.8	30.1	4.7	0.1	0.0	1.1	37.0
Private	53.6	31.9	21.4	10.1	2.4	11.1	130.5
Total ha	**123.7**	**98.5**	**42.5**	**32.3**	**2.4**	**23.6**	**323.1**
Total %	**38.0**	**30.0**	**13.0**	**10.0**	**1.0**	**7.0**	**100.0**

Source: Anonymous, 1995

Table 5. Forest types according to van der Werf (1991), with some ecological characteristics and area in ha.

Class / Order	Soil characteristics	Area (ha)
Vaccinio-Piceetea	very poor	
Dicrano-Pinion	dry sandy soils	< 4000
Betulion pubescentis	wet sandy & peat	<600
Quercetea robori-petraeae	moderately poor	
Quercion robori-petreaea	low land	< 165 000
Luzulo-Fagion	sub montan	< 1000
Querco-Fagetea	moderately rich, rich	
Eu-Fagion	dry, loam	< 4000
Tilio-Acerion	sub montan	< 10
Carpinion betuli	loam, old clay	< 4000
Alno-Padion	young, rich soils	
Ulmenion carpinif.	dry - wet	< 5000
Circaeo-Alnenion	very wet	< 2000
Alnetea glutinosae	wet, (nearly) stagnant	
Alnion glutinosae	moderately. poor - rich	< 4000
Salicetea purpureae	wet, periodically inundated	
Salicion albae	riverine	< 1000

exotic species with a high regeneration potential only in forests where nature conservation is not emphasised.

The second most important tree species in Dutch forests is the inland oak (*Quercus robur* and *Q. petraea*). This species is especially appreciated for its high quality timber production and its role in respect to nature conservation. In many older Scots pine plantations natural regeneration of oak is stimulated. Another important broadleaved species is *Fagus sylvatica*. The area of this species, which is probably the climax species in large parts of the Netherlands, is increasing. The afforestation in the new polders and in the western part of the Netherlands is reflected in the increasing areas of *Populus* and *Salix spp*. and of other broad-leaved trees. Recently also growing attention is given to autochthonous species like *Malus*, *Pyrus*, *Crateagus*, etc.

At present much attention is given to change the conventional mono-species forest plantations to mixed forest stands. Consequently, the statistical differentiation in main tree species is loosing its conventional meaning.

2.3.3 Standing stock, annual growth and annual cuts

The Dutch forest can be described as being relatively young. Only 4 % of the area of clear cut forests is older than 105 year and at least 40 % is younger than 45 year (Table 7). The main tree species Scots pine reflects this age distribution more or less, the mean age of other coniferous species is lower. Oak, with 25 % of the area younger than 45 and only 13 % older than 105 has a declining age distribution. Only beech, as oak valued for their longevity, has a half way normal age distribution. These data illustrate that the Dutch forest is relatively young. Moreover, still a large area of forest is first generation forest.

The standing stock in the Netherlands amounts to more than 50 M m^3 of wood (Table 8), or 185 m^3 per hectare (Seubring 1997). In 1988 these figures were 45.7 M m^3 and 161 185 m^3 per hectare (Anonymous 1995). The annual increment per ha diminished from 8.4 $m^3 ha^{-1} a^{-1}$ in 1988 to 7.8 $m^3 ha^{-1} a^{-1}$ in 1992/3 and increased to 8.1 $m^3 ha^{-1} a^{-1}$ in 1995. The total annual increment between 1992 and 1996 was about 2.2 M m^3.

Table 6. Distribution of main trees species between 1950 and 1996 in % of the area.

Tree species	**1952-63(I)**	**1964-68(I)**	**1980-83(I)**	**1992(II)**	**1996(II)**
Pinus sylvestris	55.2	50.6	41.9	34.7	34.4
Pinus spp.	6.4	8.1	7.9	6.6	6.3
Pseudotsuga menziesii	6.5	7.4	6.7	6.1	6.6
Larix spp.	9.7	9.4	7.7	6.6	5.9
Picea spp.	5.5	8.6	6.7	4.7	4.6
Other coniferous	0.9	0.5	0.5	0.7	0.7
Quercus robur & petraea	7.3	7.5	11.5	14.3	14.8
Fagus silvatica	2.2	2.2	3.0	3.6	3.7
Populus & Salix spp.	3.2	4.1	6.5	6.6	6,1
Other deciduous	3.1	3.5	7.5	15.0	15.0
felling area	**n.a.**	**n.a.**	**n.a.**	**1.4**	**1.9**
Total percentage	100	100	100	100	100
Total ha	183329	196323	234624	281196	279567

I) source: CBS, 1985.
II) source: Seubring, 1997

The increase in standing volume is likely to continue in the coming years as a result of the increased emphasis on nature conservation objectives in most Dutch forests. The wish to have large, thick trees in the forest will result in longer rotations and increased mean age. Moreover, the 'production' of standing and lying dead wood, also of larger dimensions, will change the biomass characteristics in different ways. The exact outcome of these and other influences as the changing site conditions due to forest soil development and pollution, is unclear.

The annual cut increased from 1992 to 1996 from 1.1 to 1.3 M m^3, resulting in an harvesting percentage, which increased from 54 to 60 %. Private owners harvest up till 74 % of their annual increment, without negative consequences for the standing stock (190 m^3 ha^{-1}). Other forest owners, notably nature conservation organisations, harvest much less.

In the past, most cuttings were derived from clearfellings. However, as a result of the increased attention being given to combined timber production and nature management, recently a change is taking place towards small-scale and selective harvesting methods and more emphasis on thinning than on final cut.

2.3.4 Forest stability

The fact that the Netherlands is highly urbanized does not only mean that forest are highly valued for recreation and nature purposes, but also that they are threatened by a variety of ex-

Table 7. Age distribution of clear-cut forest older than 16 years in K ha

	16 -45	**45 -65**	**65 -85**	**85 - 105**	**105 -125**	**125 -145**	**>145year**	**total**
Pinus sylvestris	25.6	28.6	27.1	12.3	3.3	0.8	0.3	98.2
other coniferous	38.4	25.2	4.3	0.7	0,0	0.0	0.0	69.1
Quercus robur & petraea	7.3	6.0	5.8	4.3	2.0	0.8	0.7	27.0
Fagus sylvatica	1.5	1.3	1.1	1.0	0.9	0.7	0.7	7.1
other deciduous	23.0	6.8	2.1	0.5	0.01	0.0	0.0	33.0
Total	**95.6**	**67.9**	**40.5**	**18.8**	**6.4**	**2.8**	**1.6**	**234.5**

Source: Anonymous, 1995

Table 8. Development of standing stock, annual increment, and harvest in K m^3 timber inclusive bark (> 7 cm diameter).

Year	Standing stock	Annual increment	Harvest per year	Harvest as % of the annual increment
1992	48.309	2 198	1 178	54
1993	49 311	2 211	1 214	55
1994	49 895	2 209	1 292	58
1995	50 849	2 258	1 324	59
1996	51 657	2 245	1 339	60

Source: Seubring, 1997.

ternal effects of human activities (Hilgen, 1997). Due to industrialisation and intensive animal husbandry the vitality of the forests is strongly threatened by pollution (acidification and eutrophication) and desiccation (Van Tol et al., 1998). In addition forest fragmentation is causing ecological concern. Traditional forests threats as pests and diseases have lost their significance, partly due to the declining emphasis on wood production. Unnatural high levels of game animals threaten the natural regeneration of forests. Due to the humid climate forest fires are no major hazard.

Emission by industry and traffic cause immission of SO_2 in Dutch forests and nature areas, while intensive animal husbandry causes immission of NO_x and NH_4; deposition up to 150 Kg ha^{-1} yr^{-1} has been measured locally. These immissions cause acifidication and eutrophication of the forest soils and declining tree vitality. In 1997 less than 50 % of the area of the exotic tree species *Pseudotsuga menziesii* (< 20 %). *Pinus nigra var. Maritima* (< 40 %) and *Picea abies* (< 50 %) was classified as having at least satisfactory health (Reuver, 1997). For *Pinus sylvestris* and *Larix spp*. this is between 80 and 90 % respectively, and for *Quercus robur*, *Q. petraea* and *Fagus silvatica* around 80 %. There are some indications that tree growth may be enhanced due to eutrophication, nitrogen being the limiting growth factor. However, analysis of leaves or needles indicates that quite often Phosphorus and other nutrients are deficient, causing decreased growth rates. As a result of the immissions the biodiversity values of many Dutch forests are decreasing. The composition of herbs, grasses and mosses below the canopy is changing towards more general, nitrogen liking species, while mycorrizhal fungi are declining.

Between 30 and 50 % (depending on the criteria) of the Dutch forests can be classified as being desiccated. Three causes can be indicated:
- The artificial draining of agricultural lands to prevent water-logging and the lowering of the groundwater table to allow farmers to cultivate their soils early in spring;
- The use of ground water for industrial, agricultural and human consumption;
- The lowering of the groundwater level to improve conditions for afforestation or forest growth.

To counter the negative effects of eutrophication and desiccation the government launched in 1990 a programme called Survival Plan Forests and Nature 2000. Owners of forests and nature areas are provided with financial assistance to apply measures such as crown thinning, fertilising, conversion, impoverishment by sod cutting (heather, but also pine forests on very poor, dry sandy soils), mowing etc., to improve the vitality of the forests and the conditions for their survival.

Another ecological hazard causing increasing concern is fragmentation and its negative consequences for biodiversity. Two main aspects have to be considered when discussing fragmentation. First the dispersion of forests in the landscape. Quite often smaller forests are isolated from other forests by other land uses, preventing the migration of organisms for one forest to the other. Second the same effect can be caused by the isolation of autochthonous forest patches by exotic species. To counter these problems a so-called National Ecological Network (NEN) is being developed; this network connects the dispersed forest and nature areas (Ministerie LV, 1989). Buying up of (agricultural) land by large organisations like the State Forest Service and Nature Conservation Organisations subsidised by the government is largely restricted to areas inside this network.

The main traditional hazards threatening forests are weather events and fires. Along the coast wind reduces forest growth, while damage-inflicting gales occur about once every decade as does icing. Late night frost is locally a factor to consider. Opinions on whether forest vitality is also threatened by climatic change or whether the recent decline was related to some years of relatively bad weather conditions vary; at policy level climatic change is a matter of concern for the future. Forest fire, mainly human induced, were a very serious threat up to 20 years ago, combatted in the high risk forests areas (Veluwe with mainly *Pinus sylvestris*) by very intensive watching, earlier from towers, later from small planes.

Due to less emphasis on timber production damage by fungi (such as *Lophodermium seditiosum*, *Gremmeniella abietina*, *Melampsora spp.*, *Marssonina spp*.) and insects (*Ips typographicus*, *Tomicus spp*.) are less important than before. Nevertheless regulations preventing the presence of dead stems with bark in the forest during certain periods still exists. On the other hand, eutrophication and acidification may allow organisms, which were earlier not dangerous or not present (*Sphaeropsis sapinea*, *Agrilus biguttatus*) to become threats. Dutch elm disease is still important, but more for town and road side plantations than for forests.

Game (red deer, roe deer, wild boar) continues to play an important role in forestry. Game causes damage in young plantations and can prevent natural regeneration effectively. As the latter silvicultural method becomes more prominent (see below), the need to restrict game to levels causing acceptable damage grows. On the other hand large grazing animals such as tarpans and semi-wild cattle are used as a management measure to keep large nature areas open and to stimulate micro-differentiation in vegetation composition and structure. This management practice is supported by the theory that in Western Europe the original vegetation consisted partly of a park-like landscape, in which large herbivores played an important role (Vera, 1997).

2.4 Silviculture

In 1983 90 % of the Dutch forests were closed forest, of which 75 % can be considered as high forest (Table 9). Most of these forests are only one or two generations old. Up to this time two silvicultural systems prevailed: (i) the clear-cut and replanting system, and (ii) the coppice system.

Due to the relatively harsh environmental conditions, most of the original forests were established as even-aged monocultural plantations. During this century the focus of afforestation has changed (see Chapter 2.2.1). Up till about 1940, afforestation focused on then-considered wastelands on poorer sandy soils, which were often covered with heather. Scots pine and other coniferous species were the main tree species. Between 1950 and 1980 large areas in the new polders were afforestated. These consisted mostly of better soils, and on the newly reclaimed lands mostly poplar and willow were used. Nowadays afforestation is mainly taking place on former agricultural land, which have relatively good soils and which were heavily fertilised; on these lands mostly deciduous trees are planted.

Table 9. Forest management types in 1983.

Forest management type	**Area Kha**
Closed forest	310.1
High forest	236.8
special management	49.0
road site plantings	2.8
coppice	22.3
Open forest	20.0
spontaneous	13.1
other	6.9
not forested forest area	3.2
Total forest area	**334.0**

Source: Anonymous, 1995

For a number of tree species certified seeds from selected stands and or seed orchards are available. Growing attention for natural regeneration as a silvicultural tool diminishes the economic importance of these seed stands.

Most of the plantations were managed according to the clear-cut principle. The clear-cut areas were relatively small, mostly less than 4 ha.

Coppice was historically an important silvicultural system in the Netherlands. Major species managed as coppice were oak (used for tannin and fuelwood) and ash in long rotations, and willow (coppice shoots used for dike building) in shorter rotations up to 4 years. This silvicultural practice has gradually declined in importance, in 1983 its use was restricted to only 7 % of the Dutch forests. Since then it diminished even more, but coppice systems attracts growing attention of nature conservation agencies.

Traditionally, silvicultural systems using natural regeneration did not get much attention. One of the reasons for this neglect was the reforestation subsidy granted by the government. However, in the 1980s important changes in silvicultural practice took place. These were partly caused by the results of some severe storms in the 1970s. The area of wind-blown stands was so extensive that it was not possible to immediately clear and reforest all of them. In many of these areas a good natural regeneration took place. This proved that natural regeneration was silviculturally possible as the ecological conditions had gradually evolved since the first plantations. Moreover, in the 1990s the reforestation subsidy was abolished (Chapter 3.4), and many forest managers subsequently changed from artificial to natural regeneration techniques.

Due to the growing emphasis on nature conservation objectives in forestry (Al, 1995) also some specific silvicultural methods to enhance nature in forest have been developed. Some of these so-called nature technical forest management practices (Londo, 1991) consists of the killing of trees by removing of a strip of bark or by pulling them over, or the use of large grazing animals (Chapter 2.3.4). The so-called mosaic-method (Koop & Siebel, 1993) is used to accelerate the conversion of mono-species, even-aged forests into uneven-aged, mixed forests.

Changing political (more attention to nature conservation and recreation) and economical (lower timber prices, less subsidies) conditions paved the way for more attention towards close to nature forestry. As a result a new silvicultural approach, called Integrated Forest Management (IFM, *geïntegreerd bosbeheer*), was developed in the first half of the 90s (Schulting, 1998). In IFM all functions (timber production, nature and recreation) are pursued, and the use of natural processes is stimulated. Keywords are natural regeneration, native timber species, mixed, uneven-aged stands, small-scale or selective cuttings, presence of dead wood, thick stems, no biocides. In a couple of provinces with an active political attitude towards forests and forestry, the introduction of this kind of forest management is stimulated, with good results: i.e. a growing percentage of mixed forests (Table 10).

2.5 Harvesting

Forestry in the Netherlands has a small-scale character, which is reflected in the harvesting systems too. For the small forest owners, the cooperative ‘Forest groups’ play an important mediating role in selling timber; the large owners are able to deal with contractors and traders themselves. There is an increasing tendency to sell timber on stump, which will then be harvested by either a contractor or the timber trader. Standard contracts for harvesting aim at quality and comprise clauses stipulating fines if quality (minimal damage to remaining stand an soil) is not achieved. Nevertheless, quite often sensitive felling operations (in regeneration, high quality timber) are still carried out by own staff. More and more forest owners offer quality timber to timber auctions in Germany, recently a quality auction was also successfully organised in the Netherlands.

The actual felling, delimbing and cross-cutting is mainly done by chain saw, but a small number of harvesters and processors operates in the Netherlands too. Whole stems are skidded sometimes with horses (back from being not used), otherwise with tractor and tongs. After cross-cutting in the forest, sortiments are hauled with a tractor and wagon and crane or with a forwarder. Transport to the mill is done by truck.

The accessibility of the Dutch forests is good. The network of mainly sandy roads is very dense and nowadays more used for recreation purposes (hiking, biking) than for forest operations. In consideration of nature conservation purposes, increasingly selected forest roads are closed for (motorised) traffic.

2.6 Forest products

The forests in the Netherlands supply only 7% of the domestic wood consumption amounting to 1.3 milliom m^3 of wood. Most Dutch wood is used for bulk production (first pitprops, at present industrial wood) rather than high-value special products (wooden shoes being an exception). Both timber trade and timber manufacturing are characterized by a multitude of relatively small companies; this situation limits an integrated forest - wood chain. Some large manufacturers of paper and pulpwood products depend to a large extend on wood imports.

Recently renewed interest has developed in energy wood; some electricity companies are planning to partly use wood in their major electricity generation plants. Interest is also growing in using wood for small-scale decentralized power generation.

Non-timber forest products only play a minor role; only Christmas tree production and horticultural greenery are of commercial interest. The collection of most non-timber forest products such as fruits or mushrooms are mainly recreational activities. Hunting provides on average only 7% of the income of forest owners; most Dutch people are not in favour of hunting.

3 Forest economics

3.1 Forest and forest industries in the national economy

The total output of Dutch forestry has been estimated at Dfl 161 million (EU 73 million) in 1993. The inputs of forestry amount to Dfl 81 million (EU 37 million), which gives an estimate of GDP of Dfl 80 million (EU 36 million) in that year. GDP of forestry is only a very small portion of total Dutch GDP, because the forest area is only a small portion of the total land area and because the Dutch economy is mostly industry and services-based. An amount of Dfl 115 million (EU 52 million) of the total output consists of government consumption (as a final demand category), mainly expenditures of the National Forest Service.

3.2 Employment in the forest sector

Employment in forestry and wood processing industry is about 50,000 persons (Schouten,

Table 10. Regeneration method and change from mono species towards mixed stands in ha as annual mean for 1986-1991

Owner	Regeneration method		Harvest forest		Regenerated towards		Change
	clear cut	small scale	mono spp.	mixed	mono spp.	mixed	mono > mixed
State	270	183	374	78	171	282	203
Other governmental	242	73	331	34	274	92	58
Nature conservation agencies.	52	104	112	45	25	131	86
Private	420	134	404	150	332	222	72
Total	**1034**	**494**	**1221**	**307**	**802**	**726**	**419**

Source: Anonymous, 1995

1995). This relatively high amount, when considering the small forest area, is caused by the processing of a large amount of imported wood (Oosterveld, 1997). Statistical data (table 11) suggest that the employment in forestry did not decrease in recent decades. However, this trend has to be ascribed to the definition of the units. In the early years of registering forest labour only labourers involved in typical forestry activities such as timber felling were recorded. In later years also employees engaged in different kinds of nature conservation activities are taken into account. A considerable amount of the activities in forestry is carried out by relatively small contractor companies, as many forest enterprises are too small to invest in profitable mechanisation. A large part of the timber is sold at stump.

The nursery sector is well developed in the Netherlands. This sector produces not only seedlings for forestry, but also for residential areas and a large part of its produce is exported.

3.3 Discount rate

Since 1974 the Dutch government has prescribed a discount rate of 10% to be used in the appraisal of public financed projects. In 1986 it was decided to decrease this rate to 5%. Since 1995, a real discount rate of 4% is prescribed. Benefit-Cost Analyses of public financed forestry projects are, however, seldom or not conducted in recent decades in the Netherlands. The National Forest Service and the Nature Conservation Organisations do not use a discount rate in their appraisal of management activities. Some private forest firms use a discount rate, e.g. to determine the optimum rotation.

3.4 Profitability

Since 1975, the Agricultural-Economic Institute collects data about the profitability of private forest firms larger than 50 hectare in the Netherlands. Since 1992 also data of firms of 5 – 50 hectare are collected (Berger et al., 1997). The trends concerning costs, revenues and profitability of firms larger than 50 hectare are summarized in table 12. In the course of time labour costs per hectare have considerably dropped, but most other costs increased. The revenues of timber sales decreased, while the other revenues increased. Total revenues and total costs have changed in such a way that profit per hectare has increased in recent decades, in spite of declining timber prices. The profit of forest firms in the southern part of the Netherlands and of larger firms is on average higher than that of firms in other regions and of small firms. Many private forest firms still have a negative financial result. In order to try to improve their profitability, the government has for several years stimulated the formation of cooperative forest groups by providing a subsidy to the members of such cooperatives. The cooperatives are mostly engaged in the coordination of silvicultural activities and timber sales.

Subsidies are a substantial part of the revenues (table 12). The total amount of the subsidies did not change much during the last decades, but their composition changed considerably. In the past, a substantial subsidy was given to cover the costs of reforestation and stand improvement. These subsidies have been abolished in the framework of the policy aiming at basing subsidies on outputs rather than inputs. Since the early 1990s the main subsidies consist of a fixed amount per hectare which is granted if the forest is accessible (on roads) for visitors[2]; this subsidy is considered as a public payment for the recreation function. Additional payments are made for explicitly identified old-growth forests with high ecological value. Notwithstanding the policy of basing subsidies mainly on outputs, recently a new subsidy is being given for activities aiming at restoring or preventing damage caused by pollution and desiccation (Chapter 2.3.4).

In addition to subsidies, tax reduction or exemption – income tax, property tax and in some situations inheritance tax – is used as an incentive

[2] In the Netherlands a forest owner is not obliged by law to open his forest to visitors

for forest firms in the Netherlands. The water board tax is felt as a considerable burden to forestry in some parts of the Netherlands, especially because forestry does often not benefit but rather has disadvantages from water management by the water boards.

In the framework of decentralisation, policy development and implementation is shifting towards provinces. Some provinces provide a subsidy to stimulate Integrated Forest Management (Chapter 2.4), e.g. by paying for a certain amount of large trees or dead wood being present in the forest.

Recently, increased attention is also given to search for new options for paying of those forest functions, for which no traditional markets exist. As indicated in Chapter 2.2.4 some utility companies have started occasional funding of the environmental functions of forest regarding carbon sequestration or hydrological regulation. Efforts are also underway to make financial arrangements for special recreational services between forest owners and the tourist and recreation sector.

4 Forest policy

4.1 Legislation

When in the midst of the 19th century attention became focused on the need to increase the forest area in the Netherlands, at first the afforestation activities were left to the private sector. The government's involvement with forestry dates from the end of the 19^{th} century, when the social and economic benefits of forests were clearly acknowledged. In 1899 the State Forest Service was established, and through this service public funding was started for the purchase of forests and nature reserves and for the afforestation of unproductive lands. Subsequently, in 1922 the first Forest Law was enacted. This law has been influential in conservation of the existing forest area; it ensures that no forest area is lost by stipulating the obligation to reforest cut forest areas. Subsequently, also fiscal measures were taken to alleviate the financial burden for private forest owners. The Nature Protection Act (Natuurbeschermingswet) aims at

Table 11. Number of employees in the forest sector in 1975, 1984 and 1992 in the Netherlands

Category	**Number of employees in 1977: Total**	**Based on Dutch wood**	**Number of employees in: 1984**	**1992**
Contractors				600
Forest groups and land agents				216
Roundwood trade and transport	860	860		430
Nurseries (forest and ornamental trees)	763	763		1490
Forestry	1650	1650		2185
Timber and furniture ind.				
Particle and fibreboard ind.			800	
Veneer and plywood ind.				
Sawmills			200[1]	1700
Woodenshoes ind.				207
Woodconservation ind.	39800	8000		500 á 600
Posts and poles				
Packaging and pallet ind.			9900	9366
Wooden furniture ind.			2600	2078
Other timber products industries			11400	10796
Paper and paperboard ind.	31600		1900	
Paper products ind.		9500	7400	7500
Printing industry	39300	9800		
Publishers	17100	1700		
Binding ind.	5000	300		
Lodging (in wooded area's)	±25000	±25000		

[1] in firms with more than 10 employees

Source: Ministerie van Landbouw en Visserij (1977, 1984), Schouten (1995) and Stolp (1996)

Table 12. Costs, revenues and profit (/ha) of private forest firms (?50ha) in the Netherlands in 1975, 1980, 1985, 1990 and 1994-1996 (in current prices)

				Year			
	1975	**1980**	**1985**	**1990**	**1994**	**1995**	**1996**
Cost items							
Labour	136	201	133	78	70	61	52
Contractors	58	44	184	46	92	65	92
Management + supervision	79	121	127	145	157	150	154
Other costs	64	86	95	90	112	109	108
Total costs							
Revenue items	337	452	539	359	431	385	406
Timber	102	137	174	198	132	166	135
Other revenues	32	47	54	57	61	70	75
Subsidies	116	184	296	134	193	166	195
Total revenues	260	380	530	390	387	404	409
Profit	**-77**	**-72**	**-9**	**31**	**-44**	**19**	**3**

Source: Berger *et al*., 1997

stimulating nature and landscape conservation through acquisition and management obligations. This law also protects certain flora and fauna species (LNV, 1993).

Another influential law is the Landscape Act (Natuurschoonwet), which stimulates forest management and afforestation on estates to ensure aesthetic and recreational values. The Hunting Law (Jachtwet) obliges the hunter to prevent damage by wildlife to forest and agriculture and to sustain a reasonable level of wildlife. This law also stipulates regulations concerning hunting practices and the management of wildlife. Furthermore the Land Use Planning Act (Landinrichtingswet) stipulates regulations concerning land-use planning, including measures for land-use zoning for forestry, nature, outdoor recreation and cultural history. The implementation of these laws and the policy used to be the responsibility of the state but is evolving towards a provincial and municipal task (LNV, 1993).

Since the mid 1970s forestry has received increasingly political attention (Wiersum & Van Vliet, 1998). Within the framework of the national rural planning debate, in 1977 a sector study on forests and forestry was issued. This document was followed by two major national forestry policy statements, i.e. the Long-term Forestry Plan of 1984 (Ministerie LV, 1984) and the Forest Policy Plan of 1993 (Ministerie LNV, 1993). In the last plan the following policy priorities have been formulated for the period up to the year 2020:

- Sustained conservation of the present forest area and its further development on the basis of ecosystem zonation;
- Promotion of optimal fulfilment of the forest's multiple functions with respect to outdoor recreation, nature values, timber production, landscape quality and environmental quality;
- Expansion of the forest area by at least 65,000 ha in 2020 by government, other authorities and private landowners, 10,000 ha should be located near cities and in peri-urban areas;
- Achieving this conservation and performance at a socially acceptable level of costs, focusing on market approach and budget efficiency;
- Promotion of the involvement of other than state authorities as well as non-governmental organizations and private parties in forestry development.
- Contribute to sustainable forestry world wide;

In 1989 also a Nature Policy Plan (Ministerie LV, 1989) was formulated, that aims to sustain, revitalize and develop natural and landscape values of forests and other nature areas such as wetlands, etc. The aims are to be reached by developing a National Ecological Network with central natural areas, nature development areas and connection zones. The political prominence of nature is also reflected in the fact, that in 1997 a monitoring and evaluation report concerning the state of nature was published (Anonymous, 1997); it is intended that such an evaluation is repeated each 5 years. The state of forests and results of forestry policies receive ample attention in these evaluations (Hilgen, 1997; Paasman, 1997).

4.2 Actors

The multifunctional nature of the forest in the Netherlands is reflected by the fact, that there are several groups of stakeholders who are interested in one of more specific functions of forests. Three major categories of stakeholders may be distinguished who play a role in policy formulation and implementation (Oosterveld, 1997), i.e.:

Forest owners and forest managers;
Forest users;
Policy makers.

4.2.1 Forest owners and forest managers

As discussed in Chapter 2.2.3 forest ownership in the Netherlands is divers, with forests being owned either by private owners (41%), the state (31%), local authorities and other public bodies (16%), or nature conservation organisations (11%). The State forests are managed by a State Forest Service (SFS). Originally this service was also very influential in policy making, since it had a triple function of management, extension and policy development and implementation. The extension function brought about a large and uniform forest management in the Netherlands. After 1988 the SFS has become a semi-autonomous management organisation. Its policy function was shifted to the Ministry of Agriculture, Nature Management and Fisheries, and its extension function to the provinces. As a consequence, recently a more divers forest management situation and more open process of policy formulation has developed (Wiersum & van Vliet, 1998).
The forest owners and forestry labour organizations are officially represented in the Industrial Board of Forestry (Bosschap); this non-governmental organisation officially represents the forestry sector in policy debates and has a regulatory power within the sector.

4.2.2 Forest users

Forest users have gained more and more influence the last decades, setting the policy agenda on how to develop forest management. One can distinguish four main groups of forest users according to the forest function:

The timber trade and wood industry;
The recreation sector;
The nature conservation and environmental groups;
Various utility companies such as water and electricity supplying companies.

Traditionally, the timber trade and wood industry is characterized by a multitude of relatively small companies, many of whom are not dependant on the Dutch forest (as these provide less than 10% of total wood consumption). Consequently, no strong and integrated forest - wood chain was developed. The organisations are not so large, neither influential on the national policy. International policy, however, is developed in close dialogue with the timber trade and wood industry.

The recreational sector ir organized in several influential organisations, but most of them do not have formal links with the forest owners. This is partly caused by the fact, that the recreation function of forests is basically funded by government subsidies (Chapter 3.4). The main organisation representing recreationist is the ANWB (which started as a bicyclists organisation); this organisation often acts as a spokesman representing recreation interests to the government.

The nature conservation and environmental sector is well organized in a multitude of non- governmental organisations. Over one million of Dutch people are a member of the Dutch nature conservation organisations. Some of these organisations are predominantly engaged in managing nature reserves (including important forest areas), but other act as lobby groups advocating environmental protection and nature values. They have been influential in setting the forestry policy agenda.

Recently, various utility companies have become interested in the environmental function of forest (Chapter 2.2.4). This has resulted in them becoming a new actor in forest policy development (Wiersum & van Vliet, 1998).

4.2.3 Policy makers

The Ministry of Agriculture, Nature Management and Fisheries holds the major responsibility for forest policy in the Netherlands. Since 1988 the task for forest policy development and implementation falls under the responsibility of the ministerial department of Nature Management (Directie Natuurbeheer). In addition, forestry policy is influenced by the Ministry of Economic Affairs and the Ministry of Housing, Regional planning and Environment. The first Ministry is responsible for issues concerning the timber industry, and the last holds responsibility for country planning and environmental policy matters.

4.3 Policy tools

The tools for the implementation of the forest policies fall within three major categories, i.e. legal, financial and communicative instruments.

The legal framework for forestry was already discussed in Chapter 4.1. The financial instruments vary according to the category of forest owners that is affected. The State Forest Service is financed directly from the government budget (investments and management costs). All other forest owners can apply for subsidies under the Forestry Grant Scheme (Chapter 3.4). Nature conservation organisations can get additional management grants and financial support for extension of their territory. For private forest owners also some tax reductions (e.g. in relation to inheritance tax) exist.
Additional subsidies are available for afforestation on former agricultural lands. The regulation for stimulating forest expansion on agricultural lands is an elaboration of the Mac Sharry regulation of the EU. The subsidy consists of an afforestation premium and an income bonus to compensate the income losses for a 20 years maximum. After 15 years one can decide to go back to farming if an exemption of the replanting duty (Forest law) was obtained (LNV, 1993). Another financial instrument exist for stimulating public and private co-operation in establishing forest expansion projects outside the 'Randstad'. The state will take part in the financing of the afforestation costs and give a subsidy for the value loss of the land (LNV, 1993). Another recent development is the planning of a certification system for CO^2 sequestriation, which could be used to stimulate afforestation as a means to sequester CO^2.

Communicative instruments include education, research and advice, assisting forest owners and the forestry sector at large. A special political instrument in the Long-term Forestry Plan was the encouragement towards provincial authorities to develop regional forest policy plans on an experimental basis.

4.4 Forest policy in relation to other national policy areas

Within the 1993 National Forest Policy Plan it is explicitly formulated, that forest policy is linked to several related policy fields, including those concerning land-use and landscape planning, agriculture, environment, nature, water, and recreation (Ministerie LNV, 1993). In comparison to the 1984 Long-term forestry plan the 1993 Plan indicates a change from a sectoral to a more integrated approach (Wiersum & Van Vliet, 1998). As reflected by the objectives of the 1993 Plan (Chapter 4.1) environmental and nature concerns form major concerns as do concerns related to recreation and agriculture. Of special relevance are the regulations on regional planning, which are based on a system of local (community) decision-making with respect to legally-binding local land-use plans.

4.5 EU forest and forest related policies

The Netherlands are a member of the European Union and participates in the Permanent Committee for Forestry of the EU. Although the EU is more and more involved in forestry, there is not yet a coherent EU forest policy. The Dutch government supports the realisation of a forest policy that focuses on forest expansion and vitality and makes it possible to act collectively in European and world forestry. This policy will have to be in harmony with the Nature policy that's also being developed. On European level the Netherlands also co-operates in the Timber committee of the Economic Commission for Europe and the European Forestry Commission of the FAO.

Since 1986 action is taken within the EU to protect forests against fire and air pollution, and to promote reforestation on agricultural lands and economic unattractive areas. The Mac Sharry set-aside scheme provides subsidies to farmers to fallow or reforest their lands. These subsidies play an important role in the implementation of the planned expansion of the Dutch forest area.

4.6 Education & research

In the Netherlands most academic research in forestry is performed at the Wageningen Agricultural University (WAU) and the Agricultural Research Service (DLO), which are being amalgated into the Wageningen University and Research Centre in the near future. At other Dutch universities also forestry subjects are researched, mainly by biology and sociology departments. Also some private consultancy bureaux (e.g. ETC) contribute to forestry research. The Information and Reference Center for Nature Management of the Ministry of Agriculture, Nature Management and Fisheries acts as a clearing-house between research and practice.

The Wageningen Agricultural University offers a MSc. Programme in forestry and nature management (5 years) and also an international MSc. study Tropical Forestry (17 months) (van Baren et al., 1998). The International Agricultural College Larenstein offers a BSc. in forestry and nature management (4 years). Furthermore there are several schools for technical secondary education in forestry (MBCS) in the Netherlands and a school for practical education in Schaarsbergen.

5 Main currents and challenges

5.1 Introduction

As indicated in Chapter 1.2.4, since the 1950s several major societal changes have taken place. These social trends have had a major impact on forestry. Of special importance were the increased importance of recreation and tourism, the increased appreciation for nature, and the growing environmental consciousness. These trends resulted in an increased appreciation for the recreational and nature functions of forests. Moreover, the increased attention to democratic decision making and decentralisation of governmental action resulted in an increase of stakeholder involvement in forestry development. Thus, social attitudes rather than market forces have been most influential in steering forestry development in the Netherlands (Oosterveld, 1997; Wiersum & Van Vliet, 1998). This is reflected in both forest policy and forest management.

5.2 Changes in forest policy

As a result of the recent social trends, three major current issues in forest policy may be distinguished: a changing role of forestry in landuse, a diversification in the required function fulfilment, and the development of interactive policy making.

5.2.1 Changing role of forestry in land-use

The rural area of the Netherlands has to deal with a growing number of different demands from society. The growing number of people, increased leisure time and increased mobility cause that rural areas are becoming multifunctional. The country side is no longer considered only as an area destined for agricultural and other rural production processes, but also as an area for recreation and enjoyment of 'natural' landscapes. Such multifunctional use requires an integration of forestry and nature conservation, agriculture, and tourism. One of the major consequences is, that forestry is increasingly incorporated within the broader context of the social appreciation for nature conservation. This is demonstrated by the fact, that the 1997 evaluation of the status of nature in the Netherlands (Anonymous, 1997) included several assessments about the forestry situation Hilgen, 1997; Paasman, 1997).

Although mobility in general has increased, there are still many people in the expanding urban areas who are less mobile, e.g. the growing number of elderly people. In order to provide recreational space for these people, there is a demand for new urban forests where people can experience rest and enjoy nature (Konijnendijk, 1997). The creation of such forests may also decrease the need to travel to forests which are located farther away, and thus limit environmental problems related to transport. Through their environmental functions (buffering noise, temperature, air pollution, etc.) the new urban forests will also provide a pleasant living environment. Moreover, as a result of the high social appreciation of forests coupled with the legal protection of forests, these urban forest are excellent buffers against unregulated urban expansion.

5.2.2 Diversification in fulfilment of forest functions

The forest functions have diversified over time. The functions for society (for landscape, amenity, and recreation) and for the environment (for nature conservation, sequestration of carbon dioxide, water management) have become more important than wood production. Under the conditions of high and divers public demands the effectiveness and efficiency of forest functions are increasingly being measured in social appreciation. Consequently, in planning forest policies not only the perceptions and demands of forest owners are taken into account, but the perceptions and demands of all relevant stakeholders.

One of the results of the increased appreciation of forests and their divers functions is a diversification in forest ownership (Chapter 2.2.3) as well as management styles. This has as consequence that the instruments for forest policy are gradually changing. In the past, specific policy measures existed for forestry, but the recently formulated Programme Management of the Ministry of Agriculture, Nature Management and Fisheries facilitates the management of both nature, forest and landscape. This government programme also changes the former incentive system with different policy instruments for stimulating forest management by different forest owners (i.e. the government, private owners, nature conservation organisations) to a system with equal instruments for all forest owners. This illustrates the tendency that forestry is no longer considered a primary governmental task, but an activity involving various stakeholders.

5.2.3 Interactive policy making

In response to the process of further democratization the process of policy decision-making is changing from a process based on professional expertise to a more participatory process involving a multitude of stakeholders. Moreover, a change is taking place from state supremacy in dealing with forest policy and management issues to a more decentralized approach. Thus, the policy process is increasingly characterized by a process of interaction between policy makers at various administrative levels, forest owners and managers, and different groups of forest users. In comparison with the past, also a clearer distinction is made between the different forest managers, and the interaction between forest user groups and policy makers is increasing (Wiersum & Van Vliet, 1998). The challenges of this new approach are to stimulate and facilitate a wide range of localised management practises that are focused on local needs and possibilities on the one hand, and to keep a delicate balance between the requirements for sustainable forestry and leaving sufficient room to free market forces on the other hand.

National policies are not only increasingly dealing with incorporating stakeholder interests and facilitating forest management by different ownership categories, but they also increasingly interacting with international conventions (e.g. the Rio declaration on forestry, the convention on biodiversity) and global movements such forest certification. A major task of forest policy is therefore to ensure that global and national forestry development are consistently related and logically linked to diverse and localised management practices.

5.3 Changes in forest management

As discussed above, the diversification in forest functions requires different management styles that are flexible to adapt to the local needs for different functions and offer a choice to the different owner groups. In order to respond adequately to increasingly diversified demands from numerous organised user groups, forest managers have to adapt their management practices and to adjust their technical and well as social skills.

5.3.1 Diversification of management systems

In order to respond to the changing demands for function fulfilment it will be necessary to develop new silvicultural systems. These systems needs to be highly flexible in order to allow continuous adaptation to the wishes of the community. In this context two management systems are promoted in the Netherlands, i.e. Integrated Forest Management (Chapter 2.4) and the 'Pro Silva' system. Both are multifunctional management systems based on mixed stands and selective harvesting; they allow more ecological features to develop than the traditional 'monoculture with clear-cut' systems (Paasman, 1997; Schulting, 1998).

5.3.2 Communication and negotiation with forest users

During the last decade, the increased social appreciation of forest coupled with increased political emancipation has resulted in several forestry conflicts in the Netherlands. This development indicated the need for forest managers to improve their communication skills. In order to find out what needs are present in a locality, forest management needs to stimulate the participation of user groups. This requires that forest managers do not only have knowledge on forest ecology, silviculture and forest economy, but also skills for conflict resolution and social negotiation.

Improved communication between forest managers and forest users does not only concern conflict resolution, but also the negotiation of function endowment for semi-public goods with relevant consumer groups (Hekhuis & De Baaij, 1997). Increasingly forest managers are negotiating financial contract for the delivery of specific services to specific consumer groups. This may involve contractual arrangements with water companies for optimisation of hydrological conditions, with electricity companies for fixation of CO_2, or with groups such as mountainbikers for the maintenance of specific recreational facilities. An example of the gradually increasing interest of private market forces to fund forestry activities is the establishment of the foundation FACE (Forestry for Absorbing Carbon Emissions) by the combined Dutch electricity generating companies. This foundation gives financial contributions to plantations establishment both in the Netherlands and abroad.

5.3.3 Quality production

The environmental consciousness and demand for nature in the Netherlands has grown over the past 5 years. In response to the request for more nature values, meaning older forests and mixed stands, at present increased attention is given to stimulate the production of quality timber instead of bulk production for pulp and wood chips. For instance, since two years a special quality timber auction is organized as a means to develop a high quality niche market.

Forest managers also find it increasingly worthwhile to communicate their concerns regarding sustainable forest management and quality wood production to the consumers. Consequently, the idea of forest certification by an independent auditing organisation is well received by various forest management organisations. After an initial certification of two municipality forests, recently also several districts of the Dutch State Forest Service (SFS) have been certified according to the Forest Stewardship Counsel) (FSC) standards. At present already 60,000 ha of state owned forest has been certified as being managed in accordance to the standards for sustainability and multifunctionality. During this initial phase of certification, sustainable produced wood fetches 10-15% higher prices than ‘normal’ wood. It is expected that such price differences will decrease when more certified timber enters the market. But this development should not limit the public relation effect of certification. However, for the private forest owners with small forest areas who are structurally less integrated in the forest - timber chain, the PR function of certification is considered of only minor importance.

5.4 Ecological and technical challenges

5.4.1 Improving forest vitality

The vitality of the Dutch forests is a cause of concern (Chapter 2.3.4). As long as the possible causes such as air pollution and desiccation are not controlled, it will be necessary to apply management practices (e.g. fertilising, sod cutting, removing of litter) that address their effects. Also the conversion of forests to improve their stability to withstand windthrow is a current issue. Many monocultures are gradually converted to uneven-aged, mixed forests with the aim that they become better adjusted to yearly variation in precipitation, heavy storms as well as pests and diseases. This means a gradual increase in the area of deciduous forest.

5.4.2 Maintaining biodiversity

The great social consciousness about nature and environment results in much attention to the need to conserve biodiversity. The challenge is to create improved conditions for maintaining and even improving the diversity in flora and fauna. In this respect attention is given to the ecological role of exotic tree species, the need to stimulate autochthonous species, and the need to stimulate a more divers forest structure in which all ecological phases including old growth trees and dead wood are represented.

Another option to increase biodiversity is the reintroduction of semi-domesticated large grazers in forest and nature areas (Chapter 2.3.4). The introduction of (a low density of) grazers in forest may not only result in micro-niche differentiation and thus greater biodiversity, but also increases the recreational value of forests. However, care must be taken that no friction arise between these grazers and horses (horseback riding) or dogs (accompanying walkers). The question how to manage forest grazing is therefore not only a question of ecology, but also of recreation. An interesting question is how to prevent too high grazing densities, once grazers have been introduced in all relevant forest and nature areas. In theory, culling the grazing herds might provide high-quality meet production to be sold on the speciality market, and thus provide new income. However, the prevailing notions on nature might limit this option. Most Dutch people have an aversion against hunting, which they consider merely as a pleasure hobby of hunters. There exist a strong lobby against hunting, and it is increasingly restricted to a limited number of species. It therefore remains to be seen whether culling of the newly introduced grazers will be accepted.

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Useful Internet pages

Institute for Forest and Forest Products > http://www.sbh.nl/kerngegevens
(statistical data on forestry in the Netherlands, in english).
Sub-department of Forestry, Wageningen University > http://www.dow.wau.nl/forestry/
(includes links to other Internet pages of Dutch forestry organisations)
Research Institute for Nature (& Forestry), Ministry of Agriculture, Nature Management and Fisheries > http://www.ibn.dlo.nl

Norway

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1 The country

1.1 Natural conditions

Norway (excluding Svalbard, which has been a part of Norway since 1925) stretches from 57° 57' 33"N to 71° 11' 8"N, and from 4° 30" 12"E to 31° 10'10"E. The shortest distance from the southernmost to the northernmost point is 1752 km. The length of the coastal line including the fjords is 21 300 km. The land frontier against Sweden, Finland, and Russia is 2 542 km. The widest part of the country is 430 km, the narrowest 6,3 km. The total land area is 324 thousand square kilometres. The «economic zone» in the ocean South, West and North of the mainland is about 800 thousand square kilometres.

It is a mountainous country. The highest mountains are found in the massif of Jotunheimen in the central parts of Southern Norway, where the peak Galdhøpiggen reaches a height of 2469 m above the sea level. Forty per cent of the land area has an altitude of more than 600 m above sea level. Several glaciers are found, among them Jostedalsbreen covering 486 km^2. A characteristic feature of the landscape is the long and deep fjords, the longest of which is Sognefjorden with a length of 204 km and with a depth of 1300 m.

1.1.1 Geology

There are great variations in bedrock within the country. In Southern Norway large areas of Pre-Cambrian formations are found, such as granites, gneisses, and quartzites. A similar area is found in the far North-East. West and North of the Oslofjord is a downfaulted area of Cambro-Silurian sediments, partly with limestone, and volcanics of Caboniferous and Permian Ages. An area streching from the South-West end, and up to the North end of the country, is dominated by remnants of the Caledonian Fold-belt, with a complex mixture of metamorphic rocks. During the Cretaceous and Tertiary Periods the inland plateaux and present valleys were formed, and during the last 2,5 million years the glaciers deepened the valleys, created the lakes, and carved out the fjords.

1.1.2 Soils

Most of the surficial deposits in Norway were deposited during the deglaciation period after the last ice age, 13 000 to 8 500 years ago. Bare rock and a thin cover of loose deposits dominate large areas of the country. In the inland the surficial material consists mainly of tills. Marine clay and sandy shore deposits are found below the Marine Limit, mainly in the South- Eastern part of the country, in the Oslo area below an altitude of 220 m, and in the Trondheim area.

The most common natural soil is different kinds of podzols. Peat and swamp soils are also common, whereas occurrance of brown soils is limited to a few favourable places.

1.1.3 Climate

Considering the northern latitude, Norway enjoys a relatively favourable climate. This is due to the Gulf Stream, which carries water from the Caribbean up along the coast, giving temperatures that make the land habitable further north than anywhere else on the Earth. There are, however, great climatic variations within the country. The warmest region is along the South-Western coast. The meteorological station at Bergen has the highest normal yearly air temperature with 7,7° C. The station with lowest normal air temperature is in the county of Finmark with -3,3° C. In the coastal areas the differences between summer and winter temperatures are relatively small. In Bergen the normal temperature in July is 14,5° C and in January 1,5° C. The corresponding figures for Flisa in the South-Eastern inland are 15,1° C and -8,6° C. Annual, normal precipitation at a station on the West coast is 3575 mm. The corresponding figure for a station in the interior valleys in Southern Norway is 278 mm.

The growth season with normal daily temperatures above 5° C exceeds 225 days in the South-Western coastal districts. In the South-Eastern lowland it is around 165 days, at an altitude of 1200 m around 75 days. In Finnmark the growth season is around 125 days. The great variation in geological and climatic conditions also creates a basis for great variation in vegetation, from demanding and exclusive species along the Southern coast, to modest forms of vegetation in the far North and in the mountains.

1.2 Society

1.2.1 Political structure

Norway is a constitutional monarchy with a parliamentary system. The constitution was approved in 1814, and apart from occasional amendments is still valid, making it the oldest written constitution in Europe. Executive power is formally vested in the King, but is exercised through the Cabinet, which can only operate with the backing of a majority in the Storting, the national Parliament. The King, who is also Commander in Chief of the armed forces and Head of the Church, has sole power to appoint the government, but in effect this is always done with the advice of the leader of the winning party or coalition in the Storting. Norway has not joined the European Union, but is a member of NATO.

All legislative and taxation powers are vested in the Storting, to which general election takes place every 4 years. Additionally the Sami population elects members to the Sami Council, which deals with issues of particular interest to this ethnic group. The Storting has 165 members. It cannot be dissolved until it has run full term. The largest political party has for a long time been the Labour Party. The ranking of the other parties such as the Conservative, Party of Progress, Christian Democrat, Liberal, Centre, and Socialist Left has changed over time. The right to vote was extended to all men in 1898 and to women in 1913. The voting age is 18. There is a general service conscription for men, while women can volunteer to serve.

Norway is divided into 19 counties and 435 municipalities. Elections to the political assemblies of the counties and municipalities take place every 4 years. The counties deal with matters as regional planning, hospitals and the high school system, while the municipalities are responsible for a wide array of affairs, from the kindergartens, basic schools and social welfare to land use planning. There is a complex system for allocation of financial resources to the municipalities in order to harmonise the living conditions in the different parts of the country. In each county the central government is represented by a Governor, whose task is to control the implementation of the national policies in various fields.

1.2.2 Population distribution and density

The population of Norway is 4,4 mill., which means a population density of 13 per square kilometre. The larger part of population is found in cities and urban settlements along the coast. Ten per cent of the population live north of the Arctic Circle. The capital city Oslo has a population of 500 000. The population of other selected cities: Bergen 225 000, Trondheim 146 000, Stavanger 107 000, and Tromsø 58 000. Three quarters of the population live in densely populated areas. Over many decades a concentration and urbanization of the population has taken place. Two patterns of movements are observed. First, people move from Northern and inland regions to urban regions, such as the Oslo area, and second, within the regions people move from remote districts to regional centres.

1.2.3 Basic education

The public educational system consists of basic schools (primary and lower secondary schools), high schools (upper secondary schools), and colleges and universities. The children start in the obligatory 10-year basic school at the age of 6. Then everybody has a right to enter a 3-year high school, which gives competence for college or university studies, or/and a vocational certificate. The college and university system consists a number regional colleges, scientific schools covering special fields, and 4 universities.

1.2.4 Natural resources and economy

Norway is well endowed with natural resources for economic activity. The supply of fish from the ocean, and the forest resources, created the basis for export centuries ago. Numerous waterfalls were utilised as direct source of energy for sawmilling and mining, etc. Production of hydro-electric power started by the end of the 19th century and formed the basis for industrialisation, with the development of fertiliser, pulp, and metal industry. Hydro-electric power counts for about 50 % of calculated energy consumption of the country. Around 1970 exploitation of the petroleum resources on the continental shelf started.

In 1997 the gross national product (GNP) of Norway amounted to EURO 130 milliards (1000 mill.), or EURO 30 000 per capita. The share of GNP and employment (persons) in some selected sectors is disclosed in table 1. Total employment 2,221 mill. persons.

It is observed that the contribution of the traditional rural industries is relatively little, and it has been declining over a long time. However, even though their share of GNP is modest, they are still important industries as suppliers of raw materials etc. During the last couple of decades fish farming, especially of salmon, has grown rapidly, and is together with the traditional fisheries, the basis of a large exporting segment. Extraction of oil and gas on the continental shelf has become a major sector of the economy during the last 25 years, counting for 14 % of the GNP (1997) and one half of the export of commodities, with strong impact on the Norwegian economy as well as on other fields of the society. The service sectors have also enjoyed a strong growth during the last decades.

2 Forest Resources and their use

2.1 Global overview of the land use

The distribution of the area on main land categories is shown in table 2. The small share of agricultural land is noticeable. The area of cultivated land is 1 mill. ha, or less than 0,25 ha per inhabitant. ‘Other land` comprises land above the forest line and some other barren land. It is noteworthy that around 50 % of the land area is located above the forest line.

In table 2 the term ‘forest’ is given a wide definition with modest claims as to attainable height and density of the trees. A rough classification

Table 1. GNP and employment in some selected sectors of the economy

Sector	GNP (%)	Employment (%)
Agriculture, forestry and fisheries	2,3	4,6
Extraction of oil and gas	14,0	1,0
Manufacturing industry and mining	11,7	14,3
Supply of electricity	2,1	0,9
Wholesale and retail trade	9,7	14,7
Communication	6,5	6,8
Financial services	3,4	2,2
Public services	15,4	30,7

Table 2. Land area distributed on main land categories

Used for buildings, roads, industry, etc.	1,1 %
Agricultural land	3,6 %
Freshwater	5,4 %
Bogs and wetland	6,3 %
Forest	36,8 %
Other land	**46,8 %**

Table 3. Classification of the forested area

Total forested area	**120 000 km^2**
Below the coniferous forest line	90 000 km^2
Productive forest land	72 000 km^2
Economically usable forest	(58 000 km^2)

of the forest area is presented in table 3. The coniferous forest line is found at an altitude of about 1000 m in the central inland of Southern Norway. It declines when approaching the coast, and further to the North, where it reaches the sea level. In many places areas of birch forests are found above the coniferous forest line. The term 'productive forest land' refers to land with a capacity to yield at least 1m^3/ha/year of wood over a rotation. The proportion of forest land that is economically usable depends on the price of wood and the cost of harvesting. In a governmental report (1998) it is estimated that 80 per cent of the productive forest land is economically usable.

2.2 Forest history

When the last glacial epoch ended around 10 000 years ago the forest gradually reoccupied the land. It is supposed that mountain races of *Betula, Alnus* and *Prunus* could be found in some places during the ice age, but now the climate became so favourable that new species occurred. White birch (*Betula pubescens*) and aspen (*Populus tremula)* were first. Later, when the climate became warmer, pine (*Pinus silvestris*), silver birch (*Betula pendula)* and hazel (*Corylus avellana)* arrived. During a warm period, starting around 7 500 years ago, more demanding species as e.g. elm (*Ulmus glabra*), linden (*Tilia cordata*), oak (*Quercus*), and ash (*Fraxinus exelsior*) came in. These species were for some time found over a larger part of the land than today. The elevation of the tree line against the mountains was higher than now. In many places trunks and stumps from ancient forests are still found in bogs and lakes 300 meters above the prevalent tree line for birch forest.

Around 2 500 years ago the climate became less favourable, with higher precipitation, cooler summers, and longer winters. The more demanding species retreated in the lowlands and disappeared at the higher elevations. The tree line sank, and along the coast the forests were replaced by heath and bushy birchwood. At about the same time the spruce (*Picea abies*) started to invade the land. The beech (*Fagus silvatica*) also entered by that time. The moist and cool climate was favourable for the spruce, which soon became the dominant species in large parts of the country.

As the population grew the forests were increasingly affected by human activity. Land was cleared for cultivation, and the forest provided wood for house-building and fuel. Extraction of iron from bog ore was also an activity demanding great volumes of wood, and exports of wood to countries beyond the North Sea took place already 1000 years ago.

During the first half of the 16th century water driven saws were introduced. Production and exports of sawnwood increased, and saw-milling became a major industry. The exports of sawnwood reached a peak around 1875. By that time the first pulp mills were started. This industry could utilise smaller trees than the saw mills, with consequences for the exploitation of the forests.

In the 17th century a rather extensive mining for iron, copper and silver was started. This activity required large quantities of wood and had a strong impact on the forests in many regions. In the high altitude Røros area the forests were so heavily exploited that they have not yet recovered.

The first public restrictions on trade in forest products were introduced by the end of the 16th. century with the aim of securing supply of oak timber for the navy. Later several public regulations of forestry were in force for shorter or longer periods. However, around 1850 most of the regulations were abandoned. Growing population and large exports of sawnwood were factors that made heavy toll on the forests during the last half of the 19th century. Cuttings with little regard to regeneration of the forest were practised until the early 20th century.

2.3 Land use and forest resource

2.3.1 Forest ownership

The structure of ownership of productive forest land is disclosed in tables 4 and 5 (CBS 1991). Main features of the structure are:

- There is a large number of forest owners in Norway. The size of the holdings is very unevenly distributed. Sixty percent of the smallest holdings have only 10 percent of the forest area, whereas 10 per cent of the largest holdings have 60 percent of the area. For many forest owners the incomes from forestry are marginal.
- Most of the forest land is in private, personal ownership. A large proportion of the forest land is farm forests, and managed in combination with agriculture. About 75 % of the private forest owners actually live on the farm. There is a great variation as to the economic role of forestry relative to agriculture on the farms.
- Very little of the forest land is in integrated ownership with the forest industry.
- Public ownership to forest land is less than in most countries. The term ‘Public forests’ in table 4 covers land with different legal status: Common forests, in local ownership, or where local people have extensive rights of use (6%), municipal forest (3%), forests belonging to the church (3%), and regular state forests. The regular state and the church forests are managed by the stately owned company STATSKOG SF, which also is the managerial authority for large areas above the forest line, and national parks.

The market for forest land is strictly regulated through a number of laws. Important is a law aim-

Table 4. Ownership categories (holdings larger than 2,5 ha of forest land)

Ownership category	Number	Area (1000 ha)	Area, percent
Individual owners	122 256	5 503	78,5
Stock companies, private institutions etc	2 038	484	6,9
Public forests	1 228	1 026	14,6
Total	**125 522**	**7 012**	**100**

Table 5. Ownership by size class of holdings

Size class (ha)	Number	Area (1000 ha)	Area, percent
1 - 24,9	92 528	783	11,1
25 - 99,9	40 004	1 946	27,7
100 – 499,9	11 817	2 149	30,5
500 – 1999,9	992	857	12,2
2000 -	224	1 301	18,5
Total	**145 565**	***7 036**	**100**

* A minor difference in this table compared with table 6 is due to different statistical basis

ing at securing the ownership to land being kept within the family. Another law makes acquisition of land conditional of public concession, combined with a regulation of price. The ownership structure has been stable over a long time.

2.3.2 Extent and distribution of the forest

A national forest inventory was started in 1919. The first round was completed in 1930.The activity has continued up to present time, recording several parameters related to forests. The inventory has covered all counties, except the northernmost county of Finnmark.

Table 6 gives a survey of the forest land below the coniferous forest line according to the national forest inventory. The country has been divided in three regions: (1) South-Mid-East, (2) West, and (3) North. The regional division is shown on the map, figure 1.It appears that the area of productive forest land is 7,2 mill. ha. Region (1) is richest in forest. It has 74 % of the productive forest land and is consequently of greatest importance from a forestry point of view. Of the bogs some 0,6 mill. ha are covered by trees. The productive forest land of Finnmark is estimated to 83 thousand ha. The northernmost pine forest *(Pinus silvestris)* in the world is found in Finnmark on latitude 70° N.

Tables 7 and 8 show the distribution of forest land on altitude zones and site quality classes respectively. Around one half of the forest is located below 300 m above the sea level.

The definition of site classes is as follows (yield capacity including bark over a rotation):

Table 6. The forest area below the coniferous forest line (exclusive Finnmark). 1000 ha. (NIJOS 1996)

Region	**Productive forest land**	**Other Wooded land**	**Bogs**	**Total**
South-Mid-East	5 355	1 036	972	15 245
West	916	272	191	5 850
North	1 002	413	273	6 428
Total	**7 273**	**1 721**	**1 434**	**27 523**

Table 7. Productive forest land by altitude zones (1000 ha) (NIJOS 1996)

Region	**Altitude zones, m above sea level**			
	< 300	**300 - 600**	**> 600**	**Total**
South-Mid-East	2 149	2 003	1 204	5 355
West	665	233	18	916
North	831	169	2	1 002
Total	**3 645**	**2 405**	**1 224**	**7 273**

Table 8. Productive forest land by site quality classes, in 1000 ha. (Per cent distribution in parentheses). (NIJOS 1996)

Region	**Site class**			
	Low	**Medium**	**High**	**Very high**
South-Mid-East	1 933 (36)	2 507 (47)	841 (16)	71 (1)
West	260 (28)	438 (48)	183 (20)	35 (4)
North	662 (66)	323 (32)	17 (2)	-
Total	**2 855 (39)**	**3 268 (45)**	**1 042 (14)**	**106 (2)**

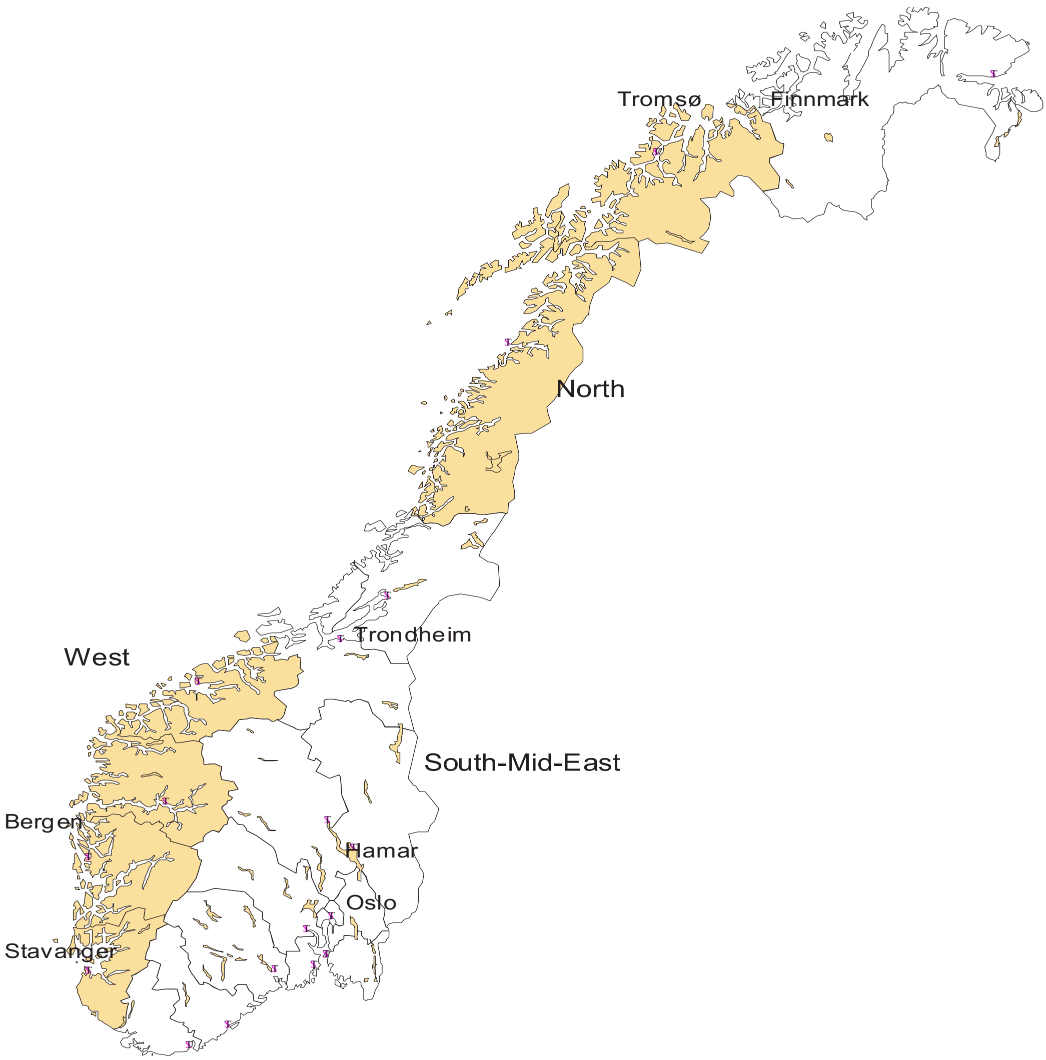

Figure1. Map of Norway showing the regional division used in this presentation

Low 1,0 - 2,7 m^3/ha/year (Rotation 130 years)
Medium 2,8 - 6,5 m^3/ha/year (105 years)
High 6,6 - 10,7 m^3/ha/year (85 years)
Very high > 10,7 m^3/ha/year (years)

It appears from table 8 that a relatively large part of the forest is found in the low and medium site classes.

The area of productive forest land is according to the national forest inventory increasing, especially in the coastal districts. It is also assumed that the forest line in the mountains is rising. A reason for the increase in forest area may be overgrowth of former agricultural land and reduced grazing in the forest.

2.3.3 Tree species origin and distribution

The overall dominating part of the growing stock in the forest consist of native tree species and provenances. In the coastal districts in West and North Norway some exotic conifers have been introduced as part of an afforestation program. The activity was specially intense during a 25 year period from around 1950. The program involved conversion of especially birch forest and heath land to spruce forest. The larger part of the new forest consists of Norway spruce, but to some extent Sitka spruce and other North American conifers have been planted.

Especially during the 1960's Central European provenances of Norway spruce were introduced on a practical scale in ordinary forestry, partly to overcome a shortage of native seed, and partly as an effort to increase future forest production. The resulting stands do not turn out to be very promising.

The distribution of the growing stock volume on different tree species is shown in table 9. In the central forest districts spruce is the dominating species. In the West and North pine and birch cover the larger part of the forest land.

2.3.4 Total growing stock, growth and fellings

Table 10 shows the volume of the growing stock on productive forest land around 1990. The total growing stock is estimated to 742 mill. m^3. In addition comes a volume 44 mill. m^3 on other forested land below the coniferous forest limit. Again the dominating place of spruce is observed. Of the deciduous tree species birch is dominant with 68 % of the volume, whilst aspen and grey alder each has 8 %, and other species cover the remaining. The percentages are somewhat different in various regions.

The annual growth on productive forest land is 21,2 mill. m^3 (table 11). Both growing stock and annual growth have been increasing for several decades. Since the first national inventory was completed in 1930 a doubling has taken place. This development is illustrated in figure 2.

Felling for sale and industrial utilisation varies considerably over shorter and longer periods, due to variations in markets and prices. It reached a peak in 1990 with 11 mill. m^3 when there had been a rising trend since the mid-seventies. During the nineties the trend has on the whole been negative. In 1996 the volume of fellings was 8 mill. m^3, distributed on 75 % spruce, 22 % pine and 3 % deciduous trees (primarily birch).

The volume of roundwood used on the farms as building material or fuel, or not recorded in ordinary statistics, has declined over a long period of time and is now estimated to roughly 1 mill. m^3 (included in table 12).

Table 12 shows the estimated annual drain from the forest in 1995.

The annual fellings of roundwood for sale and industrial utilisation are recorded by the Central Bureau of Statistics. Regarding the roundwood used on the farms etc. the statistical data are less reliable. The same holds true for losses of wood due to natural causes.

The figures indicate that the annual drain is slightly more than 50 % of the annual growth. This is reflected in figure 2 showing the increase in volume of the growing stock. In absolute terms the annual drain is of the same magnitude as it was around 1930, when the first balance

Table 9. Productive forest land by dominating tree species, excluding land under regeneration, in 1000 ha. (Per cent distribution in parentheses). (NIJOS 1996)

Region	**Dominating tree species**			
	Spruce	**Pine**	**Deciduous**	**Total**
South-Mid-East	2 537 (50)	1 763 (34)	819 (16)	5 120
West	155 (19)	326 (40)	327 (41)	808
North	185 (19)	85 (9)	691 (72)	962
Total	**2 878 (42)**	**2 175 (32)**	**1 837 (27)**	**6 890**

Table 10. Growing stock on productive forest land (NIJOS 1996)

Region	Growing stock , mill. m³, including bark			
	Spruce	Pine	Deciduous	Total
South-Mid-East	305	192	97	595
West	20	39	32	92
North	11	7	38	56
Total	**337**	**238**	**167**	**742**

Table 11. Annual growth on productive forest land, mill. m³ (NIJOS 1996)

Region	**Dominating tree species**			
	Spruce	**Pine**	**Deciduous**	**Total**
South-Mid-East	9,4	4,4	3,0	16,8
West	1,3	0,8	0,8	2,9
North	0,4	0,1	0,9	1,5
Total	**11,1**	**5,4**	**4,7**	**21,2**

Table 12. Estimated total annual drain from the forest in 1995. Mill. m³ (NIJOS 1996)

Removals			**Waste wood and natural losses**			**Total**
Spruce	**Pine**	**Deciduous**	**Spruce**	**Pine**	**Deciduous**	
7,1	2,0	1,0	1,1	0,5	0,6	12,3

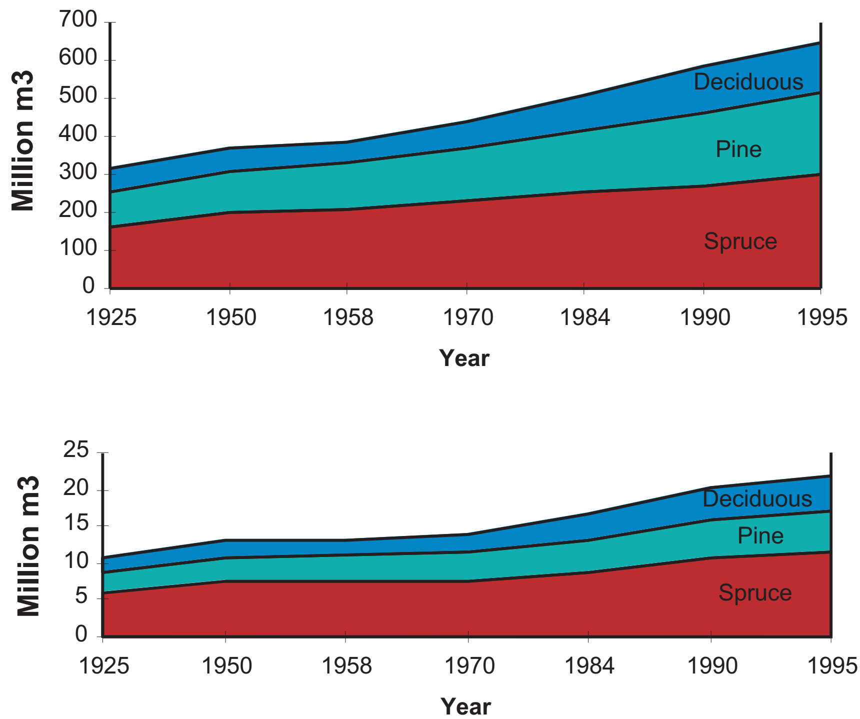

Figure 2. Growing stock volume (upper diagram) and annual increment (under bark) on forest land below the coniferous forest line (NIJOS 1996)

based on measurements were made, and when the volume of the growing stock was only a half of what it is today. The annual drain from the forest being less than the annual increment, intensified silviculture and regeneration measures, and afforestation in the coastal districts, are reasons behind this development.

2.3.5 Forest threats

The threat against the forest that has attracted most attention during the recent few decades is long-distance air pollution. Extensive research and surveillance programs have been introduced. The conclusion so far is that the forest health situation seems to be relatively stable. A small decrease in average crown density has, however, been recorded. This development might be regarded due to several factors including, but not restricted to, air pollution. Special measures, as fertilization or liming, are not recommended. A higher percentage of deciduous trees in conifer forest is desirable. And there is still regarded to be risk of a long run negative effect of air pollution, especially through the influence on the forest soil.

Fungi, insects and animals are inherent components of the natural forest ecosystem. Occasionally and locally some species may be so numerous that they make more or less damage to the trees. From the several examples that could be mentioned, a few are selected.

Relatively serious attacks from the bark beetle *(Ips typographus)* on spruce took place during the late 1970’s in the South-Eastern part of the country. The attacks were considered to be a consequence of large storm fellings and dry summers in previous years, and they had clear economic consequences. The beetle *Hylobius abietis* also harms conifer plantations and is thus of economic importance too.

The birch forest in the Northern part of the country and in the mountainous regions are frequently attacked by the larva of *Oporinia autumnata* and other species with very visible consequences in the landscape, as huge areas usually are attacked. Of the great number of fungies found in the forest the *Heterobasidion annosum* is the one that has the greatest negative effect on wood production. It is found especially on the most fertile forest land, where in many places a large part of the mature trees is attacked, with serious effect on wood quality and price. Another fungus harming wood production is *Phacidium infestans* which attacks regenerations of pine at high altitudes. During the last years great attention has been paid to the elm disease, which kills the elm trees both in the forest and in public parks etc. It is currently found in the Oslofjord area.

In many places damage on regenerations and young stands is caused by dense populations of moose *(Alces alces)* and red deer (C*ervus elaphus)*. The population of these animals has risen sharply since the 1960’s.

Local storm fellings occur normally every year. More extensive fellings have taken place with irregular intervals of several years. In 1992 a storm caused severe destruction of forest on the North-West coast of Southern Norway. In the late sixties, and especially in 1969, there were extensive storm fellings in the South-East regions.

In earlier times rather extensive forest fires occurred frequently. Due to a better access to the forests through a dense road system and effective fire departments, large forest fires seldom take place, even though the fires are numerous. Normally the burnt area is a few hundred hectares per year. It is claimed that from an ecological viewpoint more burning would be advantageous.

2.4 Silviculture

During the last five decades clear-cutting and planting has been a dominant feature of the silvicultural methods. This is particularily true for spruce forest. In pine forest use of seed trees has been applied to a greater extent. The forest stand is regarded as *the* unit for management and silvicultural treatment. Because of topography and ownership structure the area of the individual stands or clear-cuttings are often relatively small, averaging 1,4 ha.

In earlier times more or less selective cuttings with reliance on natural regeneration were dominant. It was, however, an extensive opinion among professionals that this type of silviculture led to gradual depletion of the forest, because of poor regeneration and consequent removal of the best trees. But it should also be noted that the rapid development of the clear-cutting system took place concurrently with the mechanisation of the forestry operations.

The clear-cutting system originally also presumed that a large part, at least 25 %, of the produce should be harvested in thinnings. Due to the technical and economic development the costs of thinnings have increased, and in practical forestry thinnings make up a relatively small amount of the wood harvest. This is especially true for spruce forest. In pine forest more attention is paid to the quality of the wood, and the risk of damaging remaining trees is less. Pine forest is, therefore, more intensively thinned than spruce forest. On the whole 70 % of the regeneration area is clear-cut, and 50 % is planted. Relatively little attention has been paid to the management of deciduous forest.

Tending of regenerations and young stands is regarded as a central element in silviculture. The aim may be to reduce competition from sprouts of undesired tree species, or grass, or to regulate the number of trees in order to reduce the need for future thinnings, etc. Most of this activity is performed by mechanical methods, to a less degree chemicals are applied.

During the last 10 - 20 years new trends in silvicultural practices are observed in order to meet the increasing demand for non-wood products and services from the forest, involving more attention being paid to the total ecosystem of the forest, not only usable trees. This tendency has several practical implications. Natural regeneration of the forest is more emphasized, assuming changes in cutting practices, for example smaller clearcuttings, use of shelterwood systems etc. As an illustration is mentioned that in 1995 it was planted 47 mill. plants, compared to an annual planting of 59 mill. during the preceding 10-year period.

Uniform, single-species stands do not form the ideal silvicultural picture to the same degree as before. On the contrary the aim is that future spruce stands should contain at least 10 % deciduous trees. There is a greater tolerance for «undesired vegetation». Forest close to lakes, rivers and streams is subjected to particularly cautious management. Draining of bogs for tree planting has roughly speaking come to an end. Efforts are made to maintain scattered trees beyond normal cutting age. More attention is also paid to the management of deciduous forest.

2.5 Forest production

2.5.1 Harvesting systems, accessibility

During the last decades harvesting systems have changed from being based on heavy manual work, using handsaws and axes for cutting and horses and floating for transportation, to a harvesting system heavily based on mechanisation.

Mechanisation started with the introduction of power saws for felling, delimbing and cross-cutting, and the use of agricultural tractors for extraction. Later more specialised machinery as skidders, forewarders, felling and delimbing machines were introduced. Presently multi-function machines performing, felling, delimbing, and cross-cutting based on automatically recorded tree stem parameters, are widely used.

In contemporary practical forestry two different harvesting systems are mainly applied:

(1) Motor-manual system, which means that power saws are used for felling, delimbing and crosscutting. Tractors, often agricultural tractors with some extra equipment, are used for transport of the wood to roadside.

(2) Mechanised system, involving the use of multi-function machines for felling etc., and transport to the roadside with forwarders.

An important feature and condition of this transition is the construction of forest roads. During the last 40-50 years a rather dense net of roads has been developed in the forests. The construction activity has declined in recent years. In 1996 300 km new truck roads were built, and about the same length of old roads were reconstructed. In addition comes the building of 800 km roads for tractors. The distance of transportation of the wood to the place of delivery is of great economic importance. Table 13 shows the distribution of productive forest land on classes of distance from roads. There is some regional variation, in that the densest road net is found in the more central forest districts.

Table 13. Distribution of productive forest land on distances from existing road (NIJOS 1996)

Distance	Productive forest land (%)
< 500 m	52
500- 1000 m	24
> 1000 m	24

Steepness is another factor determining economic accessibility. Table 14 shows the distribution of productive forest land on classes of steepness. Relatively much of the steepest forest land is found in Western Norway.

Table 14. Distribution of productive forest land on classes of steepness (NIJOS 1996)

Steepness	Productive forest land (%)
< 20 %	52
20 - 49 %	39
> 50 %	9

The definition of productive forest land is solely based on biological yield capacity. When wood prices and harvesting costs are considered, parts of this land are not economically exploitable. Poor site quality, topography and location are decisive factors in this connection. Traditionally there have been great fluctuations in the prices of wood over time. Thus, the share of forest land in use may also vary, and it is therefore difficult to be specific as to the forest area that on the long run really is economically exploitable.

2.5.2 Timber uses

The dominant users of roundwood for sale and/or industrial use are the sawmill and the pulp industries. These two industry groups receive about 50% and 40% of the annual cut respectively. The remaining wood is used for a great number of purposes, as poles, veneer, particle- and fibreboard, fuelwood, etc. Around one third of the sawtimber volume is chipped and used as raw material in the pulp- and board industry.

The sawmill industry consumes annually about 4,5 mill. m^3, of which 0,7 mill. m^3 is imported. The output of 2,5 mill. m^3 sawnwood corresponds roughly to the domestic consumption, but nevertheless an annual export (and import) of about 0,7 mill. m^3 takes place.

In 1997 the consumption of pulpwood (including chips) of the Norwegian pulp- and paper industry was 7,1 mill. m^3, of which 35 % was imported. This industry produces mainly for the world market, as 90 % of the output is exported.

2.5.3 Forest functions

In a commercial context the production of wood as industrial raw material or fuelwood has a dominating position. The forest yields, however, a large number of other products and services. The forest owner has an exclusive right to the wood production and hunting (within the prevailing laws), but apart from that the general public has free access to the forests for a great variety of activities.

The most important game for hunting is the moose *(Alces alces)*. The annual felling is around 40 000 animals. Other species for hunting in the forests are red deer *(Cervus elaphus)* and roe deer *(Capteolus capreolus)*, just to mention two of the more important species, and a number small game species. The total number of hunters is around 170 000 (the number of issued hunting tax cards).

Picking of berries (blue berries, cranberries, and cloudberries, etc.) and of mushrooms is another extensive activity in which many people take part, mostly for leisure. It is, however difficult to estimate the quantity or value of these products.

Outdoor life is an important feature of Norwegian everyday life, and a great number of people use the forests for different kinds of outdoor recreational activities such as hiking, skiing etc. Especially intensly used for recreation are forests close to the population centres. Great attention has been paid to the forests surrounding Oslo, where special regulations have been introduced in order to protect the recreational (and other non-wood) functions.

In addition to the role the forest plays through active utilisation it constitutes a central environmental factor. It is an important part of the landscape, it has climatic and hydrological influences, and is the natural, ecological environment for numerous species of plants and animals. During the last years the role of forest for the protection of biological diversity has been emphasised.

3 Forest economics

3.1 Forest and forest industries in the national economy

Forestry and forest industries have traditionally played an important part in the Norwegian economy. This holds still true although the relative importance of the sector has declined as a consequence of more rapid growth in other sectors of the economy. The sector can not in the same degree as before rely on the relatively favourable natural conditions that caused the early growth of the industry: abundant supply of wood of good quality, favourable transport facilities on the rivers, ice-free harbours, cheap energy, etc. This is due to the technological and economic development that have opened for industrial use of other tree species, revolutionised international transport and trade, etc.

Table 15 gives an illustration of the economic role of the forest sector. The contribution to the national product is 2 %. Its share of the manufacturing industrial sector is around 10 %.
In the pulp and paper industry there are clear economies of scale. This has led to a concentration of the production to fewer mills and companies. The same development has to some extent taken place in the sawmill industry. The industries are purchasing wood and and selling their products on the international market. Important sources of wood are the Baltics and Russia. The most important product markets are found within the area of the European Union.

3.2 Employment

Table 15 shows that the employment in the forest sector is 34 000 man-years. During the last decades there has been a steady decline in all parts of the sector, although the output has increased, at least in the industrial sector.

In forestry the total employment is around 5 000 man-years. Several more individuals are employed, as many forest owners and others do some part time work in the forest. It is estimated that the forest owners and their families perform about 25 % of the work, the remainder being performed by hired labour. A substantial part of the forestry operations are carried out by entrepreneurs using technically advanced logging equipment with a production capacity far exceeding the need of the the individual forest property.

Although the employment in forestry on the whole is relatively modest, it plays an important role in many rural districts, and for many individuals. Concentration of the industry and mechanisation of the forestry has had a strong negative influence on the employment in many rural districts, and hence on rural development. Great efforts are, however, being made to maintain rural employment and population. Strengthening of the forest sector is part of this policy. One feature is support of small scale industry for local markets and products, making use of special wood qualities.

3.3 Profitability

The measure of profitability most frequently used in forestry is the stumpage value of the harvest. The stumpage value depends on the gross sales price and the harvesting costs. The prices of wood have traditionally fluctuated over time with frequent ups and downs. However, during the last decades the overall tendency has been falling real prices. The development of the harvesting costs are more stable. During the last decades the harvesting costs have decreased in real terms, even with increasing wages and incomes in the society. The stumpage value has also had a negative trend, especially until the late nineteen-eighties. The fluctuations in stumpage value are even greater than in gross prices. Figure 3 illustrates the development in prices, costs and stumpage value during the last decades.

4 Forest and forest related policies

4.1 Legislation

Modern legislation for regulation of forestry dates back to 1891 when a law on forest protection was passed. The law turned out to be inefficient, and a new law was passed in 1932. In 1965 this law was replaced by a new one, which is still in force, with several significant amendments, especially related to environmental issues.

The aim of the Law on Forest and Forestry is to promote forestry and forest protection. Rational use of the forests should aim at yielding a satisfactory return to those who are engaged in forestry, and ensure a stable supply of wood for industrial purposes. Concurrently the role of the forests as a source of recreation, as an important part of the landscape, as natural environment for plants and animals, and as areas for hunting and fishing, should be emphasized. The law covers all forest land, but its regulations should not infringe the traditional land use rights of the Sami people. In the following some main points are mentioned.

To supervise the practising of the law a three-level forest authority has been established. The highest level is the Ministry of Agriculture, Division of Forestry. On the county level there is a County land board with a professional staff, and on the local level the responsibility rests with the municipality. A decision made by a subordinate authority is subject to control by a superior one.

Central parts of the law deal with regulations of harvesting, reforestation, and construction of roads etc. Younger satisfactory forest must be treated with the aim of furthering the development of the forest with regard to wood quantity or quality. In other forests thinning or regeneration felling must be done in such a way that future growth or regeneration is favoured. Remaining trees or adjoining forest must not be unnecessarily damaged. The term ‘younger’ refers to forest of an age lower than 75 % of the rotation age giving maximum annual increment, and ‘satisfactory’ refers to stands supposed to yield at least two thirds of normal increment during the remaining part of the rotation.

Harvesting shall be planned and carried out with due regard to the natural environment and outdoor recreation. Continued use of public paths, ski trails and other rights of way shall not be rendered unnecessarily difficult when the operations are finished. For areas of particular interest for outdoor recreation or conservation of nature special regulations can be introduced.
There is a general obligation to establish regeneration on forest land within a reasonable time. If an owner of forest land does not comply with a written request from the forest authority that steps be taken to ensure regeneration, the authority can order certain measures to be carried out to restore forest.

Table 15. The forest sector in the national economy (1995) (Based on CBS 1997)

	Norway*	**Industry**	**Agriculture**	**Forest sector**
Gross production**	183	43	2,8	4,9
Gross product**	98	13	1,4	1,7
Employment (1000)	2 106	277	80	34

* Excluding the continental shelf.
** Euro 1000 mill.

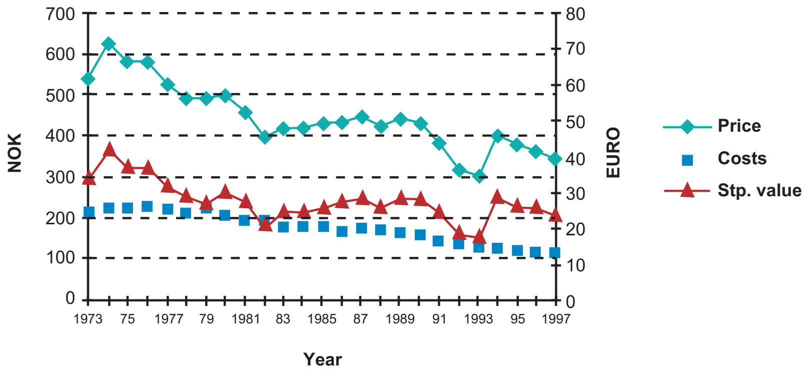

Figure 3. Average price of sawtimber and pulpwood of spruce, logging costs and stumpage value during the period 1973-1997, in 1997- NOK and Euro per m^3 (at constant rate of exchange)

For forest roads and other technical constructions the Ministry of Agriculture can establish regulations to the effect that such constructions can not be carried out unless the plans have been approved by the forest authority.

If the forest authority finds it necessary for practising the law it can direct forest owners to give written notice of planned harvesting etc. In some cases the forest authority can require a formal management plan be produced. A central point is, however, that the forest owner is entitled to manage the forest within the framework given by the law, often referred to as the principle of «freedom under responsibility».

The forest authority can also impose certain duties on the forest owners regarding treatment of forest damaged by wind, fire, etc., or in order to prevent or reduce damages by insect and fungus attacks etc.

Special regulations apply for protection forests, i.e. forests that can serve as protection against landslides, harmful floods, erosion, etc., and for other forest, agricultural land or buildings. Most protection forests are found close under the forest line. The limits of such forests should be marked on maps, or even in the field.

The law introduces a so-called ‘forest trust fund’, which is an instrument to ensure financing of forest regeneration and some other forestry measures. The arrangement implies that a certain percentage of the incomes from sales of wood be deposited on a special bank account, from which the forest owner can draw when relevant works, controlled by the forest authority, have been carried out. The deposit is usually 10 % of the gross sales income, but may vary between 5 and 25 %. The interest on the bank deposits is disposed of by the forest authority. A special regulation in the tax laws gives the forest owners a tax deduction when using means from the forest trust fund for financing silvicultural works or road construction.

A number of other laws do also have special relevance to forestry. The Law on Protection of Nature forms the legal basis for establishment of national parks and forest reserves, and in the Law on Outdoor Life some regulations regarding the rights and obligations of the general public when staying in the forest or on other out-laying land, to which there is a general right of access. Other relevant laws in a forestry context are the laws on land use, on planning and building, and on conservation of the cultural heritage.

4.2 Actors in forest and forest related policies

On the governmental level the two main actors in forest policy are the Ministry of Agriculture and the Ministry of Environment. In addition to being the proper authority concerning the Law on forestry and forest protection The Ministry of Agriculture is responsible for the forest sector policy in general, whereas the responsibility of the Ministry of Environment covers environmental issues in all sectors of society.

The interests of the forest owners are taken care of primarily by two organisations, namely the Forest Owners' Federation of Norway ('Norges Skogeierforbund') and The Norwegian Forest Association ('Norskog'). The former has traditionally had close contacts with the family of agricultural co-operatives, whereas the latter ideologically is based on individual, free enterprise.

An idealistic approach to forest and forestry is the basis of The Norwegian Forest Society ('Det norske Skogselskap'). Women in Forestry ('Jenter i Skogbruket') is an organisation aiming at involving women in a profession that traditionally almost exclusively has been dominated by men.

The main non-governmental actors regarding environmental issues related to the forest are the Norwegian Society for the Conservation of Nature ('Norges Naturvernforbund') and the Norwegian branch of World Wildlife Fund.

4.3 Forest policy tools

The main basis of the forest policy is the Law on forest and forestry, which defines a framework for the forestry practice. It forms, however, also a basis for more active public policies towards forestry. In addition to controlling the practicing of the law the forest authority has traditionally been heavily involved in guidance and planning for the forest owners regarding silviculture and road construction.

Another element of public forest policy is financial support to investments in forestry, as direct subsidies or tax reliefs. Direct subsidies are granted to a number of forestry measures, e.g. establishing regenerations, road construction and management planning. Silvicultural expenses and expenses for building and maintenance of forest roads are deductible in the calculation of taxable incomes. Special tax reliefs are also connected with the use of the 'forest trust fund' described above. The regulations regarding the subsidising and the use of the 'forest trust fund' are designed with a view to the aims of the forest policy, or e.g. to obtain a rational forest road system across the borders of the individual ownerships. These regulations are, thus, a strong political instrument. Aspects of regional policy are influencing the allocation of funds, and the decision power regarding the practising of the regulations has to a large extent been decentralised to the county level.

4.4 Forest policies in relation to other national policy areas

The forest policy is more or less closely related to several other policy areas. Forests constitute a basic element of the natural environment, and the forest policy is therefore considered in the context of the more general environmental policy. The role of forests in a policy for reducing the «greenhouse effect» is one aspect of this connection.

Because of the ownership structure there is a close connection between agriculture and and forestry, and this has also political consequences. In some respects the policy towards forestry is regarded as a part of the agricultural policy. Parts of the subsidies to forestry are allocated from the 'agricultural income agreement' funds, that are subject to negotiations between the government and the farmers' organisations. The aim is to make forestry contribute to rural development. Aspects of regional policy have on the whole had strong influence on the forestry policy, as great parts of as well forestry as forest industry are located in districts with problems of maintaining employment and population. As wood from the forest also is raw material for important manufacturing industries, the forest policy has to be viewed in an industrial context.

4.5 Forest education and research

Education in forestry has over the recent years gradually become an integral part of the general educational system. The background is found in the development of the forest sector itself , and in the general development of the society. The sector has declined relatively, employment has decreased, and non-timber aspects have come to play an ever more important role in public opinion and policy. Education is more than ever regarded a crucial factor in the economic and social development, and the educational system in general has swelled during the last decades. Changes in the labour market take place more rapidly than before, requiring the individual person to acquire new competence. The forestry education has also to be viewed on this background. Basic subjects and knowledge are emphasised.

The vocational training of forest workers, which used to take place in separate schools, has now been integrated, and are forming one option of study, in the high school system. The three-year educational program includes general topics that in principle will make the student eligible for admittance to higher education. During the first two years there are courses in natural resources and forestry, while the third year offers different options, including guided training as forest worker or machine operator. A diploma of professional skill is obtained. The programs have been designed to meet the need for training of professional forestry workers and machine operators, and also of future forest owners. The program is offered in a number of schools in different counties.

The former forestry technical schools have been integrated in the regional college system. Three-year study programs in forestry are offered at 3 regional colleges. The prerequisite for admittance is passed exam from a three-year high school. Compared to the traditional forestry schools the curriculum includes more of basic subjects. Independent work is more emphasized, and the study has on the whole become more flexible. The number of graduates is up to 100 per year.

University forest training is offered at the Agricultural University of Norway, located 30 km South of Oslo, where forest science is one of 12 lines of study. The normal study program takes 5 years. An option to follow a 3,5 year program is used to a small extent. For the time being about 45 candidates accomplish the full study program per year. The program has a main core of courses, or subjects, accounting for 60 % of the curriculum. This part covers the basic general subjects and subjects related to forest and forestry. The rest of the program involves specialisation in one of 4 directions of study: Silviculture, Resource economics and planning, Forest operations, and Wood technology. The students are also given the option of following an individual plan of study. There is a liberal practice as to accepting students with education from other institutions and offer them an individual road to a final exam. The program is open for majoring in sawmill industry.

From 1997 the Agricultural University of Norway is subordinated the Ministry of Church, Education and Research in stead of the Ministry of Agriculture, involving that the whole education system is unified in one ministry.

Research in subjects related to forest and forestry takes place at several universities and other research institutions. Special forest research institutions are the Norwegian Forest Research Institute and the Department of Forest Sciences at the Agricultural University of Norway.

The Norwegian Forest Research Institute (NISK) was founded in 1917 with the aim of strengthening the scientific basis for the management of forest resources. The activity is currently organised in three departments, namely Ecology, Management, and Economics, technology and processing. The institution has traditionally been closely connected with timber production and forest industry. However, during the last 20 years ever more of the research projects have been related to ecological and environmental problems. Problems related to biodiversity, and the influence of acid rains on forest soils, are emphasised. Research on improving products, and developing new products based on wood has also been strengthened. The institute has a staff of around 170. Its main office is located at the university campus at Ås, and a small branch office at Bergen.

The main task of the Department of Forest Sciences of the Agricultural University of Norway is to give scientifically based teaching, but the scientific staff is also supposed to allocate half of the working hours to research. The research activity of the department covers most fields related to forest and forest utilisation. The staff numbers about 40.

Other research institutions related to forest and forest resources are:
Norwegian Institute of Nature Research, Trondheim
The Norwegian Institute of Land Inventory, Ås
The Norwegian Institute of Wood Technology, Oslo
The Norwegian Pulp and Paper Research Institute, Trondheim

A number of regional research institutions have projects related to forest and forestry on their agenda.

5 Main current conflicts and challenges

A main issue in forest policy is to combine the intensification of the forest utilisation with the increasing environmental requirements. The increasing growing stock volume means that there is a potential for larger harvest of wood. It is desirable to exploit this potential in order that forestry can contribute to rural development by creating employment and incomes, and for supplying raw material to the forest industry. Considering the prevailing forest situation there should as a matter of principle be good possibilities for satisfying the many demands on the forests in a reasonable degree, even though there are obviously many conflicting interests.

Conservation of forest, meaning exclusion from cutting, has for many years been a central topic. Up to 1995 a total forest area of 1 995 km^2 had been reserved for conservation, of which 795 km^2 was coniferous forest. A large share of this forest is located at high altitudes and far north. Most attention has, however, been paid to the reservation of productive forest, particularly to productive coniferous forest. A national plan for establishing reserves covering various types of coniferous forest has been worked out. A plan to extend the area of this type of forest by 120 km^2 has been adopted and is now being implemented, bringing the share of reserved productive coniferous forest area up 720 km^2, slightly more than one percent. Some reserves of deciduous forests of oak and other species with less occurrence have also been established.

The judgement is, however, that conservation of the biological diversity in the main has to be taken care of through regulation of forestry practices. In order to achieve this a great number of measures have been put into effect. In public forest policy the regard for biological diversity has been underlined, e.g. by adapting the rules for financial support of investments in forestry. A special set of regulations for environmental forestry has been proposed (for the moment subject to hearings). In a governmental report in 1998 a new forest law with a more pronounced environmental profile has been announced. The background of this development is found in the processes resulting from the international conferences in Rio de Janeiro (1992), Montreal and Helsinki (1993), and Lisbon (1998).

Research programs on multiple use and environmental forestry have been carried out. In order to educate the practitioners of forestry The Forest Owners' Federation of Norway has accomplished a study program called «Richer Forest», the aim of which was to make the participants consider the total forest ecosystem in their activity. In 1993 a rather extensive project, called «Living Forest», in which forest land owners, forest industries, and environmental organisations took part, was started with the aim of developing a sustainable use of the forest resources. The project was terminated in 1998 with an agreement on a set of standards for forestry. However, the problem of certification of forestry, which has arised during the last years, as a consequence of consumers' demand that forest industry products are based on sustainable forestry, has not yet been clarified, whether regarding criteria, or organisation of the certification process.

Addresses of organisations related to forestry

Agricultural University of Norway, Department of Forest Sciences, P.O. Box 5044, N- 1432 Ås Tel: 47 64 94 88 80; Fax: 47 64 94 88 90

Norwegian Institute of Forest Research, Høgskoleveien 12, N-1432 Ås, Tel: 47 64 94 90 00; Fax: 47 64 94 29 80

Norwegian Institute of Nature Research, Tungasletta 2, N-7005 Trondheim, Tel: 47 73 80 14 00; Fax: 47 73 80 14 01

Norwegian Institute of Land Inventory (NIJOS), P.O. Box 115, N-1430 Ås. Tel: 47 64 94 97 00; Fax: 47 64 94 97 86

Ministry of Agriculture, Division of Forestry, P.O. Box 8007 Dep. 0030 Oslo. Tel: 47 22 24 93 61; Fax: 47 22 24 27 54

Ministry of Environment, Division for Conservation of Nature and Cultural Heritage, P.O. Box 8013 Dep. 0030 Oslo, Tel: 47 22 24 58 51; Fax: 47 22 24 27 56

Forest Owners' Federation of Norway, Norges Skogeierforbund, P.O. Box 1438 Vika, 0115 Oslo, Tel: 47 22 01 05 50; Fax: 47 22 83 40 47

Norwegian Forest Association, Norskog, P.O. Box 123 Lilleaker, 0216 Oslo, Tel: 47 22 51 89 00; Fax: 47 22 51 89 10

The Norwegian Forest Society, Det norske Skogselskap, Wergelandsveien 23B, 0167 Oslo, Tel: 47 22 46 98 57; Fax: 47 22 60 41 89

Women in Forestry, Jenter i Skogbruket, Wergelandsveien 23 B, 0167 Oslo, Tel: 47 22 46 98 57; Fax: 47 22 60 41 89

The Norwegian Society for the Conservation of Nature, Norges Naturvernforbund, P.O. Box 6891, 0130 Oslo, Tel: 47 22 99 33 00; Fax: 47 22 99 33 10

World Wildlife Fund, Verdens Naturfond, P.O. Box 6484 St. Olavs plass, 0130 Oslo, Tel: 47 22 03 65 00; Fax: 47 22 20 06 66

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Norwegian Institute of Land Inventory (NIJOS). 1996. Skog 96. Statistics of forest conditions and resources in Norway. Ås 1996

Additional literature

The National Atlas of Norway gives a survey of the physical and human geography of the country. During the period 1981-94 the atlas was published as a series of thematic maps accompanied by booklets with English summaries. From 1996 the atlas is published as books.The atlas is published by Statens kartverk [‘The state map service’], (Address: Kartverksveien 21, N-3500 Hønefoss).

Numerous publications from The Central Bureau of Statistics, Oslo, contain an abundance of information regarding nature, population, economics and society. The publications are normally furnished with English summaries and captions. The Statistical Yearbook of Norway deserves special mention in this connection.

Useful URL

The governmental electronic information service ODIN http://www.dep.no/odin/engelsk/index-b-n-a.html.

Poland

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1 The Country

1.1 Natural conditions

Topography
Poland is a lowland country situated in Central Europe. The average height above sea level for the whole country is only 174 m. Seventy five per cent of the country does not exceed 200 m a.s.l. and 22% is between 200 and 500 m.

The shape of the country could be compared to an irregular circle almost equal in size from North to South and from East to West (650 by 690 km).

The surface of the country gradually rises from the North ,(Baltic Sea) to the South. As for country relief belts running from East-West can be recognized.

Northern Poland, from the Oder up to the Niemen River, is the land of the lakes. The quaternary glaciations influenced the landscape of this region considerably. When the climate got warmer and glaciers melted, there remained not only lakes (more than one thousand of them), but also morainic hills made of sands, gravel and loam, transported by glaciers from Scandinavia. The wide old valley of the Vistula River separates the region into the Western Pomeranian and Eastern Mazurian districts.

Moving south, we find an adjacent belt of plains (Great Poland, Mazovia, Podlasie and Silesian Plain). It is part of the big Central European Plain. There are no mountains and the land is mostly flat, although dotted with hills.

Next belt to the South consists of a highland area known as Malopolska and Roztocze. On the northern edge the old (hercynian) Swietokrzyskie (Holy Cross) Mountains can be recognized.

The Sudety Mountains and Carpathians, where the tallest chain is known as the Tatras, form Poland‘s southern frontier. The Carpathians young mountains (cretaceous and Tertiary in date) constitute an extension of the Alps. In this mountain chain, only the Tatras, most of which belongs to Slovakia, have an Alpine character. The Sudety is an old mountain chain belonging to the old Czech Massif.

The highest peak in the Tatras is Rysy Mt. reaching 2500 m above sea level. Length of the Baltic seaboard is about 500 km.

Area of the country is about 312.000 km^2.

Climate
Two different types of climate are found on Polish territory: the oceanic climate (Cfb according to Köppen classification system) of Western Europe and the continental climate

(Dfb according to Köppen) of Eastern Europe. This results in highly changeable weather conditions and considerable seasonal fluctuations from year to year. Whereas the weather tends to be more stable during the summer months, winters are more variable: some are damp and cool, while others are frigid and fair.

Poland has 30-70 days of snowfall and 20-50 days with below-freezing temperatures. The ground is covered with snow, on average for a total of one month, however in the coldest NorthEastern area there may be as much as three months of snow cover.

Annual precipitation is about 600 mm, but high in the mountains it reaches 1800 mm, and the minimal value for Central Poland is only 450 mm.

The average temperature for July is 19 ^{o}C and -2 degrees for January. Length of the growth season varies from 180 to 220 days.

Soils

More than 60% of the forests (mostly on lowland) grow on rusty soils, podsolic soils and podsols developed on Quaternary sands and gravels fluvoglacial, glacial, aeolic and alluvial. Such soils (acid and poor in nutrients) are typical for conifer and mixed conifer sites.

Brown soils, lessive's and pseudo gley soils, originating mostly from boulder loams, sands, or silts on loams, are the lowland sites for mixed broadleaves and fresh deciduous-type trees.

Black earths, gley soils and gley-pod soils, originating from different parent materials to slightly loamy sands, up to loams and clays, can be found in areas of high humidity, such as terrain depressions and river valleys.. Sometimes in such conditions organic turf, muck and mud soils were formed.

Acid brown soils originating from older massive magmatic and sedimentary rocks are most typical for the highland and montana forests. On limestone rocks of different age the rendzinas were created. Near to the timberline and below the dwarf mountain pine noncarbonate weakly developed soils can be met.

The bogged high peat soils occur on watersheds.

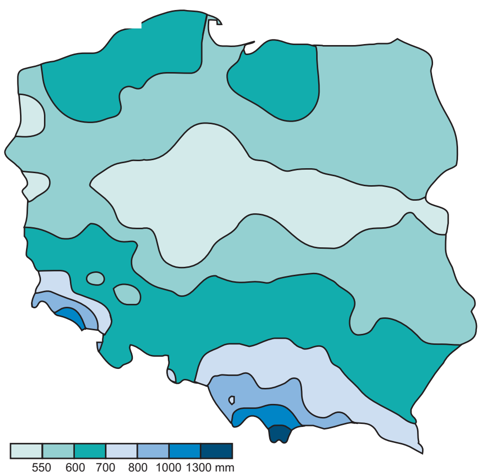

Figure 1. Mean annual precipitation (according to data from Institute of Meteorology and Water Management).

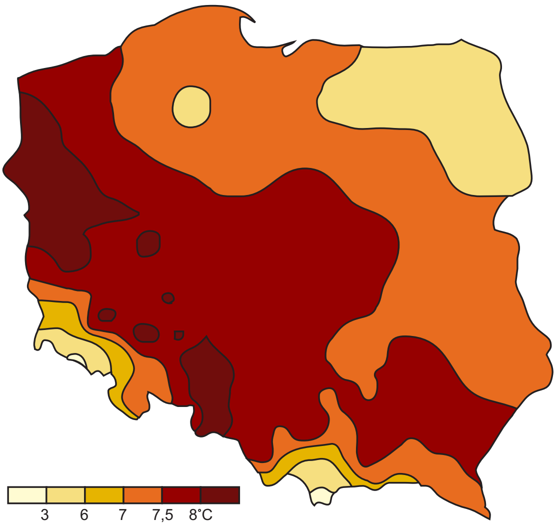

Figure 2. Mean annual temperatures (according to data from the Institute of Meteorology and Water Management).

Vegetation
As a result of glacial activity (Poland went through four ice ages) and present climatic conditions vegetation cover is very diverse. South of the country is characterized by mixed deciduous forest and boreal-type forest is seen in the North. The present forest composition is a result of both prehistoric and human activity.

Forest coverage has been reduced by 28% today. In lowland Poland the richer sites are still occupied by mixed deciduous stands. An excellent example could be the Bialowieza Forest where there still exists natural mixed stands composed of oak (*Quercus robur*), lime (*Tilia cordata*) ash (*Fraxinus excelsior*), hornbeam (*Carpinus betulus*), spruce (*Picea abies*) and pine (*Pinus sylvestris*).

In northern and mid-Poland the most typical species in managed stands is Scots pine, whereas in southern areas these stands mainly consist of Norway spruce. Spruce, under the influence of economically-oriented German forestry, was planted as monocultures in the mountains as well. But more typical for the Carpathian Mts are more natural mixed stands composed of beech (*Fagus sylvatica*), silver fir (*Abies alba*), elm (*Ulmus laevis*) and ash.

Much of the area on poor sites (sands) is covered by pine stands mostly monocultures, although sometimes birch (Betula verrucosa) is present. On fresh sites, Scots pine, sometimes with a proportion of Norway spruce forms highly productive stands of excellent quality. But there are some examples of pine stands planted on sites too rich with a resultant poor quality.

1.2 Society

Population
With a population of 38.6 M (1996) and population density 124 inhabitants per sq. km, Poland is Europe's ninth country in terms of population number and density. Population growth, quite rapid in the 80's, has lately become very slow - only 0.11% in 1996. At present Poland is an ethnically almost homogenous country and all national minorities constitute not more

than three percent of the total population. About 62% of the population live in urban areas - the largest concentration being in Silesian industrial region. Other densely-populated areas are around Warsaw, Lodz (central Poland) and the harbour areas of Triple City (Gdansk, Gdynia, and Sopot).

Industry

Polish economy was heavily influenced, through the nation being part of the former Soviet Union block up until 1989. During this time industrial development concentrated on "heavy industry" (mining and first stages of raw material processing). Very little, if any, effort was given to the development of industry producing "consumer goods" and to developing the service sector.

Another typical problem of former "peoples democracies" countries is structure of agriculture. After WW II, during the time of collectivization, big efforts were given to the winding-up of private farming. In some regions of the country so-called "state agricultural farms" were created. After 1989, the majority of these farms became bankrupt, resulting in unemployment for a large number of people.

2 Forest resources and their uses

Under the Forest Act of 1991, *a forest* means land which:

1) has a compact area of at least 0,10 ha, covered with forest vegetation (forest stands) - trees, bushes and undergrowth - or temporarily devoid of it:
   a) selected for forest production or,
   b) constituting a nature reserve or part of national a park or,
   c) registered as a monument of nature;
2) is related to the forest, as used for the needs of forest management: buildings and structures, drainage systems, forest division network, forest roads, land under power lines, forest nurseries, lumber yards as well as parking areas and recreation objects.

Sustainable forest economy - under this Law, is an activity aimed at developing the forest structure and to use it in such a way and rate that ensures the lasting preservation of forest biological diversity and abundance, high productivity and regeneration potential, vitality and ability to perform both at present and in the future, all important functions: protective, economic and social, on the local, national and global level, without harmful impact on other ecosystems.

A *sustainable forest economy* is based on the forest management plan, or in the case of a private forest on a simplified forest management plan, and focused on the following purposes:

1) to maintain forests and their beneficial influence on the climate, air, water, soil, environment for people's life and health, and ecosystem (ecological balance);
2) to protect forests, in particular such forests and forest ecosystems that constitute natural

Table 1. Contribution to GDP by industrial sectors (1994)

Agriculture, forestry, hunting & fishing	6.3%
Mining & quarrying	4.2%
Public administration and defense and	4.5%
Construction	5.7%
Electricity, gas and water	3.7%
Wholesale and retail, restaurants, hotels	14.1%
Transport, storage, communications	6.0%
Manufacturing	24.3%
Financial, real estate and business activities	7.0%
Education, health and social work	7.0%
Other services	17.2%

fragments of local nature or forests of particular significance due to their:
a) variety of nature,
b) preservation of forest genetic resources,
c) landscape quality,
d) scientific needs;
3) to protect soil and areas that are in particular danger from pollution or damage and areas of considerable social significance;
4) to protect of surface and ground waters, retain river basins, in particular on watershed areas and on areas supplying water to underground lakes;
5) to produce wood, raw materials and non-timber forest products - based on the principle of rational forest economy.

Furthermore, forest economy is based on the following rules:
1) common protection of forests,
2) consistent conservation of forests,
3) continuity and balanced use of all functions of the forest,
4) expansion of forest resources.

2.1 Forest history

The history of Polish forests is similar to the history of forests in neighboring countries. However some processes of societal development in Poland had a different intensity both in place and time. There is no doubt that today‘s perception of our forests has been influenced throughout 146 years when Poland was sub-divided and occupied by three partitioning powers: Russia, Prussia and Austria-Hungary.

Some idea of the significance of forestry for Polish people in development of human civilization , can be found in the meaning of the names: Polska (Poland) and Polacy (Poles).

The origin of these terms is derived from the name of one of the Slavic tribes “Polanie”. In the Polish language it means “people living at/ connected to an opening within the forest”. Similar historical word terminology can be found in other European nations, however in Poland they have lasted the course of time.

Intensive colonization of the forest and the start of permanent farming on such areas was in place from the XIII century. The first law acts concerning permission in use of forest goods were prepared in the XIV and beginning of the XV centuries.

Production of ashes was the first stage in forest exploitation, and such production caused much damage to the forest. The next stage was timber harvesting. In the XV century, the first water sawmills were constructed. At the turn of the XV and XVI centuries a very rapid growth in the export of agricultural and forest products from Poland to West-European countries was observed. Changes in forestry, typical for capitalism started in the second half of the XVIII century. In this time a separate forest business arose within the framework of landed properties. Some evidence of this was the preparing of forest management plans.

During the time of partitioning some differences existed between forest management in different parts under the ruling body. However in all parts heavy exploitation of the forests was observed. After this period it was evident that the forest percentage declined (before partitioning this percentage was above 43%). This dropped, in conjunction with losses accompanied with WW I, to a forest percentage of 23.1%.

The period between wars did not bring improvement, and a small percentage drop of 22.2 was observed.

The Polish forest suffered further losses in the Second World War (in area and yield). Forest percentage after WW II (in the new borders) was only 20.8%.

Strong efforts and concentrated attention given to this problem after the war, resulted in forest land area reaching 28% and an increase in the sum of standing volume within the country at around 80% (volume in year 1946 taken as 100%).

2.2 Forest ownership

The country's forests are mainly owned by public authorities, the majority being the property of the State Treasury, and under management of the State Forest Enterprise (SFE). Private forests account for 17% of the total forested area, although the proportion in central and eastern parts of the country is much higher (30-60%). The number of private forest holdings owned by individuals amounts to 900,000. The ownership structure is shown in table 2.

2.3 Land use and forest resources

2.3.1 Global overview of land use

Forests cover 28 per cent of the land area, i.e. 8.8 million ha. In the period of 1945-1995 the area under forests increased considerably (by about 2.3 million ha or 35%), however, the forest cover of Poland is still less than optimum, (assessed to be 34%). In the period mentioned above, the human population grew faster than the forest acreage, hence about 0.22 ha of forest and 40 m^3 of growing stock was felled per inhabitant. Present composition of land use categories in Poland is shown in figure 3.

Almost two thirds of the agriculture land area in Poland is composed of light sandy soils, at which 3.3 million ha or 17% are assessed to be marginal for agricultural production. In 1995 a National Programme to Increase the Country's Forest Cover was adopted by the Council of Ministers. According to ecological and economic guidelines the basis of the programme was to increase the share of forests in the country‘s natural space. The programme aims to develop afforestation of about 1.5 million hectares of abandoned agricultural land (700,000 hectares until the year 2020, and then 800,000 hectares until the year 2050). This will increase the country's forest cover to 30% by the year 2020 and to 33% by the year 2050.

2.3.2 Extent and distribution of the forests

The share of forested land in the country decreased to 38% in 1820 and to 21% in 1945. Thanks to afforestation efforts, especially in years 1947-70, the ratio of forested area to the total area of Poland increased to 27% in 1970. As a result of extensive deforestation in past centuries and very widespread post-War reforestation, Poland's forests are highly fragmented and isolated spatially. The holding of the State

Table 2. Ownership structure.

Forms of forest ownership	Forest area [ha]	Forest area [%]
Total	8,779,000	100.0
PUBLIC FORESTS	7,282,000	83.0
1) property owned by the State Treasury	7,205,000	82.1
including managed by		
-the State Forests	6,881,000	78.4
-national parks	177,000	2.0
-other	147,000	1.7
2)property owned by communes	77,000	0.9
PRIVATE FORESTS	1,497,000	17.0
Including property of:		
-individuals	1,397,000	15.9
-common land	68,000	0.8
-collective farms	12,000	0.1
-other	20,000	0.2

Source: Statistical Yearbook of Forestry, 1997.

Forest Enterprise is comprised of 28,000 complexes, of which more than 6,000 cover no more than 5 hectares (see map of forest complexes in Poland). The average size of a private holding does not even exceed 1 ha, and a holding of this size may often be made up of several separate plots.

2.3.3 Tree species origin and distribution

Forests in Poland have persisted up to the present time mainly on less fertile coniferous sites. Thus, the majority, i.e. 63% of the country's forests area are coniferous sites, 34% broadleaved and 3% alder swamp forest sites. Stand composition is to the extent of 78% mainly coniferous species, of which Scots pine (*Pinus sylvestris* L.) is dominant, at about 68% of the forest area. The share of broadleaved species in the composition of stands has risen in recent decades from 13% to 22%. Nevertheless, the situation remains problematic in relation to an excessively simplified biological structure and the large proportion (15-20%) of stands whose species composition is not in accordance with the habitat. These problems are the result of a past preference for the regeneration of pure stands. Imported species, among which the most frequent are Douglas fir (*Pseudotsuga menziesii* Mirb) and red oak (*Quercus rubra* L.) are of low significance both by area and for wood production. The distribution of the main species by area is shown in figure 4.

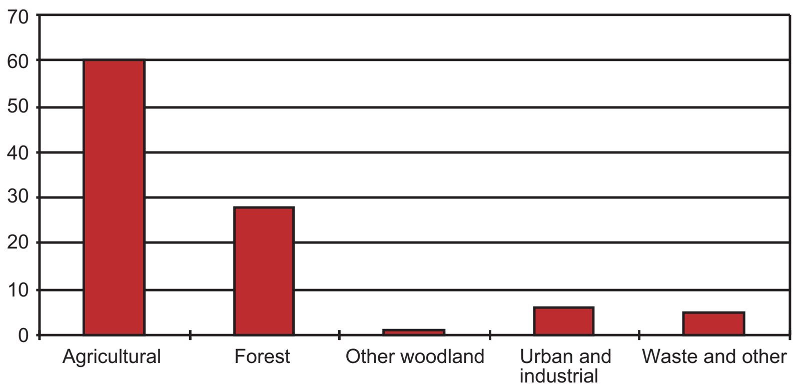

Figure 3. Land use categories in Poland. Source: General Statistical Office of Poland, 1998.

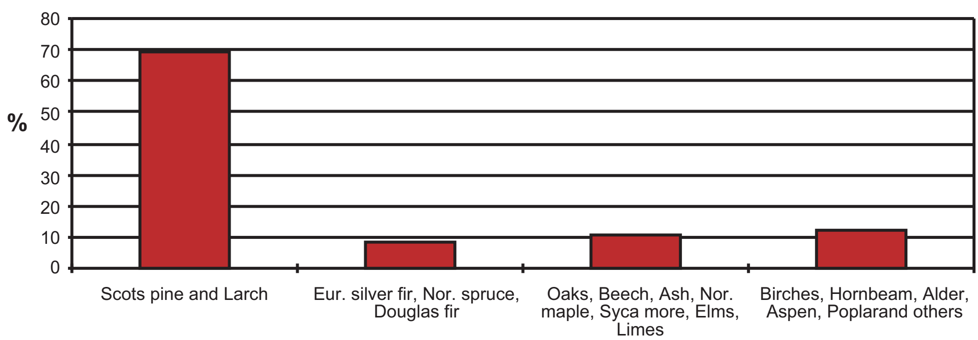

Figure 4. Species distribution by area. Source: Report on the State of Forests, 1997.

2.3.4 Total growing stock, growth and total felling

In 1997, the total growing stock volume was 1.6 billion cubic meters, 1.37 billion cubic meters being in forests managed by the State Forest Enterprise (SFE) and 0.18 billion cubic meters in the private and communes forests. About 1.25 billion cubic meters is coniferous and 0.35 as broadleaved species. This corresponds to a mean of 186 m^3 per hectare, with 200 m^3/ha in public and 118 m^3/ha in private forests. The gross annual increment amounts to 50 million cubic meters or 5.6 m^3/ha. The present level of annual timber harvesting is much lower than the volume of estimated gross annual increment. Recently only 26 million cubic meters was harvested, (2.9 m^3/ha). The ratio of harvest size to increment size is 0.5, which ensures a continual and stable growth of forest resources in Poland. Changes in the volume of total growing stock, growth and felling in the period of 1945-97 are shown in table 3.

In 1997, the mean age of forest stands managed by the SFE was 56 years, and for private forests this figure was much lower, at only 37 years. Table 4 shows the age class structure of forests in Poland.

Table 4. Age class structure in 1997 (by area of species group)

Age class	Conifers [%]	Broadleaved species [%]
1 – 20 years	14.4	13.5
21 – 40 years	25.2	24.7
41 – 60 years	21.6	24.2
61 – 80 years	18.8	14.8
> 81 years	20.0	22.8
Area of forest land: [1000 ha]	6,784	1,995

Source: Statistical Yearbook of Forestry, 1998.

2.3.5 Forest threats

Overall state in the health of forests gives cause for concern in spite of some recent improvement. Forests are threatened by diseases, pests, games, unfavourable climatic phenomena, fires and air pollution.

The forest area threatened by insect pests in 1997, mainly *Bupalus piniarius* L., *Diprion pini* L., *Neodiprion sertifer* Geoffr. and *Lymantria monacha* L. was about 450,000 ha or 5% of total forested area in Poland, and preventative measures were carried out on 120,000 ha.

Fungal diseases, especially root-rot fungus (*Fomes annosus* Fr.) and honey mushroom (*Armillaria* sp.), have a considerable impact on the health of forests and on an increase in the number of dying trees. In 1997, fungal diseases were noted in an area of 563,000 ha or 8% of forests managed by the State Forest Enterprise (SFE) and chemically preventative measures against fungal diseases were carried out on an area of 2,000 ha.

An excessive number of game, especially red deer (*Cervus elaphus* L.) and roe deer (*Capreolus capreolus* L.) cause damage mainly by tree browsing in young plantations and the debarking of trees in thickets and tree stands. This type of damage, in 1990, was observed in forests managed by the SFE in an area of about 1.3 million ha or 19% of the forested area. In 1990 substantial damage (over 20% of the trees) to forest stands caused by game has been noted on an area of 551,000 ha or 7% of forests managed by the SFE.

Table 3. Growing stock, felling and increment (wood with bark)

	Unit [1000]	1945	1971	1990	1997
Total growing stock	m^3	845,000	1,169,000	1,461,000	1,607,000
Felling of growing stock	m^3	14,500	23,000	22,000	26,000
Gross increment	m^3	20,000	30,000	44,000	50,000*

Source: General Statistical Office of Poland.
* Unofficial figure

In 1990, as the result of wind falls, wind and snow breaks, forest stands were damaged in an area of 90,000 ha, and total volume of wood harvested from damaged areas reached 5.4 million m^3, that was about 25% of a calculated yearly cut.

During the last decade there was an increase in the number of forest fires and area of forests damaged by fires. The average area of forest fires in 1991-1995 in forests managed by the SFE was about 8,700 ha, with the enormous area of 33,334 ha burnt in 1992.

Although a considerable decrease in the amount of industrial air pollution emissions has been observed since 1988, it is still considered as a damage factor of great importance for the health of forests ecosystems in Poland. In 1997, the assessed average values of SO_2 and NO_2 concentrations in the air were as follows: SO_2 - 11.26 µg/m^3, NO_2 - 18.19 µg/m^3. On the basis of studies it is estimated, that the current loss in annual increment of wood in forest stands managed by the SFE amounts to 10.5 million cubic meters, and 2.0 million cubic meters in private forests. The total size of this loss is nearly 50% of annual wood harvested volume.

The index of damage to stands, as measured using the defoliation level, is high with regards to the complexity of threat agents. However, the share of trees with defoliation above 25% decreased from about 50% in 1993 to 36% in 1997. Currently estimated defoliation is shown in table 5.

Locally, in the Sudety Mountains, the complexity of threats, with damage primarily caused by industrial air pollution from local sources, led to a decline in tree cover of an area of 13,000 ha and was a so-called ecological disaster.

Table 5. Trees defoliation in 1997.

Defoliation level [%]	Number of trees [%]
0 – 10	10.9
11 – 25	52.5
26 – 60	35.1
> 60	1.2
Dead trees	0.3

Source: Report on the state of forests, 1997.

A disastrous flood occurred in 1997 in 140,000 ha of forests, which caused damage to about 28,000 ha of forests managed by the SFE, of which 16,000 ha of stands needed to be converted.

2.4 Silviculture

Silvicultural measures take into account natural site conditions (climate, soil and topography), present state of the forest stands, and adopted aims. One of the basic silvicultural principles in Polish forestry is the compatibility of tree species composition to site conditions. There are 26 types of forest sites distinguished for the purpose of silvicultural works.

In 1993, the “Program of Conservation of Forest Gene Resources and Selection Breeding of Forest Trees in Poland” was elaborated. The Program introduced the seed regions in Poland and outlined further tasks in the field of protection of forest genetic diversity. Program plans, among others, included selection of a new area for 3,450 ha of plus seed stands, selection of 4,560 of plus trees, establishment of 44,800 ha of progeny plantations, and the establishment of 630 ha of seedling orchards.

The clearcutting system prevails, although its use was reduced from 43,000 ha in 1980 to 25,000 ha in 1997. The use of natural regeneration has increased since 1980 from a level of 2,300 ha to 5,700 ha in 1996. Shelterwood systems, in forests managed by the State Forest Enterprise, were in operation on an area of 12,600 ha, and 5,300 ha of neglected areas were brought back into production (1996). Threatened tree stands were converted in 1997 in an area of 10,500 ha. Yearly tending measures in cultures and thickets cover approximately 300,000 ha. Tending and sanitary cuts in other tree stands are performed in areas of about 500,000 ha yearly.

The framework of forest economy formed in the 19th century had a sole goal: production of raw material for the needs of the woodworking industry. This was expressed as a preference for coniferous monocultures and for clearcuttings. Applications of these methods in silviculture and forest use, contributed to a weakening in stability of the Polish forest stands, and over-simplification of their composition and structure. The estimated area of pine and spruce pure stands, growing on rich broadleaved sites, is about 400,000 ha. These stands need to be supplemented with understorey shrubs as well as with broadleaved tree species.

Reducing the number of game stock relative to sivicultural efficiency is one of the basic requirements to limit damage caused to cultures and thickets in regions with an excessively high density of game animals.

2.5 Forest production

With a share of 94% in volume of total wood harvested, SFE is the main supplier of wood in Poland. The impact of private forest owners is mainly local in character.

Total roundwood production is forecast to rise by 43% in 2010, reaching 31.7 million m^3. In 1996, the share of industrial roundwood to total volume of wood harvested was 93% and is expected to drop by 3% in 2010. The most important product from industrial roundwood are sawlogs with a share of 43% in 1996 (38% forecast in 2010), and pulpwood with a share of 35% in 1996, and 31% forecast in 2010. Although the share of sawlogs and pulpwood as a volume of industrial roundwood production is forecast to decline in 2010, their production volume is expected to rise by 12% and 9%, respectively. The timber production structure in Poland in the period 1997-1999 is shown in table 6.

2.5.1 Harvesting systems

In wood harvesting, the most common system is the tree-length method (56% of total wood harvested volume), then whole-stem method (21%), cut-to-length method (18%), full-tree method (3%) and chip harvesting (2%). Manual and motor-manual work methods dominate in wood harvesting. The mechanisation level for each operational process is varied and shown for all wood harvesting methods in table 7.

2.5.2 Timber uses

According to a prospectus made in 1996, total demand for wood is roughly foreseen to rise by 55% in 2010. In 1996 the share of sawlogs and pulpwood to total volume of wood demand was 50% and 35%, respectively. In 2010, the demand for sawlogs is expected to fall by 3%, and for pulpwood to rise by 6%. Under the 1996 prospectus, the total demand for wood in 2010 is roughly forecast to be fully satisfied through domestic production. However, in 2010 a deficiency in 0.5 million m^3 or 5% of sawlogs, and a surplus of 1.8 million m^3 or 134% of pulpwood is expected to appear. In this context, as well as in the light of a low consumption of paper in Poland, new investments in the pulp industry are presently considered.

Table 6. Timber production in Poland, 1997-1999

		Production		
Timber assortment	**Unit [1000]**	**1997**	**1998**	**1999**
Sawlogs	m^3	10,203	10,280	10,340
Pulpwood	m^3	8,173	8,450	8,700
Fuelwood	m^3	2,545	2,600	2,650
Other	m^3	1,721	1,750	1,800
Total wood in the rough	m^3	22,642	23,080	23,490

m^3 = cubic meter of roundwood, solid measure, without bark.
Source: Forest Products Markets in 1988 and Prospects for 1999.

Table 7. Mechanisation level of operations in technological process of wood harvesting

Technological process	Means	[%]
Felling	Chain saws	99.6
	Harvesters	0.4
Limbing and bucking	Chain saws	99.0
	Harvesters	0.4
	Others	0.6
Extraction	Mechanical extraction	60.0
	Horse extraction	40.0
Transport	Mechanical means	100.0

Source: Experts assessment, 1994.

Current consumption per capita of roundwood accounts for 0.6 m^3 and of paper 40kg. The timber uses in 1997 are shown in table 8.

2.5.3 Non-wood forest products

Utilisation of non-wood forest products, as in many other European countries, has a long tradition in Poland. Nowadays the main non-wood forest products are berries: bilberry (*Vaccinium myrtillus* L.), cowberry (*Vaccinium vitis-idea* L.), raspberry (*Rubus idaeus* L.); mushrooms: chanterelle (*Cantharellus cibarius* Fr.), edible boletus (*Boletus edulis* Bull: Fr.), and medicinal and ornamental plants. All citizens have open access to the public forests for picking fruits of the undergrowth for their own use. Picking fruits for industrial purpose is permitted only if an agreement has been made with the director of a local Forest District of the SFE. When picking fruits from the undergrowth endangers the forest environment in some cases it could be limited or even forbidden. Table 9 shows the estimated level of harvesting of certain non-wood forest products.

2.5.4 Forest functions

Forests serve very diverse functions, either naturally or as a result of management activities. The three main groups of forest functions are as follows:

Table 8. Timber uses in Poland, 1997

Timber uses	Unit [1000]	Apparent Consumption	Production	Imports	Exports
Wood in the rough	m^3(r)	22,651	22,642	300	291
Pulpwood	m^3(r)	8,223	8,173	200	150
Coniferous sawnwood	m^3(s)	4,333	5,010	106	783
Non-coniferous sawnwood	m^3(s)	787	900	60	173
Total sawnwood	m^3(s)	5,120	5,910	166	956
Plywood [a)]	m^3	119	132	60	73
Particle board [b)]	m^3	2,408	2,072	471	135
Fibreboard	m^3	513	727	118	332
Woodpulp	m.t.	825	707	178	60
Paper	m.t.	1,459	1,473	415	429
Paperboard	m.t.	601	87	415	1
Waste paper	m.t.	68	59	10	1

[a)] veneer and core plywood; [b)] including non-wood particle board; m^3=cubic meter (solid volume of roundwood and processed products); m^3(r)=cubic meter of roundwood, solid measure, without bark; m^3(s)=cubic meter of sawnwood; m.t. = metric ton.

Sources: 1/ Forest Products Markets in 1998 and Prospects for 1999; 2/ General Statistical Office of Poland, 1998.

Table 9. Non-wood forest products harvested in Poland

NWFPs	Units	1985	1990	1991	1992	1993	1994	1995	1996	1997
Berries [b)]	[1000kg]	8,010	3,006	1,974	1,258	606	252	292	5,683	4566
Mushrooms [b)]	[1000kg]	5,151	2,792	841	618	657	87	243	940	761
Resin [a)]	[1000kg]	8,403	6,400	2,940	806	34	-	-	-	-
Christmas trees [a)]	[1000]	564	336	339	330	303	272	317	339	292

[a)] harvesting in forests managed by the State Forests Enterprise
[b)] products purchased from collectors
Source: Statistical Yearbook of Forestry, 1998.

- *environmental* (protective), ensuring stabilisation of the water cycle in nature; the counteraction of floods, avalanches and landslides; the protection of soil against erosion and of the landscape against changing into steppe plant formations; the shaping of the climate both global and local; stabilisation of atmospheric composition and purification of the atmosphere; the creation of conditions by which to preserve the biological potential of a large number of species, ecosystems and the genetic resources of organisms; and safeguarding the diversity and complexity of the landscape, as well as better conditions for human health and life;

- *commercial* (economic), through ensuring sustainability of the use of timber and non-timber forest resources as well as hunting; the development of tourism; profits from the sale of the aforementioned goods and services; the creation of jobs and the provision of income for state and local budgets by way of taxes;
- *social*, serving to shape favourable health and recreation conditions for society; enrichment of the labour market; the creation of diverse forms of use by local communities; utilisation of degraded land and marginal soils; development of the country's culture, science and education.

As a consequence of their functions, other than *commercial*, nearly half of state-owned forests in Poland are classed as protective. These are forests protecting soil from erosion, and waters from excessive runoff and pollution; damage by industry; offering refuges to animals under special protection; significant to national security; in the vicinity of large agglomerations and subject to scientific research or mass tourism.

Forests are fundamental elements in the national system of protected areas, with forested land accounting for 63% of the area within National Parks, 66% in Nature Reserves and 55% in Landscape Parks. SFE land includes 849 Nature Reserves covering 66,400 ha, about 1,740 protective zones around sites for rare and protected animal species covering 54,500 ha, and about 3,800 Areas of Environmental Importance, covering 14,000 ha.

In 1994, within the forests managed by the SFE, special units, known as Forest Promotional Complexes (FPCs) were created. These are larger, preferably heavily-wooded areas, within one or more Forest Districts, which have been established for promotion of multi-functional forest use and the sustainable forest management policy of the State. FPCs include either whole Forest Districts, or, to a lesser extent, separate sub-districts. Thus, they are functional units, without a separate administration staff, being administered (under the supervision of Regional Directorates of the State Forests) by the personnel of the Forest Districts included within them. Total area of the ten FPCs in 1997 was 445,670 ha or 6.5% of forested area managed by the State Forests. The process of identifying areas and boundaries of Promotional Complexes seeks to ensure the representation of different nature-forest regions and the associated variability in habitat conditions, stand species compositions, valuable natural features, productive possibilities and leading functions, as well as the diversity of threats. Among the ten existing FPCs (of the 18 targeted), there are both forest areas of high nature value, such as the primeval forests (e.g. Bialowieska Primeval Forest) and areas which have been largely modified by man, such as Tucholskie Forests.

3 Forest economics

3.1 Forest and forest industries in the national economy

Despite having a relatively large proportion of forest resources in Poland, forest production is of rather low importance within the national economy. In 1996, forestry, as a share of the gross domestic product (GDP) amounted to 0.6%, and the total share of agriculture, hunting and forestry came to 6.0%.

In foreign trade, forestry products also play a minor role in the balance of trade, accounting for 0.22% of the nations total exports and 0.08% of its imports. The forest industry sector is of considerable importance, however, with export of its products amounting to 11.4% of total exports and imports of 4.4%.

3.2 Employment provided by the forest sector

In 1996, about 70,000 persons were employed in the forestry sector, the majority (about 50,000 persons) working in the SFE. During the last decade the number of employees in forestry was continuously reduced (up to 50%), mainly due to the transformation of the national economy. The level of employment in 1988 amounted to 155,000 persons (125,000 in the SFE).

3.3 Profitability

Profitability is defined as gross or net profitability. Gross profitability is the margin between gross sales revenues in relation to value of output, and net profitability between net sales revenues in relation to value of output. In 1996, estimated for forestry, an indicator of gross profitability was 4.2%, and net profitability 4.0%.

4 Forest and forest related policies

4.1 Legislation

The following legal acts refer to forests in Poland:

1) The Act on Forests - 28 September 1991 (with the latest update on 24 April 1997);
2) The Act on Protection of Nature - 16 October 1991 (being now revised);
3) The Act on Protection of Environment - 31 January 1980 (with the latest update on 29 August 1997);
4) The Act on Protection of Arable and Forest Land - 3 February 1995;
5) The Land Development Law - 7 July 1994.

The Act on Forests defines the principles of preservation, protection and growth of the forest resources as well as the basic rules of forest management, linked with other environment elements and economy of the country. This Act applies to forests in general, regardless of the form of their ownership. Under the Act on Forests, public forests are supervised by the Minister of Environmental Protection, Natural Resources and Forestry (MEPNRF) and private forests are supervised by a head of the regional or local government administration’s unit. Forest management in forests constituting nature reserves or a part of national parks is based on regulations within the Act on Protection of Nature.

Protection of nature under the Act on Protection of Nature, is defined as preservation, proper use and renewal of resources and natural elements, in particular wild vegetation and wild animals as well as nature complexes and ecosystems. Nature reserves situated on territory owned by the State Treasury shall be supervised by organisational units of the State Forest Enterprise and in particular by the directors of local Forest Districts. On the territory of the State Forests located within borders of a landscape park, tasks for nature protection are performed directly by the director of the local Forest District, in accordance with the projected protection of the landscape park, included in the forest management plan.

The Act on Protection of Environment, determines principles of protection and rational control over the environment and preserving its quality, in order to provide present and future generations with favourable life conditions and the right to use the environmental resources. Under the Act on Protection of Environment, organisations and individuals who use the land, are obliged to protect the earth from erosion, mechanical devastation or pollution with toxic substances, and if their activity is related to agriculture or forestry they are obliged to use proper cultivation methods.

The protection of forest areas, under the Act on Protection of Arable and Forest Land means:
1) restricting their designation for other purposes unrelated to forest activities; preventing the degradation and devastation of forest areas, damage of forest stand and
2) deterioration of forest production - resulting from activity unrelated to forest management;
3) restoring the economic value of the land, once deforested as a result of activity unrelated to forest management;
4) enhancing their economic value and preventing decrease in their productivity.

4.2 Actors in forest and forest related policies

Under the National Policy on Forests (NPF), the drawing-up and implementation of a state forest policy is among the duties of the Minister of Environmental Protection, Natural Resources and Forestry. In particular, the Minister is obliged to shape conditions underpinning the achievement of all the functions of forests; to provide constant supervision over the condition of forests and forestry management, over forests within National Parks, and over the preparation of programs following national policy. A further statutory duty of the Minister is to present an annual Report on the State of Forests to the government, which is later directed to sessions of parliament.

National policy in regard to forests is implemented through:
- voivodes (heads of regions), supervise over the sustainable use of private forests and their resources, along with the improvement of the condition of such forests;
- the Director-General of the SFE, aiming to improve the management practices performed on the state owned forests and also their use, to retain all the functions supplied by forests and indicated by the state forest policy;
- the Director of the National Board for the National Parks and Park Directors, this is to a certain extent determined in the Forest Act, in relation to forests under all forms of ownership and in the scope of protection and management of forests ecosystems according to the conservation plans of National Parks;
- the Office of Forest Management Plans and Survey, aimed at introducing to planning procedures the principles of forest management directed at achieving the aims of multi-functional forest use and monitoring of the state of forest resources.

Partners in the implementation of national forest policy are:
- national and regional government administration units and local administrations;
- private owners of forests and their associations, as well as other forest managers.

Also participating in forest policy are:
- trade unions, which are active within forestry in line with their statutory entitlements;
- faculties of Forestry of higher education establishments, the Forest Research Institute and other scientific institutions, through the carrying-out of research on the ecological and social functions of forests and their harmonisation with technologies and methods of production, as well as on the implementation of programs by which to educate society on nature and forests and to train forestry personnel;
- forestry scientific and technical associations (the Polish Forest Society, the Association of Forestry Timber-Industry Engineers and Technicians), in relation to the promotion of knowledge on forests and the provision of opinions and proposals with respect to national policy in this sphere;
- forestry press and forestry publishing houses, in relation to information on forests, training and national policy.

Particular roles in establishing a national policy on forests are acted by:
- the Sejm and Senat (lower and upper houses

of parliament), in relation to the framing of law concerning forests, appropriate policy safeguards in the national budget, checks on the implementation of provisions of policy on forests and the environment, and the introduction of the principles of sustainable development;
- the government, in relation to implementation of the principles of state forest and environmental policy in all sectors.

The wider involvement of society in forest policy, as stated in National Policy on Forests, is required:
- to bring into effect, consultations with the people at local, regional and national levels, in relation to the perfection and implementation of policy that takes account of needs and expectations regarding what is an asset for the whole nation, and reconciling the conflicting interests of different interest groups;
- to heed the principle that people be informed constantly about the state of forests, and in particular to take joint action for forests and forestry in association with interested organisations and local government.

4.3 Forest policy tools

In the Polish forest policy framework there is the National Policy on Forests (NPF) and several schemes, among which are:
- Program of Conservation of Forest Gene Resources and Selection Breeding of Forest Trees in Poland (1993);
- National Program of Increasing the Country's Forest Cover (1995);
- Program of the Conservation of Nature and Cultural Values in Forest Districts (1996).

National Forest Policy aims to safeguard the sustainability of forests, along with their multi-functional management and use, through:
- expansion of the country's forest resources;
- improving the state of forest resources and providing them with comprehensive protection;
- transformation of forest management and use from the previous model dominated by a commercial function into an environmentally and economically balanced model of sustainable and multi-functional forest economy, that corresponds with criteria formulated for Europe by the Helsinki process and takes into account the specifics of Polish forestry.

The Program of Conservation of Forest Gene Resources and Selection Breeding of Forest Trees in Poland defines a foundation for conservation of forest gene resources, improvement of seed base, and selection of forest trees, and also defines the conditions for an efficient performance of established goals.

The National Program to Increase the Country's Forest Cover (adopted by the Council of Ministers in June 1995), predicts afforestation of about 1.5 million ha of abandoned agricultural land until the year 2050. This Program will increase the country's forest cover to about 33%.

The Program of the Conservation of Nature and Cultural Values in Forest Districts, being since 1997 an integral part of the forest management plan, has been constructed with a conviction that the preservation of biological diversity is a vital task for managed forests.

The 1991 Act on Forests stipulates, that the SFE shall be granted subsidies from the State budget for assignments indicated by the administration, and in particular for:
- purchase of lands and forests for afforestation and regeneration, as well as purchase of other land in order to preserve the quality of its nature;
- implementation of the national program to expand the forest areas as well as a project of conservation and protection of young forest stands established as a result of the programs implementation;
- development and protection of forests in danger;
- making regular, national inventories of forests, updating information about forest resources, keeping a database on the forest resources and forest condition;
- preparing projects for the protection of forest nature reserves managed by the State Forests; implementation of the project and protection of flora and fauna species;
- providing funds for educating society forest

aspects, mainly through the creation and management of Forest Promotional Areas or designing paths for nature walks.

Under terms of the Act on Forests, private forest owners receive financial subsidies from the State budget or the SFE budget for such activities as:
- sanitary and preventive treatments of pests endangering existence of the forest;
- forest development, improvement and protection when the tree stand has to be converted and when identifying the source of damage, endangering the existence of the forest, caused by gases and industrial dust or in case of fire or other nature disasters caused by biotic or abiotic factors, is impossible;
- afforestation;

In addition, the simplified forest management plan, for forests that are owned by individuals or land communities, is prepared at the expense of the State budget. In particularly justified cases, the director of local SFE District can make available - free of charge - tree seedlings and bushes for restoring the forest stands in accordance with the simplified forest management plan.

Projects of the State budget for year 1998 included expenses for forestry amounting to 40 million ECU, in which to implement tasks resulting from the Act on Forests, about 16 million ECU was allotted, with 13 million ECU designated for afforestations of abandoned agricultural lands.

All forests are subject to taxation, with exception of the following:
1) areas outside of forest management;
2) land within holiday complexes, under construction or for recreation;
3) excluded by administrative decisions from forest administration, and selected for non-forest purposes.

The following forests are also excluded from the forest tax:
1) crops with trees up to 40 years old;
2) listed in the monument register.

The basis for forest taxation is the number of hectares - determined according to the area of the prevailing tree species in the forest stand as well as to stand quality classification for main species of trees - resulting from the forest management plan or the simplified forest management plan. Forest tax per 1 ha shall be a money equivalent of 0.2 cubic meters of wood calculated on the basis of the average sale price of wood in the first three quarters of the year preceding the fiscal year. For protective forests, forests constituting part of nature reserves, national parks and forests which are uncovered by any forest management plan or simplified forest management plan, the forest tax per 1 ha shall be a money equivalent to 30kg of wheat.

4.4 Forest policy in relation to other national policy areas

The role of forests in the socio-economic development of the country, the multitude of functions served and the numerous interdependencies between the state of forests and external economic processes all explain the need for policy on forests to be implemented within inter-disciplinary systems. This is especially in association with: - environmental policy, - national planning policy, - agricultural policy, - energy and industrial policy, - social policy, including education and science, - fire control policy, - the strategy for national development, - the strategy for the protection of biological diversity, - and the strategy for climate protection.

4.5 Forest education and research

In Poland there are 14 technical and 4 vocational forestry schools, as well as 3 forestry faculties in agricultural universities. The vocational schools and secondary technical schools educate about 4,300 people and 800-900 people graduate from them every year. Education in the college takes 3 years, and in the secondary technical school 5 years. After vocational school, graduates are qualified to become forest workers. Secondary technical schools educate forest technicians specialising in forest management. In 1997 the forestry schools introduced new forestry teaching programs, which concentrate more on the ecological aspects of forest management and use. About 1,200 students study every year at the three forestry faculties (Warszawa, Krakow, Poznan), (200 graduate every year), and education there takes 5 years.

The Forestry Centre for Ecological Education (FCEE), established in 1997, plays a key role in ecological education in forestry, by training staff to realise the idea of the sustainable and multifunctional model of forestry, forest resource protection and nature protection in forests.

The Forest Research Institute was established in 1930 as a Research Station for the State Forests Organisation (SFO). In 1934 it was transformed into the Research Institute of the SFO, and since 1945 it has been acting as the Forest Research Institute under the Minister of Environmental Protection, natural Resources and Forestry. The Institute consists of 18 scientific departments and 4 separate research laboratories. At present there are 270 employees in the Institute.

5 Main current conflicts and challenges in each country

5.1 Relations between different actors in the field of forestry

The multi-directional nature of linkages in the national policy on forests is reflected by its presence within the programs of various administrative bodies and institutions. Particularly in need of reorganisation are the links between forestry and the wood processing industry and other customers for wood, as well as the economic bodies which take profit from forests and the sector providing services for forestry. Between forestry and its customers - particularly the wood processing and paper-making industries - there should be development of functional integration and even capital integration bringing benefits to both sides.

Issues arising from the UN Conference on Environment and Development in Rio de Janeiro in 1992

Changing trends in Polish forestry, in concentrating on national conditions, reflect also the changes in European and world forest policy, as streamlined by the final documents of the UNCED and of both Pan-European Ministerial Conferences on protection of forests in Europe.

To strengthen the efforts focused on maintenance of sustainability and biological diversity of forests, procedures are being undertaken at all managerial levels, as well as programmes and complex actions taking into the account broad aspects of nature, economy, law, social welfare, administration and science. They introduce the principles of sustainable and balanced development into forestry practice.

In 1994, a document was issued from the Ministry of Environmental Protection, Natural Resources and Forestry (MEPNRF) entitled Polish Policy for the Comprehensive Protection of Forest Resources”. Resulting from this came a decision by the MEPNRF to establish special rules of silviculture and forest protection of the Bialowieska Primeval Forest and also orders from the Director-General of the SFE, i.e. General Director’s of the SFE to act for Establishment and promotion of Forest Complexes and a directive on “Grounding the Forest Management on Ecological Foundations”.

In 1997, the Council of Ministers adopted a document on National Policy on Forests, prepared under the MEPNRF. This new policy for forests creates a comprehensive framework for forestry activities.

Furthermore, updating of the Act on Forests from 1991, that went into force on 5 September 1997, balances the environmental, commercial and social functions of forests, as well as: defines basic rules of sustainable forest management; specifies obligations of forest owners in general protection and conservation of forests; defines principles and sources of financing works in the field of forest protection and control of damage to forests.

At the operational programs level, certain pro-

posals were elaborated:
- Program of Conservation of Forest Gene Resources and Selection Breeding of Forest Trees in Poland (1993),
- National Program of Increasing the Country's Forest Cover (1995),
- Program of the Conservation of Nature and Cultural Values in Forest Districts (1996),
- Project of a Strategy for Conservation of Biological Diversity in Forests (1997).

5.2 Changes in the relative importance of different forest functions

The forests as a property of the State Treasury, for the good of the nation, face a special situation. Expectations of the public toward forestry are changing. Besides wood production, environmental and recreational functions grow in importance. At the same time certain critical attitudes towards foresters appear.

Political and economic transformations that have been going on since 1989, also have a deep impact on the status of forests in Poland. There are some reforms adapting forestry to the market economy which are necessary. Simultaneously the maintenance of forest sustainability is a necessary element for ecological security of the State and satisfaction of the needs of a democratic society.

Conflicting interests are revealed in previous antagonism between intensive economic or recreational use and some environmental functions like the protection of biological diversity and of soils. Conflicts have also arisen between the use of forests for tourism, commercial and environmental functions (the littering of forests, destruction of ground cover and young trees, disturbance of animals, etc.).

5.3 Role of the State in the coming decades

As it is stated in the National Policy on Forests, the role of the State in coming decades is:
- resolving conflicts between economic growth and the need for environmental protection;
- creating legislation relative to the protection, shaping and use of the natural environment, as a prerequisite for the legal and economic balancing of forest production and the protection of the forest environment;
- introducing the legal protection of forest under all forms of ownership,
- ensuring that the State cares for forests under all forms of ownership and to establish monitoring to provide appropriate methods that are based on principles for the sustainable development of multifunctional forest management;
- developing legal and financial instruments to encourage owners and managers of forests to invest constantly and protect elements in forests which benefit society as a whole;
- creating conditions which favour the proper valuation and utilisation of wood as a renewable natural resource of varied application, and as a energy source;
- developing correct principles to harmonise the aims set by different users of forest functions with the requirements of the agricultural and forest economy.

5.4 Changes in silvicultural practices

In 1995, Director General of SFE issued the Directive on Grounding the Forest Management on the Ecological Foundations. Among new forest management guidelines limitations of clearcuttings and preferences for shelterwood systems and natural regeneration are recommended.

Organisations related to forestry

Ministry of Environmental Protection, Natural Resuorces and Forestry, Department of Forestry, Nature and Landscape Protection, 52/54 Wawelska, 00-922 Warszawa, tel/fax: +48 22 825 19 06, http://www.mos.gov.pl
Agriculture University in Krakow, http://www.rol.ar.krakow.pl
Agriculture University in Poznan, http://www.au.poznan.pl/
Warsaw Agricultural University, http://www.sggw.waw.pl
Forest Research Institute, 3 Bitwy Warszawskiej 1920 r., 00-973 Warszawa, tel.: +48 22 822 32 01, fax: +48 22 822 49 35, http://www.ibles.waw.pl
General Directorate of the State Forests, 52/54 Wawelska, 00-922 Warszawa, tel./fax: +48 22 825 85 56, http://www.lasypanstwowe.gov.pl
Polish Forest Society, 3 Bitwy Warszawskiej 1920 r., 00-973 Warszawa, tel.: +48 22 822 14 70, fax: +48 22 822 49 35
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List of abbreviations

FAO Food and Agriculture Organisation of the United Nations
FPCs Forest Promotional Complexes
FCEE Forestry Centre for Ecological Education
GDP Gross Domestic Product
MEPNRF Ministry of Environmental Protection, Natural Resources and Forestry
NPF National Policy on Forests
SFE State Forest Enterprise
UNCED United Nations Conference on Environment and Development
UN-ECE United Nations - Economic Commission for Europe

Portugal

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1 The Country

1.1 Geography and population

Portugal is a small rectangular shaped country located between the latitudes of 37º and 42º N, with about 560 km of maximum length and 220 km of maximum width, the total land area being 8.879.033 ha. On this territory lived, in 1997, a population of 9.945.700 inhabitants, most of them in the coastal area between Braga and Setúbal. In the two metropolitan areas of Lisbon and Oporto are concentrated 30,5% of the total population. So in the coastal areas forests are under pressure by demographic and urban growth. In the interior regions forests are threatened by the rural emigration taking away the people needed to manage them properly.

1.2 Societal changes and political structure

Since 1974 the country has been a democracy with semi-presidential features. This regime came after a smooth revolution which ended a period of almost 50 years of authoritative rule. Under this long period, forests expanded mostly in the common lands of Northern and Central Portugal through interventions by the Forest Services, sometimes authoritative and non respectful of the customs of local populations. Also in that period there was little public action to stimulate private forestry. It was only with democracy and financial incentives from the EU that public support to private forestry witnessed some development.

The coming of democracy brought with it full integration of the country into the EU where it is now one of the founding members of Euro after having fulfilled the Maastricht criteria. This good performance of the Portuguese economy continues with one of the highest growth rates in the EU and one of the lowest unemployment rates due to relatively flexible labour markets.

1.3 Nature

1.3.1 Climate and relief

Climate shaped by the relief is the primary factor affecting the structure and functioning of the forest ecosystems. Therefore, it is going to be the starting point for this description of the natural factors. The first thing to mention is that, even though Portugal is a very small country, it has several combinations of two types of climates, Atlantic and Mediterranean. There are, however, also elements of Continental, Alpine and Subtropical climates in some parts of the country. The Atlantic influence is stronger in the North and along the coastal regions. It is especially important in winter being responsible for relatively high precipitation and for the attenuation of the effects of dry and cold winds coming from Spain. The Mediterranean influence is stronger in the South and during the Summer which is relatively hot and dry.

The coastal region in Northern and Central Portugal with altitudes up to 400 m has a dominantly Atlantic climate with a Mediterranean influence. The annual precipitation is around 1300 mm and the temperature between 13 and 17º on average.

Going from the coast to the east in Northern and Central regions the altitudes average between 400 and 700 m, with small mountain ranges and depressions usually drained by rivers, and a few mountains with a height of 1000 m. Annual precipitation can be relatively high in the northernmost mountain ranges (>2500 mm), but in the other parts of these regions the precipitation and the temperature are not much different from those along the coast.

In the Northeast, in parts of the Central region close to Spain and in the Southern province of Alentejo, there are areas of depressed plateau which are relatively extensive in the south, ranging up to 400 m. These are the regions where the Mediterranean climate is dominant. Annual precipitation is around 800 mm in the interior North and Central Regions and between 600 and 700 mm in the Alentejo. Summers are very dry and hot and winter is cold, with some snowfall every year in the Northern and Central regions.

The Mediterranean climate is also a dominant feature of the Algarve in the southernmost part of the country with an average annual precipitation of 600 mm.

The coastal areas from the Central Region down to the Algarve have a range of up to 500 m of altitude like the ones further north, but differs because of a stronger Mediterranean influence with lower precipitation and higher temperatures.

Evapotranspiration calculated by the Thornwaite method is the following:
- between 730 and 750 mm in the Northwest and the Centralwestern region;
- between 680 and 740 mm in the Northeast;
- between 800 and 840 in the South.

1.3.2 Soils

In terms of lithology there are three main regions to be distinguished:
- the old granites and slates belonging to the Iberian Meseta which cover the North, most of the Central region and most of the Alentejo province in the South;
- the post-paleozoic calcareous areas along the coast in the Central region down to Lisbon and in Algarve;
- the fertile antropozoic plains of the rivers Tejo and Sado.

2 Forest resources and their uses

2.1 Forest history

When Portugal was established as an independent country in the beginning of the twelfth century, forests existed in valleys wher access was more difficult and on the hillsides, but the top of the mountains being more exposed to wind and erosion had poor forest coverage. These were mostly the remaining natural forests of (*Quercus robur, Quercus pyrenaica, Quercus faginea, Quercus suber, Quercus ilex* and chestnuts).

The demographic growth of the Middle Ages and the corresponding need for farmland, grazing land, wood and coal for domestic and manufacturing uses, led to deforestation, even though in some cases farming and forestry was complimentary.

During the first dynasty, which lasted until the end of the fourteenth century, most of the forest lands were under the crown, or belonged to noblemen or religious orders. They were used by the royal family and the aristocracy mostly for hunting and these rights were often in conflict with the uses of the forests by local communities for fuelwood and grazing.

The second big movement of deforestation after the Middle Ages came with navigation and the expansion of the Portuguese empire in the early fifteenth century. The demand for wood for shipbuilding became very strong since this was the most important industry in the country at that time. The species most demanded were oak and pine (*Pinus pinaster* and *Pinus pinea*). This demand was already emerging at the beginning of the fourteenth century when King Denis ordered the plantation of pines in the royal forest of Leiria under a special administration for that time, the purpose being to produce wood for the shipbuilding industry. This is still today one of the best managed pine forests in the country.

As the gap between supply and demand was widening, the imports of wood for shipbuilding started to grow in the fifteenth century, the major supplier being the Hanseatic League. The interest groups involved in these import businesses probably contributed to the lack of a stronger and more comprehensive policy to stop the depletion of forest resources and promote reforestation. Therefore, with the exception of the 1565 “Law of Trees”, forest resources continued to shrink until the eighteenth century without any major breakthrough in public policy with respect to reforestation. At that time the forest cover rate might have reached the lowest at about 7% of the country land area.

We had to wait until the beginning of the nineteenth century to see an active and scientifically based forest policy which reversed the secular trend towards forest resources depletion. This policy was strongly influenced by a group of foresters trained in Germany. This group advocated the need for reforestation, improved protection and management of existing forests, reorganisation of the administration of the royal forests, and scientifically based silviculture. These recommendations led to the creation of the Forest Services in 1824 to manage the forests in the public domain. In the beginning, the Forest Services belonged to the Ministry of Navy, a legacy from the time when wood supply to the shipbuilding industry was very important. In 1835 forests in the public domain increased substantially with incorporation of the lands once belonging to the religious orders, expelled from the country by the liberal revolution. Four years later a commission was charged with preparing a Forest Code to consolidate and reform the forest legislation. In 1864 a degree in Forestry was created for the first time, in the General Institute of Agriculture, in Lisbon, this being the start of forest higher education in the country. In 1886 the Forest Services were integrated into the Directorate General of Agriculture. This model of putting the Forest Services under the same umbrella as the Agriculture Services is still prevailing nowadays in Portugal.

The Forest Services did a great job in the afforestation of about 25.600 ha of land to protect the dunes along the coast. From the beginning of the twentieth century their efforts gradually moved to the afforestation of common lands in the mountains of Northern and Central Portugal. These efforts were intensified in the 30s through the “Afforestation Plan of the Commons north of the Tagus River”. This was a time when the political regime took a dictatorial turn, and the intervention of the Forest Services in the afforestation of common lands was also embodied of an authoritative attitude towards the local communities on many occasions. In spite of these conflicts, the Forest Services carried out their plan resulting in the afforestation of 318.000 ha from 1935 until 1972.

The intervention of the Forest Services in private forests was less active. It was only in 1945 that a special service was created for this purpose, called the Forestry Development Fund, but it had a limited impact until it was restructured in 1966. However, this and all the other reorganisations that followed to the present day didn´t succeed with an effective policy to deal with one of the biggest problems of private forestry in this country which is the fragmentation of private forest ownership, especially in Northern and Central Portugal.

The big leap forward in stimulating private initiative of forest owners and the forest contractors has been with a series of programmes funded by the EEC/EU, since 1987.

2.2 Forest ownership

85.7 % of forest lands are under private management, the rest being almost entirely communal forests managed by the Forest Services. Behind each of the three major species existing in the country (pine, eucalyptus and cork oak) can be found the four major stakeholders concerned with forestry in Portugal:

- the non-industrial private forest (NIPF) owners of North and Central Portugal, typically

with small sized holdings, managing 3/4 of the pine forests, the Forest Services managing the other 1/4, mostly in communal lands;
- the pulp industry managing 1/3 of the eucalyptus forests, the other 2/3 being with non-industrial private forest owners and in communal forests;
- the non-industrial private owners of the cork oak forests in the South with much larger holdings than the ones in North and Central Portugal.

Table 3 shows the contrasting landownership structures between North and South:
- in the North, almost 50 % of the forest lands with forest use only belong to holdings having 5 ha of agricultural land or less, and between 1,5 and 2 ha of forest land;
- in the southern region of Alentejo, 93,3 % of the forest lands with agro-forestry use belong to holdings having more than 50 ha of agricultural land, and 175,5 ha of forest land on the average.

The communal forests exist mostly in the North where they represent 44,2 % of the forest lands, while in the other regions the percentage is 5,6%, most of which is in the central region.

2.3 Land use and forest resources

2.3.1 Global overview of the land use

The forest area has been growing for the last 120 years. Until the 50s there was a simultaneous growth of forest and agricultural land which was possible because of the large amount of uncultivated land existing in the XIX century due to the secular process of deforestation mentioned before. With the intense rural emigration in the 60s and 70s farmland started to fall back while forest land continued to expand. Nowadays agricultural land represents 42,8% of the area of Continental Portugal while forest land represents 37,8%.

Table 1. Ownership of forest lands in 1995

Regions	Total area (ha)	Private forest lands		Forests managed by the Forest Services: State forests		Communal forests	
		ha	%	ha	%	ha	%
Northwest	340 700	254 476	74.7	143	0.0	86 081	25.3
Northeast	292 500	98 708	33.8	0	0.0	193 792	66.2
North	633 200	353 184	55.8	143	0.0	279 873	44.2
Others	2 672 900	2 450 594	91.7	71 748	2.7	150 558	5.6
Total	3 306 100	2 803 778	84.8	71 891	2.2	430 431	13.0

Sources: INE (1997) and our own estimations.

Table 2. Forest lands by types of management and tree species in 1991/93 (1000 ha)

	Total		Coniferous species		Eucalyptus		Broad-leaved species: Cork Oak		Other		Total	
	Area	%	Area	%	Area	%	Area	%	Area	%	Area	%
State forests	86	2.6	71	5.2	0	0.0	0	0.0	15	2.2	15	0.8
Communal forests	380	11.7	360	26.5	20	3.8	0	0.0	0	0.0	20	1.1
NIPF	2.497	76.9	899	66.1	319	60.3	621	90.4	658	97.8	1.598	84.6
Industrial forests	246	7.6	30	2.2	190	35.9	26	3.8	0	0.0	216	11.4
Others	40	1.2	0	0.0	0	0.0	40	5.8	0	0.0	40	2.1
Total	3.249	100.0	1.360	100.0	529	100.0	687	100.0	673	100.0	1889	100.0

Sources: our own estimations based on data from the Forest Services and the pulp industry

Table 3. Distribution of private forest lands by size of agricultural holdings in 1993

Classes of agricultural area (ha)	Forests with agro-forestry use: Holdings N.º	%	Forest lands ha	%	Forests without agro-forestry use: Holdings N.º	%	Forest lands ha	%
CONTINENTAL PORTUGAL								
0 - < 1	172	1.1	63	0.0	40 516	17.7	54 738	6.3
1 - < 5	3 615	23.6	3 866	0.4	141 775	61.8	326 340	37.6
5 - < 20	4 431	29.0	21 148	2.4	38 912	17.0	197 996	22.8
20 - < 50	2 371	15.5	39 188	4.4	5 763	2.5	70 725	8.2
>= 50	4 703	30.8	834 812	92.9	2 520	1.1	217 535	25.1
Total	15 292	100.0	899 077	100.0	229 486	100.0	867 334	100.0
NORTH								
0 - < 1	30	0.8	8	0.0	13 638	14.4	14101	5.9
1- < 5	1 590	44.0	1 147	4.1	57658	60.8	103 336	43.1
5 - < 20	1 454	40.2	2 643	9.5	20 218	21.3	73 353	30.6
20 - < 50	379	10.5	2 096	7.5	2 801	3.0	23 145	9.6
>= 50	161	4.5	21 891	78.8	516	0.5	26 110	10.9
Total	3 614	100.0	27 785	100.0	94 831	100.0	240 045	100.0
ALENTEJO								
0 - < 1	64	0.7	45	0.0	252	7.2	4 432	5.3
1- < 5	1 325	14.5	1 789	0.2	1 018	29.1	3 598	4.3
5 - < 20	2 257	24.8	15 919	2.2	948	27.1	10 236	12.2
20 - < 50	1 546	17.0	31 814	4.3	470	13.4	5 153	6.2
>= 50	3 920	43.0	688 010	93.3	811	23.2	60 403	72.1
Total	9 112	100.0	737 577	100.0	3 499	100.0	83 822	100.0

Source: INE (1995a).

This secular growth in the forest resource base has substantial potential to go on much further in two non mutually exclusive ways:

- further growth in the forest area up to 5.280.000 hectares (59,5 % of the land area) through afforestation of 1.068.000 ha of marginal agricultural lands non suitable for farming and about 850.000 ha of other lands with forest potential (Banco Português de Investimento *et al.* 1996);
- substantial productivity gains (around 20% more in annual increments of *Pinus pinaster* and *Eucalyptus globulus*) resulting from improved forest management and use of better plants (Banco Português de Investimento *et al.*, 1996).

2.3.2 Extent and distribution of the forests

According to the most recent forest inventory, the total forest area of Continental Portugal was 3.358.800 ha in 1995, most of which being in the Northern (658.600 ha) and Central (1.450.700 ha) regions.

Table 4 shows trends in forest lands and figure 1 illustrates forest cover in continental Portugal since 1874.

2.3.3 Trees species origin and distribution

Nowadays the major species in Portuguese forests are pines and other conifers (33,8% of the forest area), especially *Pinus pinaster* (maritime pine), cork oak (21,5%) and eucalyptus (20,7%), mainly *Eucalyptus globulus*.

The major pine species existing in the country, *Pinus pinaster*, might have been introduced by man, but a long time ago, because traces of it have been found dating from the Neolithic period. This species expanded its territory by plan-

Table 4. Trends in forest lands in continental Portugal since 1874

Species	**1874**	**1902**	**1928**	**1956**	**1968/78**	**1980/85**	**1995**
Conifers	210000	1020200	1198600	1309000	1376940	1358800	1136300
Maritime pine	n.a.	430200	1132000	1128000	1293040	1252300	1029200
Cork and holm oak	370000	782700	939600	1264000	1192480	1128700	1196400
Cork oak	n.a.	366000	560000	590000	656580	664000	720700
Other oaks and chestnut	60000	153600	193200	132000	99840	143200	174900
Eucalyptus	0	0	0	0	213720	385800	695100
Forest lands	640000	1956500	2331400	2763000	2969120	3108200	3358800
Agricultural lands	1886000	3111317	3283000	4834000		3879602	3800381
Land area	8879033	8879033	8879033	8879033	8879033	8879033	8879033
Forest cover rate	7,2%	22.0 %	26.3 %	31,1 %	33.4 %	35.0 %	37.8 %

Sources: DGF (1998a, 1998b) and INE (1947, 1992).

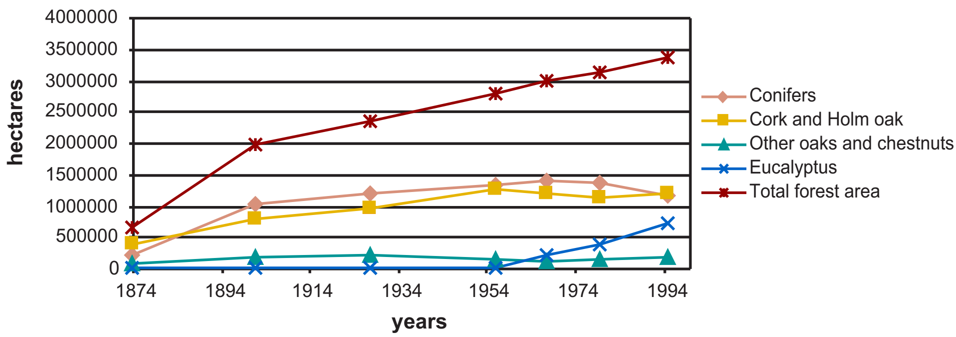

Figure 1. Forest area in continental Portugal since 1874

tation and by natural diffusion and regeneration, since the sixteenth century.

The major eucalyptus species existing in the country is *Eucalyptus globulus* which originated in Tasmania. In the 60s the eucalyptus plantations started by supplying pulpwood for the paper companies recently established in the country. This species has been replacing part of the decaying pine forests, especially in Northern and Central Portugal.

The region of Alentejo in the South remains the land of the most important agro-forestry systems in the country (*"montados"*) based on the cork and holm oak trees. The holm oak lost most of its economic value in the 60s due to swine fever which decimated the stock of Iberian pigs fed on the acorns from these trees. The cork oak has kept its economic value because of the cork manufacturing industries where Portugal is the leading producer in the world. More recently EU funds for the afforestation of farm lands (Reg. 2080/92) have been used at great profit by the landowners to renovate and expand the cork oak forests.

Although nowhere near as important as the native forests of the past, the other oaks and the chestnut forests have been growing since the 60s, especially in the Northern and Central regions.

Table 5. Area, growing stock, increment, fellings and removals in 1995

	Area (1000 ha)	Growing stock (1000 m^3 o.b.)	Net increment (1000 m^3 o.b.)	Fellings (1000 m^3 o.b.)	Annual removals (1000 m^3 o.b.)	Annual removals (1000 m^3 u.b.)
Trees in forest, total	3 383	275 760	14 312	11 500	11 300	9 400
Conifers	1 179	147 782	8323	6 200	6 100	4 900
Broadleaved	2 204	127 978	5 989	5 300	5 200	4 500
Trees for wood supply*	1 897	188 020	12 900	11 200	11 000	9 100
Conifers	1 021	140 871	7 890	6 200	6 100	4 900
Broadleaved	876	47 149	5 010	5 000	4 900	4 200

*The 344000 ha of mixed stands were evenly split between conifers and broadleaved species.
Source: DGF (1998c)

2.3.4 Total growing stock, growth and total fellings

The 11.200.000 m^3 o.b. of annual fellings for wood supply are almost as great as the 12.900.000 m^3 o.b. of net annual increment in forests for the same purpose. This is due to the fact that derived demand by forest industries is closely knit with wood supply.

Net annual increment per hectare in forests for wood supply (4,6 m^3/ha/year for *Pinus pinaster* and 9,0 m^3/ha/year for *Eucalyptus globulus*) is relatively small due to the following factors: poor management of the pine forests, old age and multiple use of the broad-leaved forests. With better forest management these increments could increase by 20%.

2.3.5 Forest threats

Fire is the major threat to Portuguese forests, especially the pine forests in the Northwest and Central West regions which were reduced respectively by 41 and 21% between 1982 and 1995. As we look at the data in the long run, this problem definitely emerges in the 60s when emigration from the rural areas was more intense. Therefore, the abandonment of traditional uses of the forests which helped in keeping some minimum management standards and the current status of poor management of many forests are certainly an amplifying factor of the meteorological conditions which ignite forest fires. The data shows some slight improvements in recent years in terms of area burnt and average size of fires. However it is too early to know

Table 6. Forest fires in Continental Portugal since 1968

	Burnt area (ha)			
Yearly averages	In forest stands: Annual area	In forest stands: Cumulated area	in shrubs	Total area
1968/69	8532	17064	8165	16697
1970/74	15349	93807	8601	23950
1975/79	46292	325268	17637	63929
1980/84	35862	504579	19279	55141
1985/89	67259	763272	42404	109663
1990/94	56413	1045336	44394	100807
1995	87554	1132890	82058	169612
1996	30542	1163432	58325	88867
1997	10574	1174006	15494	26068

Source: DGF

whether this is due to better forest management or not.

According to the June 1998 Follow up report on the Ministerial Conferences on the Protection of Forests in Europe *"forest areas damaged by insects and diseases are monitored in permanent plots (S1) and do not show signs of irreparable or permanent damages. They also include low and medium intensity classes which are closely related to the occurrence of drought. When drought is reduced, vitality immediately recovers."* (Third Ministerial Conference on the Protection of Forests in Europe, 1998, p. 201).

2.4 Silviculture

Pinus pinaster is the species managed mostly by the non-industrial private forest owners in North and Central Portugal. These owners are mostly of the following types:
- small private owners who, in many cases, are small part-time or aged farmers still living near their forests;
- larger private owners usually living in the city with their lands leased out to tenants or left under-utilised.

In the past, forest lands were a necessary complement to agriculture because they provided pasture to feed the livestock and brushwood which after being used as bedding for animals was turned into manure to fertilise the land. The forests were also a free source of fuelwood and non-wood products indispensable for the subsistence of the local communities. Thus the forest lands were actively used and were managed free of charge for their owners.

Currently things are different. Modern farming uses industrial fertilisers and foodstuffs, and the rural households no longer use fuelwood nor the non-timber products from the forests. Therefore, the forest owners don't have people going around their forests to collect the combustible materials for free. If they want them cut and removed, they have to hire someone, with increasing costs as the rural population decreases. These costs are also aggravated by the difficult topography of many forest lands in the North.

Comparing three alternative options to reduce the accumulation of combustible materials in the forest - mechanised cutting and removal from the forest, mechanised cutting without removal from the forest and prescribed burning - the first two options fall outside the range of the willingness to pay of most forest owners. The third one is affordable, but it has many restrictions in order to be implemented correctly. Also, in spite of having its roots in traditional practices, it is still very much within the circles of forest research, lacking qualified personnel in the field to use it properly.

Because the forest maintenance costs are rising beyond the willingness to pay of private owners, the benefits are uncertain and do not occur in the short run, and also because part of these benefits are positive externalities for which the private owner is not compensated, the result is that the large majority of private owners do not spend money in the maintenance of their forests. Also they do not spend money in afforestation unless it is highly subsidised. So the growth and decay of the forests is left to natural regeneration and wildfires.

When the owner decides to cut, it is not because he is following some forest management plan guided by optimal rotation principles, but because he needs cash to make ends meet. This leads to the following management practices:
- clear cut after a forest fire followed by natural regeneration;
- removal of the best trees, leaving behind the worse ones which causes negative selection and a lowering of the productivity of the forests.

Some owners in the Northern and Central regions after forest fires, replace pine by *Eucalyptus globulus* by themselves or by renting out the land to the pulp paper companies.

These companies own almost all the industrial forests in the country located mostly in the Northern and Central regions. In these forests *Eucalyptus globulus* is, by far, the major species with rotations of about 12 years long. These are certainly among the most carefully managed in the country, each pulp company having set up its own forest management firm to take care of these operations. These groups have also invested regularly in the prevention and fight of forest fires as well as in research and development to improve the productivity of the plantations. About 25 % of the eucalyptus forests are reaching the fourth rotation and have to be replaced within the next ten years. The industry will probably take this opportunity to use the results of the R&D and improve the productivity of the new plantations. The industry is also bound to take these actions because it faces legal constraints to the expansion of eucalyptus plantations.

The cork oak forests in the South are agroforestry systems where farming and grazing sometimes puts pressure on the trees. In years of bad drought there has been some unusual death rates in trees but there is no consensus yet among researchers whether it is the farming system, the drought or some pathological reason which is causing that problem. The good economic value of cork and the fact that throughout their estates most of the owners can get an almost annual income from that product is an incentive to them in regularly caring for the trees. So we cannot say that this is a fossil forest except where the cork has no economic value. The case of the agroforestry systems in the South-eastern part of the country based on the holm oak is different because they lost their economic value when the swine fever killed the Iberian pigs fed with their acorn.

2.5 Forest production

2.5.1 Harvesting systems

Since most of the forests are in hilly mountainous areas with bad infrastructure, forest operations are difficult and costly. They are done by private contractors who usually are organised as small businesses using mostly family labour, with low levels of mechanisation and capitalisation. It is this type of entrepreneurial structure which makes possible their economic survival in the face of the high costs of timber extraction.

2.5.2 Timber uses

Pine wood is used mostly as a sawn product. Woodchips for the panel industry are another important industrial use for this forest product. Finally there is also a use for pine wood in the pulp industry, namely to make *kraftliner* paper. For eucalyptus the major use is for pulp.

Table 7. Net annual increment and fellings of pine wood (1000 m^3 over bark)

	Pine			**Eucalyptus**		
	1979/83	**1984/88**	**1989/93**	**1979/83**	**1984/88**	**1989/93**
NET ANNUAL INCREMENT	7 105	6 561	5 913	3 074	5 446	5 023
FELLINGS	6 060	6 493	6 247	2 919	4 772	5 094
DOMESTIC USES (without fuelwood)	5 933	6 473	6 189	2 919	4 338	4 757
Sawnwood	4 343	4 964	5 126	278	413	424
Pulpwood	844	897	824	2 309	3 922	4 324
Other industrial uses	746	612	239	332	3	9
EXPORTS	127	20	58	210	560	503
IMPORTS	0	0	0	0	126	166
BALANCE (net increment-fellings)	1 045	68	-334	155	674	-71

Source: CESE (1998)

Table 8. Cork production (t)

Years	Total	Virgin	Amadia " & secundeira"
Average 43/51	170 000	44 000	126 000
Average 52/60	188 000	58 000	130 000
Average 61/69	221 000	78 000	143 000
Average 70/78	197 000	51 000	146 000
Average 79/87	161 100	34 900	126 200
Average 88/96	157 700	31 300	126 400

Sources: CESE (1998) and DGF.

Table 9. Domestic production and industrial consumption of cork (t)

	1985/89	1980/84	1990/94
Production	160 000	156 000	154 000
Consumption	126 000	138 000	169 000

Source: CESE (1996)

2.5.3 Non-timber forest products

Cork is the major non-timber forest product in Portugal, the country being the main producer (more than 50% of the world production) and transformer of this material in the world.

Portugal also had, in the recent past, a leading position in the production and processing of pine resin. However, the lower labour costs in China in the extraction of this product led to a quick decline of this activity in this country, annual production falling from 108.000 tonnes in 1986 to 15.000 tonnes in 1995.

The other relevant non-timber forest products are two fruits: pine nut from *Pinus pinea* with a total production of 700 tonnes in 1995 and chestnut with a total production of 20.321 tonnes in 1996. Almost all the pine seed production comes from a relatively small area located in the county of Alcácer do Sal, south of Lisbon. The chestnut production comes mostly from the North-eastern part of the country.

2.5.4 Forest functions

In 1995, the main function of 56.1% of the forest area was for wood supply. The second main function corresponding to 41,7% of the forest area was the production of non-wood forest products, mostly cork oak. Conservation and protection were the main function of 2,2% of the forest area. This number, however, should be somehow adjusted by the fact that 585.000 ha (17,3% of the forest area) of forests are included in protected areas.

Table 10. Forest according to main functions

Functions	Area (1000 ha)	%
Wood supply	1897	56,1
predominantly conifers	849	25,1
predominantly broadleaved	704	20,8
mixed stands	344	10,2
Non-wood forest products	1410	41,7
Conservation/Protection	76	2,2
Total	3383	100,0

Source: DGF (1998c)

Also, all the forest area can be used for hunting, the Forest Services having issued in 1996/97 about 306.000 hunting permits. Hunting rights can be used under two different and mutually exclusive regimes: the general regime and the special regime. Most of the land under special regime is managed by associations of hunters, similar to clubs where hunting is restricted to the members and investments are made to enhance game production. The other major form of special regime corresponds to the touristic hunting zones. These are territories managed for gaming by private firms which sell housing rights and related services at a certain price. The general regime covers the rest of the territory where hunting is allowed to everyone who has a permit issued by the Ministry of Agriculture. In this regime game

Table 11. Area under the special hunting regime in 1998

Types of zones	N.º	Area (1000 ha)
Associative	1176	1534
Touristic	623	851
Other	40	122
Total	1839	2507

Source: DGF (1998c)

is "collected" by the hunters but is not managed by them. As the special regime expands, the territory for the general regime shrinks, leading to severe conflicts between hunters in the two regimes.

3 Forest economics

3.1 Forest and forest industries in the national economy

In Portugal, the forest sector is an important but heterogeneous sector. In fact, with 2.6 % of the GDP, the forest cluster (forestry, forest industries and related industries and services) is one of the top three in the Portuguese economy in terms of value added and employment, together with the textiles and clothing, agriculture and food industries. With 12 % of the exports, it is also the second major exporting cluster in the country.

Being important in the economy, the Portuguese forest sector has a heterogeneous structure which makes it difficult to co-ordinate for public policy. As we mentioned before, the sector has evolved around three key forest products very different from each other in terms of production and business structure: pine wood and the woodworking industries (sawmilling, carpentry, panels and furniture), pulpwood and the related pulp, paper and board industries, cork production and the cork industries. These three components are very different in terms of ownership structure and forest management as well as in terms of industrial business structure: small and medium-sized firms in sawmilling, carpentry, furniture, preparation and transformation of cork, manufacturing of paper and board products and big firms in the pulp, paper and panel industries.

An important issue relating to the wood-based industries is to know if the growth in forest resources has responded adequately to the demand from the forest industries. The current situation is that timber supply is not keeping

Table 12. Gross value added of the forest cluster in 1993 (thousands of euros)

Activities	Value added
Forestry	460 730
- Roundwood	150 353
- Pulpwood	147 275
- Cork	93 644
- Non wood products	69 458
Gaming	65 542
Sawmill, carpentry, plywood and particleboard industries	281 342
Furniture industry	430 158
Woodworking machinery	25 838
Cork industries	191 010
Pulp, paper and board industries	294 710
Resin products	27 913
Other wood and cork based industries	7 128
TOTAL	1 784 371
GDP at market prices	68 210 530

Sources: CESE (1996, 1998a)
1 Euro=200,482 esc.

Table 13. Foreign trade in forest products in 1994

Products	Exports		Imports	
	10^3 euros	**% total**	**10^3 euros**	**% total**
1. Fuelwood	643	0.0	469	0.0
2. Roundwood	26 526	0.2	128 406	0.6
3. Sawnwood	69 283	0.5	53 376	0.2
4. Other wood products	55 387	0.4	30 162	0.1
5. Wood chips	1 945	0.0	6 110	0.0
6. Plywood and panels	148 751	1.0	40 901	0.2
7. Pulp	420 392	2.8	37 116	0.2
8. Paper, board and paper & board products	384 738	2.6	404 899	1.8
9. Furniture	160 498	1.1	93 874	0.4
10. Cork	29 589	0.2	27 728	0.1
11. Cork products	453 622	3.1	11 582	0.1
12. Honey	808	0.0	334	0.0
13. Resin products	28 327	0.2	6 804	0.0
14. Chestnuts and other forest fruits	14 749	0.1	838	0.0
15. Mushrooms	1 771	0.0	40	0.0
16. TOTAL (forest products)	1 797 029	12.1	842 639	3.8
17. TOTAL (all sectors)	14 841 572	100.0	22 343 607	100.0

Sources: INE (1995b, 1995c)

up with this demand, leading to a rise in stumpage prices. It is fair to say that the momentum for Forest Policy Law came, to a large extent, from pressure by the forest industries to increase the public effort on afforestation. In the short term, to loosen the pressure on domestic resources, the pulp mills are increasing their imports.

Data about the supply and domestic demand of cork presented in table 9 show a decline in production during the 80s and 90s. This is probably due to the fact that between 1939 and 1974 the area of cork oak forests decreased from 690.000 ha to 652.540 ha. Also drought and other factors not well understood yet are causing the death of some cork oak trees. However, with afforestation programmes in place since 1987 the area of cork oak forests has been growing, so that in 30 years from now the production will increase again. The fact that since the beginning of the 80s there is a shortfall in the domestic production of cork to meet the industrial demand has not been necessarily a bad thing. The positive effects of this situation are the following:

- the Portuguese cork industry became an industrial platform transforming not only the domestic production, but also a important part of the production from neighbouring countries;
- the shortages in cork supply have been an incentive for the industry to invest in new products able to make a more complete and valuable use of the cork.

3.2 Employment

The forest cluster represents 5.3 % of the workforce, making it one of the major employers in the Portuguese economy.

4 Forest and forest related policies

4.1 Legislation

The legal and policy framework for forests and forest-related activities in Portugal is undergoing substantial change which is still far from settling down. These changes have to do with the following aspects:

- the revision and consolidation of the forest

Table 14. Workforce in the forest sector in 1993/95

Activities	Workforce
Logging, cork and resin extraction	16 000
Forestry contractors	3 750
Wood transportation	2 300
Forest nurseries	1 000
Game production and management	8 000
Import and export of roundwood	770
Sawmill, carpentry and panel industries	34 376
Furniture industry	76 116
Handicrafts of cork and wood	1 000
Woodworking machinery	2 349
Furniture wholesaling and retailing	35 526
Resin industry	2 000
Cork industry and corkworking machinery	19 358
Pulp, paper and board industries	15 561
Forest related services	5 288
TOTAL WORKFORCE IN THE FOREST SECTOR:	223 394
- Forestry, gaming and related services	21 050
- Forest industries and related services	197 056
- Other services	5 288
TOTAL WORFORCE (all sectors)	4 255 000

Sources: CESE (1996, 1998).

legislation sometimes outdated and inconsistent and scattered through many different decrees and regulations;
- the reform of the public Forest Services and the creation of intersectoral co-ordination and consultation bodies to promote integration of forest related policy instruments and the participation of the various stakeholders;
- the preparation of new financial instruments to develop private forestry.

We will consider each of these aspects starting here with the first one. The new legal and policy framework for forests and forest related activities was set out by the Forest Policy Law (Law N.º 33/96) voted by unanimity in the Parliament in July 1996 and published in August 17 of the same year. This is a frame law whose main elements are the following:
- a statement of the principles and goals of the forest policy;
- the main policy tools to achieve those goals.

The forest policy principles and related goals adopted in the law are the following:
- forests are a multifunctional renewable resource which should be managed in a sustainable way;
- sustainable forest management should reconcile expansion of the forest area, productivity improvement of the existing stands and biodiversity preservation;
- forest resources are essential for the preservation of all forms of life on earth and so the protection of forests is a responsibility to be shared by the society;
- private forest owners are the major stakeholders in sustainable forest management;
- forest owners and other economic and social groups concerned with forests should be able to participate in the preparation and implementation of forest policy measures;
- forest policy should be integrated with the other policy areas and take into account the international initiatives which the country is committed to.

The major policy tools listed but not fully specified in the law are the following:

1. regional forest management plans defining the appropriate sustainable forest use for each zone and the corresponding norms to be followed by the forest owners;
2. compulsory management plans at the forest management unit level for forest units above a certain threshold to be specified in the regional forest management plans;
3. the definition of a National Forest Authority responsible for the preparation and implementation of the forest policy and the management of the state forests;
4. the creation of an Interministerial Forest Commission presided by the Minister of Agriculture and including the other ministries relevant for forests whose task is to promote the integration of the policy areas related to forests;
5. the creation of a Forest Consultative Council composed by the organisations representative of the various stakeholders related to forests and directly related to the Minister of Agriculture whose task is to propose new forest policy measures, analyse the ones the Government and the Parliament intend to approve and evaluate the implementation of the ones already in place;
6. the creation of a national, regional and subregional structure for the planning and co-ordination of forest fire prevention and fighting to improve co-operation between the Forest Services more related to prevention and the Ministry of Internal Affairs and the firemen more related to fire fighting;
7. the provision of financial incentives to the forest owners' associations;
8. the creation of a permanent forest fund and tax incentives to finance the development of forest production, the improvement of the forest landownership structure, the compensation of biodiversity preservation and forest research and training;
9. the creation of an Appeal Commission presided by the National Forest Authority to analyse the complaints from forest owners about decisions of the public administration on their forest management plans and their applications for public funds.

Since this is a frame law it has to be specified in decrees without which it cannot be put in practice. About the legislation already in place, the regulations to be mentioned are the ones about the management of cork oak forests and eucalyptus plantations.

4.2 Actors in forest and forest related policies

We have already mentioned some of the new institutional frameworks following directly from the Forest Policy Law. Besides these changes there are other very relevant reforms in the structure of the Forest Services in progress since the new Government took office in 1995. They consist basically of the following changes:

- at the subnational level the foresters who once worked in the regional services of the Directorate General of Forestry mostly in the management of public and communal forests, with total autonomy with respect to the regional agricultural services of the Ministry, were merged into the 8 Regional Directorates of Agriculture;
- there is a proposal by DGF ready for approval by the Government to externalise the forest management activities which the DGF carried out directly for most of this century in the public and communal forests, transferring these activities to a new company with public capital and private management rules;
- responsibility for the analysis, approval and financing of the forest investment projects applying for public aids was fully committed to IFADAP, the public financial institute dependent on the Ministers of Agriculture and Finances which manages all agricultural structural policy funds.

The personnel of DGF and the foresters in the Regional Directorates of Agriculture make a total of about 2.800 persons, including administrative staff. We estimate that personnel in other public and private forest-related services amounts to 1.000 persons.

In terms of planning capacities at the national level, the Directorate General of Forestry is in great need of human resources in the fields of Law and Economics and capacities in data col-

lection and treatment. General economic data is collected and published by the National Statistic Institute but in less quantity, detail and quality than for other economic activities. DGF manages only the following data collection systems:
- the Forest Inventory System;
- the data collection on forest fires;
- the monitoring of air pollution effects on forests.

The planning capacities at the forest management unit level are as follows:
- small private firms providing services to private owners for preparation of forest management plans and applications for public funds;
- management services in the pulp paper companies to supervise their own forests;
- foresters in the young forest owners´ associations which are getting started throughout the country (a total of about 50 associations).

Looking now at the actors in the private sector, let's see first the organisations representing the forest owners. Since 1992, in the North there has been a growing movement to promote forest owners' associations. This started with the creation of a non profit organisation called *FORESTIS-Associação Florestal do Norte e Centro de Portugal* [Forest Association of North and Central Portugal]. The main task of this association is to promote the creation of local forest owners' associations and provide common services to them (diffusion of technical information, publication of a periodical bulletin, training courses, forest mapping, GPS, negotiations with the Ministry of Agriculture, participation in forest events, representation of the members, etc.). So far, this work has resulted in the creation of 11 local associations covering the Northwest and part of the Northeast. Recently FORESTIS has changed its statutes in order to become more like a federation of its local associations. So far it has remained independent from the two agrarian confederations disputing the national representation of the agricultural and forest sectors.

In the South the most important forest owners are the ones who have cork oak forests. After they got back their lands occupied by the farm workers after the 1974 Revolution, some associations were born, especially in the good cork oak areas of the Tejo and Sado basins. These associations are the most influential group within FPFP-*Federação dos Produtores Florestais de Portugal*, a national federation of forest owners' associations which does not include FORESTIS and is related to one of the agrarian confederations existing in the country (CAP-*Confederação dos Agricultores de Portugal*).

To finance their activities, these associations have relied mostly on subsidies from national and regional programmes financed by the EU, the annual membership fees making up only a small part of their income. They have not yet clearly stepped into the provision of private services to their members from where they could collect revenues, such as the production of silvicultural services (plantings, thinnings, etc.) or the sales of forest products. Also there is no mandatory system where a percentage of the gross value of the timber sold by the members goes to some trust fund which supports these type of associations.

In spite of this recent progress in the collective organisation of forest owners their influence in policy making is still weak. Forest industries are more organised and more influential. The pulp and paper industry is dominated by three groups: PORTUCEL and SOPORCEL still controlled by the state and CELBI belonging to the Stora group.

The wood industries are of a much smaller size and much more dispersed, except in the panel industry where the SONAE group stands today as one of the leading industrial groups in the world market. These industries recently merged their different professional associations into a single one and are now fighting for a stronger say in forest policy making than they had in the past.

In the cork oak industries there is a big industrial group (Amorim) with interests in other economic sectors, but the sector as a whole does not seem to have reached a good level of collective organisation involving all its partners.

4.3 The National Forest Programme

4.3.1 Goals

Forest services at the national and regional level, universities and forest research stations all live on the State budget. The forest owners´ associations live mostly on public subsidies from the programmes supporting producers' organisations. The private owners invest mostly with the help of subsidies from the ongoing public programmes supporting afforestation. The forest contractors and the forest projectors are also very dependent on these public programmes. Currently there are two programmes at work - Regulation (EEC) N.º 2080/92 and the Forest Development Plan (PDF-*"Plano de Desenvolvimento Florestal"*) - about which we will talk later. PDF will come to an end next year and its follow up has to be designed on time to fit into the third Common Support Framework for the period 2000-2006 whose preparation is now underway. On March 23, 1998 the Minister of Agriculture presented for public discussion the first draft of a National Forest Plan called Plan for the Sustainable Development of the Portuguese Forest (PDSFP-*"Plano de Desenvolvimento Sustentável da Floresta Portuguesa"*). This document was prepared by DGF building on the work of their own staff and drawing also on the contributions from other sources like the BPI and the CESE reports (BPI *et al.*, 1996; CESE 1996, 1998) and the workshops organised for this purpose by DGF and some associations in the forest sector.

The core of this document is the following:
- statement of general objectives and derived strategic goals;
- specification of some medium-run operational targets derived from those goals;
- specification of some policy instruments to reach the targets.

The general policy goals proposed in this draft of the NFP are picked from the 1996 Forest Policy Law. The list of derived strategic goals is very long. We are not going to give here an exhaustive presentation of all of them, but simply pick some of the most relevant or innovative ones, in the light of what has been the forest policy in Portugal so far.

Improving the productivity of the existing stands
The Plan sets the following productivity improvement targets:
- improvement of 70.000 ha of pine forests, 20.000 ha of cork oak, 5.000 ha of holm oak and 2.000 ha of other broad-leaved species per year;
- raising the annual increment of eucalyptus by 1 m3/ha/year until 2008;
- until the year 2005, conversion of all the degraded and badly located stands (15.000 ha/year of eucalyptus, 1.000 ha/year of *Pinus pinea*, 50 ha/year of chestnut trees and 3.000 ha/year of maritime pine).

Expanding the forest area
The Plan sets a target of 2% annual growth in the forest area for the next 10 years mostly in maritime pine (15.000 ha/year), cork oak (10.000 ha/year) and other broad-leaved species (10.000 ha/year).

Improving the protection against forest fires
The plan sets the following fire protection target to be achieved through better forest management and improved co-ordination among all the services involved in fire prevention and fighting: a 20% reduction in the burnt forest lands in the period 1998-2003, and a 50% reduction in the period 2003-2008 compared to the period 1992-97.

Building forest management capacity
The plan sets the following targets to be reached by the year 2003:
- a 200% growth in the number of members of the forest owners´ associations;
- 10% of the timber and cork sales go through the forest owners´ associations;
- 10 teams of firemen in the forest owners´ associations;
- 100 extensionists assisting the forest owners´ associations and the set up of grouped forest management units;
- 10 communal forests with at least one permanent forester in charge of forest management;
- 300 forest management plans at the forest

management unit level covering an area of 250.000 ha;
- 500.000 ha managed by the public forest management company under forest management plans.

Building capacity in the forest related services
The plan sets the following targets to be reached by the year 2003:
- 10% of the forestry contractors have a level III technician;
- 30% of the forestry contractors attend training courses;
- 20% of the forestry contractors are certified;
- the forestry contractors follow the 1997 ILO occupational safety and health code for forest workers and pay them at the same level as farm workers;
- only roundwood non suitable for sawmilling is delivered to the pulp paper and panel companies;
- 20% decrease in the forest investment costs due to improved public information on these costs and competitive bidding;
- 50% of the forest projectors attended specific training courses.

The Plan expects 20% productivity gains in the forestry contractors' work by the year 2008.

Creating a Sustainable Forest Management certification system
By the end of 1999 the Pan European Indicators of Sustainable Forest Management at the Forest Management Level are tested and adapted to the Portuguese conditions.

By the year 2000 a national certification system is in place.

The regional forest management plans incorporate the monitoring systems needed for certification.

Protecting biodiversity
The plan sets the following targets to be reached by the year 2003:
- 20% of the forest projects include mixed stands;
- 100% of the forest projects protect biodiversity;
- 10.000 ha/year of private projects protecting high environmental value habitats;
- all the forest contractors follow a code of environmentally friendly practices.

4.3.2 Policy instruments

Innovative financing
Following up on the statement of the 1996 Forest Policy Law for the creation of a permanent forest fund to finance forest investment and management and compensate forest owners for positive externalities, the Plan proposes the following sources of financial resources for this fund:
- a new tax or a share of the corporate income tax paid by the water and electricity power companies;
- a new tax on the carbon emissions by polluting companies;
- 1% of the proceeds from the tax on fuel and gas;
- bonds;
- philanthropic contributions.

The Plan also announces tax incentives for forest owners not yet fully specified.

Consolidating forest legislation
The Plan announces for 1999 a Forest Code updating and consolidating all the scattered forest legislation.

4.3.3 Other goals

The plan also sets an extensive list of goals and operational targets regarding the enhancement of the protective role of forests in terms of soil and water conservation, the contribution of forests to the global carbon cycles, the protection of forest resources against airborne pollution and biotic agents, the integration of forest planning with the wider land use planning, interdisciplinarity and improved co-ordination of forest research, development of the forest industries, commercial promotion of forest products, enhancement of the recreation use of forests and improved management of non timber forest production, including gaming and fishing.

4.3.4 Issues not covered by the National Forest Programme

This draft of the NFP has no budget and financial feasibility study. The implicit and sometimes explicitly stated rationale for this incomplete approach is to start by building up consensus or broad support for the stated goals and targets and later push for the need public and private funds, knowing from the start that it will not be easy to improve the share of forestry in the public budget.

Another important point missing in this draft is a strategy to implement the Plan on the ground involving something more than the provision of financial incentives, public information and norm setting. In fact this first draft of the Plan does not address the issues of decentralisation, public participation and integrated development at the local level. Forest planning at the subnational level is only addressed through the regional forest management plans and the forest management plans at the forest management unit level. Both of these instruments are essentially silvicultural planning tools without the socio-economic and collective organisation dimensions needed for a real development process. This is why we have proposed (Mendes 1998b) that participatory forest planning should be promoted at the regional and subregional level.

4.4 Forest policy in relation to other national policy areas

Up to now there is no institutionalisation of co-operation and conflict resolution between the different bodies of Public Administration and the private sector. What exists is lobbying and informal talks between DGF and the forest interest groups, especially forest owners' organisations and the forest industries' and forest contractors' associations. Contacts between DGF and the environmental groups are much less intense.

The Forest Policy Law contains provisions for institutionalisation of co-operation and conflict resolution between the Ministry of Agriculture and the forest interest groups, including the environmentalists. This will be done through the following commissions:
- the Consultative Forest Council;
- the Appeal Commission for Forest Projects.

Intersectoral co-ordination of forest policy objectives with other policy areas is very weak. It was the acknowledgement of this fact that led the legislators to put in the 1996 Forest Policy Law the provision for a new Interministerial Forest Commission. The decree regulating this commission has already been approved by the Government on October 1997. It is presided by the Minister of Agriculture and includes representatives of the following ministers: Finances, Internal Affairs, Equipment, Planning and Territorial Administration, Economy and Environment.

The Ministry of Finances oversees together with the Minister of Agriculture the public institute called IFADAP in charge of financing the agricultural and forest structural policy.

The connection with the Internal Affairs has basically to do with the fact that it is this ministry which controls most of the fire fighting system including forest fires. Fire fighting in Portugal is carried out essentially by generous but insufficiently trained corporations of volunteers existing in most of the villages in the country. These corporations of volunteers are co-ordinated and partially funded by this ministry.

The Ministry of Equipment, Planning and Territorial Administration has many linkages to the forest sector. Here we will mention just three:
- the best development planning capacities at the regional level are in the Regional Co-ordination Commissions of this ministry;
- these regional commissions prepare and manage the regional development programmes financed by the EU structural funds some of which have been supportive of capacity building in the forest sector, especially the creation of forest owners´ associations;
- the Regional Co-ordination Commission provide technical assistance to the local govern-

ments and have responsibilities in the wider land use planning.

The Ministry of Economy is important for the forest industries since it is in charge of the industrial policy. This minister has a direct intervention in a major portion of those industries because from the three top pulp and paper companies operating in the country two of them are still controlled by the public sector. The Ministry of Economy is now in the process of setting up a holding to promote some form of integration of these two groups.

The Ministry of Environment is relevant not only for the growing importance of the environmental agenda in forest policy, but also because it oversees the natural parks and other protected areas. Forestry is important in almost all of them. In some cases it is the Forest Services which are in charge of forest management in those areas. In other cases that responsibility has been transferred to the park services.

4.5 EU forest and forest related policies

"Programa de Acção Florestal"

The major impact of EU forest and forest related policies in the Portuguese forest sector is the funding for afforestation programmes. This started with the so called *"Programa de Acção Florestal"* (PAF). This programme came in 1987, at the end of another programme funded by the World Bank (PFP-*"Projecto Florestal Português"*) which lasted from 1981 until 1988. The role of the state towards private forestry turned from one of direct intervention like in the World Bank Project to one of substantial facilitation through attractive subsidies, leaving to the forest owners and private contractors the responsibility for preparing the forest plans and conducting the afforestation works. The components of this programme, the planned targets and what was actually accomplished are summarised in table 15.

The first thing to note is that again the implemented programme intentions fell below the targets. The objectives were set too high, given the experience of the previous afforestation programme, and were not supported by enough funds from the State Budget to match the EEC financing. Again, like in the World Bank Project, the provision of forest extension services was not implemented.

This programme introduced some changes relative to the World Bank Project.

1. Instead of loans to be repaid with the revenue from the fellings, the financial incentives to the forest owners consisted of subsidies varying between 30 and 100 % of the total cost.
2. The public afforestation programmes started to support not only afforestation, but also improvement of the existing stands (restocking, reconstitution of damaged woodland, protection, forest roads, etc.) .

Table 15. Objectives and implementation of PAF

	Planned	**Accomplished**
Time horizon	1987/94	1987/94
Afforestation (ha)	400 000	108 420
Improvement of existing stands (ha)	400 000	200 888
Establishment of grazing areas (ha)	100 000	0
Forest roads (km)	7 700	6 690
Divisional roads (km)	3 400	2 903
Dams	400	1 053
Forest extension services	X	nothing was done
Total cost of the programme in 1000 euros	313 940	162 374
- Private projects		110 804
- Public projects		51 570

3. The favourable treatment received by the eucalyptus plantations in the World Bank project disappeared: they were restricted by new regulations which came out in 1988-89, the rate of subsidy was reduced and finally disappeared in 1991.
4. The public support to afforestation became less concentrated on eucalyptus and maritime pine, and began favouring other species, especially the cork oak forests.
5. The Forest Services started to withdraw from a direct intervention in the preparation and implementation of afforestation projects, appealing more than before to the private initiative of forest owners and contractors: 70,2 % of the total investment supported by PAF was for private forestry. From the remaining 29,8 %, more than half was for public projects in the North. These projects, however, represented only 17,4 % of the total investment supported by PAF which is much lower than what happened in the World Bank Project.

These situations contributed to a major shift in the regional incidence of the forest policy: while in the World Bank Project 54,5 % of the plantations were in the North, with PAF this percentage fell to 21,3 %.

To this shift also contributed the fact that nothing was done in the World Bank Project and in the PAF to establish a Forest Extension Service and to support the organisation of forest owners' associations. So without this kind of capacity building, the owners with larger forest holdings, located mostly in the South, were naturally more effective in getting the bigger share of the public support.

Regulation (EEC) 2080/92 and "Plano de Desenvolvimento Florestal"

Regulation (EEC) 2080/92 is a EU policy measure not specific to Portugal supporting the afforestation of agricultural lands. The PDF, on the other hand, is a programme specific to Portugal, financed by the EU within the Common Support Framework for the period 1994/99. This programme supports the following types of actions:
- afforestation
- improvement of existing stands and reforestation, including the case of woodlands damaged by fires less than 5 years ago;
- maintenance costs of the plantations for 5 years after the first restocking;
- installation and amelioration of forest nurseries;
- selection and production of good quality seeds and seedlings;
- construction and amelioration of forest roads and water reservoirs;
- multiple use of forest lands (grazing lands, apiculture, gaming, aromatic and medicinal plants, etc.).

This programme also has the following specific features:
- it favours grouped projects consisting of, at least, 5 contiguous, forest holdings;
- it does not support plantations with fast growing species.

Table 16. Regional distribution of the plantings and improvements supported by PFP and PAF

Regions	PFP (1981/88)		PAF (1987/95) Afforestation		Stand improvement		Total	
	ha	%	ha	%	ha	%	ha	%
North	70 670	54.5	40 443	35.6	28 671	13.6	69 114	21.3
Centre	37 400	28.8	29 137	25.7	33 395	15.8	62 532	19.3
Lisbon & Tejo Valley	9 773	7.5	13 137	11.6	43 823	20.8	56 960	17.6
Alentejo	10 455	8.1	13 861	12.2	88 395	41.9	102 256	31.5
Algarve	1 451	1.1	16 984	15.0	16 720	7.9	33 704	10.4
TOTAL	129 749	100.0	113 561	100.0	211 054	100.0	324 615	100.0

Source: Instituto Florestal

The main new features of these two programmes are the following:

- a stronger role for the private initiative of forest owners;
- more support for the cork oak forests in the south;
- financial support for maintenance costs for 5 years after the first restocking in PDF;
- a prime to compensate the loss of agricultural income for 20 years in the Reg. 2080/92;
- more support to the multiple use forest management and broadleaved species.

It is sound economic policy to appeal to the private initiative of forest owners instead of relying mostly on the Forest Services in regions where the forest lands are predominantly private. The problem is that, before having engaged in this policy shift, the Forest Services should have used the resources put forward by the World Bank Project and PAF to provide extension services and support to the establishment of forest owners' associations, especially in North and Central Portugal where ownership is more fragmented. We have already seen that little was done in this matter. So it is understandable that when the afforestation policy starts to appeal to the private initiative of forest owners, the ones who are quicker to apply for the grants and get most of the public support, are the bigger landowners in the south.

4.6 Forest education and research

Forest research is concentrated mostly in the two universities with undergraduate and graduate programmes in forestry (ISA and UTAD) and in the National Forest Research Station which is part of the public research institute of the Ministry of Agriculture. This station survives on transfers from the state budget and on public research grants, their researchers complaining with some reason on the lack of sufficient funding in the last two decades. The linkages with the industry and the private owners are relatively weak. Only the pulp paper companies were able to set up a research network centred on eucalyptus made up of their own personnel in co-operation with some universities. In March 1998 a similar network got started for the pine and the related industries. The same type of efforts are under way for cork.

Like in the Forest Services, the great majority of the work coming out from the forest research system is purely silvicultural when it relates to forestry or technological when it relates to industry. There is an almost total lack of work in forest policy and forest planning.

Table 17. Regional distribution of the investment supported by PAF, PDF and Reg. 2080/92

Regions	PAF		PDF		Reg. 2080/92		PDF+2080/92	
	1000 PTE	%	1000 PTE	%	1000 PTE	%	1000 PTE	%
Northwest	5 102 294	15.6	1 118 434	12.1	249 515	2.2	1 367 949	6.7
Northeast	7 342 143	22.6	1 122 252	12.1	1 860 203	16.7	2 982 455	14.6
North	12 444 437	38.2	2 240 686	24.2	2 109 718	18.9	4 350 404	21.3
Central West	3 664 463	11.3	1 098 589	11.9	144 307	1.3	1 242 896	6.1
Central East	5 102 701	15.7	2 647 562	28.6	1 473 633	13.2	4 121 195	20.2
Ribatejo Oeste	3 004 529	9.2	1 377 920	14.9	956 090	8.6	2 334 010	11.4
Alentejo	4 349 086	13.4	983 895	10.6	5 229 913	46.9	6 213 808	30.5
Algarve	3 987 802	12.3	903 965	9.8	1 233 117	11.1	2 137 082	10.5
TOTAL	32 553 020	100.0	9 252 615	100.0	11 146 778	100.0	20 399 393	100.0

Source: Instituto Florestal (in CESE, 1996)
1 Euro=200,482 esc.

5 Main current conflicts and challenges

The future role of the Regional Forest Services and the management of the public and communal forests
Since the Forest Services have been responsible for most of the afforestation and management of the communal lands, the major issue concerning these forests is to know what is going to be the future role of these services in this regard.

Since the present government came into power in 1995, a major structural change was undertaken in the Forest Services. Their local and regional services, which before were part of a centralised structure, autonomous from the agricultural services, lost their autonomy, and were merged with the regional agricultural services. Also the purpose of the current policy-makers is to take away from the regional Forest Services the management of the public and communal forests, transferring it to a new company to be created for that purpose with public capital and private management rules.

The rationale for this institutional change is that, as a forest management operator, the regional forest services, since they are constrained by public management rules, are thought to be less efficient than a company guided by private management rules. So the future role for the Forest Services should be more one of an extension service provider rather than a forest management operator, in conjunction with the regional agricultural services, in order to promote an integrated approach to agricultural and rural development.

Assuming this new role will not be easy without proper training and good motivation for the foresters in the regional Forest Services. While this extension mission is not yet clearly under way, what is actually happening is that most of the time of these foresters is being taken by the administrative tasks of examining the applications of forest owners for public grants.

As far as the project of the new public forest management company is concerned, it is an initiative promoted mostly by Directorate General of Forestry supported by the industry, but looked on with suspicion by the Regional Directorates of the Ministry of Agriculture, the representatives of the communal forests and the environmentalist groups. Some people think that this is not a step in the direction of getting the local communities more directly involved in the management of the communal forests and integrating this management with the other types of forests and activities existing in the local economies. Also there is a fear that this might be a step towards the future privatisation of some public and communal forests. Because of this fear there is opposition against transferring the ownership of the state forests to this company.

The idea of this new company is appealing to the wood industry, especially the sawmills and the big firms in the panel industry which are large consumers of pine wood, the dominant species in the state and communal forests. These industries are expecting that the forest company will be more efficient in the forest management and logging operations. Also it will facilitate the procurement of wood in quantity and in quality by concentrating supply, without having to pay monopoly prices because the company is public and will not behave to the detriment of industrial competitiveness.

Public policy towards the forest owners' associations
Since the existing forest owners´ associations got started they have been surviving essentially on public subsidies. So the major issue here is to know how they can reduce this heavy dependence on public funds, and what role should be kept for this type of financing.

These associations are already making some efforts towards the provision of paid private services to their members. These efforts, however, don't mean that they should be banned from public aid. They should continue to be entitled to public support because of their indispensable role in the provision of public goods necessary to the development of the forest sector, especially in regions of small scale forestry. In fact, one of the major roles of these associations is to promote forest projects at an efficient scale, which in regions of small scale forestry implies heavy transactions costs required for grouping large numbers of fragmented forest holdings.

In article 17, the Forest Policy Law claims that *"the creation and technical upgrading of the forest owners' organisations is stimulated through different types of incentives"*. The law does not specify which type of incentives should be considered. To our knowledge there is no careful studies on the roles of these organisations, the type of support they should be given by the public sector or their financing strategies. Thus public support might end up to be tailored mostly to the lobbying ability of each group of associations without a clear and national policy in this matter.

An important type of public support for the forest owners' associations could come from the regional forest services. If they are going to be effectively discharged from their responsibilities in terms of the management of public and communal forests, they will have time and human resources available to be more active than before in providing technical support to these associations.

Besides financial and technical support from the Public Administration, the forest owners' associations should also be called to participate actively in the policy-making process. We have already mentioned that an important feature of the Forest Policy Law is the creation of a Forest Consultative Council to assist the Ministry of Agriculture and the Government in general in the matter of forest policy making. The regulation for this council will be approved by the Government soon, and among its members there will be representatives of the forest owners' associations (FPFP, FORESTIS).

Mandatory forest management regulations

With the application of the Forest Policy Law, all forest types will be subject to management plans. In fact, article 5 defines two types of plans:

- regional plans to be prepared by the Forest Services which are guidelines to be respected in the management of the forest holdings in order to promote sustainable forestry;
- plans at the forest management unit level.

Only the holdings above some threshold to be defined in the regional plans will have to prepare and follow the second type of plans.

The major issue here is to know if these plans are going to be effective management tools contributing to forest development, or just some kind of administrative activity. The Forest Services consider them as one of the major instruments of their future actions. However, there are some cautionary points to be made. First, the regional plans are basically land use and forest management plans of a sectoral nature which have to fit into more global land use plans, namely the municipal and regional land use plans, an area which has been the object of a new frame law recently submitted to the Parliament. So either they are prepared first, or after the more general land use regulatory mechanisms, the regional forest management plans have to be adjusted with them.

Secondly, these forest plans are essentially land use and silvicultural plans. So they lack a socio-economic component in order to be effective forest development plans.

Finally, there is a risk of the regional plans being more like an administrative activity carried out in the offices of the Forest Services, without a strong involvement of the forest owners' associations and other stakeholders in the forest sector. So a good idea would be to give priority to the plans made in territories covered by forest owners' associations calling upon their active participation. These associations can also be an important partner in promoting plans at the forest management unit level.

The National Forest Programme

With a Forest Policy Law in the process of being translated into the decrees necessary for its implementation and a draft for a NFP put out for public discussion after several contributions presented by some major stakeholders in the forest sector the expectations are getting higher that finally a participated NFP might come up and be assumed by the Government together with an updated and consolidated legislative framework. The problem might be to get appropriate national funding to meet some of the ambitious targets set out in the plan. Lack of a strong commitment by the Government failing to show a clear sign of the priority attached to forest development will be demobilising for the forest owners and the forest industries, leading some of the major ones to withdraw from investment plans in the country and search for better opportunities outside.

Even if this planning and legislative process at the national level comes to a good end there is still a long way to go in terms of capacity building in the public administration for forest planning and forest-policy making both at the national and at the subnational level. Also the private sector is weak in this regard. The big forest industry has the means to do its job in these matters but the rest of the industries and the forest owners still have to build capacity for being more able to participate actively and constructively in forest planing and policy making. The universities and the research institutions have yet to play their role in this capacity building process.

The public finance of afforestation and the Forest Policy Law

Crucial for meeting the planned targets for afforestation will be the type of financial incentives provided to private forestry. From the previous analysis we can draw the following conclusions about the past experiences:

- since 1981 the afforestation in Portugal has relied essentially in programmes co-financed by foreign sources, the World Bank first, and EEC after, without a permanent fund fed basically by national sources;
- the priorities of the public afforestation programmes have changed substantially since 1981: after the World Bank Project, whose almost exclusive goal was to plant pine and eucalyptus forests to respond to the needs of the forest industries, other programmes came up much more favourable to cork oak and multifunctional forestry, practically banning eucalyptus from the support of public policy;
- in the same period, substantial changes took place in the type of actors privileged by the public afforestation programmes: in the World Bank Project the major players were the pulp industry and the Forest Services, whereas in the subsequent programmes the priority turned to the forest owners and the private contractors;
- the types of financial incentives to private forestry changed substantially in a relatively short period of time.

We think that the Portuguese forest sector needs a different type of public finance based on the following principles.

1. Afforestation programmes should not be subject to frequent changes in priorities, incentives and sources of funds. Instead they should be supported by a permanent fund oriented by a national forest programme with long-term goals.
2. To contribute to this national commitment to long-term forest development, a greater role should be given to domestic sources of funds, reducing the strong dependence on foreign funds whose permanence and objectives the country cannot control.
3. In the domestic sources of funds there should be some regular transfers from the State Budget compensating forestry for its positive externalities. There is a case for these transfers to be based on the consignment of the tax receipts on gas, fuel and automobiles, the argument being that forests are an important carbon sink contributing to reduce the “greenhouse effect” generated by those products. Without this kind of consignment mechanism, given the heterogeneity and weak lobbying power of the Portuguese forest sector, the insufficient public awareness for its economic and social importance and the high discount rate of political actors, there is always a risk for a macrodecoupling (Wolf, Jr., 1993) where the majority of the population benefits from the public goods and positive externalities from forestry without paying for that.
4. Also it is not good to continue with the cur-

rent misallocation of objectives and policy instruments and the microdecoupling (Wolf, Jr., 1993) in the public subsidies to private forestry which only loosely commit the beneficiaries to an active forest management. Subsidies and grants should be allocated to the provision of public goods and the internalisation of positive externalities. Commercial plantations should be supported with long-term loans (possibly at subsidised rates to compensate for some provision of public goods and positive externalities) with amortisation schemes adapted to the time profile of costs and revenues of the different species and stands. The repayment of these loans would contribute to feed the permanent fund.

5. The system should also appeal to private savings, namely through fiscal incentives.

Organisations related to forestry

Forest Services

Direcção Geral das Florestas, Av. João Crisóstomo, 28, 1050 Lisboa - Tel. +351-1-3124800 - Fax +351-1-3124988, http://www.dgf.min-agricultura.pt/ (This is a site to check for some statistics, legislation and text of the National Forest Programme)

Forest Research Station

Estação Florestal Nacional, Tapada das Necessidades, rua do borja, 2, 1350 Lisboa - Tel. +351-1-3901661 - 3973163

Scientific Societies

Sociedade Portuguesa de Ciências Florestais, Departamento de Engenharia Florestal, Tapada da Ajuda, 1300 Lisboa - Tel. +351-1-3634667 - Fax +351-1-3645000 (Publishes a periodical called “Revista Florestal” as well as the proceedings of the National Forest Congresses).

Universities

Universidade de Trás-os-Montes e Alto Douro, Departamento Florestal, Quinta dos Prados, 5000 Vila Real - Tel./Fax +351-59-320238

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Technological Centers related to the industrial associations

Centro Tecnológico das Indústrias da Madeira e do Mobiliário, Rua dos Salazares, 842, 4100 Porto - Tel. +351-2-6102813 - Fax +351-2-6179595

Centro Tecnológico da Cortiça, urbanização do cerrado, rua 13, 416 Santa Maria de Lamas 4535 paços de brandão - Tel. +351-2-7471200 - Fax +351-2-7471209

Federations of Forest Owners’ Associations

FORESTIS-Associação Florestal de Portugal, Rua do Campo Alegre, 823, 4150 Porto - Tel. +351-2-6006129 - Fax +351-2-6090156, forestis@mail.telepac.pt, http://www.ccr-n.pt/actreg/forestis/forestis.html

Federação dos Produtores Florestais de Portugal, Av. Colégio Militar, Lote 1786-6.º, 1500 Lisboa - Tel. +351-1-7100000 - Fax +351-1-7100071

Associations of Forest Industries and Forest Contractors

AIMMP-Associação das Indústrias de Madeiras e de Mobiliário de Portugal, Rua Álvares Cabral, 281, 4050 Porto - Tel. +351-2-3394200 - Fax +351-2-3394210, geral@aimmp.pt

AIECN-Associação dos Industriais e Exportadores de Cortiças do Norte, Av. Comendador Henrique Amorim, 580, apartado 100, 4535 Santa Maria de Lamas - Tel. +351-2-7442176 - Fax +351-2-7449768

AIEC-Associação de Industriais e Exportadores de Cortiça, Av. Duque de Ávila, 169, 2.º Esq., 1050 Lisboa - Tel. +351-1-3158506 - Fax +351-1-3570878

CELPA-Associação da Indústria Papeleira, Rua Marquês de Sá da Bandeira, 74, 1.º Esq., 1050 Lisboa - Tel. +351-1-7960054 - Fax. +351-1-7939054

ANEFA-Associação Nacional de Empreiteiros Florestais e Agrícolas, Estrada de Benfica, 552 - 3.º D.to, 1500 Lisboa - Tel. +351-1-7160166 - Fax +351-1-7162318

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- consult the scientific journal "Sylva Lusitana" published by Estação Florestal Nacional;
- consult the proceedings of the three National Forest Congresses organised by Portuguese Society of Foresters.

[1] This list and the previous one are, by no means, comprehensive, but it contains useful references from which much more can be found to get an overview of the silvicultural, technological, historical and socio-economic research on the portuguese forest sector.

Romania

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1 The country

1.1 Location, population and relief

Romania is located in Eastern Europe, bordering to Hungary in the West, Bulgaria and Serbia in the South, Ukraine in the North and the new state of Moldavia and the Black Sea in the East (see figure 1). The total population is 22,607,620 inhabitants[1], sharing a total area of 238,391 km^2.

The country has a wide range of natural resources. About 60 % of its area is suitable for agriculture, with climatic and relief characteristics favoring both arable and pastoral farming. Historically, there are three main important regions: Transilvania, Valachia and the historical Moldovia. The first one is separated with the other two regions by the Carpathian Mountains which are bounded by hilly regions. The structure of the actual population is determined by the historical background: Transilvania belonged to Hungary until 1918, when the national state was created on the basis of Romanian majority in that region. Hence, in Transilvania, both Hungarian and German people can be met, along with other minorities, such as Ukrainian and Serbian. The population is more homogeneous in Valachia and historical Moldavia.

Figure 1. Romania’s location in Eastern Europe

[1] Source: Romanian Statistical Yearbook 1997, Bucharest.

The plains cover about one third of the whole area, and they are located in south – the Valachian plain, in east – the Moldovian plain and a strip plain can be found in the Western part, as an extension of the Hungarian grassland. These regions are ascribed to agriculture to a large extent, and only a few forest spots can be found. The hilly regions also cover a third of the total area while orchards, pastures and vineyards represent the main use of land.

1.2 An overlook on natural conditions

Romania has various natural and artificial ecosystems determined by a wide spectrum of natural conditions shown in figure 2. The Western Plain is characterized by fertile soils, and more rainfall due to the Mediterranean influences. The Valachian plain is drier, and is actually a grassland section, much of it being covered with intensive wheat, barely, oat and maize cultures. Only a few forest areas (Oaks for natural forests and Locust for newly plantations) have been maintained in this region. The outbound strip of the Moldavian plateau preserves some relicts of the natural forests which are based on "drought ridden" forest species, such as *Carpinus minor* and *Quercus pubescens*. The Transilvanian plateau is characterized by brown soils, the most relevant uses of land being, agricultural crops, especially potato, oily plants and Sessile oak. Within the Carpathians mountains, beech, Norway spruce and fir are widely represented – according to their natural elevation.

In the Southern part of Meridional Carpathians, namely the Banat mountains, there still exists some uneven-aged monumental beech forests, located in habitats where the Mediterranean influence is apparent.

The most important forest species met in the mountainous area are Norway spruce, Beech and Fir. On large areas, brown soils provide a medium to high forest productivity, but some fragile ecosystems should be taken into account, and, according to the framework of the Romanian forest managerial planning, these areas are carefully preserved, either as natural reserves, scientific reserves or national parks. Formally, only one National Park was founded by a special law, issued in 1935 and the Danube Delta has been declared as one of the most important protected areas in Europe.

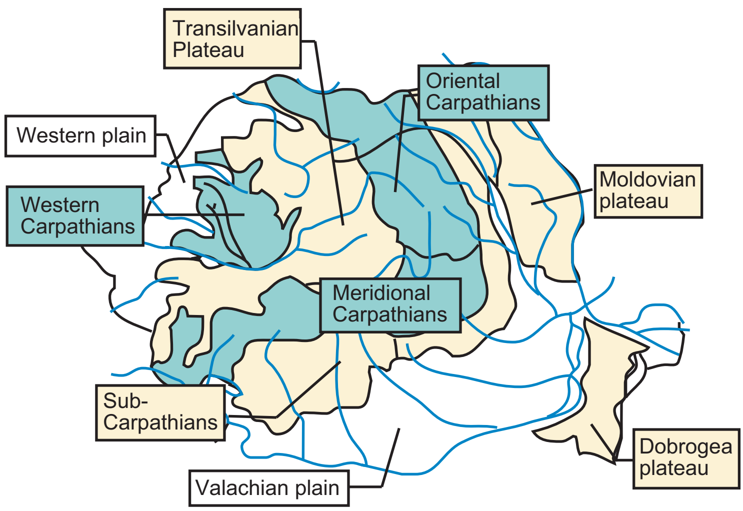

Figure 2. Main ecological regions

Table 1. Forest areas according to their main productive and protective functions

Specifications	Area in year 1955	1970	1980	1990	1997
Woodland total area	5777.3	6218.9	6227.4	6228.1	6314.0
I. Forest with special protective functions:	822.3	1139.9	2136.5	2336.0	3316.0
watershed protection	182.9	392.5	776.6	844.1	1240.0
soil protection & erosion control	441.8	491.1	728.7	827.8	1048.0
protection against climatic stress and pollutant hazards	17.2	15.7	27.8	27.7	127.0
amenity	113.6	141.4	424.4	447.9	672.0
biodiversity protection and scientific purposes	669.9	98.3	178.9	188.5	229.0
II Forest with productive and protective functions	4989.9	5079.0	4090.9	3892.1	3026.0

I-st functional group, where annual crop is scheduled on a regular basis =2523 thousand hectares
I-st functional group, where annual crop is not scheduled on a regular basis (only salvage products are yielded) =793 thousand hectares.
Source: Romanian yearbooks 1955-1997.

2 Forest resources and their uses

The first condition to be met by a patch of cultivated or wild forest vegetation is the area: (according to Romanian standards, a forest should exceed hectares). Besides official forests, the land management system recognizes an additional category, namely wood pastureland, which represents a regular pastureland covered with forest canopy, more or less continuous.

Table 1 summarizes the trend in use of Romanian forest resources. It should be stressed that dramatic changes are supposed to occur in the forthcoming two years, as the present political power intends to restore the property rights to all people who owned forests before 1948. Up to 50 hectares of forest will probably[2] be reallocated per family, as many woodlands are currently managed in accordance with high environmental standards, consisting of: long rotations, uneven age structure, close-to-nature

Table 2. Proportions of the main forest species

Species	Area 1000 hectares	Area %	Volume by stem Million m^3	Volume by stem %
total	6245	100	1341	100
Beech (*Fagus sylvatica*)	1916	31	489	36
Oaks (*Quercus* sp.)	1137	18	177	13
Hardwood broad-leaved	951	15	99	8
Softwood broad-leaved	328	5	50	4
Norway spruce (*Picea abies*)	1430	23	386	29
Fir (*Abies alba*)	312	5	124	9
Other resinous species	173	3	16	1

Source: “Le Forets de Roumanie.” (ed. C. Chirita) Ed . Academiei Republicii Socialiste România, 1981, pp: 557.

[2] The reallocation system is based on two phases: the former consists of recording all valid applications and the latter consists of effective reallocation, carried out by a special law.

Table 3. The forest areas on types of management regimes and age classes

Specifications	**1000 hectares**	**%**	**%**
Regular yielded forest of which	5646.0	90	100
1st functional group	1754.0		
2nd functional group	3892.0		
1st age class (1-20 years)	1260.0		22
1st functional group	508.4		
2nd functional group	751.6		20
2nd age class (21-40 years)	1143.3		
1st functional group	305.9		
2nd functional group	808.4		
3rd age class (41-60 years)	1023.2		18
1st functional group	223.8		
2nd functional group	799.4		
4th age class (61-80 yr.)	811.9		14
1st functional group	200.1		
2nd functional group	611.8		
5th age class (81-100 years)	559.2		10
1st functional group	170.1		
2nd functional group	389.1		
6th age class (older than 100 years)	877.4		16
1st functional group	345.7		
2nd functional group	531.7		
Forest where the yield is not planned on a regular basis	599.0	10	

Source: The National Forest Administration - Annual report for 1998

Table 4. Distribution on age classes for the main species (%)

	Species		
Age class	**Beech (*Fagus Sylvatica*)**	**Oaks (*Quercus sp.*)**	**Norway spruce (*Picea abies*)**
I	10	17	28
II	12	29	17
III	18	25	14
IV	17	13	18
V	13	8	12
VI	30	8	11

Source: The National Forest Administration - Annual report for 1998

composition and silvicultural systems and so forth. Now, the state manages about 95 % of the total forest fund, while only 5 percent are private forest.

Proportions of the main forest species are presented in table 2. As the sustained yield principle is the framework of the Romanian forest management system, the structure according to age classes is an important indicator of crop sustainability, and these figures are presented in tables 3 and 4, both for commercial forests and protective forests. It should be highlighted that, due to the multi-purpose forest management system referred to above, most forests are supposed to provide both wood and protective functions, and the traditional classification in commercial and non-commercial forests is improper.

As stated above, private woodlands account for less than 5 % of the national forest fund, and the National Forest Administration is the main body responsible for applying the national forest policy. According to its status, the forest authority takes advantage of its monopoly but, at the same time, it has to comply with a quite restrictive rule of operation, forbidding logging operations. In other words, by its own code of operation, the National Forest Administration is allowed to sell wood by stem[3], not timber as such, and the main breakthrough in this respect was carried out only in 1996, when the National Forest Administration was allowed to export some self-processed lumber for creating an investment fund directed to new road building.

The National Forest Autonomous Administration (NFAA)[4] has been reorganized and the initial number of 41 subsidiaries, one for each forest county, has been reduced to 25. The Forest Research and Management Institute is also under the NFAA and its main responsibilities are research and technological development along with forest management planning.

Each subsidiary, more or less co-ordinates forest ranges according to the forest area of each county. Furthermore, each forest county is composed of up to 10 production units, each unit being subject to a ten-year management plan. Implementation of this plan means that the allowable cut and the cutting budget are stated for a ten-year period of time, according to the well known sustained yield principle. Another characteristic of the forest management system consists of giving a high value to amenities and the non-productive functions of forests. Basically, all forests are grouped into two main classes: productive forests which are managed according to economic criteria, and protective forests where ecological considerations prevail.

In both types of forests logging activities are allowed, more or less, according to how important the close-to-nature structure of the forest is considered. Briefly, Romanian forestry is specifically oriented towards the multiple use forestry pattern.

Wood is sold by stem, basically two times a year, by auctions which are organized at each forest county headquarters. Due to the monopolistic position of the seller, the average price of timber used as a floor price within the timber auction was controlled by the Ministry of Finance until the end of 1997. The average floor price was and still is a full-cost price, assessed according to the expenditure needed to manage the forest fund within a year. From 1994 to 1996, the floor average price was not updated to the inflation rate. Now, the floor price is free, it is the forest counties which are responsible for setting it up.

Having adopted a close-to-nature managerial background, Romanian foresters apply on large areas different forms of group forest systems, and, in some places, the selection system is also currently applied. Clear cuttings and regular shelterwood systems are somehow avoided, due to their negative environmental impact. Table 5 presents the structure of the latest allowable cut, at national level, and table 6 shows some figures referring to the game management output.

Regarding game management, it should be said that in Romania there are 2227 hunting areas, covering both forests, agricultural lands and inland waters. According to the Hunting Law, Environment Law and Forest Code, game management within forests is the responsibility of the National Forest Administration, and includes surveying, selection, feeding, providing veterinary assistance and so on. For other hunt-

[3] Although one could say that harvesting rights are actually sold the whole mechanism of marking up trees, appraising them and supervising the logging works constrict the rights of the seller upon the trees which are supposed to be logged.

[4] Referred as “Regia Nationala a Padurilor” in Romanian.

Table 5. The present allowable cut of Romanian forests, million m^3

Species	Main yield (including conservation works)	Thinnings	Clearings	Salvage	TOTAL	%
Resinous	2144	1019	104	701	701	25
Beech	5251	1624	119	615	615	42
Oaks	959	307	57	400	400	11
Hardwood broad-leaved	934	808	156	320	320	14
Softwood broad-leaved	807	363	62	110	110	8
TOTAL	10095	3387	498	2143	2143	100
%	63	21	3	13	100	

Source: The National Forest Administration - Annual report for 1998

Table 6. Game crops on species, in 1997

Species	Optimal number	Actual number	Quota	Crop
Red Deer (*Cervus elaphus*)	35200	35300	1210	852
Deer (*Capreolus capreolus)*	168500	144000	1610	1720
Chamois (*Rupicapra rupicapra)*	7850	7700	121	135
Bear (*Ursus acrtos)*	4410	5366	141	141
Wild boar (*Sus scrofa)*	30700	35400	7520	7513
Hare	938000	1040000	750000	75025

Source: Romanian yearbook, 1997.

ing areas, game management is ensured by the Romanian General Association of Hunters and Fishermen, which was established in 1940, and is associated with international hunting bodies. This organization is responsible for coordinating the different hunting party sectors for deer, wild boar, fox, along with different bird species. Table 6 shows some relevant figures related to game management.

In the Carpathians there are a reasonable number of areas with special ecological niches for *Lynx lynx*, *Felis sylvestris*, *Martes martes* and *Canis lupus*. Foresters have organized some parks where *Mustela putorius*, *Lutra lutra* and *Marmota marmota* can be found.

Regarding the forest regeneration process, which is strongly determined by forest policy, reducing the share of the annual reforested area

Table 7. Regenerating the forests (hectares)

Specifications	Year 1989	1990	1992	1994	1996	1997
Total area,	54047	33558	19303	23098	25521	22185
Natural regeneration	19100	9655	6933	9233	13591	11668
reforestation	34947	23903	12370	13865	11930	10517
In forest fund[5]	26186	21840	12243	13563	11541	10373
On bad lands	8761	2063	127	302	389	144

Source: Romanian Yearbooks for the referred period.

[5] After clear cuttings

is normal to some extent, as natural regeneration is an important objective to follow, but the economic crisis also affected the forest sector. This explains the downward trend of reforestation on badlands, which is very costly. Figures are presented in table 7, and they reflect the trend from 1989.

3 Forest economics and forest policies

3.1 Timber logging and timber industry

The actual state of Romanian forestry is depicted by figures presented in tables 1 to 3. Wood-mass exploited per year has linearly decreased until 1997: in the 5 years, from 1990 to 1994, it decreased by 3.5 million m^3; in 1995 it increased slowly and following that it decreased as table 8 shows.

It should be highlighted that in the last five years illegal cuttings have increased. Therefore it is difficult to assess the annual harvest and to monitor the timber transport. These illegal cuttings are done either by those pretending to own some forests or by timber thieves.

Although in the period 1990-1997 market economy rules were, more or less, supposed to run, the economy, this is only partially true. The export of round wood was allowed but in case of resinous and beech timber it was done on a license basis; the economic agents who had been using quantities of wood for industry (pulp and paper, furniture) did not make an adequate and on time reorganization. Table 9 presents the main economic results of the National Forest Administration, during the last seven years.

A very controversial issue in Romanian forest economy was the appropriate pricing system, as the traditional full cost approach, instituted by the command and control economy, was no longer compatible with a market economy. As the Administration of National Forests still has had a monopolistic position, the floor average price was controlled by the Ministry of Finance. This control was regarded by the forest sector as a serious market distortion, favouring the logging and processing industries, and was removed at the end of 1997. This was an important step in the transition to a market economy based on competitiveness. Table 10 shows the average price trends, both in national currency

Table 8. The situation of wood-mass brought into economic circulation in the period 1985-1997, million m^3

Year	**Total Wood-mass**	**species groups**				
		resinous	**beech**	**oak**	**hard broad-leaved**	**soft broad-leaved**
1985	25043	7423	9485	2973	2920	2242
1986	22584	6695	8504	2575	2621	2189
1987	23077	7190	8689	2280	1686	2232
1988	19769	6722	7018	1824	2259	1946
1989	19043	6452	6587	1820	2214	1970
1990	16649	5813	4958	2045	2071	1762
1991	15377	4956	4644	1919	2089	1769
1992	14419	4418	4629	1739	2109	1524
1993	13590	4564	4073	1629	1872	1452
1994	12942	4285	4037	1651	1741	1228
1995	13813	4973	4215	1551	1774	1300
1996	14556	5752	4067	1656	1872	1209
1997	14397	5781	4263	1486	1755	1111

Source: Romanian Yearbooks for the referred period.

Table 9. The production value of the National Forest Administration

Specifications	Achievements (Million ECU, average exchange rate for 1997)							
Total	98.649	90.27	86.892	80.946	111.351	131.486	139.865	140.135
from state owned logging companies	59.189	57.297	54.865	51.622	77.568	91.757	100.135	100.676
from private owned logging companies	36.486	40.405	39.595	29.324	38.243	45.27	46.216	45.27
from village habitants	22.703	16.757	15.27	17.703	22.973	23.649	23.649	20.811
other resources	39.459	32.973	32.027	29.324	33.649	34.865	39.73	39.459

Source: National Forest Autonomous Administration Report

Table 10. Trend of the average controlled floor price and the average winning price, achieved between 1990 and 1997

Year	Period	Lei/m³	$/m³
1990	January-August	72.8	
	September-December	215.0	
	Average winning price	124.0	3.87
1991	January-June	215.0	
	July-November	500	
	December	790.0	
	Average winning price	402.0	3.94
1992	January-May	790.0	
	June-November	1080.0	
	December	1310.0	
	Average winning price	1203.0	4.01
1993	January	1310.0	
	February-May	1800.0	
	June-September	2850.0	
	October-December	3400.0	
	Average winning price	3247.0	4.03
1994	January-March	4185.0	
	April-August	6123.0	
	August-December	8438.0	
	Average winning price	9892.0	6.44
1995	January-December	8438.0	
	Average winning price	15667.0	7.19
1996	January-December	8438.0	
	Average winning price	24399.0	7.48
1997	January-February	8438.0	
	March-May	28850	
	June-July	30840.0	
	August-December	32903.0	
	Average winning price		8.08

Source: "Short and long run impacts on the use of forests at the economy level of the policy to liberalize the exports of sawed timber " UNEP Preliminary Report.

Note: The average exchange rate in the period between 1990 and 1997 had the following trend: 1990-32 lei/$; 1991-102l lei/$; 1992 - 300 lei/$; 1993- 805 lei/$; 1994 - 1535 lei/$; 1995- 2180 lei/$; 1996 - 3260 lei/$; 1997 - 7192 lei/$.

and USD per m^3, at national level, between 1990 and 1997.

The logging work is performed by 29 state-owned companies (derived from the prior state-owned companies), supposed to be privatized, and about 400 private companies.

The processing sector is represented by 163 state-owned processing companies and more than 1200 private-owned small companies, many of them having a negligible economic power. Table 11 exhibits some relevant figures referring to the trend of wood-based production.

The continuous decrease of wood mass volume entering the economic circuit is due to economic agents of wood exploitation and primary wood processing which have not exploited the wood mass to the approved level during the period 1990-1997; the quantity of unexploited wood mass was over 10.0 million m^3 (table 12) The logging operation system is based both on state and private companies, and the private sector produces 40 to 60% of the total sawn timber output.

The first conclusion concerning the cause that led to the decreasing of industrial production in Romanian forestry economy is the lack of a coherent development strategy.

As a contradiction, when comparing forestry with the agriculture and wood processing industries (furniture and pulp & paper) one can

Table 11. Production for main industrial products (wood-based products and pulp & paper products)

Specification	Unit	1990	1992	1994	1996	1996/1990 %
Sawn wood	1000 m^3	2932	2094	1852	1924	66
Veneer	billion m^2	73	45	39	37	51
Plywood	1000 m^3	123	100	84	93	75
Wood particle board	1000 tons	473	275	193	208	44
Fiberboard	1000 tons	184	109	102	81	44
Doors-Windows	1000 m^2	3041	1177	1304	1204	40
Wood cellulose 100% dry	1000 tons	388	182	163	203	52
Paper and Paperboard	1000 tons	540	310	288	327	61

Source: Romania Yearbook, 1997.

Table 12. The situation of wood mass volume approved and harvested during the period 1990-1997 (1000 m^3)

Year	Scheduled volume	Harvested volume: Total harvested	Harvested volume, species groups: resinous	beech	Oak	Hard broad-leaved	soft broad-leaved	Unharvested Volume
1990	17000	16649	5813	4958	2045	2071	1762	351
1991	19000	15377	4956	4644	1919	1089	1769	3623
1992	16500	14419	4418	4629	1739	2109	1524	2081
1993	15000	13590	4564	4073	1629	1872	1452	1410
1994	14500	12942	4285	4037	1651	1741	1228	1558
1995	14400	13813	4973	4215	1551	1774	1300	587
1996	14600	14556	5752	4067	1656	1872	1209	44
1997	14800	14397	5781	4263	1486	1755	1111	403
TOTAL	125800	115742	40542	34886	13676	15283	11356	10058

Source: National Forest Autonomous Administration Annual Reports realize the discrepancy between the three sectors, in terms of investment policies. Figure 3 presents the dynamics of investments in the three sectors. Nevertheless, even relative figures are quite misleading when looking at the low investment rate in forestry, where forest roads consume most of the investment funds, along with torrent control.

The third and the fourth graphs provide some additional information about the production decrement: taking into account the high inflation rate, and it is apparent that neither investments nor production really has an upward slope at all. As a matter of fact, both the wood processing and pulp & paper industry have been reduced, along with the whole industrial production.

3.2 Investments

Some relevant figures related to investments in the forestry sector are shown in figure 3. It provides some comparisons between investments in forestry and other related sectors. One can note that the pulp and paper industry investment rate is the highest, and this fact might be regarded as positive, in the long run, as pulp and paper consumption in Romania is still very low. Comparing these figures with those presented in figure 4, showing the production indices trends, it is obvious that the production indices for both wood processing and pulp & paper are still lower than the average production index, and this drawback certainly affects forestry, which provides raw material for these two industries.

3.3 Research, managerial planning and training

Research work has been carried out mainly by the Forest Research and Management Institute, which has a ruling body in Bucharest and six regional subsidiaries. Some of these forest management and research stations are also involved in forest road designing and trout nurseries. As regards managerial planning if should be noticed that many private companies have emerged recently, and these small companies are competing on a market basis.

Forestry training and education has been organised since 1883, when the first two forest rangers schools were founded at Branesti (near Bucharest) and Fratauti (near Suceava). This system had been working continuously with medium and high level schooling until 1949. Since the reform made in 1948 the forest school moved from Bucharest to Campulung

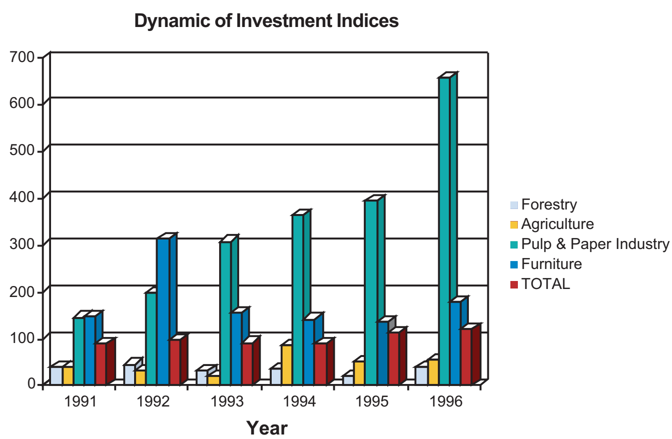

Figure 3. Trend investments in forestry and related sectors, assessed at actual prices
Source: Romanian Yearbook, 1997

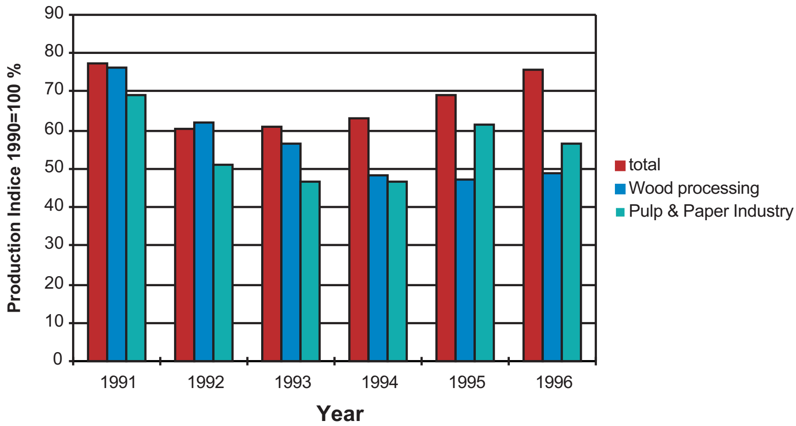

Figure 4. Production indices[5] of the whole industrial production, wood processing sector and pulp & paper industry. Source: Romanian Yearbook, 1997

Moldovenesc (52 km west from Suceava) and the forest faculty from Bucharest to Brasov. Now, there are two forest faculties for high level forestry teaching: one at Brasov, oriented towards forestry, logging and primary timber processing, considered as separate fields of study and the latter at Suceava, characterized by a more integrated curriculum combining forestry and logging. At Suceava each year, 50 new students are admitted to this schooling system.

4 Main current conflicts and challenges

Restoring privately owned forests

The privatization process Romanian forestry is facing is still being debated within the new political coalition who won the latest election. Therefore, it should be noted that there is a high economic pressure on forests, as a consequence of economic conditions and the lack of law and institutional framework.

As the restoration process is quite difficult, due to multiple causes[6], in many places the logging process, scheduled according to managerial plans, has been seriously disturbed.

Forestry reform and economic blockage

Forestry cannot be isolated from the economic environment, and if the environment is affected by a financial blockage, sooner or later forestry is also affected. This is the case in Romania. Besides that, one can realize the lack of a coherent coordination of policies and strategies in forestry, wood logging and wood processing. Some other challenges the Romanian forestry sector is facing are as follows:

- A poor accessibility of woodlands.
- Low investment level needed to develop the sector. Privatization is regarded as the best solution, but the sector is still not attractive enough, as it is supposed to be reformed with an important proportion of forest area being returned to private owners.
- Serious drawbacks within research and technological development.
- Extremely poor collaboration, technological

[6] The main cause is the lack of official papers proving the property rights of owners more than 50 years ago. The second cause is the political initiative to accept witnesses in validating the property rights. Unavoidable overlaps between hypothetical properties create difficulties in handling the problem.

blockage with respect to other countries having an important advantage in forestry, logging and wood processing.

- Slow implementation of market-based relationships in the forest sector. This process was commenced five years ago, but there is room for improvement in this area.
- Liberalization of stumpage price. This important step was carried out in 1992, but the average floor price was controlled by the Ministry of Finance for a long period of time.
- Timber trade liberalization. This important decision was adopted too late, as the European market has already been filled by Ukrainian sawn timber, and ecological labeling has invoked more and more control over the timber trade . Romania should catch up with these new directions in forestry regulations.
- Reorganization of the National Forest Administration. A more important role will be assigned to the Forestry Department, which will be deeply involved in following up forest policy at the local level. Mainly, a decentralization process has been started, and about 10 regional control bodies will share responsibility with the headquarters located in Bucharest.

The Slovak Republic

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1 The Country

1.1 Geography and climate

Slovakia is the geographical centre of Europe. Its borders from West to East lie between 16°50´ - 22°34´ longitude and from North to South between 49°37´ - 47°44´ latitude. It borders the Czech Republic in the West (261.3 km), Austria in the Southwest (115.3 km), Hungary in the South (630.9 km), the Ukraine in the East (95.8 km), and Poland in the North (508.2 km). When considering its area (49,036 sq. km), Slovakia is not among the largest of European countries (about 25th in Europe). Its territory belongs to the Alpine-Himalayan system, of which the Carpathians (Western and Eastern Carpathians) are a part of. The southern parts of Slovakia are formed by lowlands (the Western and Eastern Pannonian Basin). About 60 % of the territory lies more than 300 m above sea level and, according to relief types, about 57 % of the area belongs to the highlands and mountains (Table 1).

The highest point is 2,654 m above sea level (the Gerlach peak in the High Tatras) and the lowest point is 94 m above sea level The longest river is the Danube, which also borders on Austria and Hungary and flows along with its tributaries into the Black Sea. The total length of registered water courses (the river network) is 49 775 km (average density 1.015 m per sq. km).

According to the global climatological classification, Slovakia is categorised in the mild climate zone. A regular rotation of four seasons and variable weather with continental features throughout the year is typical for this country. The average January temperature ranges from -1° C in the Danube lowlands to -12° C on the top of the Tatra Mountains. Average temperatures in July exceed 20° C in the Slovak lowlands, while at the elevations of 1,000 m above sea level they reach about 14° C. Average annual precipitation for the whole territory of Slovakia is 743 mm of which 65 % is evaporated and 35 % runoff. The lowest precipitation means (550 mm annually) are observed in the Danube lowlands, while in the highest elevations of the Carpathians it usually exceeds 1,500 mm (Slovak Hydrometeorological Institute, 1997). Snow cover is not stable and there is not a permanent snow cover in the lower altitudes during the winters.

The typical moderate zone for Slovakia is fauna and flora, which results in a large number of species. At present, More than 11 270 plant species and more than 26 700 animal species have been described in Slovakia but estimates are much higher (Zuskin 1998). Many species exist here as endemics, and glacial relicts can also be found. Increasing numbers of endangered species recently became a serious problem in Slovakia. The largest area with Common yew (*Taxus baccata L.*) in Europe is lo-

Table 1. Share of altitude level and relief types in Slovakia (Lazistan 1997)

Altitude levels	**m**	**km²**	**% of Slovakia**
Lowlands	97-300 m a.s.l	20.045	40
Low highlands	300-750 m a.s.l	22.089	45
Middle highlands	750-1500 m a.s.l	6.350	14
Mountains	1500-2655 m a.s.l	552	1
Types of relief (altitude difference)			
Plains	0-30 m	10.984	22.4
Hills	31-150 m	9.022	18.4
Highlands	151-300 m	18.584	37.9
Mountains	301-600 m	9.611	19.6
Alpine mountains	601 m and above	834	1.7

Note: a.s.l. = above sea level.

cated in Slovakia (Protected Landscape Area Velká Fatra - an area of 860 hectares with approximately 160 000 specimens).

1.2 Society

Slovakia (census 1994) has a population of 5 356 207 inhabitants (takes about 20th place among the 41 contemporary European states). The current average population density is 109 inhabitants per sq. km. The largest city is Bratislava (450 770 inhabitants), which is also the capital of Slovakia and is located in the Southwest of the country, close to the Austrian and Hungarian borders. The average life expectancy of men (68.3 years) is 5 - 6 years less and of women (75.5 years) 3 - 4 years less than that in developed countries (Lazistan 1997). Additional significant statistics concerning the population are as follows:

- Age structure: 22.9 % of the population is between 0 - 14 years old; 59.6 % is between 15 - 59 years old (men) and 15-54 years old (women); 17.46 % is more than 60 years old (men) and more than 54 years old (women).
- Nationalities (1993): Slovaks 85.7 %; Magyars 10.6 %; Czechs 1.0 %; Ruthenians and Ukrainians 0.6 %.
- Religions: Roman Catholics 60.4 %; Evangelists 6.2 %; Greek Catholics 3.4 %; Calvinists 1.6 %; Orthodox 0.7 %; Agnostics 9.8 %; not determined 17.4 %.

The industrial sector is the core of the Slovakian economy. Chemical and rubber industries represented 11.5 % of the gross domestic product (GDP) in 1994; mechanical industry 6.4 %; food production 15.0 %; metallurgy 16.5 %; energy 12.9 %; and oil-refining 7.7 %. More than 40 types of minerals are mined and, from the international point of view, the most important is the mining and processing of magnesite.

The number of economically active persons employed in 1994 was 2 176 900: 677 200 in industry; 188 300 in construction; 214 500 in trade; and 168 800 in transport. The structure of foreign trade in 1994 was as follows: intermediate manufactured products (39.4 %); machinery and transport equipment (19.0 %); and miscellaneous manufactured articles (13.4 %) were the main export commodities. Machinery and transport equipment (27.7 %); fuels and related products (19.3 %); intermediate manufactured products (16.8 %); and chemicals and related products (13.2 %) were a decisive part of the volume of imports.

Slovakia is extremely dependent on imported energy (85 - 89 % of primary energy). The production of electricity does not fully cover consumption needs. About 5 - 10 % of annual consumption is imported from surrounding countries. The Slovak Republic is a parliamentary democracy. It became an independent state on January 1, 1993 as a result of the division of the former Czech and Slovak Federal Republic into two independent states. The President of the

Slovak Republic is the Head of State and the parliament is the supreme organ of state power and the legislative authority. Slovakia has a plural political system. The Slovak Parliament (National Council of the Slovak Republic) was represented by six political parties in 1999. The Government of the Slovak Republic is directed by the Prime Minister. From an administrative point of view, Slovakia is subdivided into 8 regions, 79 districts and 2,904 communities (1995). The head of the state forest authorities in Slovakia is found in the Ministry of Agriculture, Forestry section with Departments of State Administration Land, Agriculture and Forestry at county and district levels.

After 1989, the economic reform (transition period) was initiated in Slovakia. Such aspects as ownership structure changes, restitution, liberalisation of trade, a free market, taxation reform, related changes in legislation, etc. are typical for this period.

2 Forest resources and their utilisation

According to the official definition in Slovakia, forest includes forest stands together with their environment and other areas designated for the fulfilment of forest functions. Forest stands include tree and shrub species which, in their environment, fulfil forest functions. There are no area, age or stocking level limits. If the definition of TBFRA – 2000 (UN-ECE/FAO) is applied, the total forest area of the country would apparently be higher. The reason for this is that only forest stands situated on forest land (according to the cadastral records) are considered as a forest, but there are also large areas of abandoned land that have been naturally and fully converted into forests which are still formally considered as agricultural land.

Forestry is the economical activity aimed at the management of forests. It includes silviculture, forest protection, forest infrastructure and construction, logging, hauling, pre-processing of saw-logs and services.

2.1 Forest history

Forestry in Slovakia, which developed simultaneously with the mining industry, has a rich past and tradition. The basic forms of original production, and thus also the first theoretical knowledge in forestry, originated in Slovakia (a separately defined unit) in the great area of woods that was owned by the Hungarian ruler in the 11th century. In the period of this primary state, the rulers were interested especially in hunting and fishing. The beginning of forestry dates back to 1426, when the ruler Sigmund issued an order for using the forests for mining purposes. These measures established a system to utilise woods and clearings and to protect wood to ensure a permanent profit.

The Forest Order of Banská Bystrica, issued on May 15, 1565 by Maximilian II, was revolutionary in the development of the utilisation of the Slovakian woods. This order comprised all knowledge of forestry regarding the cutting and floating of wood. Wood cutting, and later on forestry, was an area of human activities that became the basis for successful enterprising in mining and metallurgy. The wood was used intensively, and, moreover, the woods were exploited and partially renewed by planting. Their composition, regarding species which we can observe today, is not an original one due to the modified, industrialised territory. The fact that mining not only meant a source of income but also scientific and technical development, that is of progress in general, manifested itself in the development of forestry and the science involved with it.

In the 16th and 17th centuries, after long lasting civil wars in Europe, the forests in the territory of Slovakia were exposed to high exploitation felling, due to the restoration of the economy and the development of industry. The empress Maria Theresa gradually issued forest regulations for all countries of the Hapsburg Monarchy. These regulations determined logging methods, forest regeneration and expansion methods, as well as their management by skilled employees. The Forest Order for Hungarian lands issued in 1769 prompted the planting of wood species in the free areas near villages and towns. It also ensured creativity in the forest economy and led to the beginning of forestry as an academic subject at the Academy of Mining in Banská Štiavnica in 1770, where the Forestry Institute was established in 1807. It is quite possible to consider this as the beginning of university education in forestry, not only in Slovakia but also in the world. The first professor at the institute, Dr. Henrich David Wilkens (1763 - 1832), gave most of the lectures on natural history and forestry.

Social changes after 1989 influenced the whole national economy and started a so called ”transition period”. During this period, changes in forestry typically occurred in forest ownership structure, forest management, and forest legislation, as well as in forest policy as a whole. New legal regulations and ideas have been refined, taking world and European trends and the conclusions of the most important negotiations in the area of forestry into consideration. All these new aspects of Slovakian forestry are discussed in detail in the following chapters.

2.2 Forest ownership

99.5 % of the forests were state owned between 1960 and 1991. After 1991, the forest ownership structure was substantially changed. Restitution of ownership started in 1991. Between 1994 and 1997, major parts of forests were restituted to their original owners. The current ownership structure (Figure1) is close to that which was expected. Approximately 40 % (794 500 ha) of the forest area is owned by non-state bodies and private persons. The remaining area to be restituted represents 8 %. Approximately 9 % of non-state forests remains unclaimed, with unknown owners, or is not reclaimable according to the valid legislation. The expected forest ownership structure after complete restitution and re-privatisation (Green Report, 1997) is as follows: state owned 43.2 %; municipal (cities, towns, villages) 10 %; churches 5.3 %; shared ownership (communities) 22 %; private estates 10 %; other cases or non-reclaimable 9.5 %.

Medium sized estates with an average of 100 - 700 hectares are the norm for non-state forests. A considerable portion (approximately 22 %) of the entire forest area is defined as a shared ownership. Small holdings with an average of 3 hectares and owned by more than 30 000 people cover 5.2 % of the forest land.

The approximate fragmentation in 1997 in the private sector (because all forests had not yet been restituted) according to size classes was as follows:
(0.1 - 10 ha) = 24.1 %
(51 - 100 ha) = 6.7 %
(11 - 50 ha) = 12.8 %
(> 100 ha) = 56.8 %
Restitution of ownership has resulted in a large variety of ownership types and an increased number of owners and users. The management plans are elaborated for units designed with respect to ownership and management. Their size

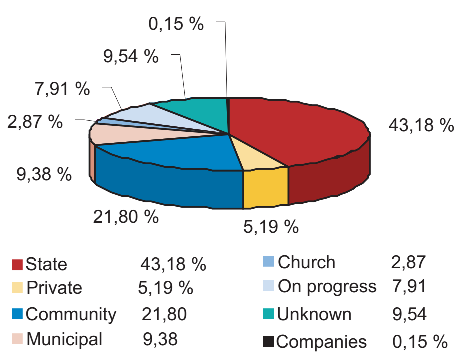

Figure 1. Forest ownership structure (Scheer, Longauer 1998)

varies between 50 and 8,000 hectares, with an average of 1,200 ha. Earlier, the management planning was done for areas of 10 000 ha on average.

Forest infrastructures (buildings, roads, special constructions) were restituted or sold separately. The ownership of forest infrastructures was relocated free of charge or for a minimum price. However, there are still many unsolved (unsolvable) cases and disputable questions, mainly concerning forestry buildings.

2.3 Land use and forest resources

2.3.1 Global view of land use

The global view of land use in Slovakia is shown in Figure 2. A major part of forested land is situated in Central and North Slovakia. There are only a few scattered forests in the South of the country.

2.3.2 Extent and distribution of the forests

The country lies in the western part of the Carpathian Mountain Ridge. About 65 % of the territory and dominant part of forested land has a mountainous character. The area of forests in Slovakia is 19 924 km^2 which equals 41 % of the country's total territory (49 025 km^2). Slovakia is thus one of the countries with the highest percentage of forests in Europe (Finland 77 %, Sweden 69 %, Austria 46 %). The area of forest per capita in Slovakia is 0.37 ha (the largest area is in Finland with 4.68 ha per capita). The distribution of forests has been increasing and will continue to increase in the long term. In the next few years, the category of forest land will be extended even more, due to natural conversion or re-afforestation of abandoned agricultural lands.

Semi-natural forests originating from natural regeneration represent 40 - 45 % of the total forest area and differ only slightly from the natural ones in terms of species composition. More than 70 fragments of natural and virgin forests with a total area of 18 000 - 20 000 ha still exist in Slovakia (Korpel 1993). This is a rather exceptional figure for European countries west of Russia.

The share of high forests and coppice is demonstrated in Table 2 together with estimated trends for the past 50 years and the transition period.

Many serious problems in Slovakia's forestry are associated with the mountainous topography. Mountain forests in elevations over 700 m represent 33 % (641 000 ha) of the total forest area. These forests are apparently affected by the trans-boundary air pollution, which is com-

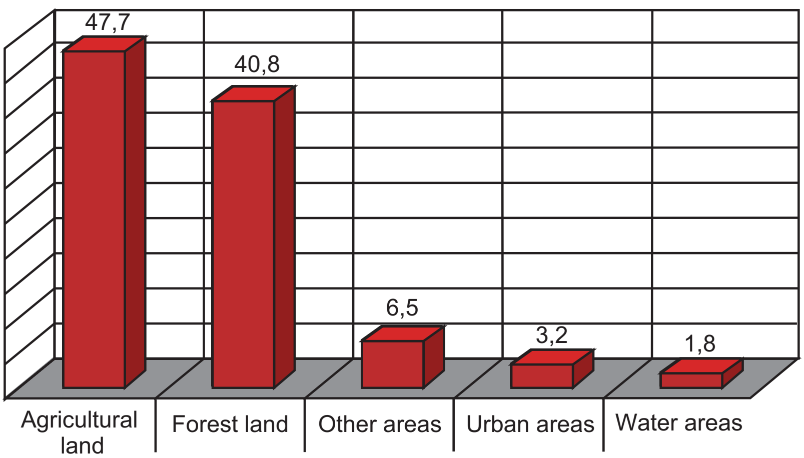

Figure 2. Land use resources (Scheer, Longauer 1998)

prised of surprisingly high amounts of heavy metal depositions. 35 % of forests are on slopes steeper than 18°, which makes them unsuitable for conventional logging technologies. Although large sections of these forests have been categorised as protective forests, even their minimum necessary sanitation requires extra management costs. Also, due to the insufficient and dense network of forest roads in the mountainous areas, the wedge (strip) system and small area clear-cutting (with a maximum width equal to twice the stand height) are more suitable than the shelterwood and selection systems.

Eight forest vegetation zones are recognized in Slovakia (table 3) according to the phytocenological classification of Zlatník (1959). General ecological characteristics of the vegetation zones are, for example, available in Paule (1995). According to the management criteria and geomorphology, 47 forest regions have recently been delineated.

2.3.3 Tree species: origin and distribution

Distribution of tree species in forests is connected relatively closely to the territory's macro-relief. In the lowlands and hill territories of South and East Slovakia, broad-leaved species are typical; in the mountains of Middle and North Slovakia, mixed forests prevail and coniferous species are dominate.

The percentage of forests with respect to dominant species is as follows: coniferous 30.8 %; broad-leaved 47.6 %; mixed forests 21.6 %.

Actual species composition (1996) and hypothetical original composition are given in Table 4.

Of course, the original composition of tree species has been changed by many years of management. The proportion of spruce (*Picea abies* L.,) and pine (*Pinus silvestris* L.,) increased substantially; the distribution of fir (*Abies alba* Mill.,), beech (*Fagus silvatica* L.,), and also of oak (*Quercus robur* L.,) has been largely reduced. The trend of development in recent decades has been illustrated very well by a comparison of the composition of tree species in origin and in 1920 to present (figure 3). It is characterised by an increase in spruce (*Picea abies* L.,) and a strong reduction in fir (*Abies alba* Mill.,), which had been our most productive tree species until recently.

Much attention has been paid to the determination of a desirable (target) composition of tree species in Slovakia's forests. The policy of the target composition of tree species is based on the basic principles of forest management - on the principle of maximal, permanent, safe and effective performance of forest functions for the public interest and for production decisions. It fully takes into account the decisions and principles by which the above principles of forest management are carried out.

From an ecological point of view, the following principles will be applied to the target composition of tree species in Slovakia:
- biodiversity protection, i.e. the principle of cultivating stands with mixed species;
- cultivation of tree species suitable to forest sites;
- alleviation of pollution deposition impact and the impact of other harmful factors by using more resistant tree species;
- elimination of one sided utilisation of the sites by altering the proportion of highly produc-

Table 2. High forests and coppice in Slovakia (TBFRA – 2000, National Questionnaire)

Category	**Unit**	**1996**	**Estimated trend for the past 50 years**	**Transition period 1990 - 1997**
Total Area of High forests	1,000 ha	1924.4	Gradual decrease of coppices through restoration of a high forest	Unchanged (Lack of money for restoration of high forests)
Total Area of Coppice and Coppice with Standards	1,000 ha	63.5		

Table 3. Vegetation zones and their area in Slovakia (TBFRA – 2000, National Questionnaire)

Vegetation zone	**Area (1,000 ha)**	**1996 (%)**
1 Oak woods and riverain forests including subcontinental thermophillous oakwoods (sub-Pannonian sector), Pannonian oak woods with hornbeam(Danubian sector), thermphillous and xerophillous oak woods, and edaphic enclaves of Scots pine on sands	167.049	8.39
2 Mixed oak forests with beech on brown soils and loess	306.365	15.39
3 Submountain mixed beech forests with oak	460.680	23.15
4 Beech woods	387.050	19.45
5 Mixed beech woods with fir, acidophillous and mesotrophic	414.314	20.82
6 Mixed beech-fir forests with spruce	193.227	9.71
7 Mountain spruce forests	41.381	2.08
8 Stretches of mountain dwarf pine	20.003	1.01

tive tree species by adding biological tree species to preserve permanently feasible development;

The following principles are applied from the point of view of economy:
- where the composition of tree species is suitable for the site, the proportion of commercial tree species is increased (spruce (*Picea abies* L.,), larch (*Larix decidua* Mill.), oak (*Quercus robur* L.,) and valuable broad-leaved species);
- silviculture is aimed at increasing the quality of tree species and increasing stem dimensions (in the south of Europe, broad-leaved species have been devastated and the north of Europe offers small-dimensioned coniferous species);
- wood production is orientated towards the utilisation of wood for its unique properties, i.e. it is oriented towards mechanical (and only to a smaller extent to chemical) wood treatment.

Today, the aim is to preserve fir (*Abies alba* Mill.,) on convenient sites, to increase the share of larch (*Larix decidua* Mill.,) and of valuable broad-leaved species, and to increase resistance to the impact of pollution.

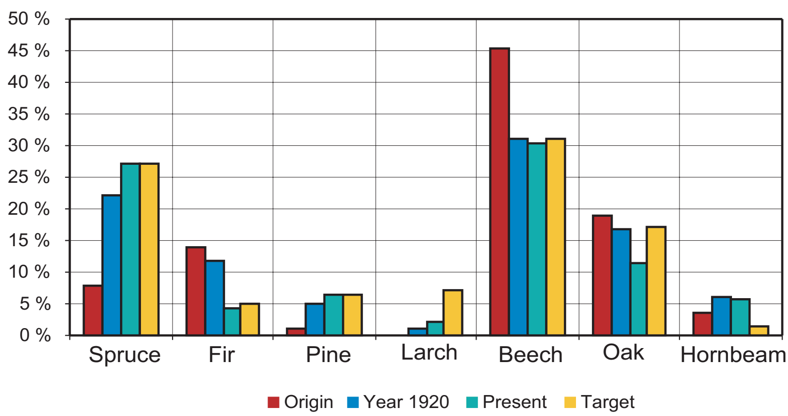

Figure 3. Development of main species composition in Slovakia (Novotny)

Table 4. Tree species structure in Slovakia (TBFRA – 2000, National Questionnaire)

Genus	Species	Composition Actual	Composition Original
Native (indigenous) tree species appearing on forest and other wooded land			
Picea abies (L.) KARST.		27.18 %	7.7 %
Abies alba MILL.		4.43 %	14.1 %
Pinus	*P.sylvestris L.* 6.26 %		0.9 %
	P. mugo TURRA 1.06 %		-
	P.cembra L.	0.02 %	0.08 %
Larix decidua MILL.		2.12 %	0.1 %
Quercus	*Q.robur* L. *Q.petraea* (MATTUSCH.) LIEB.	11.39 %	19.1 %
	Q.cerrsis L.	2.49 %	2.5 %
	Q.pubescens WILLD., *Q.pedunculiflora* C.KOCH *Q.virgiliana* (TEN.) TEN.	0.03 %	-
Fagus sylvatica L.		30.27 %	45.2 %
Carpinus betulus L.		5.65 %	3.7 %
Acer	*A.pseudoplatanus* L., *A.platanoides* L., *A.campestre* L.	1.68 %	1.9 %
Fraxinus	*F.excelsior* L., *F.angustifolia* VAHL.	1.20 %	0.3 %
Ulmus	*U.glabra* HUDS., *U.minor* MILL., *U.laevis* PALL	0.08 %	1.1 %
Betula	*B.pendula* ROTH., *B.pubescens* EHRH.	1.32 %	0.1 %
Alnus	*A.glutinosa* (L.) GAERTN., *A.incana* (L.) MOENCH *A.viridis* (CHAIX) DC.	0.65 %	0.3 %
Tilia	*T.cordata* MILL., *T.platyphyllos* SCOP	0.34 %	0.3 %
Indigenous Poplars Populus	*P.nigra* L., *P.alba* L., *P.x. canescens* (AIT.) J.E.SM.	0.13%	
Populus tremula L.		0.26 %	
Salix	*S.caprea* L., *S.alba* L., *S.fragilis* L.	0.11 %	2.2 %
Sorbus	*S.aucuparia* L., *S.torminalis* (L.) CRANTZ, *S.aria* (L.) CRANTZ	0.15 %	
Other broad-leaved	Wild fruit tree species, other trees and shrubs	0.03 %	
Introduced tree species on forest and other wooded land			
Robinia pseudoacacia L.		1.79 %	-
Populus x euroamericana		0.61 %	-
Pinus nigra ARNOLD		0.52 %	-
Other conifers	*Pseudotruga menziesii* (MIRBEL) FRANCO *Abies grandis* (DOUGL.ex D.DON) LINDL. *Pinus strobus* L.	0.08 %	-
Other broad-leaved	*Quercus rubra* L., *Castanea sativa* MILL., *Aesculus hippocastum* L., *Negundo aceroides* MOENCH	0.15 %	

2.3.4 Growing stock, growth and felling

During the last 40 years, the total growing stock in Slovakia increased almost twofold. Since 1994, it has increased by 5.2 % and presently (1997) represents approximately 250 m^3 per hectare. Detailed information about the growing stock and growth (increment) is given in table 5.

This volume of the growing stock concerns the living trees, the growing stock of dead trees in Slovakia is approximately 638 000 m^3 o.b. The difference between gross and net annual increment represents natural losses, i.e. natural decrease of trees and other incidental fellings.

Actual and objective felling possibilities are illustrated by an allowable cut. It is set according to the forest categories, tree species compo-

Table 5. Growing stock and increment in forests of Slovakia (TBFRA – 2000, National Questionnaire)

Data	Unit	1997	Estimated trend for past 50 years	Transition period 1990-1997
Total volume of the growing stock	10^6 m^3 (o.b.)	510.948	Gradually increasing	Gradually increasing
- conifers		240.798		
- broad-leaves		270.150		
Mean volume of the growing stock per hectare of forest land	m^3 ha^{-1} (o.b.)	253.5	Gradually increasing	Gradually increasing
Gross annual increment	10^6 m^3 (o.b.)	15.929	Gradually increasing	Stable
Net annual increment		13.859		

sition, rotation, etc. The annual allowable cut slightly decreased in the period between 1980 - 1993 and slightly increased later in the period between 1994 - 1997. Total annual timber felling was higher by more than 10 % compared to the allowable cut (excluding the years 1991 - 1993). When the rates of felling are separated according to the groups of species, we can say that in coniferous stands actual logging was higher by about 10 - 70 %, excluding the years 1991 and 1992. The main reason for this was over logging, which increase in 1996 and was a result of incidental felling. Their share in total logging represented almost 80 % in the last four years. On the contrary, the logging of broadleaf species between 1990 - 1997 was lower than the allowable cut and reached only about 70 - 90 % of the allowable cut. The amount and structure of fellings and removals in 1996 are given in table 6.

The contribution of individual harmful factors to the felling of losses (average 1990 - 1996) is, according to the annual Green Reports on Forests and Forest management 1992 - 1997, as follows:

Insect pests 21.0 %
Fungal diseases 5.5 %
Windstorms 41.5 %
Snow, rime, others 15.5 %
Fire 10.0 % (due to extraordinarily fire in the Zahorie region in 1996)
Air pollution 6.0 %
Illegal cutting 0.5-1.0 %

2.3.5 Forest threats

Negative changes in environmental conditions of forest ecosystems are a result of the long-term impact of anthropogenic factors (mainly air pollution) and of the synergetic impact of natural negative factors. Declining and dying forests are characterised by symptoms of diseases, reduced resistance expressed in insufficient increment, defoliation, susceptibility to unfavourable natural stresses (wind, snow, rime), inclination to damage by insect and fungi, and finally by die back. A review of serious damages caused by biotic and abiotic agents is given in table 7.

Interaction of a large spectrum of unfavourable factors mainly caused the present character of forest decline. The most unfavourable ones are anthropogenic factors and weather anomalies. Emissions and air pollution cause excessive

Table 6. Felling and removals in 1996 (TBFRA – 2000, National Questionnaire)

Category	Total Annual felling	Total annual removals		Intermediate felling	Felling of losses
	(million m^3 o.b.)	(million m^3 o.b.)	(million m^3 u.b.)	(million m^3 o.b.)	(million m^3 o.b.)
Forest total	7.387	5.618	5.107	2.013	4.144 *
Coniferous	4.462	3.523	3.023	1.256	3.322 *
Broad-leaved	2.925	2.095	1.904	0.756	0.822 *

* Does not correspond with the removals of the felling of losses!

Table 7. Damages caused by biotic and abiotic factors in Slovakia (Green Report 1997)

Category	**Unit**	**Year 1996**	**Estimated trend for past 50 years**	**Transition period 1990-1997**
Damage by insects	1,000 ha year^{-1}	20.838	Gradual Increase	Increase
	1,000 m^3 year^{-1}	782.587		
Burnt forest area	1,000 ha year^{-1}	0.238		
Volume harvested from burnt areas	1,000 m^3 year^{-1}	13.464		
Area seriously damaged by storms	1,000 ha year^{-1}	0.381	Fluctuations	Increase
Volume harvested from these areas	1,000 m^3 year^{-1}	1,996.617		
	1,000 ha year^{-1}	1.453	Gradual Increase	Increase
	1,000 m^3 year^{-1}	745.347		
	1,000 ha year^{-1}	12.190	Stable	Slight decrease
Total area of regeneration per year	1,000 ha year^{-1}	1.106		
Area seriously damaged by game	1,000 ha year^{-1}	0.012		
Area seriously damaged by grazing (domestic animals)	1,000 ha year^{-1}	181.286	Increase	Increase
Area of forests primarily damaged by air pollution	1,000 m^3 year^{-1}	382.864		
Other anthropogenic damage	1,000 ha year^{-1}	<0.035	No estimates	Unchanged
- recreation leisure activities	1,000 ha year^{-1}	0.422	Fluctuations	Stable
- fungal diseases	1,000 m^3 year^{-1}	164.241	Gradual Increase	Stable
Loss of seedlings in the nurseries	1,000 seedlings	20.500	Fluctuations	Fluctuations

defoliation and, consequently, a reduction in increment, deterioration of the overall health condition of the forest and eventually their total destruction, in some cases.

This phenomenon of forest decline has been globally observed and has been monitored in Slovakia according to the rules of the International Monitoring System since 1991 (net of monitoring plots 16x16 km).

The results of direct measurements of SO_2 and NO_x concentrations in relation to the forests, which could characterise the intensity of air pollution, are not available. In 1995, the emission sources in Slovakia totally emitted 236.4 thousand tons of sulphur dioxide, 180.9 thousand tons of nitrogen oxides, 403.9 tons of carbon monoxide and 89 thousand tons of solid particles including heavy metals. Between 1970 and 1985, the total emission of pollutants in Slovakia increased by approximately 25 % (Green Report 1997). After 1985, the level of emissions was almost stable. Recently, a depression of the Slovakian economy and the high price of fuel have influenced the unfavourable trend and contributed to a decrease in emissions of air pollutants. More than 50 % of SO_2 emissions in Slovakia are transmitted long distances across borders. The long-term trend of SO_2 development in Slovakia can be characterised as decreasing, however, the air pollutants from sources outside of the Slovakian territory represent up to 70 % (in the case of sulphur), and they play the most important role in the pollution of the environment in the Slovak Republic.

Poor forest health conditions are also caused by abiotic, primarily climatic, factors (prolonged drought, wind, snow, ice, frost, etc.). The average percentage of influence these factors have on the total annual cuts is 20 - 30 % and as much as 60 % in extreme years.

The most notable negative biotic factors are animals (forest vertebrates and insects), as well as negative plant factors (fungi and undesirable vegetation). Wildlife causes (mainly by repeated browsing of shoots) an average annual forestation loss of approximately 32 % from artificial regeneration made and, in many cases, is a limiting factor of tree species composition. Fir (*Abies alba Mill*.,), yew (*Taxus baccata* L.,), maple (*Acer pseudoplatanus* L.,), and ash (*Fraxinus excelsior* L.,) are usually damaged the most.

Prevention plays a very important role in respect to forest threats and damages. Environmentally, friendly prevention methods are the most effective protective measures capable of improving the health and resistance of forests (e.g. genetically appropriate afforestation material, species composition respecting the site conditions, sound tending improving ecological stability). Successive recovery measures combining mechanical, chemical, biological and other methods solve only acute problems. However, there are not sufficient funds in the Slovakian forestry sector for the projects promoting preventive and recovery measures.

2.4 Silviculture

Due to the long-term positive impact of professional schools and of intensive research, forest silviculture has a rich tradition in Slovakia. Nevertheless, its long history was not able to prevent many remarkable changes in the character and extent of various policies applied to it (Novotny 1997).

The volume and quality of wood mass produced, as well as the degree to which it performs various functions of public interest, depends on the forest's structure. It mainly depends on the share of tree species and space distribution of the trees in the stand that is projected for "commercial or functional types of forest". According to the agreed policy of target structure, silvicultural methods and procedures are defined as tools for forest formation and its deliberate aims. The policy takes into account the different environmental conditions and the different functional orientations of forests in Slovakia for deciding on stand structure, differing silvicultural phytotechnology, the application of methods of stand regeneration and tending.

The convenience of silvicultural methods applied (primarily of regeneration methods) is confirmed by the observation that the real share of tree species of commercial and environmental importance does not differ remarkably from the desirable share.

The 50s and 60s were a period of biologisation of all forest management in Slovakia. Most notable was the remarkable intensification of silvicultural activities in connection with the natural forest as an integrated ecosystem. Today, the ecologisation of silvicultural activities is preferred: stricter application of more natural silvicultural methods, with an emphasis on mixed stands suited to the site, an increased portion of natural regeneration, more extensive application of a selected commercial method particularly in protected forests and in special-purpose forests.

Concerning silvicultural systems, the shelterwood system is a dominant one for commercial forests and is applied according to natural conditions. The clear-felling system can only be applied under the conditions given in legislative regulations. In the future, the shelterwood system will be applied, based on the natural conditions, on an area of about 68 % of the total forest area in Slovakia; the selection system on 12 %; and the clear-cutting system on 20 %. However, the small size clear-cutting system is still the standard at present. In addition, accidental felling represents 65 % of the total annual cut. Consequently, the annual share of natural regeneration of the annually regenerated forest area has been 15 - 25 % in the last two decades (the proportion of natural regeneration at the end of the 19th century was approximately 50 % of the regenerated area).

2.5 Forest production

2.5.1 Harvesting systems and timber uses

The harvesting system includes used machinery and technology. Cutting and delimbing of the trees is carried out by using powersaws. Trees are delimbed mainly where felled, timber is dragged to the roadside by whole-stem logging. As much as 93 % of the timber is hauled by tractors (special forest haulers), 3 % of the cut wood is hauled by cableways and about 4 % by horses (Novotny 1997). Assortments are produced from stems mainly using powersaws in forest depots. About 24 % of the assortments are produced in central conversion landings equipped by mechanisation, or directly in customers mechanised depots - approximately 3 % of the volume of wood cut. In recent years, wood chipping technology with movable chippers has been introduced, with the production of chips from crown parts of the trees in the yards. In addition, tools for timber transport are adjusted to the method and place of assortment production. Assortments are transported by hauling rigs with a carrying capacity of 12 metric tons, which are equipped with hydraulic booms. Lorries with a carrying capacity of 27 metric tons are used for stem transportation. High capacity extensions and containers with a volume of 25 m^3 are used to transport chips.

The intensity of forest accessibility results from technical/operational and public/beneficial needs. At present, timber logging is carried out during the whole year and therefore roads with reinforced roadway, enabling timber transport for the whole year, are required. Today, 10.5 m/ha of hauling roads have been built. 4.7 m/ha of these are paved roads which are used the whole year round and 5.8 m/ha are seasonal roads, which are good for lorries. The amount of haulage roads and lines is 30 - 50 m/ha.

The domestic wood processing industry utilises approximately 97 % of the wood cut. The rest represents the export of assortments. The share of wood consumption for the individual branches of the wood processing industry is a result of tree species composition and qualitative (assortment) structure of the wood cut. Approximately 2.5 % of the softwood and approximately 6.5 % of the hardwood cut is used for production of veneers, plywood, matches and other special wood products. About 69 % of the softwood and approximately 36 % of the hardwood cut is used in the lumber industry. 23 % of the softwood and approximately 48 % of the hardwood cut is used for cellulose, chipboard and fibreboard production (Green Report, 1997). Approximately 5 % of the softwood and approximately 9 % of the hardwood cut is used for energy purposes. For instance, about 400 000 tons of fuel wood and 2,000 tons of chips and sawdust are currently being utilised in Slovakia for energy. Annual consumption of timber for energy production in forestry is 12 000 tons. This may increase to 115 000 tons annually in the future, due to the replacement of fossil fuels and purchased heat.

2.5.2 Non-timber forest products

Wood is by far the most important forest product, but some other notable products for human consumption include food, beverages, medical plants and extracts (e.g., fruits, berries, nuts, honey, game meat, mushrooms, etc.). Fruits, berries, and mushrooms are of some economical importance for rural populations, mostly at the local level. At the regional levels, they represent more a traditional part of the recreation and leisure activities than an economic interest. To some extent, hunting and sales of venison have a different position. They represent a regular supplementary income for hunter's associations (total number of registered hunters is approximately 40 000 in Slovakia) and also for state owned forest companies.

The main non-wood forest products in Slovakia are given in Table 8. Products which are produced on forest land were taken into consideration, including those to be marketed or for private consumption. The following products of forest fruits are concerned: sloes, mushrooms, rose hips, raspberries, blackberries, blueberries, rowan, elderberries, juniper berries, cranberries and hazelnuts.

2.5.3 Forest functions

Forests have a large scale of functions within the natural environment of Slovakia. Each forest stand has more than one function, but one or even several may be emphasised more according to the needs of society. Forests stands are divided into three categories according to their purpose: protection forests, forests with special functions and commercial forests. The categories are divided into sub-categories according to a particular dominant function and they are managed differentially in order to fulfil the dominant functions as efficiently as possible. The individual categories in 1996 were as follows: commercial forests 66.4 %; special purpose forests 17.5 %; and protection forests 14.8 %. The share of individual sub-categories in protection forests and forests with special functions is given in Table 9.

Increasing the importance of public beneficial functions (ecological and environmental functions) of forests will be a result of the conception of sustainable forest management in Slovakia. The main interest is particularly the preservation of original ecosystems by extending the network of protected territories. This network is comprised of 5 biosphere reserves with an area of 218 000 hectares, representing 16.4 % of the total protected territory in Slovakia.

3 Forest economics

3.1 Forest and forest industries in the national economy and employment

In 1996, forestry products represented 1.4 % of the gross domestic product (GDP) in the Slovak Republic. This does not include the public benefits of forests which are estimated to be at least three times higher than the value of wood production functions. In addition, the wood processing industries (primary wood processing, furniture industry and other mechanical processing, pulp industries and other chemical processing of wood) represent 7.4 % of the GDP in Slovakia.

The proportion of investments in forestry and total investments in the economy of Slovakia is apparently below the required level. The share of forestry was 0.42 % in 1995 and only 0.27 % in 1996. An insufficient reproduction of tangible investment property causes a decrease in the technical level of the forest management. It has an unfavourable impact on the economy of forest enterprises, as well as on the application of a more ecologically oriented management of forests.

The domestic market for wood has changed substantially in the past years. Demand has decreased and the quality requirements seem to be surpassing the surplus in prices. Interest in the top quality assortments of pine and cottonwood timber has been low. This development especially influences the liquidity of larger holdings which manage broad-leaved forests.

Table 8. Non-wood forest products in Slovakia (yearly averages) (TBFRA – 2000, National Questionnaire)

Commodity (tons)	**Volume M ECU**	**Value**	**Notes**
Forest fruits, berries and mushrooms (V+PS)	2541.0	2.24	Number of commodities decreases, volume increases, price SKK/kg decreases
Venison (V+PS+D)	834.0	1.42	Demand and price decrease
Medicinal plants (from forest) (V+PS)	178.4	0.19	Number of species has decreased (by 55 %) in the transition period, demand for cultivated species is stable or increasing
Honey (V+PS)	2747.8	3.97	Volume decreases, purchasing prices increase

Note: V = export, PS = industrially processed in SR, D = domestic consumption.

Table 9. Forests managed primarily for protective and special functions (by sub-categories) (Green Report, 1997)

Sub-categories	Unit	1996	Estimated trend for the past 50 years	Transition period 1990-1997
Total area of forests managed primarily for protective functions, sub-categories:	1000 ha	284.742	Gradual	Gradual
a) Forests in unfavourable sites	1000 ha	137.865*	Increase in all	Increase in all
b) Alpine forests		48.210*	sub-categories	sub-categories
c) Stretches of mountain pine		18.807*		
d) Soil protecting forests		63.775*		
Total area of forests managed primarily for other special functions, sub-categories:	1000 ha	336.641	Gradual	Gradual
a) Forests at water resources and reservoirs	1000 ha	22.297*	Increase,	Increase,
b) Forests surrounding springs of mineral water		4.892*	especially in	especially in
c) Park and urban forests		32.259*	sub-category f	sub-category f
d) Game preserves and pheasantries		24.187*		
e) Nature reserves and national parks		24.389*		
f) Forests damaged by air pollution		121.623*		
g) Research and education forests		5.125*		
h) Forests of special interest		55.520*		
z) Forest (formerly agricultural) land for afforestation		25.191		

* Refers to December 31, 1994 (sums of sub-categories are not equal to the actual area of the categories)

In order to support domestic wood processing, the wood exports were relatively strictly regulated until 1996. Due to a largely fluctuating but closed domestic market, the unfavourable economical situation in forestry, and an attempt to revive the cash flow, timber exports to the European Union and the European Association of Free Trade were liberalised in the beginning of 1997. The licences awarded by the Ministry of Economy are only required in a few cases. The share of raw timber exports (pulpwood prevails), including re-exports, has ranged between 10 % and 15 % of total timber sales. The rest of the timber volume was sold on the domestic market.

After the tax reform in 1993, the liabilities of forestry increased considerably and were reconsidered in the subsequent years. Forests managed primarily for protective and special functions as well as young stands are exempt from the real-estate tax. Specific tax procedures have been applied for incomes from timber sales, from forest estates in shared ownerships, and long-term financial reserves for silvicultural operations.

A decrease in the value added tax (VAT) for all wood assortments in accordance with EU standards has been proposed, as well as exempting silvicultural operations from the liability of the new act on VAT. A reduction in taxes on incomes from forest management, especially from small holdings, and an improvement in the legal basis for creating long-term financial reserves for forest management is being planned.

3.2 Employment

The proportion of employees in forestry compared to the total number of employees in the national economy of Slovakia was about 1.37 % (27.9 thousand workers) in 1996. About 7.5 % of them worked in the forest industries (Green Report, 1997). This figure does not include part-time, self-employed forest owners, but their number is estimated to be relatively low. On the other hand, the volume of man-days of small service providers has been increasing. The income level in forestry is below the national average. In 1996, it was 182 ECU and the difference was -15 %. In spite of the growth in nominal and real values in 1997, the relationship to the national average has been approximately the same.

3.3 Profitability

In the long-term, the total revenues from the management of forests in Slovakia have been lower than expenditures, and forest management is unprofitable as a whole. The reasons for the mentioned deficit are the status of forests, costs of public benefit functions which are not marketable, as well as the deteriorated conditions of forests in Slovakia. Therefore, forests require subsidiary support, as the dependence on external financial sources has increased. The total state financial assistance to forestry was 14 mil. ECU in 1996. In 1997 the difference was -2.6 mil. ECU. Due to traditional records, however, 40 % of the money listed as subsidies to forestry represent a financial assistance for restoration projects and remediation activities which do not match with any definition of regular and purpose oriented subsidies. The share from total financial support for different areas of forestry is as follows: primary forest production 60.7 %; secondary forest production (roads, transport) 20.4 %; ecological protection and recreation (includes refunds) 16.6 %; other purposes (management plans, chartered foresters, research) 2.3 %. These ratios are for 1996 but they were almost the same in the previous years.

The situation and development of some profitability indicators in the period 1995 - 1997 is given in Table 10.

The profit rate of forestry in Slovakia decreases and the necessary sources for common management of forests and reproduction of investment property are not being formed.

4 Forest and forest related policies

4.1 Forest and forestry legislation

As in many other countries in Central-Eastern Europe, the legal system in Slovakia was also subjected to changes in the 1990s. There are two basic parliamentary acts which cover the forests and their management:

- Act No. 61/1977 on Forests (Forest Act) amended by Act No. 229/1991 and Act No. 183/1993.
- Act No. 100/1977 on the Management of Forests and State Forest Authority (later amendments promulgated in Act No. 265/1995 and Act No. 15/1994).

As these acts were already being enforced in the 1970s, the amendments harmonise them with new ownership and the economic situation.

Partial aspects of forestry and related activities are covered by other parliamentary acts:

- The act on State Forest Improvement Fund (No. 131/1991, amendments promulgated in Act No. 16/1994)
- The act on Hunting (No. 23/1962, amendments promulgated in the Act No. 23/1992 and Act No. 99/1993)
- The act on Land Communities (No. 181/1995)
- The act on the Slovak Forestry Chamber (No. 259/1993).

Several acts primarily concerning other sectors also have a significant impact on forestry. The Act on Nature and Landscape Conservation (Act No. 287/1994) particularly expands the scope of traditionally forestry activities controlled by the environment and nature conservation sector.

4.2 Actors in forest and forest related policies

The amount of actors involved in forest policy increased considerably in the 1990s. Besides the traditional ones such as the state authorities, state forest companies, municipalities, water management, and research and education, there are also now the newly emerged non-state forest owners and their associations, associations of wood processors, entrepreneurs in tourism, and non-governmental nature conservation organisations. Some of the actors have several roles.

Table 10. Profitability indicators (Green Report 1997)

Indicator		**Year / mill. ECU**		
		1995	**1996**	**1997**
Revenues		185.9	204.4	220.9
Costs		195.2	212.6	228.6
Loss (-)		9.3	10.8	7.6
Subsidies		11.2	14.1	11.4
Profit (+)		2.0	3.3	3.8
Share of	Loss (-)	5.01	5.35	3.47
revenues	Subsidies	6.07	6.97	5.17
%	Profit (+)	1.06	1.62	1.70

a) Authorities and executive bodies of the Forestry Section of the Ministry of Agriculture include:
- Agriculture and Forest Authorities at the regional and district levels
- The Institute of Forest Management Planning
- The Institute for Education and Training of Workers in Water and Forest Management
- The Forest Research Institute.

b) Associations of forest owners are formally represented by:
- The Association of the State Forest Enterprises, a consultative body with a tendency to be a directorate general of the state-owned forest estates
- The Council of Associations of Non-State Forests.

c) Non-forestry state authorities:
- The Ministry of Environment represented by the regional environmental offices (country and district), the Slovak Environmental Agency, and the Directorate of National Parks
- The Slovak Land Fund, which formally maintains and supervises the non reclaimable land. Such land represents 8.5% of the total forest area.

d) Non-governmental organisations:
- The Slovak Forestry Chamber
- The Slovak Academy of Agricultural Sciences
- The NGOs active in the area of nature conservation.

e) Education and scientific sectors:
- The Faculty of Forestry, Technical University Zvolen
- The Institute of Forest Ecology and other bodies within the Slovak Academy of Sciences.

4.3 Forest policy tools

4.3.1 Forest policy

Endorsed by the Parliament in 1993, the “Strategy and Conception of Development of Forest Management in Slovakia” and “Principles of State Forestry Policy in Slovakia” provide most of the general guidelines for the sustainable management of forests. Ten principles of the state forestry policy have a rather declaratory character, however. Their implementation has been evaluated in the annual Report on Forestry submitted to the government and parliament.

From among the policies prepared by other sectors, the parliamentary approved Strategy of the State Environmental Policy (Decision 339/1993) and Strategy for Biodiversity Conservation and Management in Slovakia (Decision 676/1997) have had a relatively large impact on forest management.

Nonetheless, only limited participation of the forestry sector was allowed in the formulation of the Environmental Policy and Biodiversity Action Plan.

In order to prepare new forest policy and harmonise legal regulations with the EU countries, the project “Assistance in Harmonisation of Legislation and Strategy for Development of

Forestry Sector" was implemented in collaboration with the Forestry Department of the FAO in 1998/99.

4.3.2 Forest related programmes

The "Programme for mitigation of anthropogenic and especially air pollution damage to forests" was approved by the government in 1994 and reiterated in 1996. Its implementation has been restricted to only a few projects due to limited financial funds. The "Programme of afforestation of unproductive non-forest lands" (government resolution 550/1994) has set objectives in afforestation for the period 1995 - 2000 and also basic long-term frames. The original aim to afforest 50 000 ha of abandoned agricultural lands by 2000 will most likely be fulfilled by only about 20%.

The "Forestry Development Programme" (government decision 566/1996) set general priorities and guidelines for the improvement of infrastructure and more ecologically oriented forest management.

The Action Plan for Implementation of National Biodiversity Conservation Strategy for 1998 - 2010 has also had an impact on forestry. Presently, however, forestry institutions subordinated to the Ministry of Land Management are not eligible to receive direct financial support provided by the government for implementation of this plan.

4.3.3 Legal tools

The basic laws (the Forest Act and the Act on Forest Management) provide only general guidelines, e.g. concerning categorisation and the management of protection and special purpose forests. Partial acts and executive regulations issued by the Ministry of Land Management have thus been designed as direct tools for the implementation of the state forest policy.

In 1994, the system of Chartered Foresters was promoted. Each forest estate or management unit must have a chartered forester on staff or the owner must pay for a forester's part-time services. To obtain a chartered forester's license, applicants are subjected to periodical training and examination.

The Guidelines for Forest Management Planning (Regulation No. 5/1995 of the Ministry of Agriculture) have a broad impact on forest management through the management planning. The following modifications to previous guidelines should be mentioned:
- Protective functions dominate the special and commercial forest functions.
- Flexibility and nature conforming management are supported by the preference for shelterwood systems while clear-cutting is only prescribed in specific cases in new management plans.
- The age of rotation is no longer taxatively prescribed. It is set according to the production and functional values of forest stands. In forests with a predominate wood production function, the age of rotation respects the maximum value of growing stock.
- Four alternative methods are to be applied to quantify the volume of regeneration fellings. Inductive methods are applied in favour of fixed allowable cuts.
- Special management can also be required outside of nature conservation areas. It allows for the protection of valuable biotypes and habitats of rare forest related species, for example.

Management co-operation and the association of forest owners has been supported by the Act on Land Communities (No. 181/1995) and also by its executive regulation "Providing and Use of Financial Support from the State Fund for Forest Improvement" (No. 126/1994). Compensations for expenditures for chartered foresters, consultation, and education and training are provided to the management associations and established according to the above mentioned act.

Another set of regulations pursuant to the Act on Nature and Landscape Conservation has been applied to the forest reserves and forests inside national or nature parks.

4.3.4 Financial incentives from the state

There are three main sources of direct financial support to the operational level of forest management: the State Forest Improvement Fund and the State Subsidiary Fund for Agriculture and Food Production at the Ministry of Land Management and the State Environmental Fund at the Ministry of Environment. The State Forest Fund has been the absolute dominate one among them, however.

Compared to the late 1980s and considering inflation, the annual sum of direct financial incentives to forestry decreased by approximately 20% in the mid 1990s. The "subsidies" to forestry also traditionally include expenditures on projects for public benefit and restoration forestry. These expenditures account for approximately 40% of the total and therefore they may inflate external views on the extent of state support for forest management.

Tax policy: following the tax reform of 1993, the liabilities of forestry increased considerably and have been reconsidered several times. From among the different tax reliefs, the forests delineated for protective and special functions as well as young stands are exempt from the real-estate tax. Some other indirect financial incentives as a result of tax reliefs have been discussed.

4.4 Forest policy in relation to other policy areas

The forest policy has a relatively autonomous position in relation to the parliamentary approved State Agricultural Policy (1992) and the Strategy of the State Environmental Policy (1993), for example.

In relation to the State Agricultural Policy, common interests and overlaps are found especially in regards to land use, which have been summarised in the "Programme of afforestation of unproductive non-forest lands" (approved 1993).

Concerning the State Environmental Policy, several parts cause multiple tensions between forestry and nature conservation. Affluence of restrictions under the absence of a system of compensations or incentives to forest management are considered to be a very hot spot.

4.5 Forest education and research

Forestry education in Slovakia has a long tradition. The origin of forestry studies dates back to the establishment of the Mining Academy in Banská Štiavnica in 1770. This fact provides evidence that the study of forestry originated in Slovakia.

At present, the educational system of forestry has the following levels:

4.5.1 Professional forestry schools

The aim of these schools is to provide education and practical training for the forest workers. At present, there are five such schools in Slovakia with 18 areas of study. The course of study generally lasts 2 - 3 years and over 300 students graduate each year.

4.5.2 Secondary forestry schools

The aim of these schools is to prepare the forestry graduate, whose main objective is to control and manage the basic organisational units of forest practices, for practical professions. At present, there are three such schools in Slovakia, with three areas of study (Forestry, Landscape Ecology and Country Tourism). The course of study lasts 4 years with final examinations. An external form of study also exists. Approximately 200 students graduate each year.

4.5.3 University forestry education

The new tradition of university forestry studies dates back to 1952 when the University of Forestry and Wood Technology, with an independent Faculty of Forestry, was established in Zvolen.

At present, the Forestry Faculty of the Technical University in Zvolen is the foremost forestry educational institution in Slovakia. Its main mission is to provide a university education in the following areas of study:
- Forestry
- Management and Entrepreneurial Activities in Forestry
- Forest Ecology
- Game Management

The aim of the educational process at the Faculty of Forestry is to provide the graduates with a broad knowledge of forestry, emphasising the specific methods of forest establishment, silviculture and forest protection, harvesting, transport, economics, and forest management.

The full-time course of study lasts five years (10 semesters) and the part-time (external) lasts 6 years. Approximately 120 forestry engineers graduate each year. During the 45 years of the Faculty in Zvolen, 4,076 graduates were awarded the MSc. degree in Forestry.

The following organisations of forestry science and research are active in Slovakia:
The Forest Research Institute (FRI) in Zvolen was founded in 1890 under the original name "The Central Forestry Research Station". At present, the institute is directly subordinated to the Ministry of Agriculture. It is comprised of a headquarters and 5 research stations. The research section of the institute is comprised of 7 departments which are engaged in applied forestry research in the following fields:
- Forest Genetics and Tree Breeding
- Silviculture
- Forest Protection and Game Management
- Forest Environment
- Forest Management Planning and Monitoring
- Forest Economics and Policy
- Forest Techniques and Operations.

Permanent sample and monitoring plots, biological stations and research objects of the FRI can be found throughout the whole territory of Slovakia. The institute has its own laboratories, library, and other necessary facilities.

The Faculty of Forestry, Technical University in Zvolen carries out institutional research based on the support of grants from the Granting Agency of the Ministry of Education. The faculty research has been modified recently in conjunction with topical problems resulting from scientific development and the reaction to the condition and development of forest ecosystems (e.g. change of global climate, natural disasters) or the requirements of forestry practice (re-privatisation, fragmentation of management units, etc.). At present, the main research topics to be solved are as follows:
- sustainable forest management
- management of forests under changing ecological condition
- biodiversity, forest genetics
- forest monitoring and modelling of production
- biotechnology.

The Institute of Forest Ecology of the Slovak Academy of Science carries out institutional research aimed at general and special forest ecology, particularly phytopatology, entomology, dendrobiology, ecology and silviculture.

5 The main current conflicts and challenges

5.1 Forestry and nature conservation

- Due to low recognition of the Act on Forests and the Act on Forest Management and State Forest Authority, manifold tensions followed the implementation of the Act on Nature Conservation (287/1994). These are also found between the executive branches of the Ministry of Environment and the Ministry of Land Management.
- Compensation to forest owners for management restrictions due to nature conservation, half of the country's forests are already included in various nature conservation categories (IUCN categories I-V) declared by the Ministry of Environment. In spite of the tremendous increase of their area in the last 10 years, there is no system of compensation to forestry for limitations and duties imposed by the nature conservation regimes.

- From among local conflicts, the one concerning forest management in the Protected Landscape Area (Nature Park) and UNESCO MAB Biosphere Reserve Poana received the most attention in 1998. The protests of the NGO "Forest Protecting Association Wolf" were against intended small sized (up to 1.5 hectare) strip fellings in accordance with the management plans from before 1995, when new guidelines for forest management planning were enforced. Concerning forestry, the flexibility and ability to implement nature conforming practices appear to be the core aspect of the conflict. Publicity of this case influenced negative opinions about the quality of forest management, especially from urban populations.

5.2 Protective and special purpose forests

- Forests delineated for primary fulfilment of protective and special functions represent 14.8% and 17.5%, respectively. Their proportions in the total forest area have further increased. Under the lack of direct or indirect incentives, there is only a little or no interest in the loss of forestry operations, especially in the protective forests. Functional deterioration and even a destruction is undesirable, but is frequently the consequence of the neglected tending of today's protective forests which were formerly managed for productive purposes, with a changed age and tree species structure.
- High air pollution still apparently contributes to the deterioration in the condition of health, especially of mountain forests. Following the government resolution on the Program to Mitigate Anthropogenic and Especially Air Pollution Damage to Forests (1994, 1996), 50% of the fees for air pollution had to be relocated from the State Environmental Fund to the State Fund for Forest Improvement. Due to legal and institutional discrepancies, however, hardly 1% of the total annual budget had been provided for forestry from the State Environmental Fund. The situation formally improved in 1998 due to the amendments to the Act on State Environmental Fund.

5.3 Tourism and forests

Lobbying and the influence of commercial tourism have been causing multiple conflicts, but mainly in the competence of the Ministry of Environment.

5.4 Hunting and nature conservation

- Persisting conflicts, but of decreasing intensity, are due to wildlife damage (by ungulates and boars) to forest stands. The damage is subjected to regular monitoring providing relatively exact records on damage and additional expenses attributable to hunting.
- A more recent controversy is a result of the full protection (referring to the Bonn Convention) of wolf in Slovakia. The conflict is mostly between the Ministry of Environment and hunters, but farmers are also involved, partially due to the currently absent compensation system for losses caused to livestock by protected predators. Damages and risks associated with overpopulation of bears in larger recreation areas have also been mentioned in the mass media.

Organisations related to forestry

The Ministry of Agriculture of the Slovak Republic, Forestry Section, Dobrovicova 12, SK - 812 66 Bratislava.
The Forest Research Institute, T. G. Masaryka 22, SK - 960 01 Zvolen.
The Faculty of Forestry, Technical University in Zvolen, T. G. Masaryka 24, SK - 960 53 Zvolen.
Lesoprojekt, Institute of Forest Management Planning, Sokolská 2, SK - 960 52 Zvolen.

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Useful Internet addresses

Welcome to Slovakia – Slovakia List, About Slovakia: http://www.sanet.sk/
Technical University in Zvolen, Faculty of Forestry: http://www.tuzvo.sk/
Forestry Research Institute in Zvolen: http://www.fris.sk/

Slovenia

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1 Country

1.1 Nature

The basic characteristic of Slovenia is its extreme diversity of flora and fauna. On a relatively small surface are found the Alps, the Mediterranean, the Dinara Mountain massif, and the Pannonian Basin. Consequently, since ancient times many trade routes have lead through Slovenia, from the Alpine countries towards the Balkans and from Central Europe towards Italy and the Adriatic Sea.

Orographic conditions are also quite diverse. The country's altitude varies from 2864 m above sea level (Triglav in the Julian Alps) to zero (at the Adriatic Sea). The average is above 570 m as most of Slovenia consists of mountain ranges of medium height. High mountains predominate in the NW parts of Slovenia. The plains are located in E Slovenia at the edge of the Pannonian Basin. They are also found in larger tectonic basins, e.g. the Ljubljana Basin, the Drava and Savinja Basin. The landscape, uplifted, folded and thrust by mountain forming processes, has been further shaped by rivers, glaciers, and karst processes (Vidic et al. 1998). Therefore the relief varies considerably. The average slope is 21 degrees, and rocks cover 15% of the surface forest area.

As a consequence of its diverse orography, climate conditions vary as well. Slovenia can be divided into at least three climatic regions: mediterranean in the west, temperate humid in the central part, and continental in the east. The macroclimate is strongly modified by mountain chains. The transition from the (sub)mediterranean climate to the continental zone is interrupted by Dinara Mountain massif with its typical combination of a maritime and continental climate type. The major part of Slovenia is characterized by a temperate humid climate with an average annual temperature of 6-9°C and by well-distributed precipitation (1100-1400 mm/year) over the whole year with a maximum in the summer and autumn. Influences of the semi-arid continental climate gradually increase in proximity to the Pannonia flat. The maximum precipitation figures are the highest in the Julian Alps (3500 mm/year) and the lowest at the border with Hungary (600 mm/year); the range of annual temperature extremes reaches 75°C (from -34,5 to +40,7°C). The average annual temperature of Ljubljana, the capital of Slovenia, is 9,7°C.

Soils types are very diverse. Soil genesis is especially affected by parent soil material composition. Karstic terrain covers 44% of Slovenian territory. The rest is covered by clastic sedimentary rock, and to a lesser extent (<10%) by felsic, igneous and various metamorphic rocks. The predominant soils are cambisols and leptosols (Vidic et al. 1998).

From a phytogeographic point of view Slovenia is divided into six highly different regions: the alpine, pre-alpine, dinaric, submediterranean, pre-dinaric, and subpannonian. Zonality of vegetation is clearly defined due to distinctive orographic factors, different soil substratum and well-preserved forest structure. Beech sites cover 71% of the total forest area, so beech (*Fagus sylvatica*) together with spruce (*Picea*

Table 1. Representation of the individual forest sites to total forest area

Groups of forest sites	**% of total forest area**
Mixed hornbeam-oak forests and common oak forests	8.8
Flood plain forests, maple and ash forests	1.1
Acidophilous and thermophilous oak forests	2.8
Beech forests of hill and sub-montane belts	18.8
Beech forests of montane and alti-montane belts	14.5
Thermophilous beech forests	6.0
Acidophilous beech forests	17.9
Silver fir- beech forests	14.1
Silver fir and spruce forests	6.3

abies) is the dominant forest species in Slovenia.

1.2 Society

The Republic Slovenia was established in 1991 and was, prior to that time, a republic within the Socialist Federative Republic of Yugoslavia. It covers 20.256 km^2 and has a population of 1,9 million. The majority are Slovenes but there are two autochthonous minorities, the Italian and Hungarian, with a constitutionally granted special status.

2 Forest resources and their uses

2.1 Definition of forest

According to Forest Act, Article 2:
A forest is a plot of land, overgrown with forest trees in the form of stands or other forest growths which provide any of the functions of a forest. Forest, according to this law also includes overgrown plots of land which are defined as forest in the spatial element of the forest management plan. The forest infrastructure which is apportioned to individual plots is an integral part of the forest. The following are not forest within the meaning of this law: individual forest trees; groups of forest trees up to an area of 0,05 ha; non-autochthonous riverine and windbelt trees; avenues; pastures overgrown with forest trees if they are used for pasturing, irrespective of how they are described in the land register.

2.2 Forest history

There are huge differences among the various regions due to different historic use of the forest, the origins of organised forest management and the forest tradition. The Primorje region, at the Adriatic Sea, was deforested at around the year 1000. In the Dinara Mountain massif, which was unsuitable for settling and agricultural use, vast virgin forests were preserved until the last century. The first regulations for forest-use were applied in the regions where demands for timber were the largest, within the vicinity of coal mines and larger towns.

Characteristic milestones in Slovenian forest development:
- in the 15th, 16th and 17th century many forest regulations were issued for individual parts, of what is now Slovenia, in an attempt to prevent devastating forestry practices and to direct inhabitants to the rational use of forests. The oldest known forest regulation dates back into 1406 and was passed by Frederick of Ortenburg for the Kocevje region;
- 1724, the first forest management plan for forests belonging to the mining industry in Idrija;
- 1771, the Forest Ordinance for Carniola and Istria;
- 1771, the first forest management plan for the forests of Trnovski gozd;
- 18 th and 19 th century; more intensified forest use. With the development of industry and railway construction (1849 Vienna - Ljubljana), timber became an interesting market product;

- 1853, buying off the former servitudes, farmers became owners of the forest;
- 1852, the Austrian Forest Law enacted;
- 1860, the first successful afforestation of bare karst land;
- 1868, the first Slovenian Forestry School in Sneznik;
- 1869, the first Slovenian forestry manual;
- 1875, the first Carniola - Primorje forestry association founded;
- 1892, Leopold Hufnagel introduced an original selective forest management method and strongly influenced the future generations of foresters in Slovenia;
- 1931, the first one-year junior Forestry School in Maribor established;
- 1949, clear-cutting prohibited as a management method;
- 1948/49, the Forestry Institute, Forestry University and the Secondary Forestry School established;
- the period after 1945 until today, the implementation of sustainable, multipurpose and close-to-nature concepts of forest management.

2.3 Forest ownership

In 1997, forests covered an area of 1.109.710 ha. In 1990, before Slovenian independence, 38% of the forests were state-owned and the rest were privately owned by approximately 250.000 owners. In 1991, the process of returning privately owned forests, seized by the government in the agricultural reform after WW II, began (“re-privatisation” or “denationalisation”). So far about 75.000 ha of forests have been returned thus causing a drop in the percentage of state owned forests down to 30% of the total forest area. In the case that all the applied claims for returning forests are solved positively there would be finally only about 21% of state owned forests.

The social structure of forest owners was strongly influenced especially by a rapid decline of peasants after WW II. In the beginning of this century 73,3% of population were peasants, in 1948, 48,9%, and in 1991, only 7,6%. Especially during the period of intense industrialisation, many people moving into new industrial centres abandoned the countryside. Employment outside the domestic farm sphere does not necessarily mean permanently leaving it. Many of them kept their forest land and form a strong group of non-farmer forest owners. Nowadays the so-called mixed farmer households predominate in the social-economic structure of agriculture in Slovenia. In 1990, 40% of all private owners belonged to this group and they owned 22% of all private forests. An important part of their income is derived from outside the farm, but they still retain most of the agricultural areas and forests. The size of their property seldom exceeds 5 ha. Non-farmer forest owners are not directly economically dependent on their forest as a long-term resource. They are often interested only in short-term benefits. In addition, the majority of them are not qualified, willing or technically equipped for forest work.

The state-owned forests are in large complexes. On the other hand, private forests are largely dispersed which is evident through average

Table 2. The structure of privately owned forest properties in 1990

Size classes of forest properties (ha)	Portion of total number of private forest owners (%)	Portion of total private forest area (%)
up to 1	54.7	10.0
1 - 3	25.6	20.1
3 - 5	8.3	13.9
5 - 10	7.2	22.2
10 - 20	3.1	18.6
over 20	1.1	15.2
Total	100.0	100.0

private property size, its spatial fragmentation and in the high rate of non-farmer forest owners:
- an average property is comprised of approx. 2,7 ha;
- each property is comprised, on average, in 2,4 spatially dispersed allotments;
- 45% of farmer owners possess approx. 60% of whole private forests.

Fragmentation of private forest property has lasted for a century and was strongly influenced by the following factors: inheritance of properties (36%), agricultural reform after the WW II (39%) and forest depletion due to infrastructure building (21%).

In the 1991 process of returning state-owned forests, which were ex-private forest properties, seized by the government in the agricultural reform after WW II, began ("denationalisation"). Nevertheless property structure of private-owned forests has not changed significantly. Only the number of forests owners will increase whereas small-scale forest property will remain the basic characteristic of private forests. There will be some large-size private forest properties, but the majority of the returned property will be fragmented due to inheritance factors, since the forest property in most cases is not returned to the original owners but to their heirs. The share of non-farmer forest owners will increase. The average returned forest property is comprised of 30 ha and the right to inherit it is claimed by three heirs on average. Half of them are non-farmers and 60% of them were forest owners before the process of "denationalisation".

2.4 Land use and forest resources

2.4.1 Global overview of land use

Slovenia has the highest percentage of forest cover compared to other countries in Central Europe. The main reasons for such a high amount of forested surface are complex orographic conditions: the prevailing part of Slovenia is karst, which is less appropriate for settling and agricultural use. Due to the same reason, the highest percentage of forest cover is in SW Slovenia, while the highest rate of agricultural areas is concentrated in Eastern Slovenia.

2.4.2 Forest area and distribution of the forests

In 1997, the forests of Slovenia covered 54,8% (1.109.710 ha) of the total surface. The extent of forested area has been increasing for several decades mainly due to overgrowth of abandoned agricultural areas and, more recently, due to the inclusion of forest vegetation at the upper timber line into the forest surface.

2.4.3 Tree species origin and distribution

In the data base maintained by the Slovenian Forest Service (in the text following: SFS) there are 46 different tree species in evidence. The highest proportion of the total growing stock goes to *Picea abies* (33%) and *Fagus sylvatica* (31%).They are followed by: *Abies alba* (9,9%), *Quercus robus* and *Q. sessiliflora* (6,3%),

Table 3. Land use in 1995

Land use categories	Area (ha)	Percentage of total area (%)
Arable land and kitchen gardens	234432	11.6
Orchards	31494	1.6
Vineyards	22955	1.1
Meadows	34509	17.0
Rough grazing	149831	7.4
Reeds, fishponds and marshes	3299	0.2
Forests	1097929	54.2
Bare land	140593	6.9
Total area	2025627	100.0

Table 4. Change of forest area in the period between 1875 and 1997

	Year							
	1875	**1947**	**1961**	**1970**	**1980**	**1990**	**1994**	**1997**
Forest area (in 1000 ha)	737	860	943	1008	1027	1071	1094	1110
Forest covered area (% of country surface)	36.4	42.4	46.5	49.8	51.0	52.9	54.1	54.8

Pinus sylvestris (4,8%), *Acer pseudoplatanus*, *Ulmus glabra* and *Fraxinus excelsior* (2,9%), *Carpinus betulus* (2,7%) and *Castanea sativa* (1,5%). The proportion of other tree species is lower than 1% per species. All mentioned tree species are a component part of the natural vegetation in Slovenia. Spruce, in fact, is a natural tree species of mountain forests, but it was artificially introduced on other sites due to economic reasons. Therefore its proportion (33%) is higher than it would be if only considering the indigenous species (8%). The second reason for a slightly altered natural tree composition is a decrease in agricultural use resulting in a larger proportion of pioneer tree species present in forest succession. In forest regeneration the natural process largely prevails, therefore the natural tree species composition is relatively well preserved.

2.4.4 Total growing stock, volume increment and total felling

In the period from WW II until today the growing stock of forest has constantly increased. During this time the methods of forest inventories have changed which may have influenced values of growing stocks (table 5).

Besides the total growing stock, the d.b.h. structure of forest stands is also an indicator of forest history and forest management until the present time. Trees of more than 30 cm d.b.h. represent 56% of total growing stock. Forest stands are classified into different developmental phases and types. Pole stands cover 42% of the total forest area. The amount of timber phase and stand regeneration phase is somewhat lower (together 31%). Young stands cover 10% of the total area, selection forests are scarce (4%). In addition, 15% of forested area is covered by pioneer forests and coppice forests.

After WW II tree felling quantity has varied greatly. It was the highest in the first years after WW II, with a 2 - 2.5 annual volume increment felled per year, and it then subsequently declined. After 1986 the rate of felling decreased again due to unsettled conditions in forestry, especially in the privately-owned forests.

The percentage of various tree species felled does not change significantly through time. Coniferous trees felled as a proportion of the total is approximately 60%.

2.4.5 Forest threats

In the period between 1985 and 1995, sanitary felling comprised, on average, 26% of the total. Sanitary felling is in most cases a conse-

Table 5. Growing stock and annual volume increment of forests in the period from 1953 to 1997

	Growing stock (m^3/ha)			Annual increment (m^3/ha)		
Year	**Total**	**Coniferous**	**Broadleaved**	**Total**	**Coniferous**	**Broadleaved**
1953	112	64	48	2.76	1.54	1.22
1980	186	101	85	4.72	2.45	2.27
1995	208	103	105	5.46	2.52	2.94
1997	209	103	106	5.52	2.53	2.99

Table 6. The extent of annual tree felling in the period between 1971 and 1997

	Years (time period)					
	1971/75	**1981/85**	**1986/90**	**1991/95**	**1996**	**1997**
Annual total felling (in 000 m^3)	3065	3719	3272	2140	2330	2567
Annual total felling (m^3/ha)	3.0	3.6	3.0	2.0	2.1	2.3

quence of different influences: ice, snow and wind (29% of the total sanitary felling), diseases (21%), insects (19%) and other different factors, for instance wildlife (peeling), mechanised timber exploitation, emissions, unknown reasons, etc. Among diseases, oak (*Quercus sp.*) and fir (*Abies alba*) die-back and fungi influences are the most frequent. Among insects, bark beetles are the most significant.

The extent of sanitary felling is increasing. Its proportion in total felling exceeded 40% in 1996 and 1997, mainly due to abiotic factors, which caused the amount of felled timber for sanitary reasons in the last three years to reach as much as 23% of the total felling quota; abiotic factors were the reason for more than half of the sanitary felling. The reason for the other half in these years are predominantly bark beetles and die-back of firs and oaks. An additional reason for the sanitary felling increment is recognised as being because of a decrease in felling and less protection and silvicultural measures in forests, which together has a negative effect on the health condition and resistance ability of forest stands.

2.5 Silviculture

Slovenia has a tradition in sustainable forest management, the characteristics of which are: natural forest regeneration, conservation of natural tree composition, direction and usage of self-regulative natural processes, relatively high growing stock, a high proportion of large diameter trees, conservation of forest productive capacity and biodiversity, and small scale system management, etc. Silviculture is based on the principle of tending, specifically for forest stands, of the forest as a ecosystem and of the whole landscape. Among silvicultural systems the most advanced are the ideas of selection and irregular shelterwood and group system. According to the principle of close-to-nature forest management the funds needed for silviculture, especially forest regeneration, and forest protection are relatively low.

The forest companies carried out silvicultural and protection measures in all forests regardless of their ownership type until the year 1990. Special funds were raised for these purposes according to the defined percentage of sold timber. Since 1990, forest owners are directly responsible for silvicultural and protection measures. The state offers assistance with expert counselling and supplies some material help. Nevertheless, the amount of silvicultural and protection measures has reduced substantially and does not achieve the planned values in forest management plans.

2.6 Forest production

2.6.1 Timber production

Nowadays, timber felling is totally mechanised. Modern chain saws and contemporary work

Table 7. Annual realisation of silvicultural measures

Type of silvicultural			**Period (year)**					**Annual plan**
measures	**1971/75**	**1976/80**	**1981/85**	**1986/90**	**1991/95**	**1996**	**1997**	**1991-2000**
Forest regeneration (ha)	1836	3240	4569	4716	1753	1001	980	2848
Forest tending (ha)	22239	20627	22279	22569	11347	7410	10425	21637

technologies are used. The majority of chain saws are the workers' property. A low capacity utilization of chain saws and consequently their technical obsolescence is typical for private forest owners. Due to economic as well as ecological reasons harvesters have not been introduced.

Timber extraction is mainly mechanised. The rate of manual and animal skidding is low and often only in addition to mechanised skidding. In recent years there have been practically no changes in extraction technology.

Capacity utilization of skidding machines, especially tractors, is low which makes production more expensive. The average annual amount of extracted timber by an individual skidding machine has decreased. This is the consequence of increasingly fragmented forest production as well as a relatively large number of contractors working in the forests for shorter periods.

Transport of timber to the market is totally mechanised. Timber for domestic utilisation is usually transported with tractor trailers by the owners themselves.

2.6.2 Timber utilisation

A considerable proportion of roundwood is put on the market, whilst the smaller proportion is used by the owners for household supply or for their own wood manufacturing. The annual, estimated amount of domestic utilisation of roundwood is about 550.000 m^3, the precise amount being unknown. 250.000m^3 of this are logs. The owners use small size roundwood, harvesting residues (branches of trees), roundwood originating from trees growing outside the forest, and wood residues as fuelwood.

The assortment of sold roundwood depends strongly on various circumstances affecting forests, in the past few years it is mostly a consequence of natural calamities.

Before WW II, Slovenia exported a lot of roundwood. Immediately after the war large amounts of timber, from Slovenia were exported, due to the fact that timber was one of the most important exported goods. Later the export of forest products decreased heavily, as the wood processing industry developed.

Exported and imported roundwood represents approximately 10% of the timber removed. The

Table 8. Timber extraction methods

	Year			
Extraction method	**1994**	**1995**	**1996**	**1997**
Manual (%)	9	10	7	8
Animal skidding (%)	3	1	2	2
Tractor skidding (%)	83	84	87	84
Cable logging (%)	5	5	4	6
Total amount of extracted timber (%)	100	100	100	100

Table 9. Annual roundwood removals by assortment categories

	Year					
Roundwood categories	**1970**	**1980**	**1985**	**1990**	**1995**	**1997**
Logs (%)	64	52	60	57	57	46
Pulpwood (%)	10	19	18	21	23	29
Other industrial roundwood (%)	14	19	12	11	8	9
Fuelwood (%)	12	10	10	11	12	16
Total (%)	100	100	100	100	100	100

Table 10. Import and export of roundwood in the period from 1985 - 1996

a) Export (in 1000 m^3)

	Year				
Roundwood categories	**1985**	**1990**	**1992**	**1994**	**1996**
Logs	65	120	228	110	63
Pulpwood	11	56	38	3	8
Other industrial roundwood	5	30	30	...	1
Fuelwood	26	64	70	102	118
Total	107	270	366	215	190

b) Import (in 1000 m^3)

	Year				
Roundwood categories	**1985**	**1990**	**1992**	**1994**	**1996**
Logs	70	74	38	280	264
Pulpwood	427	489	199	25	16
Other industrial roundwood	1	8	7	...	1
Fuelwood	2	1	6	1	10
Total	500	572	250	305	291

main export partners are Italy, Austria and Croatia. The main import partner is Hungary. Export is mostly constituted by sawlogs and import by pulpwood.

Table 11. Annual fresh mushrooms sale in the period 1994-1996

Year	1994	1995	1996
Fresh mushrooms (t)	1248	923	505

2.6.3 Non-timber forest goods

Diverse forest vegetation results in various non-timber products. The most important are mushrooms, medicinal herbs, blueberries, strawberries and cowberries. The collection of non timber products is free. In forests where the collection of fruits, fungi or herbs could endanger plant species or forest function this can be limited or banned. Due to a risk of extinction, 28 plant species were protected in 1976. Because of a special regulation in 1994, the collection of 70 fungi species is banned or temporarily and quantitatively limited. People usually pick non-timber goods for recreation and their personal needs, although sometimes also for sale. The amount of non-timber goods and their sales is not statistically observed. Only data on the commercial sales of fresh mushrooms is available.

2.6.4 Forest functions

The concept of multipurpose forest management has been established; this means that all forests are multipurpose, and only the relative importance of individual functions in the area is different. The forests are divided into three categories according to the importance of these functions. In protection forests no measures are taken or only to a limited extent. Their share is 5,5% of total forest area. 0,7 % of all forests are categorised as “special purpose forests”, which are predominantly forest reserves. The majority of forests belongs to the category of multipurpose forest where different forest functions are enhanced. The functions are evaluated during forest inventories. They represent special demands or restrictions in forest management.

A provisional evaluation of these different functions, shows that protective functions are emphasised on 20,4% of the forest area, hydrological on 16%, natural and cultural heritage-protection on 14,2%, tourist and recreation on 8,2%, hygiene on 5,2%, wild habitat-protection on 4,9%, aesthetic on 4,3%, protective function on 2,3%, and education and research on 1,2% of total forest area. Together, they are evaluated on 53% of the total forest area, because individual forest functions overlap.

3 Forest economics

3.1 Forestry in the national economy

Forestry represents less than 0,5% of the gross domestic product. After 1990, its share decreased rapidly.

A more complete review of the importance of forestry can be observed in relation to industry based on forestry.

3.2 Employment

The number of people employed in forestry has strongly decreased during the last decade as a consequence of advanced technologies, work efficiency and forest ownership changes.

The personnel structure in forestry is quite good. Among those employed, 12% are forest engineers with a university degree and 18% are forest technicians and forest engineers with a college education. But there are still not enough experts with postgraduate education.

In 1997, there were 116 forest enterprises and about 100 independent contractors to carry out forest work. The former forest enterprises are now organised as joint-stock companies. They carry out all forest work in the state owned forests on the basis of concessionary contracts and partly offer their services to private forest owners. They also buy timber from private owners and deal in some other activities (horticulture, wood processing etc.). The forest joint-stock companies showed a profit in 1997, however profitability is still low.

The private forest owners execute approximately 90% of total felling and skidding without external assistance or with the help of family members and neighbours. They sold approx. 10% of total felling as standing timber to forest joint-stock companies who also transported most of the roundwood. The forest owners carry out about half of all silvicultural and protection measures in their forests.

Some serious problems in the involvement of private owners in forest production are present, especially their low capability for forest work,

Table 12. Share of forestry in the gross domestic product (GDP) for the period 1991-1996

Year	1991	1992	1993	1994	1995	1996
Share of forestry in GDP (%)	0.50	0.56	0.47	0.40	0.36	0.37

Table 13. Proportion of forestry and all wood industry in GDP and total number employed in 1991

	Percentage of GDP			**Percentage of total number employed**
	1987	**1989**	**1991**	**1991**
Forestry	0.7	0.8	0.5	0.6
Wood processing industry	1.6	1.0	1.2	2.0
Pulp and paper industry	1.4	1.5	1.5	1.3
Furniture industry	1.4	1.4	0.9	1.8
Together (%)	5.1	4.7	4.1	5.7

Table 14. Employment in forestry for the period 1970 - 1996

	Year					
	1970	**1980**	**1985**	**1990**	**1992**	**1996**
Number of employed in forestry	8534	7664	7548	6541	3727	3007
Index	100	90	88	77	44	36

low productivity and low capacity utilisation of forest machines.

3.3 Economic efficiency

Economic efficiency of the state-owned forest is especially observed. The results, reached by the forest joint-stock companies with a concessional contract in the state owned forests during the last years, are shown in table 16.

In private forests the decisive factors influencing economic efficiency and the methods of timber production are the size of forest property and the extent of felling associated with it. The costs are mainly influenced by the machinery work price that is greatly dependent on the capacity utilisation of forest machines. Model analysis of the capacity utilisation of forest machines, costs and cost effectiveness shows that no technology can reach a profit on small forest property, which is predominant in Slovenia, because costs are higher than sale price of the roundwood. Profit could be reached only by undervaluing the forest labour costs of forest owners. The medium size forest owners (over 30 ha) achieve positive economic effects by only using farm tractors for skidding. Only the largest forest properties can find a relationship between the combination of different technologies for timber production and positive economic effects.

4 Forest policy

4.1 Legislation

The Forest Act (1993) defines particular measures of forest management in accordance with close-to-nature and multipurpose forestry. It also strongly emphasises the public interest aspect in forests with a universal understanding of forest sustainability and all its ecological, social and production functions irrespective of ownership.

With a gradual transition into the market economy, forest policy concentrates on the protection of public interest. Therefore laws and regulations concerning timber production are decreased to a minimum level, and only those necessary, which relate to public utilisation remaining.

In compliance with the Forest Act, sub-regulations are issued to regulate individual forest activities and forest management in detail.

To enhance the public utilisation of forests the Act requires high quality professional work to be performed by the Slovenian Forest Service and clearly defines the obligations and rights of all forest owners. It also determines principles for steady financing to ensure the implementation of factors relating to the public use of forests.

Table 15. Economic efficiency indicators of forest companies in 1997

Economic efficiency indicators	Ratio	Index 1997/96
Total economy (income/expenses)	1.015	102
Return on investment (ROI) (clear profit/capital)	0.014	-
Share of labour costs (labour costs/expenses)	0.351	105
Financial independence (funds /capital)	1.195	99
Debt ratio	0.138	196

The interests of the public are shown through the following legislative regulations:

- free access- and movement- possibility in all forests,
- free gathering of forest fruits, plants, fungi and apiculture,
- hunting and gathering of free-living animals in all forests under the conditions of the act,
- prevention of use which would endanger forest sustainability and its functions,
- reduction of harmful influences and other adverse impacts on forests,
- forest depletion is banned,
- some of the forests are proclaimed as protective forests and special purpose forests,
- forest owners are obligated to provide protection and silvicultural measures as defined by the act, including obligatory afforestation after fire, and restoration of damaged forests,
- clear-cutting is prohibited,
- public forest service is budget financed,
- activities in order to implement factors in public utilisation in privately owned forests are partly budgeted
- conditions for forest workers are defined,
- forest management planning, wildlife management planning, and silvicultural planning are obligatory regardless of ownership,
- maximum allowable cut according to forest productive capacity is defined,
- forest roads planning and construction is defined in accordance with public interest.

4.2 Obligations and prohibitions

The forest owner has to take care of his forest in the best possible way so that its fertility and stand growth do not deteriorate. The forest work must take place during an appropriate season of the year and in a way which causes minimum possible damage to the forest ecosystem and ensures forest protection and safety for people. Forest work is carried out in accordance with forest management and silvicultural plans. Based on these plans, the Forest Service (SFS) issues decrees that had previously been agreed upon with the forest owners. The decrees specify the following :

- the necessary silvicultural measures for forest regeneration and the tending of seedling stage (young growth),
- the necessary protection measures,
- directions and deadlines for the realisation and repetition of individual silvicultural or protection measures,
- the quantity and structure of allowable cut,
- guidelines and conditions for timber felling and skidding,
- guidelines and conditions for the harvesting of decoration trees and resin.

It is necessary to obtain permission from the SFS for any construction of any facility, forest depletion and other interventions into the forest area. Clear-cutting as a forest management system is in principle prohibited and limited to a few specified cases. The use of chemicals in forests is prohibited and only exceptionally permitted in restricted cases. The forest owner is obliged to take every possible precaution to protect the forest against fire, diseases and insects or other damages. Loggers fire is prohibited, except in specially designed fire-places.

It is necessary to preserve the habitats of all autochthonous plant and animal species in compliance with forest management plans. The amount of autochthonous populations of free living animals must be in accordance with the forest vegetation and must not endanger other parts of forest ecosystem or prevent the realisation of the forest management goals.

Forest work may be carried out by the forest owners and forest companies or qualified contractors. Harvesting, skidding and transport of timber assortments must be carried out in a way which protects the environment and does not damage the forest ground vegetation cover or trees to a larger extent than strictly necessary. All ground damage should be restored immediately after the harvesting or transport is completed.

Stubs and logs of spruce, pine and elm must be debarked immediately after felling regardless of the felling site - inside and outside the forest. The timber assortments of spruce, pine and elm which are not attacked by bark beetles are allowed to be skidded, transported and stored for mechanical debarking. They can be proc-

Table 16. Income, costs and net income of state owned forests in the years 1994 - 1996

	1994		1995		1996	
	ECU/m³	**%**	**ECU/m³**	**%**	**ECU/m³**	**%**
Sales price of roundwood	40.04	100	44.72	100	38.24	100
Felling and skidding costs	23.15	52	29.32	66	30.74	80
Costs of silvicultural and protection measures	6.40	16	6.28	14	4.82	13
Other costs *	1.07	3	1.17	3	0.02	-
Yield product (concession payments)	9.42	24	7.95	18	2.66	7
Concessionaire obligations						
-toward forests **	2.96	7	4.37	10	2.50	7
-other obligations	1.79	5	1.37	3	0.39	1
Net income of state owned forests	4.67	12	2.21	5	0.23	-1

* the expenses for ensuring the forest social functions

** the expenses for sanitary measures in damaged forests, forest roads and forest roads maintenance costs

essed with the bark, but all the roundwood residues must be treated properly in due time.

The forest owner may, under defined conditions and in accordance with the silvicultural plan, collect seeds, resin, litter, decorative trees and other non-timber goods in his forest. Transport and sale of decorative trees is allowed if they are issued with a seal by the SFS. The hunting of forest animals, and gathering of fruits, fungi and plants may be limited or prohibited in forests where these activities might endanger forest functions. The species, quantity, method, location and time limitation, or prohibition decree, is issued by the Ministry responsible for forestry.

Forest roads and other forest infrastructure are to be planned, constructed and maintained in a way that considers technical, economic and ecological conditions in order to protect the forest grounds, plants and animals in the best possible way. The interests of mountain farms as well as tourist and recreational needs should be respected, especially mountain farm tourism development. Forest roads are open to public use.

The forest owner is in principle independent in dealings with his forest. Changes in the Constitution of the Republic of Slovenia in 1997 eliminated the clause that a foreigner may not be the owner of forests and agricultural areas. When a forest is to be sold, the neighbouring owner has the preferential right to buy it. The state or the local community has the preferential right when protection forests or forests with special purposes are to be sold.

The aforementioned regulations have two objectives:
- to bring protection forests and special purpose forests into public property,
- to decrease forest property fragmentation.

Forests that are a component part of farms are inherited according to special regulations. Farms comprising of at least 5 ha and not more than 100 ha of comparable land area are protected and may be inherited only by one heir who has to pay off all the other heirs in five years time. 1 ha of comparable land area, 1 ha of fields or gardens, 2 ha of meadows or 8 ha of forest is included. There are relatively few protected farms, therefore the measures for preventing property fragmentation have not proved as efficient. The key problem with inheriting agricultural areas and forests is how to enable the heir who intends to keep the farm to pay off other heirs in due time, while at the same time not exceedingly intervene in his forest. This problem could be solved by offering 5 or 10 year long-term loans with a low interest rate which the heir could pay out of current revenue.

4.3 The forest policy measures

4.3.1 Forestry organisation

During the period of the socialist economy all forests were managed by the forest management companies, divided into 14 regions. The system of so-called common management in all forests, enabled uniform forest management and forest development planning, expert work and the collecting and directing of money for forest investments. Private owners were organised in a special way within this common forest management and they had preferential rights to work in their forests. However, their timber had to be sold exclusively through forest management companies. All this caused the owners to feel that their ownership was in title only, as their ability to make decisions in forest management was limited. As the realisation of the allowable cut defined in the forest management plans was obligatory, they were strongly limited in the dynamics of felling.

With the changed position of private ownership and implementation of the market economy private owners are becoming the actual managers of their forests. They are only limited by the maximum level of forest exploitation (allowable cut) and the obligation to respect the regulations concerning forest work. They also have to carry out all the silvicultural and protective measures in their forests. They personally sell their timber assortments.

The public forest service (SFS) is responsible for forest preservation and its development. It is divided into 14 forest regional units irrespective of forest ownership. The units are divided into forest offices and forest districts .

The tasks of SFS are the following:
- directing forest management,
- monitoring the forests and their development,
- constructing the forest protection plan and ensuring that all protective operations are accomplished,
- constructing the forest management and silvicultural plans, as well as wildlife management plans,
- directing and monitoring sanitary measures in torrent regions,
- co-operating in land planning,
- preparing expert analyses for skidding tracks and forest roads,
- planning the maintenance of forest roads,
- advising and instructing private owners,
- popularisation of forestry and increasing public awareness of the forests’ importance.

The forest operations in state-owned forests including timber sale are carried out by forest enterprises that may also offer expert service to private owners, if needed. The forest enterprises perform the following tasks:
- silvicultural and protective operations,
- timber harvesting,
- maintenance of forest roads,
- timber sale,
- timber transport,
- skidding tracks and forest roads construction,
- forest nursing.

Due to the small-scale of private forest property there are no typical private forest companies belonging to one forest owner (small household enterprises). Such companies of larger private owners are in the establishment phase, but so far larger-scale forest owners allow the forest enterprises or contractors to implement forest management. No privately owned forest household has employed its own forest expert so far.

There is a long tradition of private forest owners organisations which have, however, never developed to larger extent. Nowadays two forms of organisations are most common: forest co-operatives and groups of forest owners co-operating in mechanised forest operations. Private owners are usually members of the forest co-operatives to assure easier timber sale, and rarely to co-operate in forest management. The state, in principle, supports forest co-operatives but has so far not been able to enforce any stimulating measures to encourage forest owners to establish more co-operatives. The state is more open to supporting the mutual help of forest owners in groups co-operating in mechanised forest operations, where the owners exchange machinery services, since this work is not taxed.

4.3.2 Forest management planning

The national forest management policy is specified by the Forest Development Programme and was passed by the State Parliament in 1996. The programme specifies the tasks for forest preservation and development and the conditions for their multipurpose use. It includes also the preservation and management programme of wildlife.

The forests management plans define actual conditions for co-ordinated forest use and interventions, the necessary extent of silvicultural and protection measures, the allowable cut and the conditions for wildlife management. Three sorts of forest plans exist:
- the regional forest management plans (for 14 regional forest units),
- the forestry unit management plans (for 254 forestry units),
- forest silvicultural plans.

The forest management plans are designed as common plans for all forests irrespective of their ownership. They are based on the following elements: actual forest structure, analyses of former forest management, determined characteristics of forest development and the knowledge obtained by monitoring forest development. The forest management plans are worked out by the SFS and verified by the Minister, responsible for forestry. Regional forest management plans consider the guidelines of the Forest Development Programme for Slovenia. The forestry units management plans consider guidelines of the regional forest management plan.

The regional forest management plans define:
- forest functions and their evaluation,
- forest management goals,
- directions and measures for achieving the defined goals,
- directions for preservation of autochthonous wildlife populations and the relationship between wildlife and their environment which presents the basis for the regional hunting plan,
- the areas of protection forests and special purpose forests are defined as well as the sanitary measures and guidelines for damaged forests.

The forestry units management plans define:
- the forest management goals,
- intensity of forest management,
- guidelines for goal achievement,
- measures and methods for their implementation in different planning units (e.g. forest types etc) of forest area.

The forest silvicultural plans are for the purpose of implementation of the forestry unit management plan on the stand. They define:
- forest silvicultural goals, the silvicultural guidelines and measures,
- extent, intensity and urgency of silvicultural and protection measures,
- areas where individual tree marking for felling is not obligatory,
- time and spatial felling plan (restrictions),
- methods and conditions for timber harvesting,
- guidelines to preserve and improve ecological and social forest functions.

4.4 Financial support in forestry

The state directs private forest management also by economic measures, among which the most import are the following:
A) free forest counselling,
B) direct (budget) financing of some forest activities,
C) forest investment subsidies for private forests.

Ad A) Private owners assured for free counselling organised by the SFS.

Ad B) The Forest Act (1993) defines that the state funds cover in total the following:
- all protective measures and material regarding bark beetles and other possible factors of forest disturbances,

- all measures regarding fire prevention in forests vulnerable to fire,
- all measures in the protection forests and torrent forest regions.

Ad C) The state funds, formed for financing and co-financing of privately owned forests work, have been low and are at present in reality decreasing. The benefits available for private owners are diverse and can be divided into four groups:
- the right to full or partial funding of silvicultural and protective measures,
- the rights to partial funding of conversions of degraded forests, sanitary measures in damaged forests and forest road construction,
- the right to tax concession and in some cases complete tax exemption,
- the right to compensation for lower timber yield in the special purpose forests.

The subsidies can be realised in nature (e.g. tree plants) or in money. In privately owned forests the following measures are partly budgeted:
- silvicultural and protective measures,
- special measures to improve or maintain wildlife habitats,
- restoration of forests if the party responsible for damage is unknown,
- reforestation of forests after fires, and restoration of forests damaged by natural disturbances,
- maintenance of forest roads,
- second stand thinning, conversion,
- forest road construction,
- production of seed in nurseries and forest nursery investments.

The basis for the budget-funding are forest silvicultural plans, other executive plans and an annual plan of forest investments designed by the SFS. Partial budget-funding (subsidies) depends on the following criteria:
- type of measures: forest regeneration (30-50%), cleaning (20-40%), tending of seedling and sampling stage (30-50 %), first thinning (40-60%) etc,
- the emphasis on social and ecological forest functions,
- the forest property size (the right is entitled only to the owner of the property up to 100 ha of economy forests),
- social and economic status of the forest owners (in the demographically endangered areas the owners are entitled to 30% higher partial budget-funding).

The state covers approximately one third of the forest road maintenance costs - the basic funds for road maintenance are provided by the owners through a unified payment (tax) of 6.9% of cadastral income. In private forests the thinning of pole stages, conversions, forest road construction and forest nursery investments are partially funded on the basis of public tender. So far no public tender has taken place.

The forest owner is entitled to compensation if his beneficial interest has been limited due to the fact that his forest was classified as a protection forest or special purpose forest. He can also request that the state or the local community that categorised the forest buys it off. If the private owner has to carry out special work due to a specially emphasised social forest function and the forest is not categorised as a special purpose forest he can reach an agreement with the state or the local community in which compensation for the work and compensation for degraded timber forest production is defined. About 60% of private owners are not acquainted with this right.

Table 17. Budget funds for forests in the period 1992 - 1997 (in ECU/ha of forest)

	Year					
	1992	**1993**	**1994**	**1995**	**1996**	**1997**
Silvicultural and protection measures	1.65	1.65	1.77	2.07	2.45	3.32
Forest road maintenance	1.05	0.89	0.84	0.93	1.36	1.40
Total	2.70	2.54	2.61	3.00	3.81	4.72

4.5 Forest education and research work

Forest workers are educated in two or three year-long vocational training programmes in Postojna. The same school educates forests technicians in a four-year secondary school.

The Department of Forestry and Renewable Forest Resources of the Biotechnical Faculty, within the University of Ljubljana exercises two educational programmes: a four-year undergraduate study course of forestry and a three year higher professional study course of forestry and management of renewable forest resources. The three year college course is a recent innovation and has substituted a former two year one. Both studies are based on the principle of close-to-nature forest management. The studies offer an integration of ecological, technical and economic knowledge. The study of forestry is gradually widening into a holistic study of the whole forest landscape, therefore new branches besides classic forest disciplines are being lectured. Graduates are often employed in the field of natural heritage protection, wildlife management, urban forestry etc. Post graduate education includes regular postgraduate forestry studies. The same department also carries out the interdisciplinary programme of post graduate natural heritage studies. The study is combined with practical work in a wide range of outdoor projects. There also exists a network of studying objects for systematic research and education of close-to-nature forest management and nature itself. There is also an idea of having a school forest unit.

The Department of Forestry and Renewable Forest Resources has regular contacts to many faculties abroad, and with some of them (Seattle, Washington, Zvolen, Vienna) have also formally signed agreements of co-operation.

Research activities in the forestry field are carried out by the faculty and the Slovenian Forestry Institute. Basic research is funded directly by the Ministry for Science and Technology, application and development research projects are funded by the Ministry for Science and Technology and the Ministry for Agriculture, Forestry and Food and a certain number, although rare, are financed by the forest enterprises. The research programmes include silvicultural research of forest nature, the forest as an object of protection and management and the forest as part of the living environment. The university students participate in the research work as well.

5 Current conflicts and challenges in forestry in Slovenia

The transformed social and economic circumstances after 1990 reveal the following characteristics:

- the division of public and commercial activities in forestry,
- public interest in forest sustainability and all its functions is ensured by the SFS,
- the transformation of forest enterprises into - joint-stock forest companies that carry out commercial activities,
- new subjects in the commercial sphere of forestry,
- private forest owners are officially independent and decide independently about forest production and timber sale in co-ordination with forest management plans and the public forests service guidelines.

The Fund of Agriculture Land and Forests administers the state owned forests, and work in them is carried out by the forest companies on the basis of concessional contracts. The financing system of forest reproduction has been transformed; each owner is responsible for forest reproduction, and the state only gives assistance with subventions and tax exemptions and concessions.

Successive natural calamities have strongly influenced the economic benefit in forests. Problems in the wood industry, and especially the pulp industry have strongly influenced the conditions in forest management. Timber sale - specially of lower quality timber - is more difficult .

5.1 Changes in the relative importance of different forest functions

The forest legislation (4.1) and practices have established three groups of forest functions - ecological, social and production. Due to altered social and societal conditions the demands for forest products and the dependence on forests have changed. Ecological and social forest functions have become more important in the last decades. The importance of timber production remains significant because of a large forest area and lack of other renewable and unrenewable natural sources, and ensures an important development perspective that proves to be especially successful in high quality timber production.

5.2 Changes in silvicultural practices

In the last fifty years the close-to nature forest management system has been established . An important contribution has been made by phytocoenology research and forest sites mapping, the establishment of selection and irregular shelterwood silvicultural system and the establishment of silvicultural planning (scale 1:5000) that takes into account the sites and stand conditions in detail and the actual forest owners interests.

In the last decades the proportion of pioneer forests with spruce conversion has decreased. The present proportion is null while in the past decades the annual range was about one thousand hectares. The same proportion is seen for artificial forest regeneration with spruce. The reasons lie in the different method of silvicultural work-funding and a changed concept of forest silviculture.

Among negative trends it is worthwhile mentioning a decrease in the extent of felling and range of tending and regeneration measures. The proportion of protective measures increases, the latter being the consequence of an increase in red and roe deer population, a higher portion of spruce stands and the lower extent of felling and other silvicultural measures.

The described changes show the realisation of some forestry policy guidelines specified in the Forest Development Programme and these are to increase the growing stock, to change the forest structure towards a more natural one, to carry out measures of medium intensity, and to advance natural regeneration etc., while at the same time some guidelines are not being pursued: to produce high quality and large diameter timber, and intensive tending during young development phases etc.

Organisations related to forestry

Ministry of Agriculture, Forestry and Food, 1000 Ljubljana, Dunajska 58, SLO
Fund of Agriculture Land and Forests of Republic Slovenia,1000 Ljubljana, Dunajska 58, SLO
Slovenian Forest Service, 1000 Ljubljana, Vecna pot 2, SLO
Slovenian Forestry Institute, 1000 Ljubljana, Vecna pot 2, SLO
Biotechnical Faculty, Department of Forestry and Renewable Forests Resources, 1000 Ljubljana, Vecna pot 83, SLO
Secondary School of Forestry and Wood Processing, 6230 Postojna, Trzaska 36, SLO
General Forestry Association, 1000 Ljubljana, Miklosiceva 38, SLO
Cooperative Association of Slovenia, 1000 Ljubljana, Miklosiceva 4, SLO
Association of Slovenian Forestry Societies, 1000 Ljubljana, Vecna pot 2, SLO

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Spain

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1 The Country

1.1 Physical Geography

Situation
Spain and Portugal share the Iberian Peninsula, which is connected to the continent by a 400 km-wide isthmus that, being made up principally by the mountain range of the Pyrenees, constitutes, moreover, an importunate geographic barrier counting, as it does, with many peaks which exceed 3,000 metres in height. The peninsula is separated from Africa by the Mediterranean Sea and the Ocean Atlantic which meet in the Strait of Gibraltar, where the distance between the continents is only 14 km.

Spanish territory is completed by the archipelagos of the Balearic Islands, in the Mediterranean, and the Canary Islands, off the Atlantic coast of the Sahara desert. Ceuta and Melilla, two city enclaves in Morocco are also part of Spanish territory

This geographical situation between two seas (the Atlantic and the Mediterranean) and the markedly continental nature of the climate resulting from the coastal mountain ranges are the main reasons why Spain is a country of very varied natural landscapes and of strong contrasts between these (TERAN et al., 1978).

Geographic units
Spanish territory can be divided into the following large geographic units:
An extensive Central Meseta or plateau, slightly inclined towards the Atlantic Ocean, divided into two parts by an important mountain range (Central System). To the north of this range is the Meseta of the Duero, that takes in the greater part of the basin of the river Duero and reaches average altitudes of between 700 and 1000 m. To the south is the Meseta of Castile - La Mancha and Extremadura, that includes grand part of the basins of the Tagus (Tajo) and Guadiana rivers, with average altitudes of 500 to 700 m.

A mountainous ring surrounds the Central Meseta to the north (Montes of Galicia, Cantabrian Mountains and part of the Iberian Mountains), to the east (Iberian Mountains) and to the south (Sierra Morena). With no important mountain systems to the west, the Meseta slowly drops into Portugal.

Peripheral mountain ranges, resulting from Alpine folding, to the north (the above mentioned Pyrenees) and to the south (Baetic and Penibaetic ranges, the latter with the highest peaks: the Sierra Nevada reaches over 3.400 m).

Two roughly triangular depressions outwith the Central Meseta. In the north-east the valley of the river Ebro, bounded by the Pyrenees, the Iberian Mountains and separated from the Mediterranean by the Catalan Coastal Range. In the south-west the valley of the river Guadalquivir, bounded by the Sierra Morena and by the Baetic and Penibaetic Mountains, but open to the Atlantic Ocean.

A series of more or less discontinuous coastal plains. Given the proximity of the mountain ranges to the sea these plains are generally narrow and not very extensive.

The two above-mentioned archipelagos, the Balearic Islands in the Mediterranean and related to the peninsular mountain ranges; and the Canary Islands in the Atlantic, of volcanic origin and with the highest peak in Spain (Pico de Teide, 3.718 m).

This continuous alternation of high mountain ranges, mesetas and lower mountain ranges, also explains the variety and the contrasts of the Spanish landscape (TERAN et al., 1978).

Relief

The great geographic units make up a very varied relief, but the principal characteristic of this relief is its high average altitude of 660 m. This is twice the European average and is only surpassed by Switzerland. However, this high average altitude is not due to the importance of the mountain systems but rather to the extensive area of the Central Meseta.

The classification of Spanish territory by altitude gives the following results:

- 11% of the area is between 0 and 200m high
- 32%, between 200 and 600 m
- 39%, between 600 and 1,000 m
- 18%, over 1,000 m

Lithology and soils.

In terms of lithology, a siliceous Spain, a calcareous Spain and a clay Spain can be distinguished.

The siliceous Spain is found principally in the western half of the Peninsula, the Central and Penibaetic Ranges, the Sierra Morena and part of the Pyrenees. The soils are mainly formed over granites and slates, and abundant vegetation grows over these (especially in the north and centre of the peninsula).

The calcareous Spain is centred on a fringe running parallel to the Pyrenees (including part of these same mountains) that continues to the centre of the Cantabrian Mountains. From there it changes direction, and heads south-east through the Iberian Mountains out into the Mediterranean to include the Balearic Islands. It occupies a large part of the south-east of the peninsular and continues towards the west with the Baetic and part of the Penibaetic ranges. The soils are formed over very varied material with, in general, rather poor, sparse vegetation (except in the north).

The clay Spain occupies most of the Central Meseta and of the valleys of the Ebro and the Guadalquivir. These soils are made up of tertiary and quaternary materials, generally with a high pH, and are severely altered by intensive and extensive agricultural use over many centuries.

The make up of the Canary Islands constitutes an oddity, being comprised of different volcanic materials.

The diversity of soils is notable and contributes to the bio-geographic diversity. On the other hand, part of the erosion which exists in greater or lesser degree in a large part of the territory (see point 4.3) is one of the more unfavourable characteristics that conditions the application of forestry and emphasises the need for forestation.

Climate

The geographic situation and relief explain the climatic diversity of Spain. The Iberian Peninsula and the Balearic Islands are affected by the Atlantic and polar masses of air and centres of action, by the Mediterranean depressions, and, to a lesser extent, by the continental air masses of Central Europe (cold) and the Sahara (very hot and dry). The climate of the Canary Islands is regulated by the moist trade winds and dry Saharan winds (TERAN et al., 1978).

In all cases the relief, and especially the alignment of most of the mountain systems (east-west), is an element of contrast and modification of the climate.

With the exception of the north and almost all the north-west, Spain has a Mediterranean climate characterised by dry summers and abrupt changes. The elevated mountains represent transitions from Mediterranean to Atlantic climates. The two Mesetas, the Ebro Valley and the mountain ranges in the interior have a markedly continental climate.

The Lautensach-Meyer classification of precipitation and rainfall deficit is considered adequate. This establishes, through Thornwaite's concept of potential evapotranspiration, a definition of aridity. Thus, (TERAN et al., 1978) define:

- A humid Iberia, characterised by no months with rainfall deficit, that comprises the north of the peninsula and almost all the north-west (Galicia). This is the non-Mediterranean or Atlantic Spain.
- A semi-humid Iberia, with one to four months with deficit, but a positive annual balance. This includes almost all of the mountain systems in the rest of the peninsula.
- A semiarid Iberia, with four to six months with rainfall deficit, and without annual surplus. Large areas of the Central Meseta, the valleys of the Ebro and Guadalquivir, the Mediterranean littoral and Balearic Islands are included within this zone.
- An extremely semiarid Iberia situated in the extreme south-east of the peninsula with seven to eleven months of deficit.

This panoramic view of the Spanish climate is rounded of with reference to the Canary Islands, whose climate presents the following characteristics. Relatively moderate rainfall in the north of the mountainous isles, with deficits compensated for by the condensation of the atmospheric humidity (in which process the vegetation plays an important role); acute aridity in the south of the isles, and in those closest to the African continent, with zones of transition.

In the Köppen climate classification, the majority of Spain is included into the climate type C (temperate) with two subclimates, one humid temperate (C_f) in the north and northwest, and another one temperate with dry summer season (C_s) in the rest of the Peninsula. Smaller presence of dry climate (B) in the SE corner of Spain, as well as cold climate (D) in the upper levels of the main mountain ranges (Pyrenees, Central, Sierra Nevada) may be also found.

Vegetation

Climate, lithology, soils, relief and geographic situation, together with human activity during thousands of years have configured Spanish flora and the vegetation, rich in species (more than of 5.500) many of which are endemic. According to BOLOS (1978) three floristic regions are found in the Iberian Peninsula: Boreal-Alpine, Euro-Siberian and Mediterranean. The Canary Islands are included in the Macaronesic region of Atlantic archipelagos.

The Boreal-Alpine region of Spain is situated exclusively in the highest altitudes of the Pyrenees. It is characterised by not very extensive forests of *Pinus uncinata* and *Abies alba*, and by other more extensive ones where these species appear mixed with *Pinus sylvestris* and *Fagus sylvatica*. These latter also form pure stands. Above these forest stands there are meadows of *Festuca sp.* (calcareous soils) and of *Nardus stricta* (siliceous soils).

The Euro-Siberian region of Spain constitutes the north (Cantabrian range, western Pyrenees) and the north-west (Galicia). It is an ideal region for oaks (*Quercus robur* and *Quercus petrea*) whose natural extension has been profoundly altered principally by agricultural and grazing. The more highly degraded areas have been reafforested with *Pinus pinaster*, *Pinus radiata*, *Eucaliptus sp*. and *Castanea sativa*. There is also abundant heaths (*Erica sp*) that represent the highest degradation, together with gorse (*Ulex sp*).

The beech woods (*Fagus sylvatica*) are well represented, especially towards the east. Their natural area has generally been little altered and is currently undergoing a certain expansion (abandoned grazing land, episodes of colonisation under the cover of conifers).
The Atlantic - Mediterranean transition sector located in the high mountains of the interior (Central System, Iberian Mountains) could be included in this region with an interesting presence of *Fagus sylvatica* (Iberian Mountains) and very important formations of *Pinus sylvestris*. In the western zone of the Central System *Pinus pinaster* and *Castanea sativa*, appear together with species of *Quercus*.

The Mediterranean region makes up the rest of the Iberian Peninsula and the Balearic Islands, with more than 80% of Spanish territory. This is the most varied region with the highest number of species (floristic wealth) and of associations (phito-sociologic richness) (BOLOS, 1978).

The Evergreen oak (*Quercus ilex*) characterises the major part of this region's territory, although its natural extension has been profoundly altered by substitution by crops and scrub. The most highly degraded zones have been reforested with the Mediterranean pines found in the zone (*Pinus nigra, P. pinaster, P. halepensis, P. pinea*). Other zones present very sparse arboreal formations, typical of the Spanish forest landscape, the dehesas or open pasturelands.

In the continental climate zones of the eastern part of the peninsula with basic soils there is a predominance of natural coniferous formations of (*Pinus sylvestris*, *nigra and pinaster*), of which the junipers (*Juniperus thurifera*) stand out for their originality at a European level. In the lowlands near the Mediterranean see *Pinus halepensis* predominates.

The Cork Oak (*Quercus suber*) predominates the siliceous soils of the Southwest of the region and forests of Pinus nigra, Pinus halepensis and Pinus pinaster appear in the Mediterranean mountains. This latter species also has an important presence in the continental dune of the Duero Meseta.

Mediterranean scrub (macchia) dominates the most arid zones the different formations and presence of *Pinus halepensis*. The only European palm: the Mediterranean Fan Palm (*Chamaerops humilis*) appears in the arid coastal zone, and in the very arid extreme southeast there is a conifer from the north of Africa, *Tetraclinis articulata*.

The Macaronesic region, in the Canary isles, forests of *Pinus canariensis* characterise the higher zones together with the presence of relic formations (from the Terciaria era), whereas the temperate moist forests (*laurisilva*) occupy the areas of higher humidity. In the lower zones there is a range of Mediterranean transition and arid sub-tropical formations (*Euphorbias sp*).

1.2 Human Geography

The organisation of Spanish territory is the State of the Autonomies, an almost federal, asymmetric structure, established by the 1978 Spanish Constitution, that re-established the democratic system, together with the fundamental principals of the Spanish juridical organisation.

The seventeen Autonomous Communities, (table 1 includes data about population and area), were not implanted by force, as in a federal state although they have, in fact, developed all over Spain. These organisms have assumed responsibility for forests and their exploitation since 1986.

Spain has a population of 39.669.394 (1996) and an area of 505.960 km^2, with a density of 78,4 inhabitants/km^2. The population is mainly concentrated in the coastal zones, where the density reaches 200 inhabitants/km2, while the regions of the interior are sparsely populated with a density of 25 habitantes/km2 (Castile and Leon –27-, Castile - La Mancha –22-, Extremadura –26-, Aragon –25-).

The number of municipalities in the year 1991 was 8.097, a drop of around 1,000 in the last 40 years. Moreover, 851 of these have fewer than 100 habitants, and are thus faced with a difficult future.

These figures (sparse population in the interior, reduction of municipalities and the low population of many of these) are indicators of rural depopulation, that has had and still exerts a negative effect on forest development in Spain.

In the field of the Spanish economy, the Gross Domestic Product (GDP), based on figures for 1996, was 463 billion ECU (El País 1998). In 1995 the per capita income was 15,586 dollars (the average figure in the European Union in the same year was 19,918 dollars, in other words, the Spanish average is 78.25% of the EU average.).

The economic weight of the different sectors of the Spanish economy is as follows (1996):

- Agriculture*: 3.7%
- Industry: 24.8%
- Construction: 8.2%
- Services: 62.9%

*reaches over 10% in Extremadura, Castile and Leon and Castile - La Mancha.

The relatively low weight of agrarian production within the Spanish economy as a whole is clear. The forest sector represents less than 5% of this agrarian production, so its economic direct importance is minimum.

The active population in Spain is 16,200,000 persons (1998), which represents an index of activity of 50%, one of the lowest in the European Union together with Italy. Moreover, the unemployment rate is 11% (1998), used to be one of the highest in the EU but has reduced significantly in the past years. The distribution of the active population by sectors is as follows:

- Agriculture: 8,1%
- Industry: 20,4%
- Construction: 9,8%
- Services: 61,8%

One of the pillars of the Spanish economy is tourism, with more than 60 million tourists in the year 1997, who assured a net inflow of 18 billion ECU (1996) to the Balance of payments. This flow more than balanced the chronic deficit in the Commercial Balance of approximately 13 billion ECU (1996).

Another important element for the Spanish economy has been the net transference of financial resources since the country's entrance into the European Union. These funds have been principally for the agrarian sector and infrastructure and have totalled 6,4 billion ECU (1996); Spain being the principal receiver of EU-funds with 33.2% of the total.

1.3 The forest sector

The following are the responsibilities of the central state in forest policy matters:

- International relations and representation in the EU
- Airborne fire-fighting
- Forest inventories
- National Parks (with shared management responsibilities)
- Large-scale subventions and investments (hydrology, re-afforestation, etc.)
- Taxation
- Forest and nature protection frame law.

In Spain a National Forest Policy has not been defined yet, but negotiations on a Forest Strategy have intensified recently (MMA, 1999). Instead, the policies of various Autonomous Communities have been translated into law on a regional basis: Forest Law of Catalonia (1988), Navarre (1990), Andalucía (1992), Valencia (1993), etc.

The basic standing legislation is limited to two principal laws:

- Forest Law (Ley de Montes) (1957).
- Frame Law of Conservation of Natural Areas and Wildlife (Ley de Conservación de Espacios Naturales y de la Flora y Fauna silvestres) (1989).

In addition, most of the Autonomous Communities have established their principal directives on forestry, in the denominates Forest Plans (Planes Forestales)[1].

The competent bodies in forest matters depend on different organisms according to each Autonomous Community.

The data corresponding to the Spanish forest areas distributed by Autonomous Communities appears in the table below (table 1).

In addition to this, it must be remembered that there are 3,278,961 ha of forest land with a

[1] Plan Forestal de Andaluciá (1990); Plan Forestal de Galacia (1992); Pla General de Política Forestale deCatalunya (1994), between others.

tree density of between 5 and 20%, known as sparse woodland (arbolado ralo). These areas, as well as their importance for the area they occupy, include a pastoral system of special importance, namely the dehesas, or open pasturelands, and which, as such, are not included within of the wooded forest area mentioned above, although they are included within the total forest area.

The distribution of the wooded forest area is 3,713,900 ha of broad-leaved, 5.436.600 ha of conifers and 1.475.300 ha of mixed conifers and broad-leaved.

The dominants forest species in Spain are the following:
- *Quercus ilex*: 1,965,500 ha as a pure stands and mixed with other species (560,000 ha with *Quercus suber*).
- *Pinus halepensis*: 1,459,800 ha, principally as a pure stands.
- *Pinus sylvestris*: 1,449,000 ha, in pure and mixed stands.
- *Pinus pinaster*: 1,494,800 ha, of which 771,000 ha are in the north of Spain.
- *Fagus sylvatica*: 568,400 ha, in pure and mixed stands.
- *Pinus nigra*: 565,600 ha, in pure and mixed stands.
- *Pinus pinea*: 374,900 ha, in pure and mixed stands.

A very important element to bear in mind is the area included in the Protected Natural Areas, made up of 3,040,581 ha 1995, which represents 6% of the territory, and where important areas of forests are protected.
Spain began an intense programme of reforestation in 1940. The total area forested up to 1986 can be estimated in 3.7 million ha (MADRIGAL, 1998) and up to now of at least 4 million ha.

The percentages of forested area, by species, appear in table 2 (MADRIGAL, 1998).

These figures illustrate a generalised use of pines (80%) which can be explained by the pioneering character of these species that makes them very adequate for soil-defence reforestation and a majority of slow-growing species (67%), and a predominance of autochthonous species (83%) for the same reasons.

Table 1. Area (forest and totals) and Population in Spain.

Autonomous Community	**Wooded Forest Area (density>20%)**	**Total Forest Area**	**Total Area**	**Population**
Andalusia	1,544,517	4,325,378	8,759,968	7,080,002
Aragón	975,395	2,478,761	4,772,026	1,180,989
Asturias	325,700	667,252	1,060,357	1,079,218
Balearic Islands	122,475	203,902	499,168	744,153
Canary Islands	91,572	485,981	744,695	1,545,532
Cantabria	165,543	323,275	532,139	525,288
Castile – La Mancha	1,165,769	3,473,536	7,946,185	1,654,138
Castile and Leon	1,615,790	4,516,386	9,422,402	2,490,203
Catalonia	1,310,506	1,855,944	3,211,325	6,093,492
Extremadura	810,070	2,278,588	4,163,457	1,046,492
Galicia	1,045,376	1,968,310	2,957,509	2,715,337
Madrid	163,582	392,968	802,792	5,055,278
Murcia	102,330	505,781	1,131,397	1,076,635
Navarre	343,902	529,163	1,039,072	524,386
Basque Country	350,252	469,354	723,481	2,065,670
La Rioja	128,916	294,403	504,526	263,188
Valencia	363,994	1,215,078	2,325,508	3,920,615
TOTAL	**10,625,698**	**25,984,062**	**50,596,014**	**39,188,194**

Areas of reforestation with fast-growing species, with the aim of producing wood, are estimated in accordance with the II National Forest Inventory as follows:
- *Pinus pinaster* in the North of Spain: 285.000 ha.
- *Eucalyptus*: 380.000 ha, together with 345.000 ha mixed with *Pinus pinaster* in the north of Spain.
- *Pinus radiata*: 174.000 ha.
- *Populus*: 100.000 ha.
- Total forest plantations: 1.284.000 ha (10% of the total of forests)

2 Forest resources and their uses

2.1 Typology of the natural resources

The conditioning factors of physical environment examined in point 1.1 and the long history of human pressure on forest resources have led to the current situation that allows the establishing of the following schematic typology:

Forests of natural origin
In the Euro-Siberian region of the north of Spain oak forests are rare and beech forests are important. There are also extensive stands of pine forests with *Pinus sylvestris* and *Pinus pinaster* in the Atlantic - Mediterranean transition zones.

All these forests can be considered as good wood producers (especially wood for sawmills)

Table 2. Forested area by species.

Species	**% Area**
Pinus sylvestris	15,9
Pinus halepensis	15,2
Pinus pinaster (north of Spain)	7,1
Pinus pinaster (rest of Spain)	14,1
Pinus nigra	11,0
Eucalyptus sp	9,5
Pinus pinea	7,4
Pinus radiata	4,4
Populus sp.	2,5
Other species and mixtures	12,9

with production of fuel wood in disuse and another complementary use for extensive grazing, which is a source of conflicts. The role of soil protection and hydrologic regulation becomes more important the further south it is. The social demand for conservation (inclusion in Protected Natural Spaces) and recreation is growing.

The Mediterranean region, in which the protective role must be considered as a priority, present a varied range of forests whose production is low, and where the social demand of conservation and recreation is also growing. *Pinus nigra* forests are acceptable producers of wood, *Pinus pinaster* moderate, but *Pinus halepensis* forests must be considered weak producers.

In the Mediterranean region there is other, non-wood production such as the stands of *Pinus pinaster* on the Meseta of the Duero (production of resin), those of *Pinus pinea* (production of fruit) and the cork oaks of *Quercus suber* in the south-west (cork production).

In the Boreal-Alpine region situated in the Pyrenees the scarce fir forests and the more extensive mixed stands and pine forests of *Pinus sylvestris* and *P. uncinata* are preferentially protectors to which their low production of wood and recreation must be subordinated..

In the Canary Islands (Macaronesic region, 1.1) there are forests of *Pinus canariensis* (protectors and producers) and temperate rain forests (laurisilva) (strictly protected).

Forests from reforestation
In general the plantations of *Pinus pinaster* (north), *Pinus radiata* and mixtures; of *Eucaliptus sp* (north and south) and of *Populus sp* (zones near rivers) are preferentially producers of wood (for sawing and pulp) and many of them are in their second and third rotations. They are all highly productive.

The rest of the stands resulting from afforestation, except some localised Atlantic - Mediterranean transition zones, are preferentially protective stands. In any case, they are far from maturity or the age for turns, and the only wood products proceed from thinnings. Thinnings have been very much delayed or still has to be done in many of these forests.

Sparsely wooded areas

These are natural forests with a low density (5% to 50% density or cover) that, in general, constitute one of the characteristics of Mediterranean Spain (1.3). Formed by species such as *Quercus ilex* and *Quercus suber* and other *Quercus*, generally mixed, their principal use is for fuel wood and extensive grazing, some production of cork, and even extensive agricultural crops. These are the habitat of select fauna, with species in danger of extinction (birds of prey and carrion eaters, Iberian lynx) and the abandonment of grazing has converted them into important hunting zones.

Scrub

The major part of the 12 million ha of non forest land, mainly covered by scrubs is found in the Mediterranean region. The variety of formations of scrub is very high, from fairly stable scrubs that represent the highest possible grade of complexity (climactic formations), through all the stages of degradation of scrub. These latter formations are unstable (high fire risk), provide very limited soil protection and very low direct profitability, only being apt for extensive grazing or hunting, or for some very specific use (aromatic plants, honey production).

2.2 Wood: stock and consumption

The evolution of wood resources in Spain between 1975 and 1995 can be illustrated with the data extracted from the two national forest inventories and seen in table 3.

The annual wood fellings in Spain is around 14-15 million m^3 c.c., which represents approximately 50% of growth, so that by no means forestry is a threat for the sustainability of Spain's forests, although there is no guarantee of measures to prevent the excessive ageing or other external threats.

Wood consumption in Spain is approximately 25 million m^3 (1992), which represents 0,6 m^3/person and year (the European Union average is 1,0) and the consumption of paper is 109 kg/person and year (the European Union average is 158). The average Spanish values are a result of lower per capita income. The distribution of wood consumption is as follows:

Total round wood consumption: 18,000,000 m^3, distributed between:
- Paper: 5,750,000 m^3
- Boards: 4,050,000 m^3
- Mining: 600,000 m^3
- Sawmills: 6,650,000 m^3
- Other: 950,000 m^3

Used paper: 2,100,000 tons, equivalent to 7,000,000 m^3 of uncut logs.

The production of timber is 14,500,000 m^3, and the recovery of used paper is 1,550,000 tons, which is equivalent to 5.150,000 m^3 of round

Table 3. Growing stock and increment during the period 1975-1995.

	Tree number (10^6)			Standing volume c.c. (10^3 m^3)	Increment (10^3 m^3)
Diameter	**> 20 cm**	**< 20 cm**	**Total**		
1º IFN	1,143.3	6,587.0	7,730.0	456.7	31.34
2º IFN	4,666.4	7,686.5	12,352.9	594.2	30.09 (*)
2 – 1º IFN	3,523.1	1,099.5	4,622.9	137.5	-1.25
% growth	308.15	16.69	59.80	30.10	-3.98

(*) The maturing of many replanted stands from the 1940s-50s produced a drop in growth.
Source: 1º y 2º Inventarios Forestales Nacionales.

wood, that is, a total 19,650,000 m^3. That implies a production deficit of roundwood that rises to 5,350,000 m^3 in Spain. If the trade of wood products during the different steps of productions is included, the deficit is approximately double.

In fact, the most important proportions of forest products imports into Spain are high-quality wood for sawmills and used paper (almost 700,000 t in 1996).

However, in addition to the wood deficit, another added problem is the low added value of the products generated, given that Spain produces a large quantity of pulpwood and a smaller amount and of low quality for sawnwood. This is the opposite of the situation in other countries of the European Union.

2.3 Silviculture

150 years ago Spanish foresters began to learn the forestry that was being taught in the German schools and started to apply it to Spanish forests. In general the results of this long practice are positive, especially in achieving natural regeneration in the Euro-Siberian and Boreal-Alpine beech forests, and in the pine forests of the Atlantic - Mediterranean transition zones. There are, however, some problems due to excessive grazing pressure.
In many Mediterranean zones, taking the precaution of opening the canopy avoids damage to the regeneration process as a result to prolonged droughts and late frosts. This is the case of the *Pinus pinaster* forests in the Meseta of the Duero, and of other pine forests in the mountains of the interior and the south.

As general rule, clear cutting is applied in the *Pinus pinaster* and *Pinus radiata* plantations in the north of Spain, followed by reforestation through plantation. This system is also used in the plantations of *Populus sp*, also with artificial regeneration and in *Eucalyptus sp* using its ability for coppice.

The different modes of shelterwood systems are applied in the majority of forests, both in Euro-Siberian and Boreal-Alpine (beech and pine forests) and in transition and Mediterranean pine forests. When there are no problems with livestock and precautions are taken against droughts and frost damage, natural regeneration is achieved in a reasonably short time.

There is little tradition of using the selection system (fir in the Pyrenees) or poor application of this system, where, in some cases, it becomes an unsilvicultural technique (the exploitation only the best trees and without taking into consideration the future development of the stand).

Thinning is beginning to be used increasingly in forests coming from natural regeneration in public forests as well as in private *Pinus radiata* plantation. Little has been done in the rest of the forests resulting from afforestation, especially in slow-growing species. Low thinnings and selective thinnings are carried out in the best stands of beech and *Pinus sylvestris* forests.

Silviculture is applied within the Forest Management Plans with sustained yield in almost all state-owned and municipally-owned forests but very little in private forests. However, recently a preoccupation has been observed on the part of the forest administration to incentive the structuring of private forests (Catalonia).

The relatively high productivity of the plantations in the north of Spain leads private owners to reforest their forests after clear cutting, although the small scale of ownership impedes the implementing of management plans. Some forest administrations (the Basque Country and Galicia among others) support the grouping of private landowners to limit the inconvenience of forest smallholdings.

The continued utilisation of the dehesas (open oak forests as grazing land) leads to an absence of regeneration of the tree cover, as a result of grazing pressure. The problem could be solved by limiting their grazing, but this would suppose an important loss of income for the private landowners. This solution is not applied, and justifies the diagnosis by Quezel (1977) which considers these formations to be fossil forests.

The enormous extension of degraded scrub raises the necessity for reforestation. More than 5 million ha could be afforested to increase the protection of soils at risk from erosion and regulate the hydrologic regime, and around 0.5 million ha would be susceptible to afforestation with fast-growing, high-production species (especially in Northwest Spain).

Forest fires (see 4.2) constitute the critical factor of continued application of silviculture. Fire prevention work is a costly tool that needs to be intensified.

The most usual rotations are:
Slow growing species:
- 100-150 years for *Fagus sylvatica*
- 100-125 years for *Pinus sylvestris* and *Pinus nigra*
- 80-100 years for *Pinus halepensis* and *Pinus pinaster* (except in Northwest Spain)
- 80 years for *Pinus pinea*

Medium- and fast-growing species:
- 25-30 years for *Castanea sativa* in coppice
- 30-40 years for *Pinus pinaster* (north of Spain)
- 25-35 years for *Pinus radiata*
- 10-20 years for *Populus sp*
- 10-12(15) years for *Eucalyptus sp*
- Cork 8-15 years (between the age 50-200)

2.4 Forest Production

The most important forest production in Spain, corresponding to 1995, according to the figures of the Agrarian Statistical Yearbook (Anuario of Estadística Agraria) (1997) are as follows:
- Wood: 15.6 million m^3. Of this production 61% is produced in the coastal regions of the north of Spain and 7.7% in the province of Huelva (south-west Spain), principally eucalyptus. Most of the wood (74,3%) is produced on private land. The distribution of wood production (1995) by species is:
- Conifers: 9,787,000 m^3. Of which, 30.8% *Pinus radiata*, and 45.5% *Pinus pinaster*.
- Broadleaf: 5,785,000 m^3. Of this, 77% was eucalyptus, and 13,1% poplar.

Thus 81.2% of the wood produced in Spain comes from fast growing species, which, nevertheless, only occupy 12% of the wooded forest area. In a country with the climatic characteristics of Spain, fast growing species have an important role to play, the following aspects of which need to be recognised:
a) Environment: avoiding imports from countries where forest resources are under threat.
b) Employment: creating numerous jobs in the sector, that would not exist with other species.
c) Industry: allows the existence of industries that need raw material that could not be supplied from other sources and ensures a forest cluster which meets the needs of modern economies of scale.

It is important to highlight that the average increment of the Spanish forests is 2 m^3/ha per year, far below of the average for the EU countries.

Other forest production
- Fuel wood: 4,833,000 steres/year, currently this production has recovered from minimum values reached at the beginning of the 1980s with 1.5 million steres. 79.6% of the production of fuel wood is obtained from private properties.
- Cork: 70,000-80,000 tons average production between 1975-95. In earlier years production was somewhat above 100,000 tons.
- Resin: 1,000-2,000 tons/year, production stable since 1991, year in which the production subsidies disappeared. Up to the mid-1970s the production surpassed 40,000 tons/year. The possibility of re-starting help for the sector is currently being studied. This measure implies an increase in production and exploitation of the *Pinus pinaster* forests in Castile and Leon, the principal resin producing region.
- Chestnuts: 10,000-20,000 tons/year. Production is concentrated in the north-west of Spain.

- Pine nuts: 4,000-6,000 tons/year. The production is localised in three regions: Castile and Leon, Andalusia and Catalonia.
- Fungi: 25,000 tons/year. This is currently growing and is of high economic value for many forested districts, principally in Andalusia, Catalonia, Castile and Leon and Galicia.
- Pastures and meadows: These support a livestock load of 455,000 tons live weight a year, clearly inferior to that of 20-30 years ago due to the process of intensification in livestock.
- Hunting: There are 1,400,000 hunters in Spain, whose catch is 17.5 million pieces with a weight of 15,500 tons/year. This economic activity has become very important in recent years, and constitutes the principal use of forests in many zones (Castile - la Mancha, Extremadura and Andalusia).
- Fishing: There are 850,000 anglers who capture more than of 30 million units/year and obtain 6,000 tons of fish. Similar to hunting. Fishing is also on the increase.
- Environment and leisure: This is without doubt the “forest” production with the highest prospect for growth and economic development, through of rural tourism, and the parallel economic activities that can derive from it. The rural development programmes, principally those within the LEADER programme, are a clear example of this, and the links between the forest sector, environment and rural development.

3 Forest economics and forest policies

3.1 Forest Economy

The major part of forest property in Spain is in private hands as can be seen from the structure of ownership (table 4).

The number of forest landholders in Spain, although not known exactly, is approximately 2 million. This is a very high number, owing to the smallholding structure of the sector.

The share of the forest sector to the GDP is, approximately 2%, considering the whole of the primary and industrial sector. The economic value of primary forest production in 1995 was (million ECU):

Timber	621
Firewood	56
Cork	58
Acorns	11
Chestnuts	7
Pine nuts	1
Truffles	4
Fungi	50
Grazing	412
Hunting *	171
Fishing (inland) *	27

* Only the economic value of the pieces captured is considered, which constitute the smaller part of the total that these sectors output.

Table 4. Classification of the forest area in Spain according to ownership.

Type of ownership	Forest area	Total forest and other forest land area	Average area
State and regional forests	665,191	1,088,581	501
Communal forests	2,759.811	5,382,734	619
Contractual Forests (*)	479,966	903,476	501
Private Forests	6,549,206	18,041,328	2.6
Other ownership	171,521	467,935	
Total	**10,625,898**	**25,884,250**	

(*) Private or communal afforestations with management contract with the Forest Service for the length of the first rotation.

Source: Anuario de Esta dística Agraria (1997) and 2º Inventario Forestal Nacional.

The data corresponding to the foreign trade in forest products expressed in volume and value are as in tables 5 and 6.

Table 5. Foreign trade (million ECU, year 1997):

Product	*Exports*	*Imports*
Wood and manufactured products	430	950
Cork	142	44
Wood pulp	249	266
Paper	1.203	2.117
Furniture	1.286	601

Source: Departamento de Aduanas e Impuestos Especiales.

The principal stakeholders of the forest sector are, as well as the different public services and municipalities, the approximately 2 million private landowners, who represent the major part of forest production. The degree of participation of the landowners in associations is very low, despite being a smallholding sector. However, the level of participation in associations has grown notably during recent years. The most representative organisation of the private forest landowners is the COSE, that groups together the regional forest owners associations.

3.2 Industry and employment.

In first place it is necessary to highlight the statistical difficulty with reference to the industrial forest sector, so that the data are of approximate nature (AITIM and VIGNOTE et al, 1996-97).

Forestry
Approximately 30.000 jobs, 10% related with cork.

Industries of primary transformation
- Sawmills: predominance of family-run sawmills, there are between 2,700 and 3,300 companies, of which only some 350-400 can be considered industries (with more than of 5 employees). The total number of workers is between 15,000-23,000. The turnover of this industry is approximately 180 million ECU.
- Board and plywood industry: 470 companies and 12.500 employees, with a turnover, only in boards, of 180 million ECU.
- Cork Industry: 320 companies with 5,000 employees, as well as 6,000 other jobs generated indirectly. Turnover 60 million ECU.
- Resin Industry: currently in decline, there are 15 centres, although not all working, and 200 workers, as well as the 2,000 resin-tapers who still exist, although many no longer work in the forests. The current economic value is very low.
- Pulp Industry: 12 companies (of which 8 also manufacture paper), for which reason the employment is reflected jointly with the papermaking industry. The turnover is 300 million ECU.
- Hunting Industry: this cannot be properly considered an industry, but its growth has led to a proliferation of the “industrialisation”. It generates 45,000 jobs and has a turnover of 375 million ECU.

Secondary industries
- Carpentry Industries: These have a turnover of 360 million ECU, and it is necessary to distinguish between two types of industry:
- Craft industries: 25,000 companies and 50,000 workers.
- Industrial companies: 2,500 companies and 65,000 employees.
- Furniture industry: turnover 2960 million ECU. There are two distinct categories within this heading:
- Craft industries: 8,000 companies and 18,000 workers.
- Industrial companies: 3,050 companies and 65,000 employees.
- Paper-making industry: 200 companies and 20,000 workers (including the production of pulp). Turnover 1390 million ECU. 91% of the production is concentrated in the Basque Country, Catalonia and Valencia.
- Packaging and toy industries: Turnover 300 million ECU.
- Barrel-making industry: Turnover 6 million ECU.

Table 6. Foreign trade of wood and cork based products (thousands of tons, 1987-1996)

Year	**1996**		**1995**		**1994**		**1993**		**1992**	
Product	**EXPORT**	**IMPORT**	**EXPORT**	**IMPORT**	**EXPORT**	**IMPORT**	**EXPORT**	**IMPORT**	**EXPORT**	**IMPORT**
Pulp	673	494	664	323	619	404	595	410	565	386
Paper & cardboard	973	2377	918	2381	823	2377	734	2075	624	2046
Roundwood	124	1462	336	1659	202	1089	40	964	51	1544
Sawnwood	31	1136	31	1114	36	936	37	940	34	1184
Firewood	61	52	45	50	30	65	12	102	9	98
Veneer and chipboard	469	530	406	378	407	355	490	333	286	368
Palets	74	60	49	49	39	41	26	34	21	37
Joinery & manufacturies	74	77	70	76	49	61	36	62	37	78
Cork	54	15	57	17	52	11	53	11	46	11
Furniture	153	47	124	37	101	35	63	72	60	57

Year	**1991**		**1990**		**1989**		**1988**		**1987**	
Product	**EXPORT**	**IMPORT**	**EXPORT**	**IMPORT**	**EXPORT**	**IMPORT**	**EXPORT**	**IMPORT**	**EXPORT**	**IMPORT**
Pulp	6224	410	523	384	551	323	547	422	512	429
Paper & cardboard	566	1723	526	1422	472	1137	438	927	461	743
Roundwood	8	1673	10	1614	98	2657	131	1395	32	657
Sawnwood	57	1110	64	1184	79	1985	116	994	127	858
Firewood	8	67	15	41	7	50	3	47	-	-
Veneer and chipboard	266	334	242	252	164	297	158	226	181	149
Palets	24	24	31	12	52	12	29	4	15	7
Joinery & manufacturies	37	69	47	59	49	52	45	37	42	51
Cork	48	11	38	11	47	8	44	7	43	4
Furniture	54	46	56	42	69	31	62	23	62	21

Source: Estadísticas de Comercio Exterior. Departamento de Aduanas.

Total amount of labour of the forest sector: 330.000.

In addition to the employment generated by the industrial sector, which represents the highest volume, the workers directly involved in primary production, extraction of wood and other products (except hunting) have to be taken into account. These represent between 40,000 and 50,000 jobs.

4 Forest and forest related policies

4.1 Legislation and forest administration

The frame legislation currently in force is the 1957 Ley de Montes (Forest Law) of the year, which has been waiting for updating since the establishment of the Constitution (1978). This law is inadequate for the actual federal organisation of Spain. In the absence of an effective frame law the different regions have approved their own legislation outwith a common framework as can be observed in the following table.

Table 7 shows the degree of legislative development of the different autonomous communities.

The forest services are since the beginning of the 80's ruled by the regions. Substantial differences in organisation between the regions can be increasingly be observed (rank, department, budget). In general a common problem of the Spanish forest administration is the lack of qualified personnel and budget.

4.2 Research and teaching

Forest research in Spain is carried out fundamentally by the Centre for Forest Research (Centro de Investigation Forestal; CIFOR) of the National Institute of Agrarian Research (INIA). There are also other centres; some recently created as is the case of those in Catalonia (CTFC and CREAF), the Basque Country, Castile - La Mancha, Valencia (CEAM) or Castile and Leon (Valonsadero); and other already established centres such as those in Galicia (Lourizán), Andalusia or Madrid. Lastly there are different the University departments which also carry out research into forests.

The teaching of forestry can be grouped on three levels:

- Forest ranger: qualification corresponding to vocational technical training, that permits access to the corps of Forest Agents.
- Diploma in Forestry: 3-year university studies taught in the universities of Madrid, Albacete, Vigo (Pontevedra), Santiago (Lugo), Leon (Ponferrada), Valladolid (Palencia), Lleida, Valencia (Gandía), Huelva and Soria.
- Degree in Forest Engineering: 5 year university studies taught in the universities of Madrid, Cordoba, Lleida, Santiago (Lugo) and Valladolid (Palencia), as well as the private University of Ávila. There are projects to enlarge BSc studies to MSc in Huelva, Albacete and Valencia.

Table 7. Legislation on forest and nature conservation in the different Autonomous Communities.

	Forest Law	**Protected Areas Law**
Andalusia	1992	1989
Aragón		1998
Asturias		1991
Balearic Islands		1991
Canary Islands		1994
Cantabria		
Castile - la Mancha		
Castile-León		1991
Catalonia	1988	1985
Extremadura		1998
Galicia		
Madrid	1995	1995
Murcia		1992
Navarre	1990	1996
The Basque Country	1986[I]	1994
La Rioja	1995	
Valencia	1993	1994

[I](Normas Forales Forestales of the Provincial Government of Álava)

4.3 EU policies and the Spanish forest sector

The influence of the different community policies on the Spanish forest sector has always been indirect, due to the absence of a community forest policy. Basically the most important measures have been:

a) Indirect policies:
- Protection and promotion of the cork sector (included in Annex II of the Treaty of Rome, 1957).
- LIFE Programme: 30 million ECU in the year 1997.
- Other programmes, such as the network for control of atmospheric pollution in forests , etc.

b) Measures accompanying the reform of the CAP, which came into force in 1993:
- Reforestation of agricultural lands: 120 million ECU a year, with a reforested area of 70,000 ha/year.
- Agro-environmental programme: indirect effects on the forest sector. Important in relation with the conservation of natural resources.

c) Common Environmental Policy: 5th Programme of Common Action (1995-99): its effects on the forest sector are very limited.

d) Rural Development Policy: fundamentally carried out through the LEADER programmes, its effects are also tangential.

Spain's natural resources constitute a recognised ecological heritage within the European Union (first country in Nature 2000 protected area of the EU) thanks to their wide bio-diversity and to their relatively good state of conservation; However, the weight of the forest and environmental sector in the Spanish economy is very low. Thus it is difficult for the same forest sector to conserve these resources, given the low profitability of the woodlands in Spain, and consequently the necessary finance must come from outwith the countryside, either from Spanish society as a whole or from Europe.

5 Main current conflicts and challenges

5.1 Lack of forest policy

The territorial division of Spain into regions and the responsibilities these have taken together with the residual responsibilities maintained by the central state make it extraordinarily complicated to design and implement a country-wide forest policy that has to synthesise and include 17 autonomous policies.
The Spanish Parliament still has to promulgate the basic forest law that is forseen in the Constitution, although various regions have done so. This fact will present difficulties of co-ordination on a legal framework, a key theme of any forest policy.

On the other hand there is no clear orientation for the forest managers and stakeholders. The public (central and autonomous) powers try to placate that sector of public opinion which is sensitive to environmental themes (and in certain aspects disorientated by the ENGO) and little more. This favours non-intervention, and the consequences are becoming brusquely evident (forest fires) or in the longer term (ageing of the forest stands, absence of regeneration, diseases and plagues, etc.).

The statistics related to forests, with the exception of the National Forest Inventories and figures related to fires, are difficult to compile and delayed. The channels between the State Administration and the Autonomous Communities for the transmission of information about the latter's forest activities are non-existent or disorientated.

In many Autonomous Communities the administration's technical staff is small, little motivated or is dedicated exclusively to nature conservation tasks or CAP-afforestation grants and bureaucracy.

This rather negative panorama, (although signs of positive changes are being detected) leads to the conclusion that the principal problem of

Table 8. Statistics for fires in Spain

Period	1991-95	1985-90	1980-85	1975-80	1970-75
Number of Fires	15,000	12,000	8,000	6,000	3,000
Forest Area	97,000	90,000	99,000	95,000	48,000
Total Area	207,000	233,000	244,000	240,000	103,000

Source: Anuarios de Estadística Agraria. MAPA.

the Spanish forest sector is none other than the lack of a forest policy.

5.2 Forest fires

There is no doubt that forest fires constitute the other important problem that affects the forest sector in Spain, and the Mediterranean countries in general. The statistics for fires in Spain are as in table 8, given as average values for the period.

During recent years the north-west of Spain (Galicia, Asturias, and the provinces of Zamora and Leon) concentrates 57% of the forest fires, although only 2% of the forest area affected, most being zones of extensive grazing areas.

Causes of forest fires during 1994:
- Negligence: 15,5%
- Lightning: 4,3%
- Other causes: 2,1%
- Provoked: 54,8%
- Unknown: 23,4%

As can be seen, the action of man, directly or indirectly, is the major cause of fires.

The historic reasons that explain the abundant fires in Spain (Vélez, R., 1991) are:
- Inadequate use of fire in the rural environment (stubble burning, proliferation of grazing land, etc.)
- Abandonment of the forests
- Grazing pressure: competition and promotion of pastures
- Restrictions of the traditional uses of the forest
- Forest plantations
- Pressure of urbanisation
- Criminal (revenge)

5.3 Soil erosion

The erosion of the soil in Spain is a problem that comes down from far in the past. In fact, at the beginning of the 20th century Hydrologic Forest Divisions were set up to fight against this problem. Nowadays, the responsibility for this is shared between the central and regional services.

The intensity of erosion in Spain can be perceived in the data referring to the area affected according to the Hydrologic Forest Restoration Plan of 1991:
- Extreme erosion (>200 Tm/ha per year): 1,112,000 ha (2.2% of the land area of Spain).
- Very high erosion (100-200 Tm/ha per year): 2,561,000 ha (5.1%).
- High erosion (50-100 Tm/ha per year): 5,488,000 ha (10.9%).
- Medium erosion (12-50 Tm/ha per year): 12,923,000 ha (25.6%).
- Low erosion (5-12 Tm/ha per year): 17,309,000 ha (34.2%).
- Very low erosion (<5 Tm /ha per year): 11,151,000 ha (22%).

The cost of reconstructing the plant cover in Spain to reduce erosion to acceptable values, according to the above mentioned plan of restoration, would suppose between 120-180 million ECU per year, a time span of 20 to 40 years and action on 2-4 million ha.

5.4 Profitability of the forests

The stands precedents of afforestation with fast-growing species are the most productive. For the rotations indicated the average production can be estimated as:

Populus sp.	10-25 m3/ha/year
Eucalyptus sp (north-east)	18-20 m3/ha/year
Eucalyptus sp (south-east)	3-6 m3/ha/year
Pinus radiata	15-20 m3/ha/year
Pinus pinaster (north)	6-10 m3/ha/year

The adequate application of thinnings in pine forests and genetic improvement techniques in all cases can increase these figures by at least 20%.

The natural stands of slow-growing species subjected to Management Plans present the following average productions:

Pinus sylvestris	2-4 m3/ha/year
Fagus sylvatica	1-4 m3/ha/year
Pinus nigra	1-2 m3/ha/year
Pinus pinaster (except in the north)	1-2(3) m3/ha/year
Pinus halepensis	0,5-1 m3/ha/year

In forests of these species without Management Plans the figures are approximately 50% lower.

The conclusion is that, except in the case of the fast-growing species, and not even in all these cases, Spanish forests are non directly profitable for their owners. The absence of a forest-chain policy, to facilitate the connection between supply and the demand has to be added to this physical reality. Rural depopulation aggravates the situation in that the micro-market that facilitated the consume of wood, fuel wood and fodder by the rural populations near the woods has disappeared. The lack of management provoked by the nature protection policy, and the abandoning of traditional uses leads to the multiplication of forest fires thus complementing this chain of problems in need of urgent solutions.

5.5 Extensive grazing

The history of Spanish forests is closely linked to the history of stockbreeding and grazing, given that the characteristics of the Mediterranean forest mean that the livestock are of special economic importance. It is also necessary to recognise the cultural and ecological importance of extensive livestock breeding in Spain, not only because of its role in the conservation of traditional natural resources but also because of its by wide bio-diversity.

According to various authors (Fernández Tomás, G., 1985), the economic value of pastures as forest production, could be the most important in quantity.

Problems presented by extensive grazing in its relation to the forest sector:

Excess of livestock
Historically, the principal cause of destruction of the forests has been related to the development of the pastures for the livestock (Mesta), and still continues to be an important problem in many zones. This problem worsened after Spanish entry into the European Union and the application of the CAP, which has been "generous" in subsidies for extensive livestock farming. The stockbreeder's use of fire to improve and increase the grazing both favours the appearance of forest fires and impedes the development of forest regeneration.

The excessive livestock load accentuates the serious problems of erosion even when it is not the direct cause of these. Moreover it provokes the disappearance of forest species of major interest.

Scarcity of livestock
Although in general this can be considered as a positive factor for the development of the tree cover (in fact a large part of the increase of the forest area in the last 20 years is due to this abandonment) there are also negative elements derived from the disappearance or reduction of extensive livestock grazing:

- Problems of rural depopulation: abandonment of the villages and of the woodlands , which in turn accentuates the risk of forest fires.
- An increase in combustible material in the woodlands, which in many zones with natural fire risk has been the principal cause of their proliferation.
- Loss of genetic material of undoubted value, and loss of the pastoral culture. The absence of economic and social interest in the woodlands, as well as in the population of the villages also threatens a long lasting preservation of the forests.

In general, the livestock problem in Spanish forests can be summed up as the absence of planning that balances livestock load to the grazing capacity of the forest and fixes the areas (in regeneration) closed to grazing.

5.6 Sustainability

The concept of sustainability applied to the foresty in Spain could be considered from various points of view:

- Sustainable management: An instrument for verification whose maximum expression could be the Eco-certification of forest products. In Spain this certification is up to today non-existent.
- Environmental Impact Assessments: only demanded for primary afforestation and changes to agricultural use.
- Management Plans: Forest management plans cover today some 20% of Spain's forests.

As far as the integral rural policy is concerned, a priori the forest sector undoubtedly forms part of Rural Development, and this is recognised and clearly manifested in the Agenda 2,000. However this does not mean that a forest policy is articulated within Rural Development in response to the problems that face the sector, but rather that it simply recognises its importance as a key element in sustainable development.

Organisations related to forestry

Federal Forest Service

D.G. Conservación de la Naturaleza (Federal Forest and Nature Conservation Service), Gran Vía San Francisco, 4, E-28005 Madrid, +34-91347 59 88

Regional Forest Services

Direcció General de Medi Ambient, Govern Balear, Forners 10, 07006 Palma de Mallorca

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Dirección General de Medio Ambiente Natural, Junta de Comunidades de Castilla-La Mancha, Pintor Matías Moreno 4, 45071 Toledo

Director General de Medio Natural, Junta de Castilla-León, Muro 9, 47071 Valladolid

Dirección General de Medio Ambiente, Junta de Extremadura, C/ Juan Pablo Forners 9, 06800 Mérida

Dirección General de Medio Natural, Comunidad de Madrid, Princesa, 3, 8ª Planta, 28008 Madrid

Dirección General de Medio Natural, Diputación General de Aragón, Pº María Agustín 36, 50071 Zaragoza

Dirección General para el Desarrollo Sostenible, Generalitat Valenciana, Arquitecte Alfaro 39, 46011 València

Dirección Xeral de Montes e Medio Ambiente Natural, Xunta de Galicia, San Lázaro s/n, 15703 Santiago de Compostela

Dirección Regional de Montes y Medio Natural, Principado de Asturias, Edificio Administrativo, Planta 3ª, Sector Central Izq., Coronel Aranda 2, 33005 Oviedo

Dirección General de Medio Natural, Gobierno de la Rioja, Prado Viejo 62 bis, 26071 Logroño

DirecciónGeneral de Ordenación y Gestión del Medio Natural, Gobierno Vasco, Duque de Wellington 2, 01010 Vitoria

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Dirección Regional de Montes y Conservación de la Naturaleza, Diputación Regional de Cantabria, C/ Rodríguez 5 1º, 39002 Santander

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http://agrobyte.lugo.usc.es/index.html
http://www.inia.es
http://www.grn.es/fl/foro/forespano.htm
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Sweden

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1 The country

1.1 Natural conditions

1.1.1 The climate

The annual mean temperature of the Scandinavian countries is considerably higher than that typically prevailing at their latitude due to the prevailing south-western air currents and the Gulf stream. Both annual and diurnal temperature amplitudes are rather moderate, although only western coastal areas experience true oceanic climate. Soil freezing occurs all over Sweden but to much greater depths in the north. Permafrost is not recorded with certainty in the mineral soils except at high altitudes. For the regional features of the Swedish natural vegetation climatic factors are of considerable importance. The length of the growth period, defined as the number of days with an average temperature exceeding +6^{o} C, is closely correlated with the major vegetation regions (cf. below).

Precipitation in Sweden is rather unevenly distributed, low precipitation (appr. 400-500 mm) being typical for the Baltic islands, while high amounts (appr. 700 to 1000 mm) are found in various areas from the south to the north in the western parts of Sweden. The highest precipitation almost always occurs in late summer. The depth of the snow cover is quite variable over the country. Its maximum in the mountain valleys of southern Lapland occasionally amounts to 1.8 m. The period of snow cover near Stockholm on average is about 3 months, but it varies between years from a few weeks to over 4 months.

1.1.2 The landscape from a historical point of view

Sweden belongs to Fennoscandia, a physiographical area predominantly characterised by very ancient bedrock, Pleistocene glacial sculpture, and Late-glacial and Post-glacial crustal uplift. From a historical viewpoint Norway, Sweden, Finland and north-western Russia belong to the same physiographical region. There has been alternating periods with brackish water and freshwater in the Baltic. The last glaciation left Sweden covered by glacial drift. The drift mainly consists of till, covered over large areas by glacial clay, and locally coarse-grained sediments. Long eskers are a characteristic feature of the Swedish landscape, particularly in the eastern lowlands. Calcareous soil was transported by the inland ice-sheet from the limestone bedrock and spread over large areas. The bedrocks to a great extent are hard-schistose and prevailingly silicious, but they also include softer, calcareous rocks.

About one third of the current land area was under water as the ice border retreated from south to north of Sweden approximately 10 000 years ago. The sea-level varied greatly during different stages in the recession of the ice. One important zone-determinant is the highest shoreline, which is the highest point the sea reached after the melting of the inland ice. The area below the highest shoreline was originally covered by silt or clay sediments. Due to wave actions this material was washed away from the hills and redeposited on lower parts. The height above sea-level of the highest shoreline varies from about 10 m in the south of Sweden to about 300 m in the northern province Ångermanland.

Most of the cultivated land in Sweden is to be found below the highest shoreline, while most forest areas are to be found in the upland regions. There are two forested upland areas that differ climatically and with regards to vegetation from all other parts of the country – the South Swedish highlands and the inland, alpine regions of Norrland.

1.1.3 Soils

Till is the most important soil type in Sweden, it consists of unsorted glacial material, such as boulders, stones and sand of varying size. The thickness of the till layer varies from 4-5 m in the south to 8-9 m in the north of Sweden. In some areas such as the southern parts of Sweden (Skåne) and in the area around the lake Storsjön in central Sweden clay till is frequently found formed by the calcareous bedrock and slate in a mixture. Clay, silt and fine sand were originally deposited in the glacial lakes. Wide areas with sand of varying size are found along the eskers and in areas with end moraine.

The soils of Sweden are chiefly podzolic with a mor (raw-humus) layer, although mull is to be found in combination with brown soil in the southern or western parts of Sweden. The degree of podzolisation is highest in the southern and the northern uplands. The podzol profile is characterised by the acid raw-humus layer underlying a thin mat of needles and decayed vegetation. The thickness of the raw-humus layer varies in different forest soils between 0 - >20 cm. Under the humus layer there is an ash-like bleached horizon poor in mineral-nutrients followed by a red-brown-coloured enrichment horizon. Cultivation of the landscape is closely related to soil conditions. The earliest cultivated land is found in areas with calcareous till. Whether the soil has been cultivated or not depends upon the composition of the bedrock, the altitude and the local climate.

Another important type of soil is peat which originally covered about one sixth of the terrestrial area of Sweden. The percentage of peatland varies from almost none in agricultural areas to about 70% in upland regions. The largest continuous peatland area is the Sjauna area in the northern part of Sweden (almost 150 sq. miles). In the south-eastern lowlands, the peatlands are originating to a great extent from shallow lakes filled up gradually by vegetation, but in the western and northern uplands the peatlands were formed from paludification of terrestrial soils.

1.1.4. Vegetation zones and forest types

The present plant cover of Sweden was formed after the glacial period, the first forest trees to enter from the south were birch (*Betula verrucosa*) and Scots pine (*Pinus sylvestris*). When the climate improved other forest trees such as pedunculate oak (*Quercus robur*), wych elm (*Ulmus glabra*), alder (*Alnus glutinosa*), small-leaved lime (*Tilia cordata*) and hazel (*Corulus avellana*) were dominating in the southern and central parts of Sweden. The Norway spruce (*Picea abies*) entered from the north-eastern parts of Sweden and the European beech (*Fagus sylvatica*) from the south. The beech is successively driven back by the expanding spruce, which not yet spontaneously has reached the southernmost parts of Sweden.

Different vegetation regions may be distinguished from the north to the south of Sweden (Sjörs, 1956):
1. The alpine region (above the tree limit) and subalpine region (dominated by birch - *Betula verrucosa* var. *tortuosa*)
2. Northern coniferous forest region (without oak)
3. Southern coniferous forest region (with oak)
4. Southern deciduous forest region (without Norway spruce)

The *alpine region* may be divided into three subdivisions/belts: the high alpine; the middle alpine and the low alpine belt. It includes the vegetation above the tree limit, which is sparsely distributed among heavy boulders and rocks. In the *subalpine region* birch, mainly *Betula verrucosa* var. *tortuosa*, is the most important forest tree. The *northern forest region*, which is characterised by two coniferous species (*Pinus sylvestris* and *Picea abies*), is a part of a vast circumpolar Taiga region, which continues through northern Russia, Siberia and North-America. In this region birch, grey alder (*Alnus incana*) and aspen (*Populus tremula*) are common deciduous tree species. Characteristic for the *southern coniferous* region is the dominance by coniferous tree species but with an admixture of deciduous tree species, among others oak and ash (*Fraxinus excelsior*). The northern limit of those two tree species coincides with an important biological boarder, the "limes norrlandicus". North of this border most species with a southern distribution type in Sweden are seldom found. The *southern deciduous forest* region is dominated by deciduous trees, mainly European beech.

1.2 Society

1.2.1 Population density

Sweden is a sparsely populated country. The average number of inhabitants in Sweden in 1996 was 22 per sq. km land area, varying from 3 in the Norrland region to 269 in the Stockholm region (Data from "Statistisk Årsbok 1998"). The total population in Sweden in 1996 reached a number of 8.844.499 distributed on a land area of 410.934 km^2.

The Swedish population has increased by almost five times since the 1750's. The average life length has increased from appr. 40 years in 1850 to 75 years in 1980. The percentage of the population living in the cities at present is more than 60%.

1.2.2 The Swedish industry and tourism

Sweden is one of the main forest producing countries in Europe, the productive forest area covering about 57 % of the total land area. The pulp- and paper- and the sawmill industry in the 1980's contributed about 1/5 of the total export value. The arable land production and food manufacturing industries are concentrated to the southern and central parts of Sweden. The agricultural production in 1980 amounted to about 2.5 % of the GNP.

Figure 1. Climatic forest regions in Sweden. (From The Swedish National Atlas The Forest).

Iron is dominating the mining industry and iron ore used to be an important export product. Currently, however, most iron ore is processed within Sweden, and exported as highly processed products by the engineering industry. This industry is producing a variety of products from nails to cars. Most Swedish employers (30-40 %) are active within this industrial sector. Important Swedish companies, manufacturing engineering products at the international market, are among others Atlas Copco, ASEA, Ericsson, Saab-Scania, Sandvik and Volvo.

Other important Swedish industrial activities are to be found in the chemical and pharmaceutical products sectors. The building and construction industry sector, including the building material, concrete- and stone manufacturing parts, to a great extent is directed towards the Swedish market. This is also true for the Swedish graphical industry including newspapers and publishing houses.

The tourism in Sweden is increasing and is dependent on the country's wide magnificent countryside. Sweden has 96,000 lakes and uplands ranging from the gently to awesome peaks and 4,800 miles of coastline and 51,000 islands. Of great national importance as well as for development of outdoor tourism is the old Swedish common right that allows to use essentially all land for non destructive activities including camping and collecting of berries and mushrooms. Excluded from this common right are areas only that are protected for some reason like e.g. historical sites or bird sanctuaries.

2 Forest resources and their uses

2.1 Forest resources and forest production

Sweden is a northern European country that experiences harsh winter climates and has short growing seasons that limit tree growth. Rotation periods vary from 60 to 80 years in the south to 90 to 120 years in north. The forest ecosystems are simple and with few commercially valuable tree species, Norway spruce and Scots pine accounting for 46% and 38% of growing stock, respectively. The forest resource situation has improved successively, and the actual as well as potential harvest has continued to increase. Currently the wood balance is very favourable. The gross annual increment is approx. 100 million m^3 (forest cubic metres); while the potential harvest is in the order of 80 million m^3 in the short run and 90 million m^3 in the long run. The actual gross harvest is in the order of 70 million m^3 (68.5 million m^3 as an average between 1990-1995, 68.1 million m^3 forecasted for 1996) (Anon. 1997).

2.2 Silvicultural systems

2.2.1 Ecological planning on the landscape level

During the late 1980s the necessity to leave a forest policy mainly focused on timber production became obvious. The faculty of Forestry at SLU (The Swedish University of Agricultural Sciences) since the beginning of the 1980s had increased research activities on biodiversity in the forest landscape and on the prevailing clear-cutting forest management practices affected biodiversity. The National Government Organisations (NGO:s) working with environmental questions since the late 1960s had criticised the Swedish forestry; focussing on the forest companies and their forest policies. Around 1990 the true sustainability of the Swedish forestry was questioned by customers and consumers organisations in Europe. It became clear that the only way to run forestry with both high production and maintained biodiversity was to integrate production and biodiversity questions in forest planning. It was obvious that solving the problems with biodiversity would be impossible on the stand level. Therefore, the interest was focused on ecological planning on the landscape level. For the large forest companies with large coherent forest areas it was natural to consider landscape planning. For private forest owners with small land holdings that was not the situation.

In the natural boreal forest fires were the most important ecological factor. For pine forests on dry and mesic sites the intervals between for-

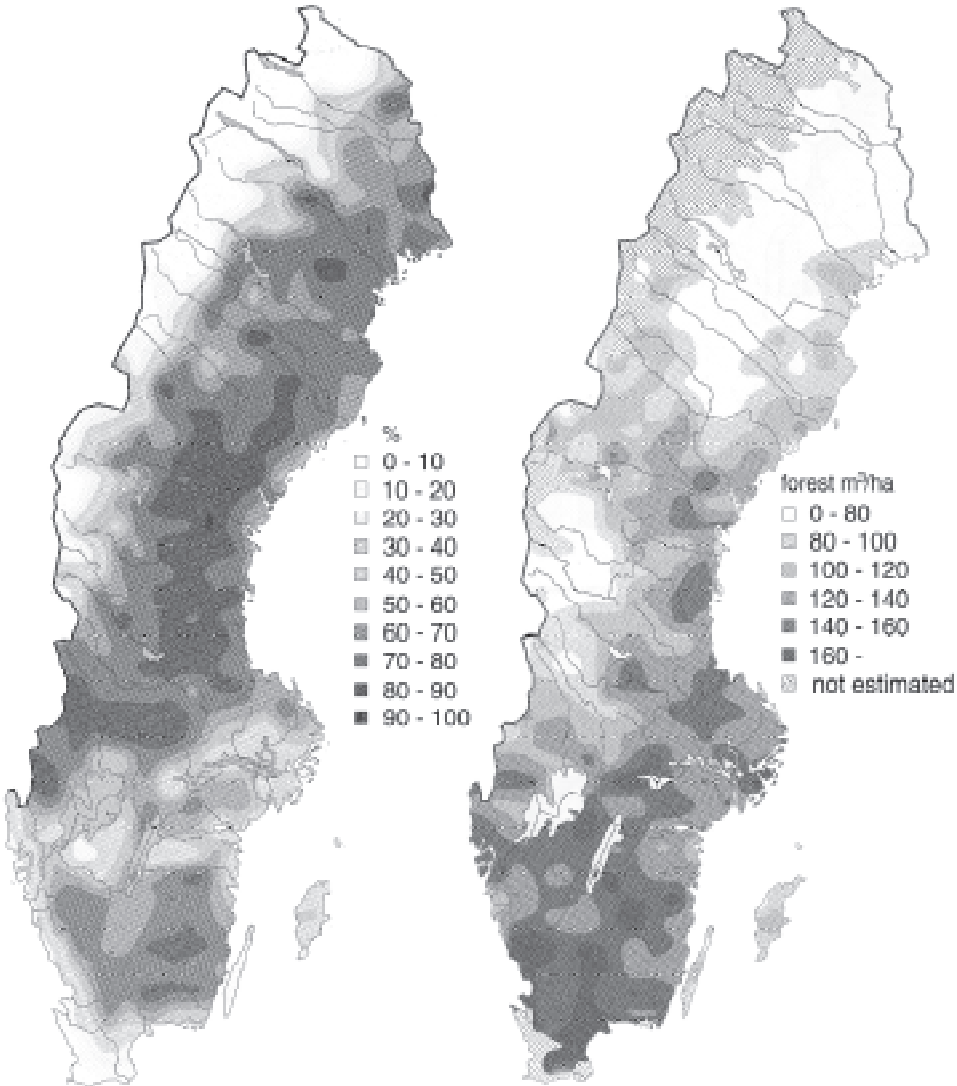

Figure 2. a) Distribution of forest land in Sweden. b) Distribution of forest standing volume, all tree species. (Source: The National Forest Inventory).

est fires were 50 to 70 years, for spruce or deciduous tree-dominated forests on mesic sites 100 - 200 years. Spruce forest on moist and waterlogged sites was not devastated by forest fires and such stands became fire refugia in the boreal forest landscape.

Theoretical model work has suggested that the flora and fauna of Scots pine forests on dry or mesic sites and Norway spruce or deciduous dominated forests on mesic sites are relatively well adapted to large scale fire disturbances. On these sites modifications within the clear felling system are proposed. On sites seldom hit by fire, long continuity forest will develop.

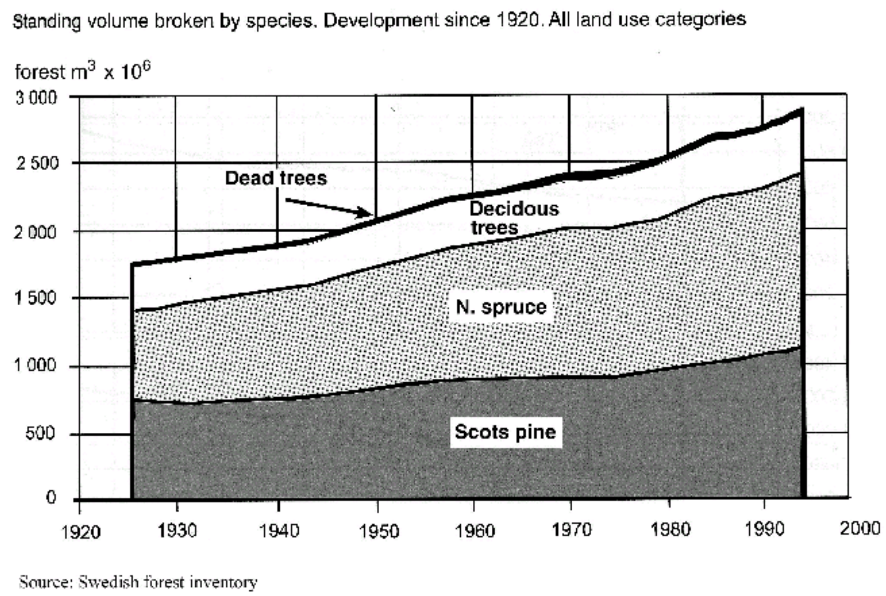

Figure 3. Development of standing volume for different tree species since 1920 at all land use categories. (Source: The National Forest Inventory).

They can host species extremely sensitive to large-scale disturbances. When such sites are used for timber production, modified forestry practices are suggested such as selective cutting, partial cutting or dense shelter wood systems.

2.2.2 How to maintain the landscape

Empirical results indicate that nature reserves combined with intense timber production on the remaining forestland will be insufficient to maintain the biodiversity in the landscape. To preserve features necessary to all occurring red-listed species, the landscape must be managed both by means of a static part e.g. non-harvested nature reserves which fulfil the demands of species which require continuity at the site, and a dynamic part which harmonizes with the fire generated dynamics in the boreal forest landscape. The dynamic part may encompass a system of patches managed so that important successional stages are continuously present in the landscape.

2.2.3 What are the most important problems for the future?

Clear-cutting management dominated Swedish forestry during more than 40 years. The scientific knowledge about clear cutting and the outcome of that management system is well established. The current forest policy with equal emphasis on timber production and maintaining of biodiversity is fairly new.

Other management systems are insufficiently understood. Therefore, research on new planning models, reforestation methods and production tables in different types of selective cutting management practices is urgently needed. In current forestry different measures have been taken to promote biodiversity. These include leaving old trees, groups of trees, buffer zones along gullies, lakes and mires etc. It is essential to assess whether these measures result in the expected biodiversity improvement, or whether additional measures have to be taken to ensure sustainability of the forestry.

2.3 Planning framework - special institutionalization

The National Forest Inventory (NFI) is an annual inventory covering the entire area of Sweden. The object of the inventory is to provide basic data for planning and control of the forest resource at the national and regional level and also to give basic data for forest research. The main task is therefore to give information on the state of the forest resource and on land use and on how these are changing. The NFI is carried out by the Department of Forest Resource Management and Geomatics, Section of Forest Resource Data at SLU.

The first inventory started in 1923. Since 1953, the inventory covers the entire country every year. Since 1983 the annual sample consists of some 17,000 systematically distributed circular plots. Of these 10,000-11,000 fall on forest land. The inventory uses permanent plots with a radius of 10 metres as well as temporary ones with a radius of 7 metres. The permanent plots are reinventoried after 5-10 years, thus allowing an efficient estimation of changes. The main observations on all land are: land use category, ownership category, growing stock, growth, tree distribution and recent felling. On forest land: terrain conditions, vegetation cover, maturity class, age, site quality, recent and suggested silvicultural measures, degree of stocking damage and regeneration status (in young stands).

The General Forest Inventory was a public inventory of private farm forests that started in 1980 and worked until 1994 when it was terminated by the new Swedish forest policy. However, the importance of management planning is still emphasised in the new policy. Management planning is now also required from an environmental point of view. Forest owners must themselves provide the basic data for this planning.

3 Forest economics and forest policies

3.1 Forest economics, forest industries and employment in the forestry sector

The forest and forest industry sector is vital to the Swedish economy. The forest products consist primarily of softwood lumber, wood pulp, newsprint and other wood products. At the same time the role of the forests is to provide non-wood goods and services. Environmental considerations are becoming increasingly important. In the forest policy from 1994 the environmental and productive aspects of the forests are given equal priority (cf. below).

A comparison with some other countries or regions demonstrate the economic relevance of the forestry sector in Sweden (Anon. 1998).

In 1995 the value added for the Swedish forest industry was 55 billion kronor and for forestry 23 billion kronor.

Wood fuel and by-products from the forest industry are of great importance for the Swedish energy supply. Of the total energy supply, 485 TWh in 1996, 18% is bioenergy, of which the major part is of forest origin (NUTEK, 1997).

Models for analysing non-timber value of the forest are being developed (e.g. Mattsson and Li, 1994, Bostedt and Mattsson, 1995). This non-timber value of the forests, i.e. value for e.g. recreation and hunting, has been estimated to be considerable and with a potential to increase.

In 1996 the number of employees in the forest industry (wood processing, pulp, paper, and paperboard goods industries) was 1996 93,600 and that in forestry 26,300 (Anon. 1997). In forestry the total number of workhours in the field has decreased dramatically during the last 20 years, figure 4.

Trade accounts for about 30% of Sweden’s GDP, with export of natural resource commodities contributing about one quarter of the total

Table 1. Forest products in the economy, selected countries and regions.

Country/Region	Export (E) Million USD	Import (I) Million USD	Balance (E - I) Million USD
Sweden	10 996	1 324	9 672
Finland	10 302	700	9 602
Canada	25 333	2 622	22 711
USA	16 973	22 599	-5 626
EU (total)	50 819	51 836	-1 017
Developed Countries	108 827	107 021	1 806
Developing Countries	23 161	32 913	-9 752
World	131 988	139 934	-7 946

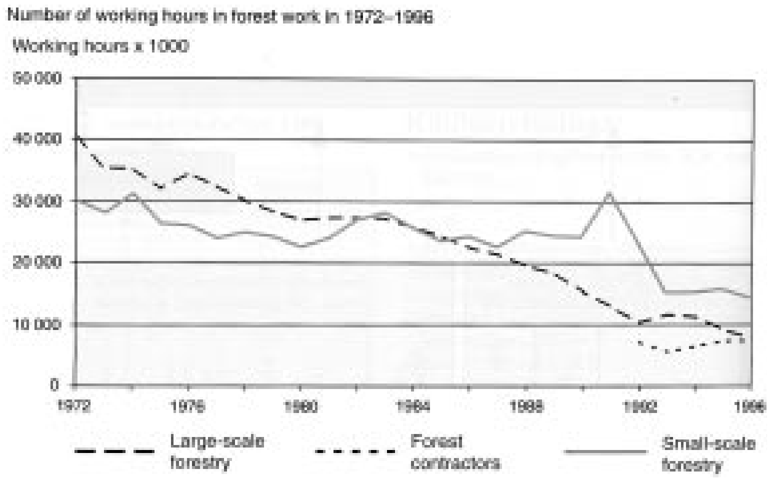

Figure 4. Number of working hours in forest work in 1972-1996. (Source: Swedish Official Statistics, SCB).

export. The forest sector is the world's second largest exporter of soft wood lumber and newsprint (after Canada), and the third largest exporter of wood pulp (after Canada and the US). The most important paper and board grades produced in Sweden in terms of export value are newsprint and container board.

Table 2. Employees in forestry and the forest product industry, 1 000s.

	1980	1990	1996
Forestry	50	34	26
- employees	40	26	16
- forest owners	10	7	10
Forest product industry	132	110	93
- wood processing	71	50	44
- pulp and paper	61	60	49

3.2 Forest ownership

The total Swedish forest area is 22.5 million hectares. 10% (2.2 million hectares) is owned by the state or public agencies, 39% (8.8 million hectares) by forest companies and 51% (11.5 million hectares) by individuals. In Southern Sweden, Götaland, the individual ownership is dominating, 3.9 million hectares (78%) out of 5.0 million hectares. (Anon. 1997).

Before 1993 the ownership pattern of forest land was approximately as follows: the State 20%, other public agencies 5%, forest companies 25%, and individual owners 50%. During 1993 the principle parts of the State Forest, and the State Forest Industry Company were merged into a new company, AssiDomän. Slightly less than 50% of the shares were sold on the market, mostly in small lots of 100 shares or less.

Many forest companies have their roots in former iron-ore companies that also owned large areas of forest. One of these, Stora (Stora-Enso since 1998), celebrated its 700th anniversary a few years ago. In connection with development of the saw-milling industry during the latter part of the 19th century, these companies also consolidated their ownership of forest land. In 1906 an Act of Parliament prohibited companies to buy forest land.

The individual ownership has its roots in a "farmers' class" with specific representation in the Swedish parliament during the 18th and 19th centuries. Nowadays, the combined agriculture/forestry family enterprises no longer dominate. The number of absentee owners has increased, as has the number of forest owners who are not economically dependent on their forests.

3.3 Forest and forest related policies

3.3.1 A new forest policy

A new forest policy, based on Agenda 21, is in effect since January 1'st, 1994. This policy puts equal emphasis on environmental and timber production aspects of forestry. The policy can be illustrated by the first paragraph which states: "The forest is a National resource. It shall be managed in such a way as to provide a sustainable yield and at the same time maintain biodiversity. In forest management other public interests should also be considered". (Swedish Forestry Act, 1993). The first forestry act, essentially a reforestation law, is from 1903. It has been followed by revisioned acts in intervals of 15 to 20 year. Environmental consideration for the first time was added to the act of 1975.

The Forestry Act, as compared to previous ones, puts less emphasis on the detailed regulation of silviculture, with the explicit aim of thereby promoting biodiversity. As means to achieve the objectives the current forest policy the government will buy land corresponding to 5% of the forest land during the coming 30 years, to create forest reserves.

Forestry is also regulated by the Nature Conservation Act of 1994. This act controls for example ditching and also gives possibilities to protect biotopes less than 5 ha of high conservation values. Examples of such biotopes are forests along gullies, post-fire successional forests and natural and seminatural old forest.

Inventories on a national scale, aiming at the documentation of biodiversity, has been carried out of wet land forests and forests of high conservation values referred to as woodland key habitats.

The forestry policy is implemented by regional Forestry Boards. This is done by enforcement laws and by guidance. The National Board of Forestry was created 1941. Until 1981, the County Forestry Boards previously rather independent, were organised under a regional office and include a number of field districts. The Boards works locally close to the forest owners.

In 1979 the State forests were put under the control of the Forestry Act, and thus subject to control by the County Forestry Boards under the supervision of the National Board.

Members of the County Forestry Boards are selected to represent different local interest and ownership groups. Integration with the County Administrative Board was secured by making the County Governor chairman of the County Forestry Board, and allowing the Chief Officer of the Forestry Board to represent the forestry sector in the sessions of the County Administrative Board.

On the local level the forestry board officials work in close cooperation with the forest owners association and forest industry but also with local organisations of environmentalists and ornithologists.

3.4 Legislation - targets and strategies

The current Swedish forest policy comprises two goals, one goal for forest environment and one for wood production. The two goals have the same priority, which implies that they should be given equal weight in the management of forest resources (Anon. 1994a).

Environmental goal
"The productivity of forest sites shall be maintained at sustainable level. Biodiversity and genetic variation in the forests shall also be secured. The forests must be managed so that plant and animal species which exist naturally in the forest ecosystems can survive under natural conditions and in reproductive numbers.

Endangered species and vegetation types shall be protected. The forest's cultural heritage, aesthetic and social values must be protected."

Production goals
"The forest and forest land shall be utilized efficiently with the aim of a sustainable and valuable yield. The composition of forest production must be such, that it has a potential to satisfy a variety of future human needs."

The Forestry Act specifies the minimum requirements for landowners. Swedish legislation is formally developed at four levels:

1. Acts passed by parliament
2. Ordinances or orders given by the government (written by the minister in charge)
3. Directions or regulations set by the responsible authority (for forestry, usually the National Board of Forestry) and supported by an act or ordinance
4. Recommendations made by the authority

The first three are legally binding, while the fourth is not and is used to further clarify how the first three should be interpreted. An act itself is usually very short and often weak on details. Further down on the list, the directions become more specific. Political bodies do not have direct managerial influence on the authorities, and political interference in the activities of the authorities is illegal. Hence, Forestry Acts serve as general guidelines, with actual implementation occurring via ordinances from the minister in charge of forestry, and directions and recommendations provided by the Forestry Boards.

Specific environmental restrictions exist for forests in the vicinity of mountainous areas, for forests which are also used for reindeer grazing by the Sami people, and for forests with specific regeneration difficulties. Selected valuable broadleaved forests in Southern Sweden, including beech and oakwood land should be retained, but still be subject to commercial utilisation. There are also a number of subsidies for the regeneration of selected valuable broadleaved forests.

3.5 Forest policy tools

In the Swedish forest policy of 1994 the balance between the various forest policy tools has been altered (Anon. 1994b, Fredman 1997). Less emphasis is laid on forest legislation and subsidies, and more emphasis on extension service. Forest owners must now take greater responsibility from both the economic and management points of view.

The new legislation has been simplified and is generally less restrictive. This allows forest owners considerable freedom of action. However, most of the basic requirements in the old Forestry Act have been retained, but subsidies as a policy instrument are only used to promote the forest environment.

3.6 EU and other international perspectives

The Swedish political standpoint has been to oppose the implementation of a common EU forest policy. Instead over the last several decades Swedish forest policies and policy implementation has been guided by spirit of the UN Forest Principles. The traditional "Swedish model" for forest policy development and implementation includes an efficient and sustainable production chain from the forest to the forest industries and to the international market for forest products. Over the last decades public opinion has forced an adaptation of the prevailing management systems to meet environmental needs.

Sweden was actively engaged in the UNCED process with Agenda 21, the development of the Forest Principles, the Helsinki Resolutions and the IPF process as a follow-up of UNCED. Promoting the capacity of countries through rural development have been a major goal of Swedish foreign aid policy over the years.

3.7 Organisations - stakeholders and partners

The Forestry Boards and the National Environmental Protection Agency have already been presented. Both authorities implement the forestry and environmental policies of the government. The County Administrative Boards, town and rural districts have established their own environmental sections.

The forest and forest industry companies act as economic enterprises, acting to achieve the long-term profitability. Most of the companies are not only sizeable forest owners, they also run forest industries, pulp and paper mills as well as sawmills, and aim at optimising the economic output of their enterprise as a whole. The forest management part of the forest companies are often organised as independent economical units which means that they sell their roundwood to their industrial partner under the prevailing market conditions. These economic units are often legally distinct units.

Previously, separate industry associations existed for each of four forest industry activities: pulp and paper, packaging and other paper goods, saw milling, and other wood products and panel products. Theses industry associations now work collaboratively under the umbrella of the Swedish Forest Industries Association in Stockholm. This association includes as members only a small proportion of the saw milling firms, but 95% of paper producers and all pulp producers. Since the forest companies now own almost 40% of the forest area, it is natural that their associations play an important role in the development of the forest policy.

Small private forest owners are organised into seven different forest owners' associations. The associations cooperate in the National Federation of Swedish Forest Owners' Associations (Skogsägarnas Riksförbund). Their 89,000 members own 5.7 million ha of forest. The associations were formed to improve the financial yield of forestry operations among their members. This is done by co-ordinating the timber trade and by helping the forest owners with logging and silvicultural practices. In order to ensure a stable market for timber and to control pricing, the associations have build up their own forest industries.

The forest sector labour unions are also important actors in forestry policy making. In the 1970s and 1980s the unions were principal advocates of the regulations that led to a focus on forest productivity at the expense of land owners' profits. These included requirements on cutting, regeneration and thinning; for example, new paragraphs introduced in the Forest Act of 1981 could oblige forest owners to clear cut or thin stands with the objective of increasing short-term timber supply. However, these requirements were also designed to create employment.

A large number of other organisations play important roles in Swedish forestry, including primarily environmental organisations and recreationists, as the World Wildlife Fund and the Swedish Association for the protection of the Environment. Not the least through the ability to utilize the market power the environmental organisations have been very successful in affecting the forest sector. As a result of the activities of these organisations chlorine is no longer used by the Swedish forest industry for bleaching, and most of the forest area owned by the forest companies is or will be certified by the Forest Stewardship Council.

4 Main current conflicts and challenges

4.1 Environment vs. forest production

In an evaluation of the current status of the implementation of the Forestry Act, done in 1997 by The Forestry Board and the EPA it is concluded that

- regeneration results are unchanged but lower ambitions are worrying for the future production. The regenerations requirements stated by the Forest Act is filled in 80% of the planted area and only in 68% of the naturally generated area.
- Thinnings are not carried out to a sufficient extent
- Natural- and culture heritage considerations have improved but every fourth harvested area does not fulfil the requirements of the Forestry Act.
- Increased is required for nature reserves, legal habitat reservations and nature conservation agreements in order to increase the protection of biologically valuable areas.
- Inventories, regional plans of action and continuing education of the forest owners is required.
- Supervision and continued evaluations of forestry practises are required, for example in habitats with endangered species
- The rules for legal habitat protection are insufficient and need an overview.

The Environmental Protection Agency (1996) reports that from 1992 to 1996 290 different reservations covering a total of, 96,000 hectares, including 46,000 hectares of productive forest area has been protected as nature management or national parks. Half of this area is forest in proximity of high mountains, one fourth coniferous forest outside this area and the rest broad-leaved forest mainly in Southern Sweden. The total area corresponds to about 0.2% of the Swedish forest area. The total protected area (national parks, nature reserves or Forest Service reserves in Sweden is 3.66% (832,000 hectares) of the forest area. However, of this area almost 80% is forests in proximity of high mountains which means that 43% of this area is protected. Outside of the mountainous regions only 0.81% of the forest area is protected.

Comparing the periods 1923-1929 and 1989-1993 the total area of old forest (older than 140 years) has decreased. This is most obvious in Northern Sweden (except for forest in the mountain regions). In the North share of forest older than 160 years has decreased with one third during the last twenty years. In Southern Sweden a small increase has occurred.

Between 1991 and 1996 about 500 legal habitat protection agreements have been signed. This corresponds to a total area of about 1,000 hectares. Half of the agreements concern primeval conifers forest. The average compensation to the land owner paid by the State is 35,000 Swedish kronor per hectare. It has been estimated that about 25,000-30,000 hectares can be considered for legal habitat protection agreements. At the present level of funding it will take 50 years to cover this area.

The first agreement between a landowner and the State special management practices based on environmental considerations was signed in the spring of 1994. The period for the agreement is usually 50 years with an average cost of 6,300 Swedish kronor per hectare. Since 1994 and until 1996 190 agreements have been signed covering a total area of more than 1,000 hectares of forest area.

4.2 Other areas of conflict

4.2.1 Hunting vs. forest production

Hunting is of significant recreational and economical importance in Sweden. The number of hunters has increased during the last decades and is presently limited primarily by the availability of lease of hunting rights. It is obvious that forestry and hunters often will have different opinions on suitable population sizes of the hunted game species. These are moose, that increased in number up to the 80’s, and roedeer, that has increased in population size in the southern parts of Sweden. Both these species cause considerable grazing damage to forest plantations, which must be compared with the value of the hunting (Mattsson, 1992).

4.2.2 Reindeer management vs. forest production

Reindeer management has long traditions in the northern provinces of Sweden. The relation between forestry and reindeer management is complicated, since present forestry practices would have negative as well as positive effects on the reindeer herds. Movement routes from winter grazing to summer grazing areas might be cut off through forest operations. Important food sources as lichens will decrease after harvest of old forest. On the other hand the amount of green fodder will increase with availability of felling residues. The number of reindeer has increased from 200 000 animals to 300 000 during the last decades and it is unlikely that these big herds can be maintained on natural grazing only. Probably supplementary fodder will be needed. Thus, the future reindeer management will be dependent on cooperation with forestry as well as on finding optimal herd sizes (Mattsson, 1992).

5 Conclusion and outlook

In many ways, Sweden's history and experience with forest policy, and the forestry institutions that have evolved, are unique. They are the consequence of the historical development, the importance of forestry in the economy, the ownership structure of forest lands, and the attitudes of the people. Forestry policy generally has been the outcome of consensus, thereby making enforcement a matter of partnership between the state and the forest owner rather than one of confrontation.

A major characteristic of Swedish forest policy and forestry institutions has been its flexibility, despite significant public regulation and intervention. Major recent changes in policy have involved a restructuring of the forest industry, with consequent privatisation of the Forest Service and layoffs of substantial numbers of workers, and adoption of greater market incentives at the forest level. These have made Sweden's forest sector more competitive and, at the same time, a greater emphasis has been put on ecological functions of the forests and the environmental soundness of the products.

Major changes can be expected in the future. Presently the government stimulates the establishment of local collages. Many of those try to find their identity within the forest sector but also seek specialized forestry profiles in their educational programs.

Another interesting fact is an upcoming discussion about intensively managed forest lands; plantation forestry close to the pulp mills. These ideas can be found in a report about Forestry 2021 published by the National Environmental Protection Agency. Other areas would be preserved as reservations. This would mean a major break with the present forest policy where production and environmental considerations go hand in hand on the major part of the forest area. Still another change that will affect the forest sector is the closing of nuclear power plants. The demand for bioenergy will increase. This will influence the roundwood market and consequently the forestry policy.

Acknowledgements
We thank Arvid Engström for valuable comments on an earlier version of this manuscript.

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Additional information, data and maps are to be found at:

The web site SkogsSverige ("Swedish Forest"): www-forest.slu.se

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1 The Country

1.1 Natural Conditions

1.1.1 Country Information

Switzerland lies in the central part of the Alps which extend from Southern France to Austria and Slovenia. The Alps and Jura mountains with the central Plateau in between determine the country's broad geographical zonation (Bär 1979; SAEFL 1997). Its surface covers an area of 41,285 square kilometres. The greatest distances of 350 kilometres and 230 kilometres occur from west to east and north to south, respectively. The highest elevation point is the Dufourspitze in the Monte Rosa massif in the canton of Valais (4,634 metres above sea level) while the lowest is the Lago Maggiore in the canton of Ticino (193 masl). The geological formation was principally determined by the collision of the European and African plates as well as by several periods of glaciation. Four major rivers originate in the Gotthard massif and take their course towards different European regions: - Rhine, Rhone, Ticino and Inn.

1.1.2 Regional Diversity

Switzerland can be divided into five regions (BRP 1998) with the following percentages of the territory (figure 1): Jura (12%), Plateau (23%), Pre-Alps (16%), Alps (40%) and the Southern Alpine slopes (9%). The diversity of climatic and soil conditions ranges from lowlands to high mountain elevations. The rapidly changing topography in the Alps and the Jura mountains and the relief determined by the great valleys led to a large variety of landscapes and

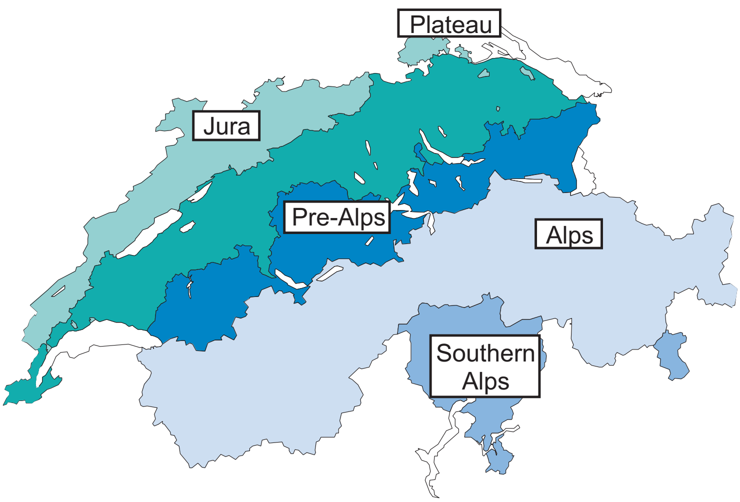

Figure 1. Major Regions of Switzerland.
Source: Based on Regional Forest Zones; Federal Office for Statistics

vegetation forms. Beyond the timber line mosses and lichens are found, and in a short distance a Mediterranean flora with chestnut forests dominates in the southern foothills. In higher elevations conifer forests are common whereas in the central part and in the Jura deciduous and mixed forests are predominant.

1.2 Social, Economic and Political Aspects

1.2.1 Population and Language Groups

The population (1996) amounts to 7.1 million of which 17% are in the age group below 15 years and 15% in the group above 64 years (SFSO 1998, 16-17). 19% of the inhabitants are expatriates. The average population density is 171 persons per square kilometre. However, it varies considerably among the regions with a large concentration occurring in the Central Plateau, the Northern foothills of the Jura Mountains and in the Southern parts of the canton Ticino.

Switzerland is a country with four main language groups, in which people with different cultural habits and historical traditions live together. According to the census of 1990 the main language groups are German (63.7%), French (19.2%), Italian (7.6%) and Romantsch (0.5%). 8.9% of the population have indicated another language as means of communication.

1.2.2 Employment and GDP

3.8 million (1996) are regularly employed in full and part-time positions. 4.7% of the labour force are occupied in the primary sector, 26.5% in the secondary sector and 68.7% in the tertiary sector (SFSO 1998, 16-17). The unemployment rate was 3.7%.

In 1996 the gross domestic product (GDP) per capita was 25,400 US$ (SFSO 1998, 16-17). It was considerably higher than the average GDP per capita in the EU countries (19,333 US$) in the same year. However, while the average annual increment in real terms of the EU countries was positive (+1.4%) over the period 1990-1996 the development of the Swiss GDP per capita was slightly negative (-0.1%).

1.2.3 The Swiss Federal System

Since 1848 Switzerland is a federal state with a political structure at three levels: the Federation, the Cantons and the local Authorities (Linder 1998; SFC 1998). The Federal Constitution (FC) determines the division of competences between the Federation and the Cantons. Powers which are not constitutionally given to the Federation are original cantonal competences. Any new transfer of powers to the Federation requires a change of the Swiss Constitution (Art. 3 FC). Since 1978, when the Canton Jura has been created, the country is formed by 23 Cantons, three of them are divided into two half-cantons for historical reasons (Art. 1 FC). Each canton and half-canton has its own constitution, parliament, government and courts.

The cantons, (figure 2) are divided into representative political communes in which decisions are made by local councils (ca. 80%) or by the assemblies of all citizens (ca. 20%). The degree of autonomy given to local authorities is determined by the cantonal constitutions and varies widely. At present there are almost 3,000 communes; the number tends to become smaller due to the merging of local units.

1.2.4 Elements of Direct Democracy

In addition to the representative elements (election of the members of parliament) the Swiss political system shows two significant elements of direct democracy: the compulsory respectively the optional referendum and the popular initiative. Both instruments are constitutionally founded and currently used in different ways on the three federal levels of the country's political system. In general terms the referendum is an approval or a veto cast by a popular ballot with regard to acts of parliament and/or government. The popular initiative is a political instrument by which citizens may seek constitutional amendments, changes in legislation or the adoption of new legislation. At the federal level only popular initiatives aiming at constitutional amendments are possible (Art. 118ff. FC).

1.2.5 Political Organisation of the Federal State

The members of Parliament are elected by some 4.6 million citizens. The Federal Assembly has two Chambers: the National Council with 200 members elected by common rules valid throughout the Federation and the Council of States with 46 representatives elected (2 for a Canton; 1 for a Half-Canton) by the people according to the rules of each Canton (Art. 71ff FC). The United Federal Assembly i.e. both Councils together elect the seven members of Government (Federal Council) and the Chancellor in charge of the Federal Chancellery.

1.2.6 Federal Government and Administration

The Government is formed by the Federal Council (Art. 95ff FC). It defines the fundamental goals of state action and determines the necessary resources for their attainments; represents the Federation within the country and abroad; conducts the preparatory procedure leading to new legislation; submits proposals, laws and decisions to the Federal Assembly; enacts regulations as empowered by the Constitution and by federal laws; and makes decisions with regard of important infrastructure and other works. The administration is organised in 7 Federal Departments with the following competences: foreign affairs; home affairs; justice and police; defence, protection of the population and sport; finance; economic affairs; environment, transport, energy and communications.

2 Forest Resources and Their Uses

2.1 Forest History

As in the neighbouring countries the forests of Switzerland have been influenced and partially transformed by long lasting and changing human interventions (Hauser 1972; Schuler 1980). Of particular importance was the medieval colonisation with land clearing in the Central Plateau and the Jura which peaked during the 12th and 13th century. Forests in the vicinity of villages were intensively used for local wood supply, food and other forest products, and as part

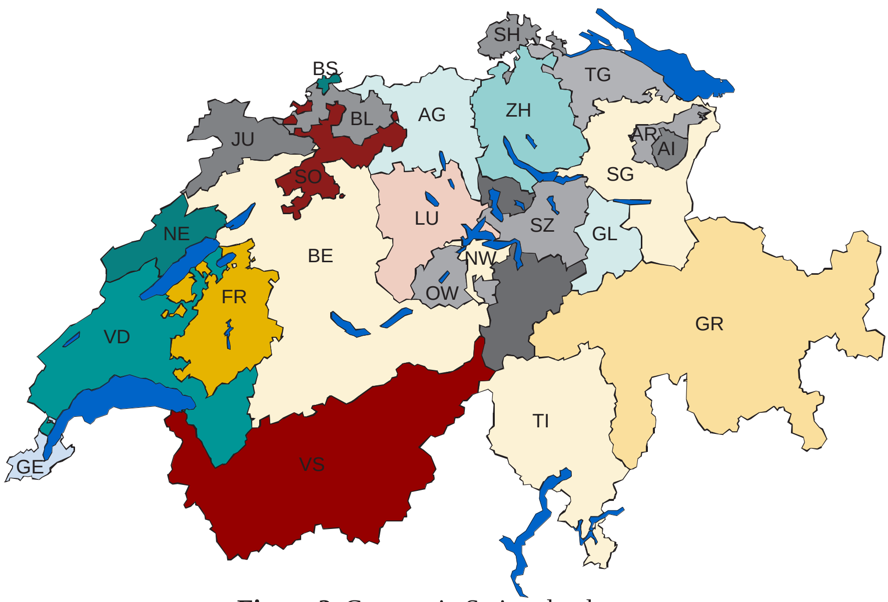

Figure 2. Cantons in Switzerland
Source: Federal Office for Statistics, 1998.

of the agricultural space in combined production systems. From the 15th century onward large scale forest exploitation for mining, salt production as well as for artisanal and industrial uses developed. Wood exports mainly by floating to Austria, Germany and Italy were another factor that sped up changes in the forest vegetation. An outstanding example in this context is the Swiss National Park in the Canton of Grison: today many people consider the park to be a typical natural landscape, although large scale clear cuts for local industries and wood floating on the Inn to the salines in Austria were practised over centuries (Parolini 1995).

An interesting aspect in the Swiss forest history are the collective and communal land use systems and the logging bans for forests with important protective functions (Price 1990). They have been common in the Alps and Pre-Alps since the 14th century. In the Alps common resource use systems have been maintained and developed into communal and corporative forest ownership. In other parts of the country forest areas were divided among their owners and became private farm forests.

Already during the 17th and more strongly in the 18th century the reduction of usable forests and the fear of a general shortage of wood induced efforts towards a more sustainable utilisation and management. The physiocratic societies aiming at improvements of land uses and agricultural production played an important role in the process of introducing improved forestry practices. During the brief period of the Helvetic Republic (1798-1803) a project for a central forest law was elaborated, but failed to be adopted (Schuler 1998). With the reconstitution of cantonal powers in 1803 such efforts became obsolete and forestry matters remained cantonal competences. The Swiss Constitution of 1848 acknowledged this fact by not referring to forests and forestry at all.

During the 19th century local land slides and large scale flooding occurred in the cantons Grison, Ticino, Valais and Uri in 1834; in the Emmental in 1837; and in the valleys of the Reuss, Rhine, Rhone as well as in those of the Southern Alpine slopes in 1839 (Schuler 1998). They were associated with progressive clear cutting on steep slopes along the valleys. This led to an increasing sensitisation of the population and politicians. Personalities such as Karl Kasthofer, Charles Lardy, Xavier Marchand, Elias Landolt and Karl Culmann made valuable contributions and provided information to the public. The Swiss Forestry Society founded in 1843 acted in the same sense. The most important result of this political process was the adoption of Article 24 of the Federal Constitution in 1874 (Bloetzer 1978). It established a federal frame competence in mountainous areas for protective measures against the effects of natural calamities, for reforestation and for the preservation of the remaining forests. Parliament promulgated the first federal forest act in 1876 and in the 90th the positive impacts of federal responsibilities on forests became visible. In 1897 Article 24 of the Constitution was changed and a second federal forest law was promulgated in 1902 for the country as a whole.

2.2 Forest Ownership

2.2.1 Ownership Pattern

326,000 ha or one third of the forest area are privately owned. There are approximately 260,000 owners with an average forest area of little more than 1 ha each (BFS/BUWAL 1997). The private forests traditionally belonged to farmers, but there is an increasing proportion of owners with professional activities in other sectors. Private forests are frequent in the Pre-Alps (46%) and the Plateau (41%) and of lesser importance in the other regions. No recent data are available on parcelisation. Public forests cover some 878,000 ha or two thirds of the country's forest surface. Public tenure dominates in the Alps, on the Southern slopes of the Alps and in the Jura mountains, where 70-80% of the forests belong to the public owners. In the Plateau and Pre-Alps public ownership amounts to more than 50%. The average size of holdings is small, with 70% of all public owners having less than 100 ha.

Different Groups of Public Forest Owners
More than 90% of the public forests are owned by local communities (boroughs), municipali-

ties and local corporations. The local communities developed as associations of burghers, whose civic entitlements included the right to share the timber and pasture in certain forests around settlements. During the 19th century the tenurial rights of these associations were recognised by forest legislation as full right ownership. Today 400,000 hectares or 50% of all public forests belong to this category. A second group of owners are political municipalities managing at present 250,000 hectares or 30% of the public forests. Their ownership results from a transfer of local rights to the political entities during the 19th century and from buying forests in recent times. The third group, classified as corporations and co-operatives under the forest law, includes different kinds of associations which own approximately 100,000 hectares, (figure 3).

2.3 Land Use and Forest Resources

2.3.1 Overview on Land Uses

The last available figures on the overall land use pattern in Switzerland date from the 1979/85 areal statistics (BRP 1998, 52), (figure 4).

Typical for an Alpine country is the considerable proportion of other lands which includes rivers and lakes, vegetation on steep slopes and vegetation-less areas above the timber line. Altogether the figures on the existing land use pattern show that settlement and agricultural areas amount to less than half (44.2%) of the country's surface. An update of the land-use census between 1992-1997 in 9 cantons in the Western part of the country shows that the actual settlement areas have expanded by 14,000 hectares (BRP 1998, 53). A similar evolution has probably taken place in the other parts of the country. A quite different development can be found with regard to forests and wooded lands, especially if one considers long term trends. Between 1870 and 1996 the country's forest area increased from 770,000 to 1,200,000 hectares or by almost 60% (SAEFL 1997b, 17).

2.3.2 Extent and Distribution of the Forests

The national forest inventory 1993-1995 shows a total forest area of 1,234,000 hectares (Brassel and Brändli 1999). In order to be defined as forest an area needs to meet a set of minimum criteria such as a width of 25-50 metres, a cover of 20% and a height of 3 metres. The forest area extends from 200m altitude in the southern Ticino to 2,300 m at the timber line in the central valleys. Almost half (42%) of the forest is on slopes with a gradient greater or equal 40% and one fifth on slopes over 60%. Three quarters of the forests are situated in mountainous areas and half at altitudes higher than 1,000 metres above sea level.

The forest cover amounts to 30% of the Swiss territory, with considerable regional variations.

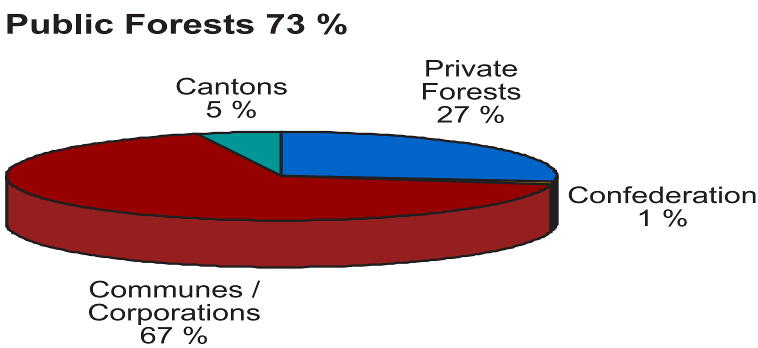

Figure 3. Forest Area by Ownership
Source: BFS/BUWAL, Jahrbuch Wald- und Holzwirtschaft der Schweiz 1995, p 69.

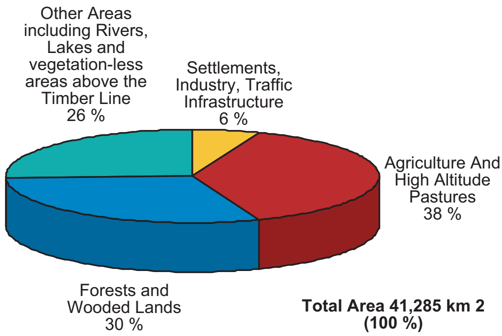

Figure 4. Land Use Pattern in Switzerland
Source: BRP, Vademecum (p 53), Arealstatistik 1979/85.

South of the Alps nearly half of the land is covered by forest. In the Central Plateau, which is the country's most densely populated region, forest cover is only 24%. A similar rate of forest cover exists in the Alps (25%), where the high altitude is a natural barrier to tree growth. Regional variations are even more evident if one considers the forest area per inhabitant. A citizen in the densely populated Plateau is surrounded by ten times less forest than his fellow countryman living in the Alps, (table 1).

Relative to the National Forest Inventory data 1983-1986 the forest area of the country increased by 4% or 47,000 hectares. Regional variations are considerable with a small increase in the Plateau (0.5%), the Jura (1.6%) and the Pre-Alps (2.6%), and a large increase in the Alps (7.6%) and the Southern Alps (5.6%).

2.3.3 Tree Species and Age Class Distribution

Tree Species

The national forest inventory sampled around 50 tree species. The most important tree species in Swiss forests are Norway spruce (*Picea abies, 39%*), silver fir (*Abies alba, 11%*) and beech (*Fagus sylvatica, 18%*). Other species like Scots pine (*Pinus sylvestris*), maple (*Acer ssp*), ash (*Fraxinus excelsior*) and oak (*Quercus spp.*) are fairly common but do not reach a high percentage in the species composition. Typical alpine species are for instance European larch (*Larix decidua*) and Swiss stone pine (*Pinus cembra*).

Coniferous species are predominant in the Alps (78%) and Pre-Alps (68%). In the Jura broad-leaved species, in particular beech (*Fagus sylvatica*), prevail but spruce (*Picea abies*) and silver fir (*Abies alba*) cover a considerable part of the forest area. This is also true for the Plateau, where the distribution of coniferous and broad-leaved species is almost equal, (figure 5). A particular case are the Southern slopes of the Alps, where the climatic conditions favour a larger range of broad-leaved species, and where land use practices increased the area of sweet chestnut (*Castanea sativa*) over centuries. 60% of all trees in Switzerland are coniferous and 40% deciduous.

Table 1. Forest area per capita by region

	Jura	Plateau	Pre-Alps	Alps	South. Alps	Switzerland
Forest area in 1000 ha	201	227	220	415	171	1,234
No. of inhabitants in 1000	1,018	4,091	827	643	293	6,872
Forest area per capita in ha	0.19	0.05	0.27	0.64	0.58	0.18

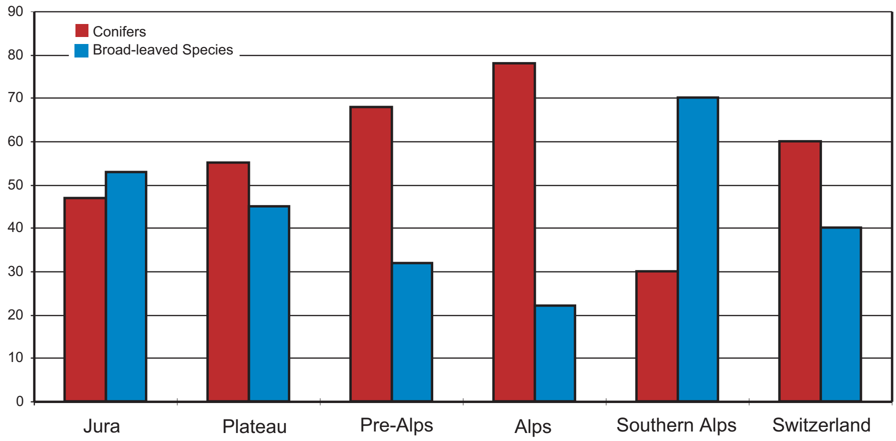

Figure 5. Regional Distribution of Coniferous and Broad-leaved Species
Source: National Forest Inventory 1993-95.

Age Class Distribution
Information on the age class distribution is only available for even-aged stands. Where the age of even-aged stands was estimated in two thirds of the cases based on defined parameters. No inventory information is available for uneven-aged stands, which represent 15.7% of the total forest area. The age class distribution in even-aged stands shows a below average representation of the classes 1-20 and 41-60 years, and an over-representation in the classes between 80 and 120 years as well as over 140 years (Brassel and Brändli 1999).

2.3.4 Growing Stock, Growth and Annual Fellings

Growing Stock
Between 1986 and 1996 the total growing stock in stemwood with bark increased by 42 million cubic metres to a total of 418 million cubic metres of which two thirds (63%) are in the diameter classes between 30 and 60 cm. The growing stock in stemwood without bark, excluding dead and down trees, is around 388 million cubic metres. In comparison with other European countries the growing stock volume per hectare is exceptionally high. The Swiss average volume per hectare is 362 m^3, with increased by 25 m^3 within the last 10 years. The comparison between regions indicates high growing stocks per hectare in the Plateau (433 m^3) and the Pre-Alps (461 m^3), whereas growing stocks in the Alps (309 m^3) and Southern Alps (215 m^3) are below average.

Distribution by Species
Spruce represents almost half or 198 million cubic metres and beech another 17% or 71 million cubic metres of the total volume of growing stock. Altogether, conifer species contribute more than two thirds (72%) to the country's growing stock with as much as 79% and 88% in the Pre-Alps and Alps. Even in the Jura and the Southern Alps where broad-leaved species are more predominant, the share of conifers in the total growing stock is more than half. The proportion of conifer species decreased by 1% of the total growing stock and by 4% in the Southern Alps during the last 10 years.

Annual Increment
The mean annual increment, measured as stemwood with bark at a callipering limit of 12 cm amounts for the whole of the country to 8.3 m^3/ha. Higher increment rates exist in the Plateau (12.3 m^3/ha) and the Pre-Alps (10.4 m^3/ha) and lower rates in the Alps (5.7 m^3/ha) and the Southern Alps (4.2 m^3/ha). Increment including ingrowth is even higher with an additional volume of one m^3 per year and hectare on an average.

Balance between Growth and Wood Removals
A comparison on the basis of stemwood with bark shows that the total annual growth volume of the forest in Switzerland of 9.8 million m^3 exceeds the combined volume of removals and natural losses of 7.2 million m^3 by 30%. If the annual growth volume is compared with the yearly removals for commercial use of 5.4 million m^3 (stemwood with bark) the difference amounts to more than 50%. Regional variations are an indication for differences in the profitability of timber harvesting. Whereas for instance in the Plateau and Jura the harvesting rates in relation to growth volume turn around 60%, they are about half in the Pre-Alps and Alps, and drop to 16% in the Southern Alps (SAEFL 1997b, p 45).

2.3.5 Forest Threats

Principal Causes
The national forest inventory 1993-95 identified the extent of forest damages over a period of 10 years. Storms (66%), insects (13%) and vitality losses (12%) are the principal causes with a combined effect of more than 90% of all causes. Landslides, snow, forest fires, fungi and avalanches are other agents of mainly local importance. In a period of 10 years the area affected by damages amounted to 235,000 hectares or 20% of all forests. The volume of compulsory harvesting was in the order of 22 million m^3 or almost half of all fellings.

Physical Damages to Forest Stands
The second national forest inventory (1993-1995) recorded that 28% of the sampled trees on the permanent plots had physical damages. 6.1% of all trees were damaged due to timber harvesting and another 2.0% due to other direct human impacts. The regional variations of direct anthropogenic damages is considerable and related to the intensity of harvesting practices.

Damages to Regeneration by Browsing and Grazing
Figures from the national forest inventory indicate that 14% of the young trees are damaged by game and another 4% by other factors. As in the case of other forest damages, one has to consider that regional and local variations are significant. Especially in the mountainous areas the effect of browsing on the establishment of natural regeneration is important. Grazing is another factor which has an impact on 10% of the country's forests. According to inventory data it is still practised rather intensively on 80,000 ha and extensively on 36,000 ha. Of the total regeneration area of 160,000 ha approximately 20,000 ha (11%) show effects from intensive or extensive grazing practices.

Environmental Monitoring Systems
The impact of depositions of air pollutants on the environment is subject to continuing debates and it is still difficult to rely causes and effects (SAEFL 1997a; SAEFL 1997b, p 29). The National Air Pollution Monitoring Network (NABEL) measures trends and current air pollution levels throughout Switzerland with a network that has 16 stations. The National Soil Monitoring Network (NABO) monitors the contamination of soils at 105 permanent plots of which one third are situated in forest areas (BUWAL 1993).

Monitoring of Crown Defoliation
Since 1983 the state of crown defoliation has been regularly monitored (SAEFL 1997b, p 31; Brang 1998). Until 1992 the annual inventory of forest condition was consistently made on permanent plots on a 4x4 kilometre grid as part of the SANASILVA programme. With progressing work of the national inventory monitoring was subsequently reduced to a 8x8 kilometre grid. Since 1995 these plots have been assessed every three years. The changes in the monitoring approach imply that comparisons over longer time periods need a careful analysis before conclusions can be made. The measurement of crown defoliation refer to the needle/leaf losses of trees with a diameter grater than 12 cm. Depending on the magnitude of the loss a tree is assigned to one of the following defoliation classes: Class 1 identifies tree crowns with little or no defoliation, class 2 defoliation between 26 and 60%, class 3 and 4 crown defoliation above 60%. Altogether defoliation of classes 2-4 increased from 13% in 1986 to 21% in 1996.

2.4 Silviculture

In Switzerland silvicultural concepts and practices close to nature were developed (Leibundgut 1979, 1984; Ott et al. 1997; Schütz 1990, 1994, 1997). Today silviculture close to nature aims in particular at favouring forest biotope diversity and the potential of natural stand development for ecological and economical reasons (Schütz 1998). It comprises a great diversity of silvicultural techniques according to Leibundgut's principle of "free use of cuttings". The reference for silvicultural considerations is the classification of Swiss forest vegetation with 71 defined communities based on floristical, physiognomical and ecological criteria (Ellenberg and Klötzli 1972; Keller et al. 1998).

High forests with even-aged, uneven-aged and selection-type stands cover 80% of the forest area. The remaining area comprises a variety of forest types such as coppice with standards, coppice and chestnut selva, open stands as well as brushwood close to the timberline, (table 2). Natural regeneration (83%) and mixed regeneration (11%) are predominant whereas plantations (6%) are of little importance. The proportion of naturally regenerated forest varies between the regions. It is particularly high in the Alps and Jura, however only about half in the Plateau region.

2.5 Forest Production

2.5.1 Harvesting Systems and Accessibility

Based on the data of the National Forest Inventory current harvesting methods combine hand yarding (21%), winches (22%), skidding in forest stands (32%), skidding on roads (30%) and skyline and cable systems (20%). Whereas skidding in forest stands in combination with winches is largely practised in the Jura and the Plateau, cable yarding combined with road skidding are common in the Alpine regions. The forest road density changes with region and elevation. Road density is between 40 and 60 metres per hectare in the Jura and the Plateau, and between 10 and 20 metres per hectare in the Alpine areas. Above 1000 metres elevation the road density is less than half in comparison with the lowlands.

2.5.2 Timber Uses

Annual Wood Production

Annual wood production (BSF/BUWAL, 1997, 72-73) oscillates since the 80th between four and four and a half million cubic meter per year with an exceptional peak of 6.2 million in 1990 due to wind throw. The repartition between saw and veneer logs (63%), wood for other industrial uses (17%) and energy wood (20%) has remained fairly stable over the years. Around three quarters of the annual production is coniferous. A significant aspect is the export of coniferous logs which has risen from 400 000 cubic meters in the 80th to the present level of 700 000 m3/year. The export of hardwood logs turns around 300 000 m3/year.

Wood Processing

The annual production of semi-processes products (BSF/BUWAL, 1997, 85) shows the following aggregates. Sawnwood production turns around 1.5 million cubic meters of which 90% are coniferous. Plywood production has always

Table 2. Forest Area by Type of Forest

Forest type	Area in 1000ha	%
Even-aged high forest	837.3	67.9
Uneven-aged high forest	96.3	7.8
Selection-type high forest	52.4	4.2
Other forest types	153.9	12.4
Brushwood and inaccessible forests	94.2	7.6
total	**1,234.0**	**100**

Source: National Forest Inventory 1993-95.

been small and practically disappeared since 1990. Particle board production used to be at a level of 600-700 000 cubic meters and has decreased during the last years. In 1996 the production of wood pulp and cellulose amount to around 900 000 tons. Paper production was at almost 1.5 million tons relying to a considerable extent on recycled waste paper and imports (BUWAL 1998a, 77-79).

2.5.3 Non-timber Forest Products

A recent report (SAEFL 1997b, 51-53) contains some information on a large variety of non-wood products. The study made an effort to quantify the various components. Even if the results are only of indicative value they show the order of magnitude of the importance of these products. Based on economic value estimates the collection of mushrooms and honey, tree nurseries and Christmas tree production, bark chips and compost mould, as well as fodder from pastureland are of particular importance. Hunting and game are another factor of considerable economic weight especially if the cost for equipment and permits are taken into account.

2.5.4 Forest Functions

From a recent representative empirical study for the whole of Switzerland (BUWAL 1998b) we know that during the summer period almost 60% of the population visit forests daily or at least once a week, another 30% once or twice per month. During the winter season daily and weekly visits amount to almost 40% and monthly visits to over 30%, (table 3).

Based on a studied area of 160,000 ha indicative data on the protective importance of forests in Switzerland was collected (SAEFL 1997b, 65-68). They show that 42% of the forests provide protection against landslides with higher proportions in the mountainous regions. Of the total area of water protection zones 50% or 65,000 ha are situated in forests. In the Alpine regions of the country between 7 and 19% of the forests have special protective functions against avalanches, (table 4). With regard to the importance for conservation and landscape protection one should mention that more than 200,000 ha of forest are in areas which have been classified as landscapes of national importance in federal inventories. Altogether 19% of the forests are located in federal inventories indicating high values to be protected.

3 Forest Economics

3.1 Forest and Forest Industries in the National Economy

Share of the Sector in the Gross Domestic Product: In 1995 the total value added of the Swiss wood processing industry was 5.4 billion Swiss francs or 1.5% of the gross domestic product (BFS/BUWAL 1997, 81). The value added of forestry amounted to slightly more than 400 million Swiss Francs or 0.1% of GDP (BFS/BUWAL 1997, 80). The contribution of the forest and wood processing sector to the national economy fell by 50% between 1975 and 1995, (table 5).

3.1.1 Wood Consumption

Total wood consumption (in roundwood equivalents) rose from 5 million m^3 in 1975 to a peak of almost 9 million m^3 in 1990. It dropped considerably in 1991 and oscillated at a level between 6 and 7 million m^3 in the following pe-

Table 3. Frequency of Visits to Forests by Seasons / Switzerland

	almost daily	once / twice a week	once / twice per month	less than once per month	never
Summer season	13.5%	44.3%	29.2%	9.2%	3.7%
Winter season	9.0%	28.9%	33.5%	16.3%	12.2%

Source: BUWAL 1998, Monitoring of Social Demands Towards Swiss Forests.

Table 4. Percentage of the Forest Area with a Special Function for the Protection of Soil

	Jura	Plateau	Pre-Alps	Alps	South. Alps	Switzerland
Studied area in ha	13,571	3,913	23,368	95,958	25,729	162,461
Protection against landslides %	35	34	47	53	58	42
Protection against avalanches in %	0	0	7	18	19	10

Source: SAEFL 1997b, p.66(modified)

riod (BFS/BUWAL 1997). The overall consumption pattern followed the increase in population of 1 million inhabitants during the same period. The per capita consumption remained more or less stable at 1 m^3 per person varying annually between 0.9 and 1.3 m^3 per capita. In 1996 the final wood consumption by major components (in solid wood volume) showed the following proportions (BUWAL 1998, 12): one third of the consumption is wood for construction, furniture and wooden articles; one third is consumed as paper and packaging material; and one third is used for wood energy. In comparison with the corresponding figures of 1991 the consumption of wood for construction and furniture as well the use of wood for energy have increased, (figure 6).

3.1.2 Wood Balance

The wood balance (in roundwood equivalents) shows that approximately two thirds of the consumption are compensated far by annual fellings. Imports were around 7 million m^3 in 1996 and exports around 5 million m3 (BFS/BUWAL 1997, 96), (figure 7).

Export and Import Values (1 Euro=1,6 SFr): In financial terms exports amounted to 2,609 million Swiss francs (2.9% of all exports) and imports to 4,861 million (5.6% of total imports), (table 6). Net imports were 2,252 million Swiss francs. 90% of the trade in unprocessed wood, semi-finished products, finished products and cellulose (1996) takes place between Switzerland and countries of the European Union. Imports originate mainly from Germany, Austria, France, Italy and Scandinavia. Unprocessed wood and wood products exports go mainly to Italy and Germany as well as to France and Austria to a lesser extent.

3.2 Employment

Employment in the wood processing industry amounts to almost 90,000 jobs, which is 8% of the total industrial sector and 2.4% of the na-

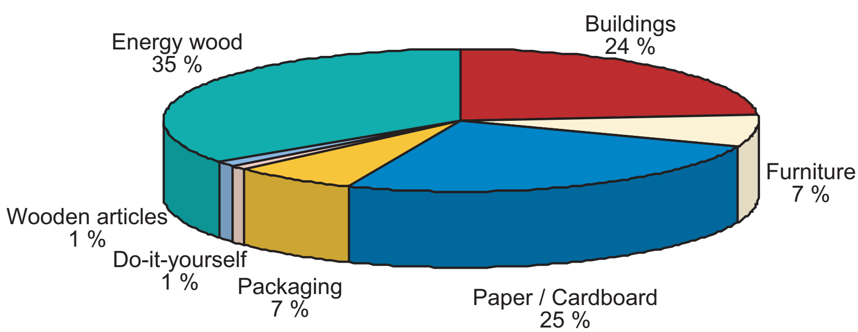

Figure 6. Final Wood Consumption by Type of Product 1996 (solid wood)
Source: BUWAL 1998; Endverbrauch des Holzes in der Schweiz 1996, p 12.

Table 5. Economic Importance of the Wood Processing Industry: in Mio SFr (1 Euro=1,6 SFr)

	1975	1985	1995
Total value added timber industry.	3,900	4,650	5,410
Sawmill industry	350	400	470
Particle and fibreboard industry	100	150	170
Pulp, paper and cardboard industry	600	800	930
Joinery, furniture industry and parquetry	2,000	2,300	2,680
Carpentry, timber work	600	800	930
Others	250	200	230
In % of the gross domestic product	**2.8**	**2.0**	**1.5**

Source: BFS/BUWAL 1997; Wald- und Holzwirtschaft der Schweiz, Jahrbuch 1995, p 81.

tional labour force (BFS/BUWAL 1997, 81). Joinery, furniture making and parquetry together with carpentry and timber work provide two thirds of wood processing employment opportunities. In comparison with the figures of 1975, employment in wood processing has remained stable, (table 7) but its importance in the national labour market has decreased.

Employment in the forestry sector is smaller and amounts to approximately 9,000 man year equivalent in 1995 (BFS/BUWAL 1997, 80). Total employment including forest contractors remained stable during the last 20 years. In the public sector there is a clear shift towards a permanent labour force, whereas temporary labour decreased by 70% over a period of 20 years. Productivity in wood production per hectare increased. Between 1980 and 1996 labour input for wood production in the Plateau area dropped from 30 to 15 hrs/ha, in the Jura from 20 to 10 hrs/ha, and in the Alps from 10 to 7 hrs/ha (BFS/BUWAL 1997, 78).

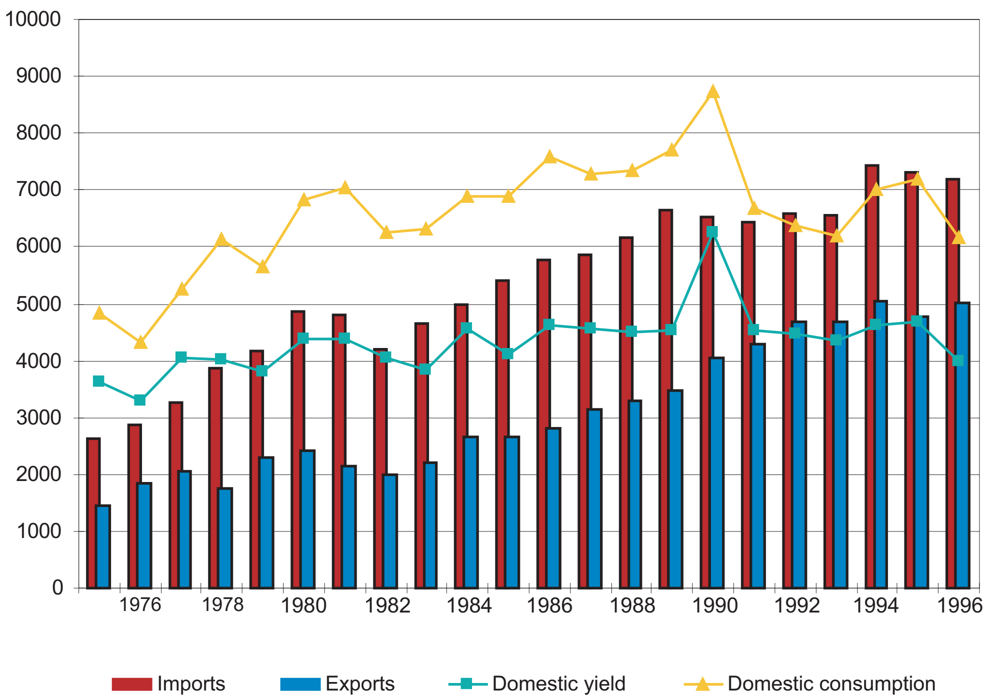

Figure 7. Wood Balance of Switzerland 1975-1996 (in 1000 m³ roundwood equivalents)
Source: BFS/BUWAL 1997; Jahrbuch Wald- und Holzwirtschaft 1996, p 49.

Table 6. Export and Import Values of Wood and Wood Products 1995: in Million Swiss Francs (1 Euro=1,6 SFr)

	Total	Wood/ Wood Products	Pulp/ Cellulose	Paper	Furniture, prefabricated Buildings
Exports	2,609	534	86	1,735	254
Imports	4,861	1,114	311	2,124	1,312
Net Imports	2,252	580	225	389	1,058

Source: BFS/BUWAL 1997; Wald- und Holzwirtschaft der Schweiz, Jahrbuch 1996, p 48.

3.3 Profitability of Forest Enterprises

The federal forest statistics provide information on 3,700 public forest owners with regard to income, expenditure and aggregates of production (BFS/BUWAL 1997). The statistics distinguish between management activities related to wood production, other production such as nursing and smaller wood working units, and services for protection and recreation, (figure 8). The Swiss forest owner association offers an entrepreneurial accounting system which is used by an increasing number of forest owners (WVS 1996). Additional information is available from federal and cantonal budgets. Altogether the figures from the forest statistics show that from 1987 onward the proceeds from wood production and services do not cover fully the expenditures of public forest enterprises with the exception of 1990 with an exceptionally high log production volume due to the Vivian storm catastrophe.

Financing of forest management activities, (figure 9) depends increasingly on public expenditure for securing protection values and other public interests (Schmithüsen 1996; Schmithüsen and Schmidhauser 1998). The proportion of proceeds from wood sales oscillates for all public forests at present at a level of 60%, and at a level of 40% in the Alpine region. Multiple use forest management requires an expanding income basis from public sources. The federal and cantonal governments, other public entities but also the public forest owners themselves contribute in various combinations.

4 Forest and Forest Related Policies

4.1 Legislation

4.1.1 Federal Constitutional Competences

The Swiss Federal government has a comprehensive set of constitutional competences with regard to natural resources conservation and environmental protection. The set includes competences which were established in the 2nd Federal Constitution of 1874 in particular with regard to forests and protection from water ca-

Table 7. Number of employees in the wood processing industry

	1955	1965	1975	1985	1995
Sawmill industry	**9,621**	**8,501**	**5,435**	**5,938**	**5,113**
Particle and fibreboard industry	1,315	2,862	2,012	1,373	1,123
Pulp, paper and cardboard industry	9,142	9,593	8,852	6,159	4,156
Joinery, furniture industry and parquetry	41,901	55,704	53,191	52,816	50,726
Carpentry, timber work	15,202	14,715	7,183	12,976	19,623
Others	11,663	6,694	3,415	3,587	2,971
Wood trade and transport	3,500	4,800	4,700	4,300	4,000
Total wood processing industry	**92,344**	**102,869**	**84,788**	**87,149**	**87,712**
in % nationally	**3.9**	**3.7**	**3.1**	**2.9**	**2.4**

Source: BFS/BUWAL 1997; Wald- und Holzwirtschaft der Schweiz, Jahrbuch 1996, p 81.

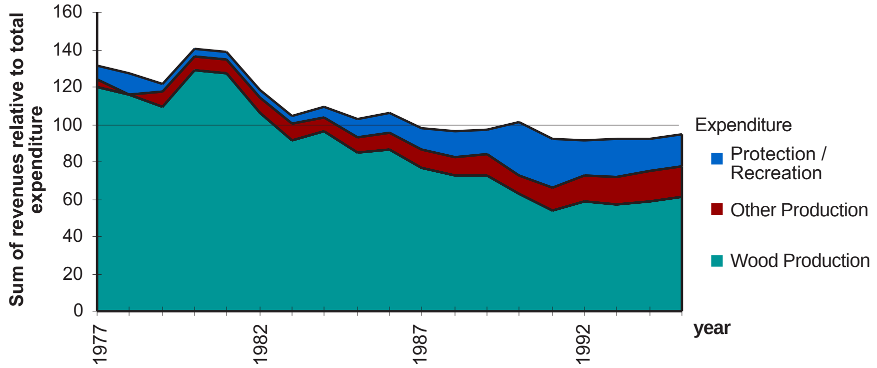

Figure 8. Proportion of Revenues by Output Segments in Relation to Total Expenditure of Public Forest Enterprises in Switzerland (Fixed Assets Excluded)
Source: Schmithüsen and Schmidhauser 1998, 12.

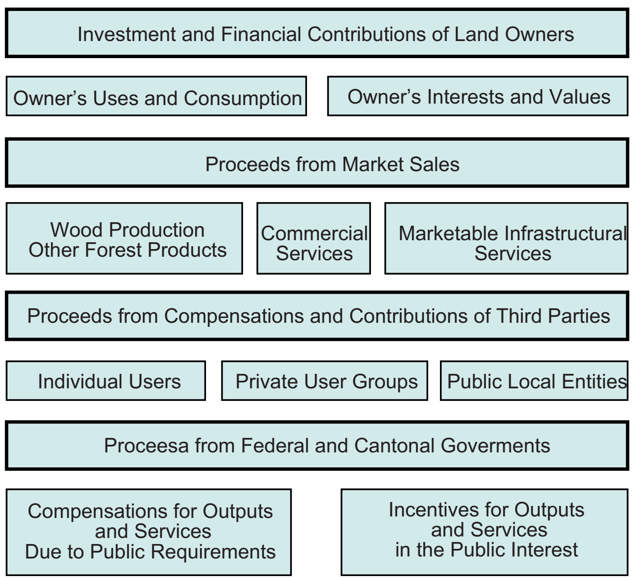

Figure 9. Financing of Multiple Outputs and Services from Forest Land Management in Switzerland.
Source: Schmithüsen and Schmidhauser 1998, 103 (translated and modified)

lamities (Art 24), and competences introduced by constitutional amendments after World War II (Schmithüsen /Zimmermann 1999). The latter refer to the protection of nature and landscape (Art. 24 sexies), land use planning (Art. 22 quater), environmental protection (Art. 24 septies) and to economic welfare (Art. 31 bis). There are further federal competences which enable policies that have important impacts on forest protection and forestry development. This refers to cross-sectoral competences such as training and education, scientific research, regulating commerce, entrepreneurial activities and employment. It also includes sectorial competences such as for water protection and management, agriculture and energy (Kissling / Zimmermann 1998).

4.1.2 Federal Forest Law of 1993 (FL)

Starting in 1985 a total revision of the forest law took place (Zimmermann 1988). The new Federal Forest Law was adopted by the two chambers of the federal parliament in 1991 and is in force since 1993. The law reacts to important changes of the role of forests in society and focuses on two central issues. First, it aims at a balance between the interests and possibilities of forest owners, and the increasing and diversified interests of public user groups. Second, it tries to establish an equilibrium between public demands and public commitments in order to protect forest lands and to maintain a wide range of socially desirable forestry outputs. The forest law of 1993 retains the principle of forest protection and conservation, which so far has proved to be useful. It provides for a multifunctional sustainable forest management, which aims at the protection from natural hazards, wood production, recreational and educational uses, landscape and nature conservation as well as at the forest sector development (Art. 1 FL). The protection of nature and landscapes became one of the specific requirements to be addressed in planning and management regulations. Forest utilisation may be reduced in certain areas, if compatible with the general objectives of the law. In addition, specific forests may be set aside by the cantons in order to maintain and conserve biodiversity (Art.20 FL). With regard to forestry development, the law introduces the principle of compensation to forest owners, if they are required to carry out work or provide services of public interest at costs which cannot be covered otherwise (Art. 36-38 FL). Furthermore the law regulates the federal support of education and training as well as of monitoring activities (Art. 29, 33 FL). It also allows for the possibility to transfer specific tasks to non-governmental organisations, and contains a new article which stipulates that the public and the political authorities have to be regularly informed (Art. 32, 34 FL).

4.1.3 Revision of Cantonal Forest Legislation

Because of the shared competences as stipulated by the Federal constitution the cantons are now in the process of revising their forest legislation. Approximately half of the cantons already completed this task. The others have prepared projects, which are at different stages of parliamentary deliberations (Keel/Zimmermann 1997). Major issues which require cantonal regulation and which have raised conflicting debates during the legal process are the definition of minimum criteria for forest areas; the system of compensation in kind for land for which a clearing permit is issued; the regulation of access for mass-events in the forests; forest management planning; public financial transfers to forest owners; and the organisation of cantonal forest services.

4.2 Actors in Forest and Forest Related Policies

At the federal level the two chambers of parliament and the Federal council are the principal actors in setting the Federal public forest policy. They are responsible for the programme formulation and annual budgetary decisions on public funding. Since 1998 policy implementation has been the task of the Federal Department for the Environment, Transport, Energy and Communication. Within the department the Swiss Agency for the Environment, Forests and Landscape is in charge of forest related matters, such as game protection and protection against natural calamities amongst others. At the cantonal level forestry matters are dealt by various departments, such as the department for agriculture, public infrastructures and environment. A Public Forest Service with headquarters, field districts and range units exists in all cantons (Zimmermann 1997). The conferences of the Cantonal Forest Directors and of the chiefs of the Cantonal Forest Services act as liaison units between the cantons and with the Federal administration.

The Swiss Forestry Association, the Swiss Forest Owner's Association and the cantonal affiliates are the principal representatives of the forest sector. The interests of the forestry personnel are represented by other specialised organisations. In the wood processing sector a larger number of associations exists representing different branches of manufacturers and wood product traders. Joint committees and liaison groups such as the Swiss Association for the Forest, the Rio Committee on Forests and the Swiss Wood Processing Industry Conference have been established. These organisations facilitate an exchange of information and foster the co-operation among the different policy actors.

New actors appeared on the scene, which shape political processes that lead to the adoption or reinforcement of forestry programmes (Schmithüsen 1995, 48). This refers to the role of citizens and of the mass media, which acquired a much higher sensitivity for the political impact of conservation. It also refers to the spectrum of political parties, environmental parliament groups and commissions as well as a large number of professional organisations. A significant development is the creation and consolidation of a wide range of non-governmental organisations, which engage in the promotion of nature protection (Schmidhauser et al. 1993; Schmidhauser 1997). These groups are not only the driving force behind articulating public concern, but they also assume a major role in the implementation of conservation programmes by using the expertise of their members. In addition, as land owners they are increasingly involved in conservation. By using their rights of appeal in the courts they are important agents in the administrative decision making process. The conservation groups formulated criteria on sustainable forest resources utilisation and set up monitoring systems in order to evaluate policy results. The Swiss environmentalist group includes approximately 10 organisations with specific nature conservation objectives. Together the four largest groups have more than 300,000 members (including double membership).

4.3 Forest Policy Tools

4.3.1 Regulative and Incentive Instruments

Whereas previous policies relied mainly on prohibitions and obligations, a more proactive approach with a wider range of policy instruments is now taken (Zimmermann 1994; Kissling/Zimmermann 1996). Regulative instruments keep their importance, in particular with regard to protecting forest areas from uncontrolled changes in land-use and from devastating practices. Instruments which restrict forest management decisions, however, are replaced by joint management systems which engage forest owners and public authorities on a negotiation and contractual basis. A critical review of the existing incentives for afforestation, forest roads and co-operation of forest owners is necessary in order to develop output oriented systems and accurate measures of performance and impacts. New categories of incentives for silvicultural practices close to nature, multiple use management and promoting measures are introduced in order to maintain biodiversity. Compensatory payments to forest owners for specific tasks or restrictions in the public interest are provided for by the new federal forest law. On the whole policy instruments are more specifically related to determined public targets with precise commitments of the beneficiaries.

4.3.2 Informational (persuasive) Instruments

With the shift to a collaborative forest policy, informational and persuasive instruments gain considerable weight (Schmithüsen 1997). This refers to information and debate in parliament and in other political entities, to information and arbitration processes among different interest groups, and foremost to a more substantial dialogue between forest owners and public authorities. Monitoring and performance measurement systems produce information on forest health, composition of forest stands, and on the impact of uses, as they affect forest ecosystems and biodiversity. There is also an increasing demand for information on the economic performance of forest enterprises and on services rendered to the public as part of sustainable forest management.

4.3.3 Process steering instruments

These instruments are particularly concerned with the organisational structures and competences, and communication practices between governmental services and non-governmental organisations. Decision making procedures among public agencies, establishment of lead agencies, organisation of public hearings, as well as regular assessment and evaluation are important issues. A noticeable element is the tendency to separate more clearly the regulatory function of public forest services from their role as managers of the forest land. The allocation of financial resources in relation to specific targets based on global budgeting and/or service contracts is a new feature in public process-steering. It requires criteria of financial controlling which measure efficiency (output/input), effectiveness (attainment of objectives), economy (real costs/standard costs) based on best practices, as well as distribution effects.

4.3.4 Impact of Policy Measures

To date, there has been no systematic and scientific evaluation, either of the whole public forest policy programme or of some individual or specific instruments or measures (Zimmermann 1998). However, there are data and information available which are suitable for a partial evaluation of the principal instruments of Swiss forest policy. From the Forest Statistic Yearbook, for example, we know in which region or canton deforestation permits have been granted. With regard to the purpose of deforestation, three categories are dominant: traffic installations, raw material and refuse (figure 10).

Quite similar is the situation relative to financial contributions, the second principal instrument of the federal forest policy. From the budget and the account of the Confederation we know the amount allowed each year by the Federal Assembly for the financing of three types of measures: forest tending, protection against natural hazards, and improvement of forest management conditions. An estimate, based on the 1996 figures published in the official gazette, shows that the share of the Alps and Jura in the decisions made by the Swiss Forest Agency on public funds was as follows (Zimmermann 1998): 85% for forest tending; 100% for protection against natural catastrophes; and 75% for measures of improving forest management conditions. 90% of the decisions of the agency thus referred to forests in mountainous regions, which is considerably higher than the proportion of these forests within the country, (figure 11).

4.4 Forest Policy in Relation to other Policy Areas

The various constitutional amendments have led to a growing network of distinct policy areas focusing on resources conservation and environmental protection (Schmithüsen 1995, 46f. Kissling-Näf and Zimmermann, 1998):

- conservation linked to the use of renewable natural resources such as forest, water protection and fishery policies,

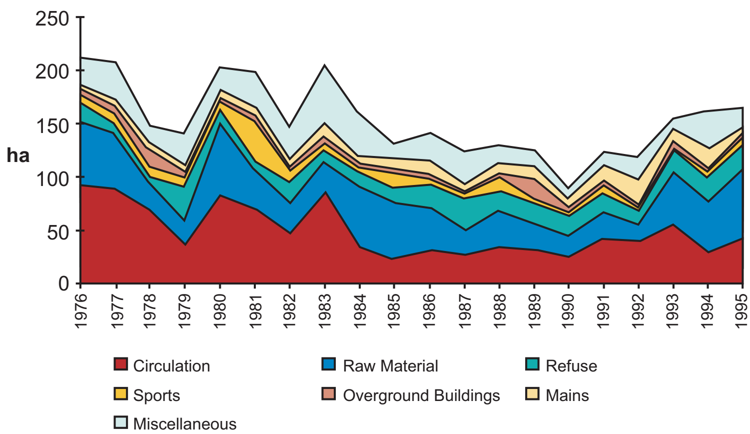

Figure 10. Authorised Deforestations in Switzerland
Source: BFS (several annual editions)

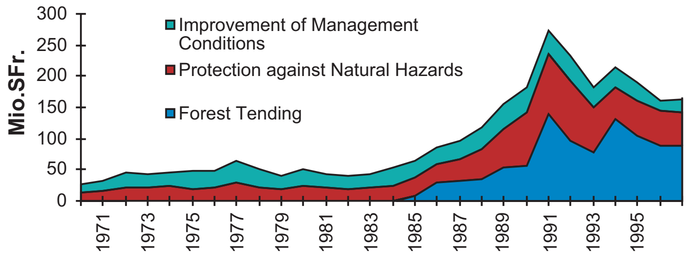

Figure 11. The Financial Support allocated by the Confederation for Forest Measures (1972-1996)
Source: Swiss Forest Agency, Annual Reports

- conservation of nature and landscape as well as of the available space;
- conservation of the environment in particular with regard to air, soil and pollutants;
- improvement of economic conditions and rural development.

The programmes are not only complementary, but also in competition with each other. Sectoral resource policies tend to integrate conservation aspects, cross-sectoral conservation policies become increasingly involved in regulations of specific uses, and land use planning integrates all aspects of land development and conservation.

A centre-piece in the expanding federal conservation policies was the adoption of the Nature and Landscape Conservation Act in 1966. The law was the starting point for a new policy area, which evolved considerably during the eighties. The law emphasises the systematic conservation of biotopes, remaining mire landscapes and alluvial forests. The constitutional amendment on environmental protection of 1971 provided for "protecting man and his natural environment from harmful or irritating impacts". Its legal implementation was achieved in 1985, when the Federal Law on Environmental Protection was adopted. The law establishes guidelines such as the principles of prevention and responsibility of intervention. It further contains procedural and administrative provisions with regard to the assessment procedures and the designation of competent governmental authorities. The law addresses specifically those conservation areas, which had not been regulated before: air pollution, protection against noise, control of environmentally dangerous substances, soil protection and waste disposal.

Conservation is not limited any more to the protection of certain species or endangered biotopes. Instead it aims at the integration of conservation aspects in the general resource management (Keller et al 1997). One of the most effective instruments in this context is the right to appeal against deforestation permits (including forest roads) by recognised private nature conservation organisations. Similarly the environmental impact assessment gives an opportunity for conservation agencies and private organisations to intervene in administrative procedures at an early stage and thus to claim that the forest area is maintained.

The linkages between land-use planning and forest policy programmes follow from the Federal Land-Use Planning Law (Art. 3) which provides for the protection of natural resources and forests, preservation of landscapes and recreational areas, as well as the maintenance of important forest functions. The co-ordinating role of land-use planning involves many sectoral policy areas including transport, energy, agriculture, forestry, mineral exploitation, as well as urban and regional development. Important linkages between land-use planning and forest policy exist when determining forest areas and forestry related land-use. The forest law provides for the maintenance of the country's forest area and of the prevailing regional distribution of the forest cover (Art. 5 and 7 FL). It stipulates that the borders of forests have to be defined and are to be marked in land-use plans

(Art. 11ff FL). The Federal Law on Land Use Planning requires the agreement of the land-use planning and forest authorities for forest roads, forest operating centres and other permanent infrastructure (Art. 22 and 24).

4.5 International Policy Developments

4.5.1 Rio Process

National sustainability concepts and action plans are directly linked to the 1992 UNCED Conference in Rio (Agenda 21). For this purpose an interdepartmental commission representing 20 offices was established in March 1993 (IDARio 1996, 1997). An action plan for sustainable development, which incorporates mid-term planning, has been devised by a small high level expert group (Conseil du development durable 1997). Based on these findings, the Federal Council presented a strategy for sustainable development in 1997 which is now the main document for further actions (Federal Council 1997). With regard to forests Switzerland is actively involved in the Rio follow-up process (Mühlemann 1999).

4.5.2 Ministerial Conference on the Protection of Forests in Europe

Switzerland made specific contributions in implementing the six resolutions of Strasbourg as well the four adopted in Helsinki (Conference Report Vol. I 1998). With regard to the guidelines for sustainable forest management and for the conservation of biodiversity (Resolutions H1, H2) the main actions are an assessment of Swiss forest policy, a national debate on appropriate criteria and indicators for SFM, the preparation of a forest development strategy, the setting aside of forest areas and the establishment of a gene reserves network (Conference Report Vol. II, 227, 1998). During the preparatory process of the Lisbon Conference an important contribution has been made by identifying more consistently the social aspects of sustainable forestry (FA/ECE/ILO 1997).

4.5.3 Bilateral undertakings

Switzerland has recently completed a process of bilateral negotiations with the European Union which covered amongst others trade, traffic and research. There are considerable differences between Switzerland and the EU countries with regard to policies on sustainable land-uses and environmental conservation, but the trends point in the same direction (Zimmermann 1998): a more consistent consideration of ecological aspects in resources utilisation, public compensations of forestry outputs in the common interest, and policy measures which integrate forestry more closely at regional and local levels into rural development. Switzerland is involved in the process of shaping the Alpine Convention.

4.6 Forest Education and Research

4.6.1 Education and Training

Technical and professional forest education is provided for by the forest worker apprenticeship, by two forestry schools , and by the department of forest sciences of the Swiss Federal Institute of Technology (ETH) in Zurich. The tendency that university graduates find employment in a wide range of activities increases, particularly as independent professionals or as employees in private companies (Lanfranchi et al. 1995). On the job training and continuing education is promoted by a central Co-ordination and Documentation Centre (CODOC) which was established in 1988 by the Swiss Forest Agency. Professional and technical training and education in wood processing is provided for by the Swiss School for Wood Technicians and Engineers in Biel. The Federal Institutes of Technology in Zurich and Lausanne offer special programmes for architects and engineers in wood construction and technology.

4.6.2 Forest Research

Forest research is mainly carried out by the Swiss Federal Institute for Forest, Snow and Landscape Research (WSL) in Birmensdorf and

Davos and its two regional branches at the ETH Lausanne (Antenne Romande) and Bellinzona (Sottostazione Sud delle Alpi). Major research contributions are made by the Department for Forest Sciences and the Department for Environmental and Natural Sciences of the Swiss Federal Institute of Technology (ETH) in Zurich. There is a growing number of institutes in Cantonal universities and in other Federal Centres which are engaged in forest related as well as nature conservation and environmental protection research. Wood research is mainly undertaken by the two Federal Institutes of Technology in Zurich and Lausanne, by the Federal Institute for Materials (EMPA) in Dübendorf and by the Swiss Wood Engineering School in Biel.

5 Main Current Conflicts and Challenges

5.1 Changing Demands on Forests

Changes occur in a highly complex society in which the tertiary sector contributes more than half of the employment and economic activity, technology and information processing induce rapid adjustments, and in which the majority of the population lives in an urban or peri-urban environment. As a result the forests are looked upon not only for wood production, but also as multifunctional resource and recreational area which generates many benefits to the communities and which may be used by the citizens.

Two recent studies, one for mountainous regions and one for Switzerland as a whole, inquired the population's perceptions and attitudes of forests. Both inquiries clearly show that people judge the value of forests for recreation and as natural environment to be significantly higher than the economic values of forests (BUWAL 1998b, Schmithüsen et al. 1998; Zimmermann et al. 1996, 1998). The results of the studies further indicate that in future the forests will be appreciated even more for their immaterial values and less for the goods they produce. Besides the ecological and recreational values, the protective role of trees and forests will increase in importance. Demands for multifunctional forests as well as for local and regional differences determining their social meaning will be more pronounced. Wood production will remain important but will require increasingly a well-reasoned justification.

5.2 Old and New Forest Related Conflicts

The conflicts relate to economic efficiency in a world wide competitive environment versus cultural values and personal identification; to social divergences on individual demands and personal choices versus efforts and restrictions in the common interest for present and future generations; and to a changing understanding of the role of government in natural resources conservation. They involve contradictory interests between the expansion of public infrastructure and settlement areas versus maintaining the forest cover; between compensatory afforestation and natural forest successions versus agricultural and touristic land use; between forest production and technology versus use restrictions and nature conservation; between the interests of land owners and other users; and between various kinds of recreational uses. Conflicts exist with regard to various options of forest management which result from contradictory positions of forest owners and forest services, non-governmental organisations and the public. Such conflicts reveal more fundamental disagreements on political and institutional issues in particular on forest sector regulation at the local, regional and federal level, on financial contribution to provide multiple benefits from forestry; and on the role of public administrations and non-governmental association in rural and urban developments.

5.3 Policy Development

Policy formation and implementation is increasingly concerned with the role of forests as parts of nature and landscape, as parts of the global environment and as integrative elements of culture. Policy processes lead to a wide range of programmes with growing impact on forest protection and forest management. This involves cross-sectoral programmes of nature and landscape protection, land-use planning and environment as well as natural resources and regional development policies. A broad policy network emerges that integrates different social regulations related to the protection and sustainable use of forests. This raises issues on the relevance of forest policy for the objectives and measures of neighbouring programmes, and refers to the impacts of policies which address other land-uses and cross-sectoral conservation. The linkages between different policy areas have become a central element in shaping future forestry practices.

Forest planning which largely focussed on regulating timber flows and forestry practices has now an additional and crucial task in implementing complex policy networks at local and regional levels. It is an integrative part of determining varying and multifunctional land-use and landscape management, which considers economic outputs and values associated with nature to be of equal importance.

5.4 Challenges to Sustainable Forestry Practices

The expanding range of conservation needs, combined with more information on the values of biotopes and ecosystems leads increasingly to concerns on the ways and means in which forests are to be utilised and managed (Schmithüsen 1995, 49). Forestry is no longer a uncontested sectoral activity, which is left to forest owners and foresters. Forest owners are accountable for the far reaching demands of conservation groups and the increasingly sensitive public. Forest management is not limited to its traditional role of ensuring sustainable wood production. It integrates many more aspects and has to prove that the forest uses safeguard biodiversity and protect cultural and aesthetic patterns.

A combined approach of conservation and sustainable uses puts new demands on forest management in order to acknowledge the interdependence between investments in resources utilisation and restrictions of uses. This requires political arbitration processes based on a broader perspective of the economic and social issues at stake. Conservationists need to understand the rationale of forestry activities within the broader context of regional development. Forest managers need to understand that economic and competitive wood production implies a compromise between uses and preservation and that alternative solutions are as much political as technical issues.

The values associated with forests are locally specific, and have different implications in time and space. Forest management practices which are flexible and multipurpose oriented facilitate the integration of varying priorities. It provides for a kind of utilisation which satisfies different groups of the community and leaves opportunities related to changing social demands. For such reasons conservation of natural forests, silvicultural practices close to nature, and selective uses which maintain specific ecosystem potentials will gain even more importance. The need to satisfy different user groups and simultaneously accommodate changing demands on forests has shaped forestry practices in Switzerland. As a result Swiss forests are characterised by a large variety of vegetation and selective utilisation patterns, which in turn are a valuable asset for the future.

5.5 Challenges to Forest Owners

Due to the high share of public forests in Switzerland and in view of the strong instruments for direct democratic intervention at all levels of the community, the objectives of what is to be considered as appropriate forest practices will become more and more subject to pluralistic political bargaining processes. Such processes will be of particular importance when local and regional decisions on forests are at stake. The change from the principle of sustainable wood production to the much broader meaning of sustainable forest management offers a basis for more differenciated and locally specific management objectives which correspond to the needs of the land and the public. Such a change is facilitated by the fact that the past and current forest management in Switzerland has led to forest stands which allow a variety of silvicultural treatments and which have a high potential for protecting biodiversity and conserving nature.

The challenges to public forest owners are foremost to react to changing public demands in a transparent manner and to use decision making processes that favour a consensus among user groups. This again implies the task to convince the political bodies to provide the necessary organisational and financial means for multifunctional forestry practices sustaining a variety of public uses. The challenges to private forest owners are in particular to articulate their immediate interests, to deal with external demands largely focussing on immaterial values, and to maintain their autonomy in management decisions in a situation where they depend increasingly on financial support and compensations from public entities.

5.6 Challenges to Foresters

A new repartition of the commitments of owners, public entities, user groups and non-governmental organisations in a combined multipurpose resources management perspective is the consequence. The self-financing capacity of the forest sector has to be seen within a political framework that stimulates sustainable production satisfying private and public interests. The challenge to foresters in Switzerland will be to determine the actual and potential benefits from forests, to define the ecological limits of uses, to analyse competing as well as complementary demands and to evaluate the impacts of alternative management strategies. Their work relates to the significance of forests in the overall landuse patterns and as a constituting element of landscapes and environment. All this requires economic thinking, knowledge of political processes for arbitration and consensus finding, and openness for the social dynamics which determine a specific set of demands in a country, a region and at a given locality.

5.7 Challenges to Education and Research

Swiss forest research and education are at present in situation of rapid and rather profound changes moving from the established pattern of applied forest sector activities to a much broader perspective of natural resources management and environment. The new mandate of the WSL adopted by the Supervisory Council (ETH Rat) in 1997 shows this evolution. The institute’s programmes focus now on landscape including social aspects, on forestry with more attention on economic factors, and on protection from natural hazards including monitoring and evaluation. The central theme are terrestrial ecosystems that are less intensively used and the impacts which result from human interventions and conservation measures. Similar developments exist at the ETH Zurich with efforts to create broader networks integrating environmental sciences and disciplines concerned with land-use, primary production and rural development. International research co-operation such as through IUFRO and IPCC as well as European networks such as Cost and FAIR are of considerable importance in reorienting and broadening national research programmes.

5.8 Challenges to Public Forest Administrations

The multiple demands on forests in a rapidly evolving economic and political environment require the maintaining of the high level of forest management and a flexible adaptation of forestry practices to the complex interactions between private and public interests. The streamlining of state intervention in accordance with the principles of new public management is one of the important factors of change. It implies a more precisely defined balance between political targets and commitments, between public benefits and financial resources, and between multiple forestry outputs and cost sharing to produce such outputs. New ways of implementing public policy programmes based on target oriented outputs and contractual arrangements have been introduced in order to improve the efficiency of the public sector and to link more consistently commitments and required resources. The forest sector and forest administrations have, in fact, been chosen in several cases as pilot projects in order to gain experiences with the application of new public management concepts.

The diversification of public demands on forests, a new understanding of sustainable development, profound changes in the relationship between government and citizens as well as structural limitations on financial resources are decisive factors that determine the range of action of public forest administrations. In future this requires even more than now:

- openness and flexibility in reacting to public demands on forests and forestry practices;
- comprehensive and continously renewed knowledge on the ecological, social and economic criteria which determine their political relevance;
- transparency in the preparation of decisions and negotiation abilities with non-governmental organisations, citizen groups and other administrations;
- and economic thinking in efficiently using scarce public funds for specific tasks in order to foster multifunctional forest resource development.

The ongoing changes, both at the level of the federal government and of the cantonal forest services, are steps in this direction. Further efforts will be required to ensure sustainable uses and the conservation of nature in the forests of Switzerland.

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Mountain Forest Project http://www.bergwaldprojekt.ch/
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1 The Country

Ukraine (Ukrainian *Ukraina*) is the largest state of Europe after Russia. Ukraine includes the south-eastern part of the East European Plain and the Ukrainian Carpathians, which form part of the Eastern Carpathians. Its total area comprises 603,700 square km (233,090 sq mi), with a maximal east-west extension of 1,316 km (818 mi), and a north-south extension of 893 km (555 mi). It is located: eastern length from 22 Grad 08 Minutes till 40 Grad 05 Minutes _northern latitude from 52 Grad 18 Minutes till 44 Grad 22 Minutes.

1.1 Nature

Two great tectonic structures dominate the territory of Ukraine - the East European platform, and the Alpine geosynclitic region. The platform is a rigid, low motion tectonic structure whose lower part consists of ancient crystaline mountainous rock (granite, basalt, crystal slates, etc.), while the upper part is made of insignificant layers of sedimentary rocks (sand, clay, lime, etc.). The Alpine geosynclitic region (Carpathians and Crimean mountains) is an area of relatively young, intensive tectonic motions. Sedimentary mountainous rock dominates its structure.

Most of the territory of Ukraine is dominated by the East European plain. Mountain ranges only rise in the west (Ukrainian Carpathians) and in the extreme south (Crimean mountains). The highest point in Ukraine is Hoverla (2061 m) in the Ukrainian Carpathians. The plains cover almost 95% of the country, with an average elevation of 175 m above sea level. There is a considerable surface incline from north to south and from west to east (to the Dnieper). The largest rivers are Dnieper, Dnister, Bug and Donets.

The climate is predominantly moderate continental, except for a narrow strip along the southern shore of the Crimea, which has a subcontinental climate. Typical continental climate characteristics increase from the west to the

Figure 1. General view of Ukraine among neighbouring states

east, and there is some variation in climatic factors (precipitation, humidity, wind regimes) in relation to latitude.

The coldest month is January, with an average temperature of -7°C in the north-east to 4°C along the southern Crimea. The warmest month is July, with average temperatures of 18°C in the west, 19°C in the south-east, 22-23°C in the south, and up to 24°C along the southern Crimea. The average annual precipitation amounts to 550-650 mm in the mixed forest zone, 450-650 mm in the forest-steppe zone, 300-350 mm in the south, over 1000 mm in the Crimean mountains, and over 1500 mm in the Carpathians.

The following agrosoil zones can be found in Ukraine: Polissya, Forest-Steppe, Steppe, Dry Steppe, and Carpathian and Crimean mountain regions; they all show a wide variety of soil structures.

Derno-podzolic soils are predominant in the nothern regions. There is deficiency in humus and nutrient substances in those soils. But the application of organic and mineral fertilizers as well as lime application increases its fertility. The lowlands in the Polissya are occupied by meadow and meadow-swamp soils.

In the Forest-Steppe zone, especially in Volyn and Podolsk Hills, gray and dark-gray podzolized soils prevail. Ukraine is famous for its chernozem soils (44% of its territory), which are the most valuable in the region. In the middle Forest-Steppe zone soils are predominantly podzolized, and they gradually change into typical chernozem southwards. Solid tracts of chernozem soils are deposited in the Steppe zone.

Dark chestnut and chestnut soils are typical of the southern coastal regions and the Northern Crimea.

The vegetation of Ukraine is rich and diverse. The natural flora consists of about 30,000 species, including 4,000 sea plants, 15,000 mushrooms and micromycetes, over 1,000 lichens, 800 mosses, and 4,523 vascular plants. An additional 1,000 species of vascular plants are cultivated in forests and botanical gardens. In addition to the native flora of Ukraine, vegetation continues to diversify by introduced species.

About 600 species of higher plants are endemic to Ukraine. More than 600 species are rare and endangered and need protection. About 30% of the native plant species grow in forests, hedge rows, and forest meadows; 15% in dry and wet meadows; 20% in steppe; 10% in swamps and wetlands; 15% are found in waste-land and fallow habitat; with an additional 5% exfoliates and 5% on saline lands and along sea shores.

Certain zones are found within the territory of Ukraine: mixed forest zone (Polisya), forest-steppe zone and steppe zone:

Ukrainian Polissya. The zone of mixed forests in Ukraine occupies the northern part of its territory. It is called the Ukrainian Polissya and covers 14,5% of its territory (113,5 thousand sq. km). The Polissya is one of the most important forest resource regions in Ukraine. Pine-oak forests are predominant in a large part of its area. Oak-hornbeam forests grow in the southern part. The largest area of swamps in Ukraine is in the Polissya. These are lowland swamps with rich and diverse plant cover.

Forest-Steppe. The forest-steppe zone is situated south from the zone of mixed forests, stretches widely for 250-350 km from west to east, and occupies 202,8 thousand sq. km (33,6% of its territory). A peculiar feature of the zone is the alternation of vast steppe areas with strips of broad-leaved forests. Forests occupy about 15% of the zone and are more regular in the western part of the Forest-steppe. Here beech, oak-pine, oak-hornbeam, and alder forests grow. The number of species such as oaks, hornbeams and limes increases eastwards. Pine forests grow on sandy terraces.

Steppe. The Steppe zone is situated in the southern part of Ukraine and stretches for 1100 km from south-west to north-east and for 500 km from north to south to the Black and the Azov

Figure 2. Natural zones on the territory of Ukraine

seas and to the foothills of the Crimean mountains. The total area is 240,2 thousand sq. km (about 40% of the Ukrainian territory). As to its soil-climatic conditions this zone is divided into the northern, central, southern and dry Steppe. Formerly steppes were covered with natural grass vegetation. At present they are ploughed up. Natural vegetation is preserved on the slopes of gullies, at the foothill regions of the Crimea and in some nature reserves.

Ukrainian Carpathians. The natural complex of the Ukrainian Carpathians consists of the Pre-Carpathian hilly plain, mountain ranges and Zakarpatya low land, it occupies 37 thousand sq. km. Forests cover 40% of its area, natural forage lands - 35%, and agricultural land - 25%. In the Ukrainian Carpathians there are more than 2 thousand higher sporiferous and flowering plants. Among flowering plants there are 70 tree species, 110 bush species, the remaining part being grass vegetation. Five altitudinal vegetation belts can be identified: 1) oak forests growing in the foothills of Zakarpatya, at an altitude 100-580 m above sea level, where common and sessile oaks, beeches, hornbeams, ashes, elms, and birches prevail; 2) beech forests (altitude - 450-1030 m) with strips of pure beech, fir-beech and fir-spruce-beech forests. This zone occupies 70% of the Ukrainian carpathians area; 3) spruce forests (up to 1470 m) with strips of pure spruce and mixed (fir and beech) forests; 4) the subalpestrine belt (1200-1600 m), where mountain pine, alder, blackberry, bog bilberry, and rhododendron prevail; 5) an alpestrine belt, the so-called, the poloniny (1800-1850 m above sea level), here the major areas are under grass vegetation.

The Crimeans. The Crimeans are divided into 3 natural geographic zones: the Foothills, the Main range and the Southern coast of the Crimea. The Crimeans stretch for 150 km in length and up to 50 km in width along the Southern coast of the Crimean peninsula. The mountain vegetation is very diverse. The northern slopes are chiefly covered by oak and beech forests, the southern ones - by separate forest tracts consisting of common and Crimean pine, oak and beech forests. There are many relict plant species here.

1.2 Society

On August 24, 1991 the Supreme Soviet of Ukraine passed the Act of Independence for Ukraine. On December 1, 1991 an all-Ukrainian referendum was held which supported independence with 90% of all votes. Ukraine is a presidential parliamentary republic. Its capital is Kyiv. The head of state (president) is elected by the citizens for a five-year term. The legislative body is the parliament (Verkhovna Rada) which is elected for a four year term and consists of 450 people's deputies. There are fifty registered political parties, and the factions of eight parties (and blocs) are represented in Verkhovna Rada.

Ukraine is an industrial-agrarian country. It is rich in coal, iron, ore, manganese, nickel and uranium. The leading industrial branches include ferrous and non-ferrous metallurgy, machine, ship and instrument building, space technology and aircraft construction, power engineering, mining industry, as well as food and textile industries. Overall, there are almost 300 industrial branches. The total arable land area amounts to 34,2 million ha. Construction and transportation systems are well developed, and the labour force is highly qualified. Reforms are under way to aid Ukraine's transformation from a planned market system to a market economy. It has opened its doors to foreign capital investments, international cooperation, and tourism. Reforms touch all areas of life - economy and policy, science, culture and education.

The value of Ukraine's gross domestic product (GDP) in 1995 was estimated at $35.9 billion. Agriculture, which includes forestry, accounted for 13.2 percent; industry, which includes mining and manufacturing, accounted for 34.4 percent; trade and other services accounted for 36.9 percent; and other sectors, including construction, accounted for 15.5 percent.[1]

The population of Ukraine is 50.9 million (1998), with a population density of 85,7 persons/square km. The population consists of 72 % Ukrainians; the remainder represents a mix of Russians, Jews, Belorussians, Moldovians, Bulgarians, Hungarians, etc. Overall, more than 110 different nationalities are represented. About 68 percent of the population lives in cities and towns.

The country's labor force totals approximately 28 million people. About 40 percent of workers are employed in industry, 40 percent in the service sector, and 20 percent in agriculture and only 0,3 percent in forestry. Unemployment is rising steadily, especially in the form of hidden unemployment, which includes people who have been kept on payrolls but have not been paid salaries.[2]

The transition from the Soviet period has brought serious new problems. Much of the old elite (*nomenklatura*) has weathered the transition well. Many Soviet-era managers and factory directors retained their positions and profited from privatization. Highly placed members of the Communist Party hierarchy and security apparatus moved into business, often of a dubious kind. A thin stratum of new rich has begun to appear.

For the vast majority of the population, however, the transition has meant a catastrophic decline in living standards. Since 1991 the average standard of living has declined by 80 percent. An estimated 45 percent of the population, especially the elderly, now lives below the poverty level. Unemployment is growing, and health care is deteriorating. Life expectancy of males has dropped from 65 to 58 years. Ecological disasters, poor diet, and other factors have lowered resistance to diseases. Epidemics of diphtheria, cholera, and hepatitis have been frequent in recent years. A tragic consequence

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[2] "Ukraine," *Microsoft® Encarta® 98 Encyclopedia.* © 1993-1997 Microsoft Corporation. All rights reserved.

of the Chernobyl' explosion has been a large increase in thyroid cancer in children.[3]

Ukraine is moving towards integration into Europe by developing its national economy, creating a social system and coping with ecological crises.

2 Forest Resources and Their Uses

2.1 Forest History

During the first millennium A.D., almost all of Ukraine was covered with forest, except the steppe zone, where tree growth was restricted to gullies and river banks. The Polissya zone, Carpathians and Crimean mountains had an almost closed forest canopy. Only swamps, sandy soils and steep mountain slopes remained treeless. The forest-steppe zone, especially at Galychyna and Podillia, was also densely wooded. The most comprehensive information on forest distribution in the Ukraine during the 16th and 17th centuries can be gleaned from Beauplan's maps (Guillaume le Vasseur Sieur de Beauplan (1959)), and the maps of forest distribution during the first millennium. These maps verify that a considerable decrease of forested land occurred. During the 19th and 20th centuries, the virgin forests of the Polissya and the forest-steppe zone were reduced to small remnants. According to the 19th century forest maps, coniferous forests dominated in the forest fund land of Polissya. The main species was pine, intermixed with small numbers of oak, black alder, poplar, etc.

From 1946 until 1978, about 3.5 million ha of new forests were created in Ukraine. Afforestation occurred particularly in the steppe zone, where the forested area increased by a factor of 2.5 to 3. Overall, the increase in forested area during this period was a mere 3%.

Development of industry during the second half of the 19th century increased demand for timber and led to the mass destruction of forests in Ukraine.

The natural composition of forests deteriorated, along with a decline in forest resources and overall wooded area. As a rule, valuable species such as oak and pine were felled in Polissya and the forest-steppe zone, and beech in the Carpathians. They were replaced by less valuable species such as hornbeam, maple, lime tree, and birch, etc.

Excessive exploitation of the Carpathian forests resulted in a 25% decrease of oak and beech forest during the last 100 years. This in turn led to soil erosion, increased flooding and other negative impacts.

Deforestation was mainly linked with the need for land for agricultural purposes. Large areas of Ukrainian forests were replaced by agricultural crops or settlements. Also, deforestation for increased land utilisation, by making pastures in mountainous regions (like Carpathians and Crimea), was recorded.

2.2 Forest Ownership (privatization, fragmentation)

Ownership of natural resources, including forests, is determined by the Constitution of Ukraine. Article 13 of the Constitution declares: "Land and fossils, the atmosphere, water and other natural resources which are within the territory of Ukraine, as well as natural resources of its continental shelf, are subject to the ownership rights of the Ukrainian people. The ownership right is executed on behalf of the Ukrainian people by the bodies of state and local administration within the limits set by this Constitution."

The ownership of forests and their use are determined by the Forest Code. Article 6 of the Forest Code declares: "All forests of Ukraine belong to the state. On behalf of the state, man-

[3]"Ukraine," *Microsoft® Encarta® 98 Encyclopedia.* © 1993-1997 Microsoft Corporation. All rights reserved.

agement of the forests is carried out by Verkhovna Rada of Ukraine. Verkhovna Rada delegates its powers of forest management to corresponding Radas of people's deputies determined by this Code and other legislative acts. The Radas of people's deputies award land areas of the forest fund for permanent use or take them back within their competence in the fashion determined by this Code."

The state forest land, which is managed by the State Committee of Forestry of Ukraine (Kyiv), contains 73.2% of the total forest area, with the remainder of forests in long-term use under the management of peasants' unions and other users.

Some scientists, politicians, and specialists on Ukraine, question the value of forest privatization, as it may result in the deterioration of the state of forests, lead to a decrease in productivity, and exert a negative impact on the climate as well as recreative, protective and other useful forest functions.

2.3 Land Use and forest resources

2.3.1 Global overview of the land use

Ukraine has the largest area of arable land in Europe and almost 40% of the world's total area of the most productive black soils. The distribution of lands by different types is presented in figure 3.

The state forest land of Ukraine amounts to about 10 million ha, 8.6 million ha of which is covered by forest vegetation. There are 0,17 ha of forest per person. The total forest cover of the country is 14.3%. Forest plantations make up 40% of all forest land. The total forest stock amounts to 1.3 billion cubic meters.

2.3.2 Extent and Distribution of the Forests

The forests of Ukraine show a very uneven distribution. In Polissya, the percentage of wooded area is 26.1%; in the forest-steppe zone, 12.2%; in the steppe zone, 3.8%; in the Carpathians, 40.5%: and in the Crimea, 32%.

This uneven distribution of forest resources and the current level of forested area are the result of climatic conditions and anthropogenic influences over a long period of time. For example, from 1814 to 1914 the forested area of Ukraine decreased by 30.5%.

The most wide-spread conifer species are pine, spruce, and fir. Oak, beech, and white maple dominate among the deciduous species. In 85.3% of all forested area, these species predominate. Overall, forests in Ukraine show the following composition: 47.7% coniferous; 41.7% hardwood broad-leaf species; 10.9% softwood broad-leaf and brushy species.

The age structure of forests is characterized by the predominance of young (32% of all forested area) and middle-aged stands (44%), with a relatively small percentage of mature (11%) and ripening (13%) stands.

The percentage of stands with a prevalence of mature trees of such valuable species as pine and oak with tall trunks is low (2% and 1.9%, respectively). The percentage of mature stands has decreased sharply, due to intensive clearcutting, mostly before 1965. This resulted in the depletion of forest resources and the decrease of water-protection and other protective forest functions.

2.3.3 Tree species origin and distribution

Favourable soil-climatic conditions support a diverse species composition in Ukraine's forests. Twenty-five valuable deciduous and coniferous species grow within the country's territory, including high-quality timber species such as oak, beech, maple, white maple, and ash (table 1). There is also a considerable admixture of such species as cherry, pear, maple, and white maple, which form valuable raw material for the furniture industry.

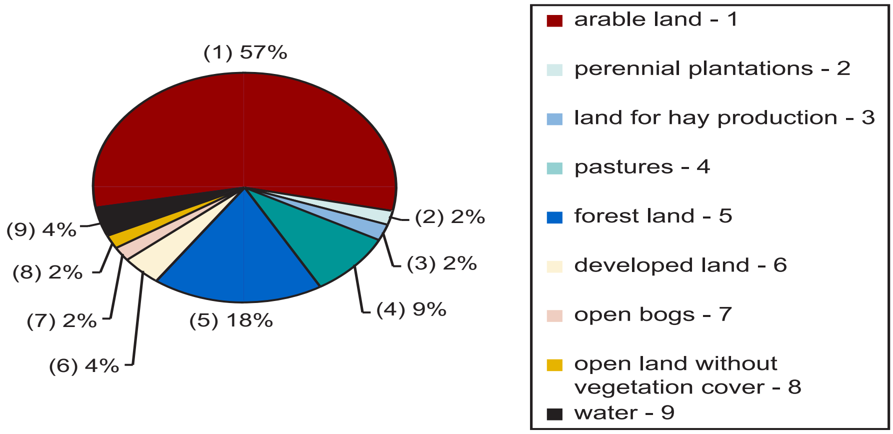

Figure 3. Structure of land resources of Ukraine

2.3.4 Total Growing Stock, Growth and Total Fellings

The general state of forests in Ukraine does not meet ecological and economic requirements. Great damage occurred during the reconstruction of the national economy period in the post-war years. Felling rates at that time exceeded scientifically substantiated standards. This resulted in changes in forest structure, deterioration of natural ecosystems, degradation of vegetation cover, and depletion of forest resources. Excessive thinning of plantations (improvement felling) and forest draining during 1970-1980 did not lead to the desired results. The productivity of forest plantations used by non-specialized departments (specifically of the agricultural enterprises), is low. Inadequate management practices have led to forest damage by pests and diseases.

Logging volume has been reduced from 15.3 million cubic metres in 1990 to 12.1 million cubic metres in 1995. A dangerous situation has developed through an attempt to meet the nation's timber demands. The annual shortage amounts to 18-20 million cubic meters, and only 30-35% of the country's actual timber needs can be met by utilizing local resources.

The total forest stock of Ukraine is estimated at 1.3 billion cubic meters, with an average stock of timber per ha of 153 cubic meters, and an annual increment of 4.2 cubic meters per ha.

2.3.5 Forest threats

All forests of Ukraine are heavily impacted by anthropogenic factors, along with the damage caused by a number of biotic and abiotic factors.

During 1981-1991, 2,500 ha of forest died because of industrial emissions. The general decline of industrial production in recent years has led to a decline of emissions (by 40% from 1991-1995). The output of atmospheric pollutants from stationary emission sources alone declined by 8% from 1994 to 1995.

According to 1995 figures, the contribution of various industrial branches to overall emissions amounts to the following percentages: electric power, 33%; metallurgy, 25%; coal industry, 23%; chemical industry and oil refineries, 2%. The decrease of total emissions (caused by the economic crisis) coincides with structural changes of the emissions. The use of low-quality coal by electric power plants has led to higher levels of sulfur and ash, increasing the amount of detrimental emissions from many Ukrainian plants. Forest damage is highest

Table 1. Main types of wooden species

Species	Origin	Spreading*
Abies alba Mill.	A	7
Acer platanoides L.	A	1,2,3,4,7,8
A. pseudoplatanus L.	A	3,7,8
Alnus glutinosa (L) Gaertn.	A	besides 7
A. incana (L) Moench.	A	1,2,7
Betula pendula Roth	A	everywhere
B. pubescens Ehrh.	A	1,2
Carpinus betulus L.	A	1,3,7,8
Castanea sativa Mill.	I	6,8
Cornus mas L.	A	3,4,5,6,8
Fagus sylvatica L.	A	7,8
Fraxinus exelsior L.	A	everywhere
Larix decidua Mill.	A	7
Picea abies (L) Karst.	A	7
Pinus sylvestris L..	A	1,2,3,4,6
Populus nigra L.	I	5
P. tremula L.	A	everywhere
Quercus robur L.	A	1,3,6,7,8
Q. borealis Michx	A	5,6
Robinia pseudoacacia L.	A	everywhere
Salix alba L.	A	1,2,3,4,6,7,8
Taxus baccata L.	A	1,2,3,4,6,7,8
Tilia cordata Mill.	A	3,6,7,8
T. platyphyllos Soop.	A	7
Ulmus carpinifolia Rupr. ex Suckow.	A	1,3,7,8

Notes: origin A - aboriginal species (native); I - Introduced.
*Spreading: 1) Western and right-bank of Polissya; 2) Left-bank of Polissya; 3) Right-bank of Forest-Steppe; 4) Left-bank of Forest-Steppe; 5) Steppe (including the steppe of Crimea);
6) The Crimea mountains (The Crimeans); 7) The Carpathian Mountains; 8) Trans-Carpathian.

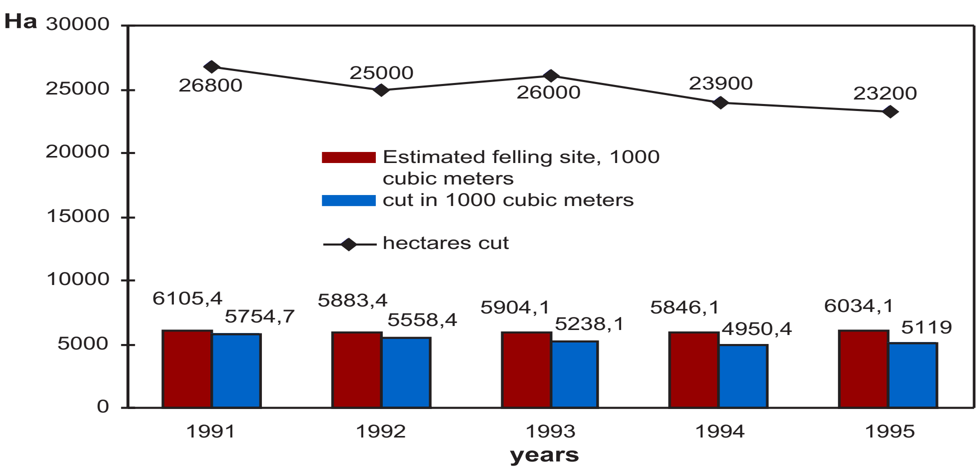

Figure 4. Dynamics of the main felling in ha and the allocated and actual harvest

around the main industrial centers of the country.

Due to harmful emissions, the protection function of many forests has been lowered considerably, leading in turn to a decrease in stand growth. In the Severodonetsk region, for example, average annual growth of young pine has decreased by 50-59%, due to pollution. In some cases, pollution has led to complete degradation and even the death of stands.

The Chernobyl catastrophe had a very damaging impact on Ukraine's forests. An area of 3.5 million ha was polluted with radio nuclides, and 200,000 ha had to be taken out of the harvest plans. As a result, the Polissya region alone suffers an annual loss of 11 million cubic metres of wood.

In Ukraine, the proportion of mature stands amounts to no more than 4.2% of the entire forested area, which compares badly to the scientifically based norm of 17%. Most of the industrial wood is thus harvested in the course of thinning and sanitation cutting. Excessive cutting of mature stands leads to an overall decrease of the forests' health and a weakening of the forest ecosystems. As a result, infestations with harmful pest species (bark beetles, fungal diseases, etc.) may occur. Pest infestation is a particularly serious problem in the northeastern part of Ukraine. In recent years, there has been a marked spread of such diseases, which now affect about 10% of all forested areas.

Another factor in the destabilisation of Ukraine's forest is fire. In recent years, there has been an increase in forest fires. From 1989-1992, an average of 3,000 fires a year were reported, damaging about 2,300 ha of woodland. In 1994, 7,400 fires were reported, damaging 3,100 ha of forest land.

Visitors to the forests caused about 95.1% of all fires in 1994; 0.1% were due to logging activity, 2.1% to agricultural combustion, 0.4% were caused by lightning, and other reasons accounted for 2.3%.

In some years, strong winds account for considerable forest damage. They are most detrimental to pure fir plantations and poorly managed areas (over-thinned stands, badly located cuts, ignorance of main wind direction, etc.).

Wet snow may also cause some forest damage. In 1996, stands of birch, fir, and artificial pine plantations in the western part of Ukraine were heavily affected by wet snow.

2.4 Silviculture

Regeneration of forests in Ukraine is done mostly by replanting. In 1995, 38,600 ha of new plantations were established on forest fund land, with an additional 12,900 ha planted in quarries, ravines and other unfavourable areas, and 1,900 ha were planted to create wind belts.

Today, Ukraine has about 1.4 million ha of newly planted field protection and erosion control belts, 150,000 ha of which cover the banks of small rivers and ponds, and 440,000 ha serve as wind belts, protecting up to 13 million ha of arable soil.

However, today's system does not provide adequate protection to agricultural fields from water and wind erosion. Some farms do not have wind belts at all, while others only have a few. Ca. 30% of all forest belts are in an unsatisfactory condition and in need of reconstruction. Planting happens too slowly, and river banks are in need of further afforestation. Overall, the existing system does not favour the protection of agricultural landscapes and the land fund.

Through the establishment of new plantations, the use of nature's productivity could be increased, along with the overall amount of forested area. Introductions as well as natural selection and genetic manipulation leads to a further increase in valuable woody species.

Forest cultures (plantations) were first introduced in Ukraine at the end of the 17th/beginning of the 18th centuries. Before the 20th century, technologies for establishing forest plantations, advanced soil preparation and further treatment of young trees had already been developed and improved.

During the past 70 years, more than 5 million ha of forest cultures and 1.74 million ha of wind belts were planted. The forest cultures use about 20 different species of conifers and broad-leaf trees, and about 40 types of the highly productive domestic species.

Since 1971, a special inventory of valuable seed stands has taken place. Selected seed trees are marked within the stands, and their seeds are used to establish special plantations, which in turn supply young trees for further plantings.

The principal method for the creation of forest cultures in Ukraine is sowing and planting (80% are planted).

One of the management goals of Ukraine's foresters for the 21st century is to increase the country's forested area by 25%, for which an additional 5 million ha need to be planted.

2.5 Forest Production

2.5.1 Harvesting systems, accessibility

According to Ukrainian legislation, main felling include 3 systems: clear cutting, selective cutting, and gradual cutting which are internationally well known.

The selection of a specific cutting type is influenced by organizational and technical factors, and the consideration of environmental protection aspects and preservation of forest functions. Furthermore, groups and categories of forests, properties of individual species, trends in the forest regeneration process, forest type, age structure and stand condition, soil stability and other factors are taken into account.

Clear cuttings are cuttings where all trees are harvested at the same time (as a rule during one year). The main technical and organizational factors to consider include dimensions and location of the felling site, felling site development, orientation of the felling site and felling direction, and clean-up procedures after felling.

Gradual felling involves the removal of trees in several steps. Important factors are the selection of trees at each step, the number of steps, timber stock at each step, and time between felling steps.

In selective felling, only a small proportion (no more than 10%) of mature and overmature trees are cut, maintaining an uninterrupted tree cover on the site. Organisational-technical considerations are basically the same as for gradual felling.

Besides the three systems mentioned above, a combined felling system is used which includes elements of all three systems.

All forests of Ukraine are accessible to conducting a forestry activity. The certain difficulties are available only in the very humidified and mountain forests.

2.5.2 Timber uses (industries, sawn goods, fibre, paper, fuelwood etc.)

Of Ukraine's total annual timber harvest, 30% is used for lumber, 19% for packaging purposes, 18.1% for construction, 14% for furniture production, 11% for lodge poles, 6.1% for industrial purposes, and 1.7% for pulp.

The statistical data on import and export of wood are absent however actual timber needs of a national economy are satisfied approximately only on 30-35% at the expense of local resources.

2.5.3 Non-timber Forest Products

Non-timber Forest Production is an official activity of the forest enterprises and there is an certain official market for these products.

The output of non-timber products from Ukraine's forests per ha amounts to 65-70 kg of mushrooms, 10 tons of birch juice, 6 tons of vitamin powder, 30 kg of raw material for medicinal and technical use, 6 tons of birch bark (for pitch production), 200-450 kg wild fruit, 100-120 kg grass (for hay making), up to 650 kg of gum and turpentine, and 100-200 kg of honey.

The annual output of the country's forest enterprises comes to ca. 16,000 tons of wild fruit and berries, ca. 3,500 tons of mushrooms, 40-45 tons of birch juice, 260 tons of honey, 1,200 tons of raw material for medicinal and technical use, 30,000 tons of hay, 60-70 tons of vitamin powder, and 11,000 tons of gum and turpentine.

The total area of forest land open to hunting in Ukraine amounts to 50.8 million ha. About 30 species of animals and more than 80 species of birds constitute the traditionally hunted species. Main game species are elk (moose), red deer, wild boar, hare, and red fox.

2.5.4 Forest functions

The basis of forest use in Ukraine is the division of forests into forest groups (in accordance with the Forest Code of Ukraine Resolution of the Verkhovna Rada of Ukraine of January 21, 1994). The Forest Code defines the forests of Ukraine as a national heritage which fulfills ecological, protective, recreational, aesthetic, and educational functions. The forests have a limited significance in terms of exploitation and are subject to state audits and protection. The state forest land of Ukraine is divided into two groups: forests which mainly fulfill protective functions (water protection, nature preservation), and forests which, along with their ecological significance, are subject to exploitation. To ensure the continued protective function and sustainable use of the latter, limited use regimes have been established. The first group comprises 3.453 million ha, the second, 3722 million ha.

Technological progress and spreading urbanization in Ukraine have led to a strong increase of recreational demands from the population. The country's forests serve as prime recreation areas. The positive social effects are counterbalanced, however, by the sometimes negative impact of increased recreational pressure and tourism on the forest ecosystems.

Special recreational areas have been set aside under the state forest land, including both wooded and non-wooded forest land, as well as non-forest areas such as rivers, lakes, hedge rows, alpine meadows, rocks and cliffs, roads, etc.

3 Forest Economics

3.1 Forest and forest industries in national economy

Ukraine is involved in forest-economy cooperation on a European level, concerning the fields of forest regeneration, forest resource use, and reform of economic mechanisms. Such cooperation occurs with Sweden, Germany, Switzerland, Italy, Russia and other European countries. Ukraine exports timber, lumber, mushrooms and other forest products to countries in Europe, and is involved in joint ventures including logging, tourism, recreation and other types of forest-related activities.

Unfortunately, the cooperative efforts of Ukraine are not altogether successful. Increased export of secondary and round timber, which is in high demand on the domestic market, leads to shortages within Ukraine and has negative effects on the country's wood-working industry. The European models of sustainable forest use and management have not been sufficiently studied in Ukraine, and their practical implementation is sadly lagging behind.

3.2 Employment

The forestry sector supplies employment for a considerable part of the population, particularly in western and northern Ukraine. In 1991, 97,750 workers (it makes 0,2% of total population or 0,3% of the country's labor force) were employed in state forest enterprises (including 42,407 in forest production, 38,864 in industrial production, and 12,525 in capital construction). There is a marked shortage of young workers and female employees in the forestry sector - an imbalance which fuels social problems.

Due to inflation, insufficient funding to forestry through the state budget, and a decrease of the operational volume of forestry production, the number of people employed in the forestry sector has decreased considerably.

3.3 Profitability

The forestry sector is of great importance to the economy of Ukraine as a source of state revenues, forest resources (raw materials), and improvement of the country's environmental health. The forests are state-owned, and different ministries influence the activity of forest enterprises. Under the communist system of planned economy, the main objective of forest enterprises (state forestry) was not to obtain revenues but to collect, by all means, money from the state budget for forestry production. This old system has now lost its influence on the forestry sector, and new instruments of planning and cost evaluation are being developed.

Wood products continue to be the main source of income from the forestry sector. Since there is no established market for certain non-timber forest products and forest functions (e.g., recreational, protective functions, etc.), the state forestry does not generate any income from their use.

4 Forest and forest related policies

Ukraine state forest policy is the combination of legal, economic, administrative, social and forest management measures directed towards sustainable forestry.

4.1 Legislation

Forest management is carried out in accordance with Ukraine‘s current legislation, in particular with the Forest Code of Ukraine, regulations on the forest fund of Ukraine, resolutions on hunting, and other normative documents.

Forestry legislation in Ukraine was established by the different Legislative Acts of 1918, 1968, 1977, 1979, 1994. On January 21, 1994 a new «Forest code of Ukraine» was adopted, in which Ukraine‘s forests became the property of the state (Article 6). Acting for the state, the Verkhovna Rada of Ukraine is in charge of all state forests. It delegates its powers concerning forest management to the corresponding Soviets of People's Deputies, who within their competence, give land plots from the Forest Fund for constant use or withdraw them according to the order determined by the Land and Forest Codes.

Forest land plots from the Forest fund are given for constant use to specialised forest enterprises and organisations where there are specific departments for forest management, afforestation, health improvement, sport and tourist purposes, and research. If citizens (of Ukraine) have special training they can be given individual forest land plots from the Forest Fund with an area up to 5 hectares, provided that it is part of the farmer's property. According to a new Law, the forests of Ukraine are its national wealth, and according to their purpose and location perform chiefly ecological (water protection, protection, sanitary, health-improvement, recreation), aesthetic, educational, and other functions; they also have exploitation purposes and are subject to state registration and protection (Article 3). The main requirements concerning forest management organisation are also envisaged (article 34). These are: forest preservation, their protection from fires, protection against harmful insects and diseases, improvement of water protection, climate regulation, sanitation, health-improvement, and other useful properties of forests for the purpose of people, and health protection. This rational use of the forests is in order to systematically meet the requirements of production and population in timber and other forest products, extended reproduction, improvement of species composition and forest quality. Improvement of forest production efficiency is on the basis of unified technical policies, and science and technological achievements. In fact, this is the strategy of forest growth and the role of forests in the state of Ukraine. It should be noted that, based on complex management, the principle of continuous and rational use of forests (it corresponds with principles of sustainable forestry), with their dominant water protection, water regulation, climate regulation and environment creating role, started to be realised in Ukraine in 1959.

The Ukrainian state forest policy is a combination of legal, economic, administrative, and forest management measures directed at preservation and reforestation, rational use, and enhancement of the multi-functional role of forests as a global ecological factor in the interests of the nation.

4.2 Actors in Forestry and Forest Related Policies

The main actors in forest policy, defined by the Forest Code, are institutions, such as: Ministry of Fotrestry, Ministry of Agriculture, Ministry of Environmental and Nuclear Safety, other ministries and users of forest resources, and state administrations at different levels.

Political parties and non-governmental organisations and other nature conservation and environmental movements, have a significant influence on forest policy. Among them the best known are Green party, Rukh, Zelenyj Swit (Green World), Association of Foresters, Green Peace Ukraine, National Ecocenter etc.

4.3 Forest policy tools

The Ukrainian State University of Forestry and Wood Technology, in accordance with the current legislation of Ukraine, has developed the national scientific-technical program “Forest”: regeneration, protection, and rational use of forest resources for 1996-2015, which was accepted by the ministries and departments of Ukraine and the National Academy of Sciences of Ukraine.

The program’s goal is to lead Ukraine out of its current ecological-economic crisis and create stable economic conditions through increasing the forested area to an optimal level, meeting the demand for forest raw materials, and protecting forest ecosystems and their natural functions.

Priorities in the Realisation of the Program:
- substantiation and realisation of the complex interrelated measures aimed at increasing the total forested area by a factor of 1.5-2;
- establishment of a safe forest production complex in the zone of the Chernobyl APS;
- creation of conditions for the natural regeneration of forests and intensive forest regrowth on eroded land, -realisation of measures for protection and preservation of forests, reasonable use of those environmental resources which play a role in maintaining natural forest functions;
- orientation of the forest industry towards the application of ecologically safe and energy-efficient techniques and technologies for logging, resource transportation, yarding, preservation and primary processing of wood and waste material;
- transfer of the processing branches of various industries - woodworking, forest chemical, pulp and paper, etc., towards a regime of reasonable timber use, and partial transfer to other materials.

Adoption of this program seems a high priority for the forest sector, especially on the threshold of the new millennium.

Since 1993, the sectoral state scientific-technical program for the development of forestry has been operational in Ukraine.

4.4 Forest Policy at the European Level

The State Forest Policy of Ukraine is determined by directions of rational use, preservation and renewal of Ukrainian forest resources, in the context of requirements adopted in the resolution of World Conference on Environmental Problems and Development in Rio-de-Janeiro, 1992.

Ukraine has been in attendance in the Helsinki Process (Ministerial Conference on the Protection of Forests) since 1996, as well as in some another events of the Intergovernmental Panel on Forests of the UN Commission on Sustainable Development (for instance the Sessions in New York, 1997, 1998 etc.). The Ukrainian Delegation had a few meetings in New-York with representatives of EU, Canadian and Russian delegations, and representatives of Eastern and Central European countries to further develop the co-operative framework of the Intergovernmental Panel on Forests. Ukraine supported the proposals concerned with preparation of a “Forestry Convention”, dealing with Bio-diversity, Climate Change, etc.

Since 1992, Ukraine has taken part in the project of the International Program “Biodiversity” which is financed by the World Bank at the through a specially founded Global Ecological Fund. Since 1994, with the help of the INTAS Fund, Ukraine has an opportunity to join the EUFORGEN Program for forest genetic resources preservation.

Ukraine takes an active part in the development of measures aimed at preservation and increase of forests in the border regions with the following countries: Poland, Belorus, (program “Green Lungs of Europe”), Russia, Czech Republic, Slovakia, Romania, and Hungary. These are joint measures for the utilization and development of forests and recreational resources of these countries.

4.5. Forest Education and Science

The Ukrainian State University of Forestry and Wood Technology (USUFWT; Lviv) trains forestry specialists. It is the only higher educational establishment with a profiled forestry program, and is a well-known centre for forestry education and science in the country. It was founded in 1874 within the Krajova forest school in Lviv. The university has six faculties: the faculty of forestry, the faculty of logging engineering and mechanics, the faculty of woodworking technology, the economic faculty, an extra-mural faculty, and the faculty of pre-university and post-university training and has more than 4,000 students. Over 300 qualified lecturers work within a total of 29 chairs.

USUFWT trains specialists in a wide variety of forestry branches. Since 1997, it is involved in a full-scale joint European project, which is financed by the Tempus-Tacis program. As part of this project, the university started a Master’s program in environmental economics and natural resources in 1998.

Forestry specialists are also trained at the faculty of forestry of the National Agricultural University (Kyiv), at Kharkiv State Agricultural University (Kharkiv), and eight colleges and technical schools of forestry.

Current research in forestry, forest science and the woodworking industry is conducted at the Ukrainian State University of Forestry and Wood Technology (Lviv), the National Agricultural University (Kyiv), the Kharkiv State Agricultural University, the Ukrainian Scientific Research University of Forestry and Agroforest Recultivation (Kharkiv), and the Ukrainian Scientific Research Institute of Montane Forestry (Ivano-Frankivsk).

The scientific-technical staff at USUFWT includes 34 Doctors of Science, professors, and 200 candidates of science, and associate professors. Research at USUFWT covers the following fields:

1. Problems of specialized training under a multi-level educational system.
2. Increase of productivity and biological stability of forest and urbanized ecosystems.
3. Development of energy and resource-saving technologies and equipment for the forest-industrial complex of Ukraine.

4. Development of advanced technologies, materials, and equipment for the woodworking industry.
5. Improvement of the organization and management of forestry, forest and woodworking industries.
6. Economic and social development of the forest complex under the conditions of national-cultural revival of Ukraine.

USUFWT is a member of IUFRO, and host to numerous international conferences, symposia, and seminars.

5 Main current conflicts and challenges in each country

In order to continue to provide Ukraine with forest resources it is necessary to carry out profound transformations in the areas of forest growing, forest use, and timber use, and combine methods of forest exploitation with ecological requirements. This calls for the following measures:

1. Increase of forested area through the gradual fading-out of agricultural use, and subsequent afforestation of eroded, low-productivity land (formerly forested areas as well as previously treeless land, i.e., on alkaline soils).
2. Intensification of forest utilization by means of more efficient logging techniques, including the harvest of soft-wood broadleaf species, faster growth rates, and restoration of low-productivity stands.
3. Improve economic conditions by accelerating market relations in the field of forest resource use and stand regeneration.
4. Implement structural improvements in forest management, with the goal of a more efficient timber use.
5. Establishment of an interconnected web of nature reserves, representing the different ecological zones in their natural state, with the aim of building a regional system of eco-reserves of about 6-6.5 million ha; set up a monitoring system for natural resources and the environment.
6. Establish a technique to decrease radioactive pollution of forest resources; development of a forest management system for forests polluted with radio nuclides, and prevention of secondary pollution by means of fire suppression, especially in forests with high levels of radioactive pollution. The implementation of the above measures will contribute to the increase of a forest resource base, the decrease of the timber deficit, stabilization of the forestry complex, and aid Ukraine in its transition into the next millennium, ensuring a continued supply of the country’s own forest resources while at the same time preventing the destruction of the forest’s ecological functions.

Organisations related to forestry

State Committee of Forestry of Ukraine, 5, Khreshchatyk str., 252601 Kyiv MSP, UKRAINE, Tel. +380-44-228 56 45, -226 32 53, Fax: +380-44-228 77 94, E-mail: yyy@mlg.kiev.ua

Ukrainian Research Institute of Forestry and Farm Forestry after G.M.Vysotskyy, Director Ihor Patlai, 86, Pushkin str., 310024 Kharkiv, UKRAINE, Tel.: +380-572-43 15 49, Fax: +380-572-43 25 20, E-mail: root@u-fri.kharkov.ua

Ukrainian Research Institute of Mountain Forestry after P.S. Pasternak, Director Vasyl Parpan, 31, Hrushevskyy str., 284000 Ivano-Frankivsk, UKRAINE, Tel/Fax: +380-3422-252 16, E-mail: lis@girlis.ivano-frankivsk.ua

Ukrainian State Project Forest Inventory Production Association “Ukrderzhlisproekt”, The Chief Anatoliy Zaremskyy, 22, Proletarska str., 255 710 Irpin, region Kyiv, UKRAINE, Tel.: +380-4497-55 155, Fax: +380-4497-55 156

Ukrainian State Design and Survey Institute of Forestry “Ukrdiprolis”, General Director Stepan Kryvovyazyy, 50, Bratislavska str., 253 139 Kyiv, UKRAINE, Tel.: +380-44-512 2754, -512 2612, Fax: +380-44-512 2754

Kharkiv State Design and Survey Institute of Farm Forestry and Forestry, “Kharkivdiproagrolis”, Director Mykhailo Trohymenko, 36, Serikovska str., 310 017 Kharkiv, UKRAINE, Tel.: +380-572-12 52 52, -12 16 07

Ukrainian Center of Training, Retraining and Improvement of Professional Skill of the Staff of Forestry “Ukrtsentrkadrylis”, Director Petro Dyshko, 2, Lisodoslidna str., 255 510 Boyarka, region Kyiv, UKRAINE, Tel.: +380-4498-35 988, Tel./Fax: +380-4498-35 879

State Special Forest Protection Assosiation “Ukrlisozahyst”, General Director Viktor Kucheryavenko, 127, Internationalna str., 312 140 Pokotylivka, region Kharkiv, district Kharkiv, UKRAINE, Tel./Fax: +380-572-493 075

Ukrainian State Forest Seed Station “Ukrderzhlisnasinnia”, General Director Volodymyr Zaichenko, 14, Lisodoslidna str., 255 510 Boyarka, region Kyiv, UKRAINE, Tel.: +380-2983-52 97, -50 60

Ukrainian State Base of Air Protection of Forests, The Chief Mykola Andryushchenko, 5, Khreshchatyk str., 252601 Kyiv MSP, UKRAINE, Tel.: +380-44-229 6322, Fax: +380-44-228 5608

Azov-Sivash National Natural Park, Director Volodymyr Zubkov, 54, Petrovskyy str., 326 610 Genichesk, region Kherson, UKRAINE, Tel.: +380-5534-221 09, Fax: +380-5534-233 89

Shatsk National Natural Park, Director Mykhailo Lvovych, 264 663 Svityaz, region Volyn, district Shatsk, UKRAINE, Tel./Fax: +380-3355-230 43

Forest and Hunting Magazine, The main editor Valentyna Maksymenko, 5, Khreshchatyk str., 252601 Kyiv MSP, UKRAINE, Tel.: +380-44-229 5984

Society of Foresters of Ukraine, The chairman Yuriy Marchuk, 5, Khreshchatyk str., 252601 Kyiv MSP, UKRAINE, Tel.: +380-44-226 2655

State Higher Forest Educational Institutions in Ukraine

Ukrainian State University of Forestry and Wood Technology, 103, General Chuprynka Str., Lviv, 290 057, Ukraine, Rector Prof. Dr. Yu.Tunytsya, Tel.:+380-322-35 24 11, Tel./Fax: +380-322-97 17 65, E-mail: ukrdltu@forest.lviv.ua

Specialities:

Forest, Park and Garden Management	BSM
Plant Protection, Forest Ecology	BS
Landscape Architecture	BSM
Logging and Wood Processing	BSM
Forestry Equipment	BSM
Automation of Technological Processes and Production	BSM
Artistic Design	BS
Accounting and Audit	BS
Management	BSM

National Agrarian University, 15, Gueroyiv Oborony Str., Kyiv, 252 041, Ukraine, Rector Prof. Dr. Dmytro Melnychuk, Tel.: +380-44-263 51 75, -267 82 33, Tel./Fax: +380-44-263 71 55, E-mail: rector@usau.kiev.ua

Specialities:

Forestry - BSM

List of Abbreviations

B - Bachelor

S - Specialist

M - Master

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1 The Country

The British Isles lie off Western Europe's seaboard. The largest island, Great Britain, consists of three nations: England, Scotland and Wales. Ireland, to the west, consists of the Irish Republic, a separate state within the European Union, and the British province of Northern Ireland. The nations of Great Britain and the province of Northern Ireland constitute the United Kingdom (UK). The Channel Islands and the Isle of Man are self-governing in terms of domestic policy, though the UK is responsible for defence and international relations: they are part of neither the UK nor the European Union.

1.1 Natural conditions

1.1.1 Geology

The United Kingdom is founded on rocks of all geological periods, with no one period predominating. There is a systematic progression, from the youngest formations in the south-east of England to the oldest, Precambrian rocks in north-western Scotland. Faulting, folding, erosion cycles and volcanic activity have produced complex local variation, more noticeable in the solid geology of the north and west. Much of the country was glaciated during recent ice ages, and surface deposits throughout the country reflect this history.

1.1.2 Topography

Mainland Britain is about 1000 km long. The country is generally low-lying in eastern and central England. Mountains occur in north-west England, Wales, Scotland and Northern Ireland, with high moors in south-west England and forming a ridge through northern England. Although steep, the mountains exceed 1000 m only rarely. Britain has many, but short, rivers. There are numerous off-shore islands especially off the west coast. The land area of the UK is 241,800 sq. km.

1.1.3 Climate

The climate is mild and oceanic. Prevailing westerly winds, warmed by the Gulf Stream, give the country a warm climate relative to its latitude. The mean annual temperate ranges from 6°C in the Scottish Highlands to 10°C in coastal southern England and Wales. Most of the western UK receives 800-1200 mm of precipitation annually, while the east receives 600-800 mm. Local extremes range from 500 mm to 5000 mm. Precipitation is well distributed through the year, but is greater in autumn and winter; it falls largely as rain, except on the higher mountains. The western UK is among the windiest places on Earth.

1.1.4 Soils

The lowland areas of the south and east comprise brown earths (cambisols) of varying *p*H and nutrient status according to parentage (whether derived from calcareous rocks), together with gleys (gleysols) in poorly drained areas. In sandy areas podzols have developed, carrying heathland. Upland areas generally comprise acid brown earths (dystric cambisols) (*p*H 4-5) which may still carry oak woodland. However, in the wetter and cooler areas soils have often acquired a humic surface horizon and are now humic gley soils (dystric gleysols) or stagnopodzols (humic gleysols/placic podzols) both of which are generally highly acidic and nutrient-poor. Some extensive upland sphagnum peats (dystric histosols) have developed, and, on harder rocky areas, shallow peaty rankers (shallow dystric histosols).

1.1.5 Vegetation

The climatic climax vegetation type of most of the UK is woodland: mixed deciduous temperate in the south (oak (*Quercus* spp.), elm (*Ulmus* spp.), lime (*Tilia* spp.), ash (*Fraxinus excelsior* L.)), grading towards a sub-boreal type, dominated by Scots pine (*Pinus sylvestris* L.) and birches (*Betula* spp) in the far north. (Prior to the last ice age, Norway spruce (*Picea abies* L. (Karst.) was also part of this assemblage.) Only at high elevations would alpine shrubby and herb cover arise. Since the last ice age, up to 99% of the area may at one time have had forest cover.

Two important factors have obstructed formation or retention of the climatic climax:
- the breaking of the land bridge to continental Europe after the ice age, and the isolation of montane areas, which prevented recolonisation and left a flora impoverished compared with other European countries;
- prolonged and massive human intervention, such that there is hardly any primary woodland which has been largely unmodified by human activity.

The National Vegetation Classification is used to classify semi-natural woodlands into 19 woodland and six scrub communities.

The Ecological Site Classification is still being developed by the Forestry Commission Research Agency. It "is intended to provide a sound ecological basis for the management of forests for timber production, wildlife conservation and other benefits. It is applicable to all kinds of woodlands, from plantations of a single species through the range to semi-natural woodlands of many species." It can also be used to evaluate the potential of non-woodland sites.

1.2 Society

1.2.1 Population distribution and density

With population of 58.5 M (1995) and population density 242 inhabitants per sq. km, the UK is Europe's third most densely populated country (after the Netherlands and Belgium). Over thousands of years, there have been successive waves of in-migration from countries on the north-west seaboard of Europe. More recently other ethnic groups, now making up about 5% of the population, have migrated, largely from the Indian sub-continent, Africa and the Caribbean area.

Depending on definition, between 75% and 90% of population live in urban areas, with concentrations in south-east, central and parts of northern England, south Wales, and in Scotland between Glasgow and Edinburgh. In the north and west, particularly of Scotland, population is very sparse.

There has been slow population growth since the early 1980s (0.3% p.a. 1985-95). There is marked ageing in the demographic structure.

1.2.2 Political structure

Politically, many matters, including control over land use change, are under the charge of local government entities or regional authorities. Over the past 20 years there has been a tendency for central government to exert stronger influence over implementation of policy. By contrast, some powers, including development of forestry policy, are in process of being devolved to the nations of Scotland and Wales. Forest policy in

Northern Ireland is the responsibility of the Department of Agriculture for Northern Ireland, not of the British Forestry Commission: forestry statistics for Northern Ireland are not included in those given as applying to "Britain".

1.2.3 Industry

The UK's industrial structure is partly a legacy of its early historical industrialisation. Primary (extractive) industries have declined dramatically, except for oil and gas; manufacturing has also declined relatively; service industries now dominate both contribution to gross domestic product (GDP) and employment (see table 1).

Geographical concentrations in former extractive and heavy industry areas has been perpetuated by population inertia, although new industrial areas have also been encouraged by government policy.

2 Forest resources and their uses

In the UK there is no very clear definition of "forest". It was formerly a legal designation, referring to areas where the "forest law" applied. It is often used to indicate extensive areas which are (normally) tree covered for the purpose of timber production, as distinct from small, multipurpose "woodlands". However, this distinction has no official recognition in statistics, which refer to tree-covered area irrespective of size and purpose.

2.1 Forest history

Although formerly heavily forested, the UK has experienced extensive deforestation from prehistoric times. By the time of the Norman Conquest of England (AD 1066), the recorded forest cover of that country had declined to about 15%. Clearance of forests for arable agriculture and sheep grazing continued through the following centuries, although with periodic attempts to encourage reforestation for strategic reasons. Following the Industrial Revolution, both strategic and industrial timber supplies from domestic sources were considered unnecessary, and tree planting came to have a dominant aesthetic role.

From a low point of only 5% forest cover in 1900, Britain has undertaken major afforestation this century leading to a doubling of forest area. The history of the forests means that they are largely divided between broadleaved species, mostly under formal management for a variety of objectives, with age classes ranging up to 200 years and more, concentrated in the south-east of the country; and conifer forests formed artificially for largely commercial purposes during the twentieth century, concentrated in the north and west.

2.2 Forest ownership

The state forest enterprise became an increasingly significant owner during the century, and was the main agent of forest expansion until 1982, when the private sector overtook it. At

Table 1. Contribution to GDP by Industrial Sectors (1994). Anon. (1996)

Agriculture, forestry, hunting & fishing	2.0 %
Mining & quarrying including oil & gas	2.3 %
Public administration, defence and social security	6.7 %
Construction	5.4 %
Electricity, gas and water	2.7 %
Wholesale and retail, restaurants, hotels	14.4 %
Transport, storage, communications	8.5 %
Manufacturing	20.9 %
Financial, real estate and business activities	26.7 %
Education, health and social work	11.9 %
Other services	3.8 %

the same time, a sale of some of the state's forests was initiated, along with privatisation of public utilities – notably water boards – with a forest holding. A proposal to privatise Forest Enterprise has so far not been implemented, largely as a result of widespread public opposition. Presently 34% of forest area is owned by the Government through the Forestry Commission, and is run by Forest Enterprise. Other public ownership, by local government and environmental agencies, is on a smaller scale, with timber production only incidental.

Charitable bodies, e.g. Woodland Trust, the National Trust [for Places of Historic Interest and Natural Beauty] and its equivalent body in Scotland, also own rather a small, though increasing, area, unimportant for timber production, but often very important for landscape and recreation objectives.

Community forests in the European sense do not exist in the UK. "Community Forests" have a different meaning, being the result of recent initiatives to encourage planting by diverse land owners, with a view to improving environment and public *access*, but not necessarily *ownership*.

Private ownership of forests was, until about 1960, mostly as part of a larger estate embracing agricultural and shooting interests. Expansion from that time until 1988 was largely undertaken as a tax management exercise, usually for those with no traditional involvement in rural matters; forest management companies provided the professional services.

Financial institutions (e.g. pension funds) became more important owners during the 1980s, with the objective of gaining capital growth.

The wood processing industries have only recently become significant forest owners. They have attempted to secure a portion of their timber supplies by acquiring forests which are approaching rotation age – often those established under the earlier tax incentives (now that forest ownership for tax purrposes has become less attractive).

Table 2 shows the estimated distribution of private ownerships by size categories.

2.3 Land use and forest resource

2.3.1 Global overview of the land use

Present land use in the UK is divided as in table 3, which also shows the prevalence of various land designations (some of these overlap).

2.3.2 Extent and distribution of the forests

Forest cover increased during 1950-1990 at an average of more than 30 000 ha y^{-1}. The mean rate of expansion during the 1990s has fallen to

Table 2. Size of private forest ownerships

Size category (ha)	Number of holdings	% of total	Area of holdings	% of total
< 1	27 100	26	14 000	1
1 – 2	19 400	18	29 000	2
2 – 5	25 700	24	81 000	6
5 – 10	14 500	14	104 000	7
10 – 20	8 400	16	119 000	9
20 – 50	6 200	6	198 000	14
50 – 100	2 500	2	188 000	13
100 – 500	1 800	2	364 000	26
500 – 1000	360	<1	242 000	17
> 1000	40	<1	58 000	4
Total	106 000		1 397 000	

Table 3. Land use categories in Great Britain (compiled from various sources)

Agricultural	75%
Productive forest	10%
Other woodland	1%
Urban, industrial, waste and other	14%
National Forest Parks	0.8%
National Parks	9.3% (England & Wales)
Areas of Outstanding Natural Beauty	14.6% (England & Wales)
Sites of Special Scientific Interest	9.0%
Environmentally Sensitive Areas	7.2%
Country Parks	0.1% (England and Wales)
Community Forests	3.0% * (England)

* Actual woodland cover is only 5.5% of that area

18 000 ha y^{-1}. By 1998, cover had reached 2.440 M ha, of which 2.229 M were classed as "productive". Present percentage cover of Britain, about 11%, is unevenly distributed, with only 8% in England, 12% in Wales, and 16% in Scotland. The forest area of 0.04 ha per head is very low by world standards. Proposals have been made for further increase by 50-100% during the next 50 years.

Owing to the process of selective forest clearance for agriculture, and the primacy given to food production during the era of most rapid afforestation, most woodland in the UK occupies the poorer soil types and steeper sites. In particular, conifer afforestation has been largely confined to dystric cambisols, histosols and gleysols in the upland west (mostly spruces), and sands and podzols of the lowland sandy heaths (mostly pines).

2.3.3 Tree species: origin and distribution

Most coniferous plantations are of exotic species, usually originating from the west coast of North America. The exotic Sitka spruce (*Picea sitchensis* (Bong.) Carr.) covers 28% of Britain's forest area, especially in uplands of the west and north, where lodgepole pine (*Pinus contorta* Mill. Ex Mirb.) is also planted on peaty sites. Scots pine (*Pinus sylvestris* L.) is the only native coniferous timber tree, found or planted usually on rocky or sandy sites, which on the east side of the country it shares with Corsican pine (*Pinus nigra* var. *maritima* (Ait.) Melville). Japanese larch (*Larix kaempferi* (Lamb.) Carr.) and its hybrid with European larch are planted on better-drained sites in the uplands. Overall, conifers occupy 63% of forest area, ranging from 39% in England to 83% in Scotland.

Broadleaves are mostly native or more anciently imported species (there is some debate about whether some important species, e.g. beech (*Fagus sylvatica* L.), arrived naturally). The most important, both by area and for timber production are oak (*Quercus* spp.), beech, ash (*Fraxinus excelsior* L.) and sycamore (*Acer pseudoplatanus* L.). The distribution of the main species by area is given in table 4.

Spruces are preferred for pulp production, and are also used for relatively low grade sawnwood. High growth rates compromise the structural value of several conifers, but "minor" species such as Douglas fir (*Pseudotsuga menziesii* (Mirb.) Franco) can produce high grade saw timber. Broadleaves have a range of specialist uses, with *Quercus*, *Fagus* and *Fraxinus* preferred for furniture. Birch (*Betula* spp.) is hardly considered as a commercial species presently.

2.3.4 Total growing stock and growth

Estimated UK growing stock volume at 1997 was about 273 M m^3, or about 110 m^3 ha^{-1}. There has been a 50% increase in volume since 1950 mainly for two interconnected reasons. Firstly

Table 4. Species by Area.

Picea sitchensis	28%
Pinus sylvestric	13%
Quercus spp.	9%
Larix spp.	8%
Pinus contorta	7%
Picea abies	6%
Betula spp.	4%
Fraxinus excelsior	4%
Fagus sylvatica	4%
Pseudotsuga menziesii	2%
Pinus nigra	2%

(FICGB undated).

there has been a 30% increase in the forest area of the UK since 1950. Secondly, much of this area was planted with coniferous species and is now reaching its greatest mean annual increment. Growing stock continues to increase by 4–5 M m^3 y^{-1}, with about 1% annual increase in growing stock per hectare.

Increment ranges from 4-24 m^3 ha^{-1} y^{-1} for conifers, with a mean of 10-12 m^3 ha^{-1} y^{-1}, while that for commercial broadleaves is in the range 4-12 m^3 ha^{-1} y^{-1} (except for poplars, which are more comparable in increment with conifers).

The age class distribution of the growing stock is shown in table 5.

By European standards this distribution is very young. This results from both the recent large-scale afforestation and the practice of felling at the optimal economic rotation. For conifers, the maturing of young forests will increase both total growing stock, and the percentage in the 40-80 year class. For broadleaves, the future of both the total and its distribution is less clear: there has been much recent planting of broadleaves, but also a move to exploit over-mature stock.

2.3.5 Forest threats

Two major problems in silvicultural practice are deer (red (*Cervus elephas* L.), roe (*Capreolus capreolus* L.), fallow (*Dama dama* L.) and sika (*Cervus nippon* Temminck); and wind.

Deer browsing is a particular problem in artificial regeneration of conifers, unless exclusion or rigorous population control is achieved. The exotic grey squirrel (*Sciurus carolinensis* Gmelin) is also a problem in the establishment of broadleaved crops.

Commercially significant insect problems have been posed by *Dendroctonum micans* Kugelmann and *Elatobium abietinum* Walker (spruces) and *Panolis flammea* Denis and Schiffermueller (lodgepole pine). *Adelges nordmannianae* Eck. is said to be the reason why European silver fir (*Abies alba* Mill.) is hardly grown commercially in the UK. Defoliation of oaks by *Tortrix viridana* L. may prevent natural regeneration of oak woodland. *Hylobius abietis* L. and *Hylastes* spp. both cause problems requiring routine treatment in establishment of conifer crops.

Dutch elm disease, caused by fungi of the genus *Ophiostoma* and spread by bark beetles of the genus *Scolytus*, has wiped out the rural populations of English elm (*Ulmus procera* Salis.), and other broadleaved species have suffered from vascular wilts. The butt-rot fungus *Heterobasidion annosum* (Fr.:Fr.) Bref. is a problem for conifers especially on mineral soils, but has been successfully checked by treatment

Table 5. Age Class by Species Group (FICGB, undated)

Age class	Conifers	Broadleaved species
>120 years	0.5 %	11,0 %
80 - 120 years	1.5 %	22,0 %
40 - 80 years	13,0 %	32,0 %
0 - 40 years	85,0 %	35,0 %
Area of forest land: million ha	1.52	0.63

of cut stumps. Other fungal agents (e.g. *Brunchorstia pinea* (Karst.) v.H.) may restrict use of some conifers on some sites.

Wind is particularly important on the west side of the country where wind speeds are highest and soils often provide poor rooting conditions. Thinning may so predispose crops to windthrow, that the operation is not normally undertaken on exposed upland sites. The rotation length is often curtailed at even less than the normal "economic" rotation, when the crop reaches a height at which a substantial proportion of the trees is likely to blow down.

Fire is normally only a serious problem in young conifer plantations, more particularly on the drier, heathland sites. Low temperatures and desiccation are also usually a problem only for young crops. Atmospheric pollution has generally been considered of minor and local importance for trees in the UK, compared with the problem in parts of continental Europe.

2.4 Silviculture

By far the most common system is *clearcutting* (usually with artificial regeneration by planting, though use of natural regeneration is increasing). *Shelterwood* systems are used on a small scale in lowland Britain, but there are few examples of true *selection* systems. Neglected areas of *simple coppice* in southern England are being brought back into production on a small scale. Nominally, coppice occupies about 40 000 ha.

There is increasing interest in "continuous cover [non-clearcutting] forestry". Transformation from even- to uneven-aged structure is being attempted on a small scale; but in upland Britain windthrow risk limits this. Perhaps 10% of forest may eventually be converted to this system.

Especially during the major afforestation phase, crops were normally planted as monocultures, often over wide areas, reflecting the productive superiority of such species as Sitka spruce, across a range of site types. Plantings of intimate mixtures are hardly more common in restocked areas. Sometimes conifers are mixed with broadleaves as a "nurse crop", and sometimes a mixture of a productive with a less productive species is planted in the expectation that the less productive component will eventually be suppressed. In either case a monoculture is the intended and expected outcome. More common presently are mosaics, in which species, especially a prescribed proportion of broadleaves, are planted in adjoining stands rather than intimately mixed.

Use of biocides is largely confined to tree nurseries and the crop establishment stage. The insecticide permethrin is used against attack on seedlings by *Hylobius* and *Hylastes*, and on lowland sites control of weed competition using glyphosate is normal. Exceptionally, aerial spraying is undertaken against defoliating insects.

2.5 Forest production

In 1996, 8 630 000 m^3 were felled in Britain, of which 7.7 M m^3 were of conifer timber, and of this 4.6 M m^3 came from the state forests. Annual removals had risen to 9.3 M m^3 in 1998, and are predicted to reach 16.3 M m^3 by 2025, as the conifer plantations from the main expansion period reach their optimum economic rotation. Average annual harvest area during 1989-93 was about 34 000 ha in state forests, with final felling comprising 26% of this area, thinning the remainder (FICGB, undated). At present annual increment exceeds annual cut and other losses by more than 4 M m^3.

Much the greatest part of broadleaved volume was obtained from the private sector. This production is now declining, owing partly to environmental constraints, but private conifer production is projected to overtake that of the state by about 2010.

2.5.1 Harvesting systems

Some important features of harvesting are summarised in table 6.

Mechanised harvesting is becoming ever more common in the large coniferous forests of the Forest Enterprise. However, mechanised harvesting is less common in the private sector, and can be as little as 10% in broadleaved woodlands in some areas of the country.

Most cross-country movement of timber is undertaken by forwarder, with only around 10% moved by cable systems in terrain too steep, rough or wet for tractor access. Very little forest area is considered inaccessible for harvesting.

2.5.2 Marketing methods

There are three principal methods of sale in the UK. In standing sales the buyer is responsible for harvesting, transportation and clearing the site. In roadside sales the owner is responsible for harvesting and converting the timber to length; it is sold at a place in or near the woodland easily accessible by road transport. The final method has the owner responsible for harvesting and transporting the converted-to-length timber to the customer. The most common method, for Forest Enterprise is by standing sales especially for larger areas of even-aged good quality coniferous timber. Long-term supply contracts have been introduced for specific industrial buyers.

Broadleaved timber is sometimes sold at stump: the owner fells the tree and the purchaser can then inspect the quality of the timber. The extraction and transportation may then be carried out by either the owner or the buyer.

Forest Enterprise publishes the prices it receives for auctions of timber and these often act as guide prices for private forest owners. There are a number of initiatives to help private woodland owners sell their timber, as market demand and prices are particularly weak for small diameter roundwood, especially of broadleaved species.

Management companies and timber merchants handle a large proportion of the private timber sales.

2.5.3 Timber uses

In the United Kingdom centralisation is apparent with only 4 paper mills and 7 panel mills. The still-increasing concentration results from mergers, closure of small plants, and opening of high capacity mills. Paper production consumes some 1.3 M m^3 of UK roundwood (15% of production) and board production consumes some 1.7 M m^3 (22% of production). There are 212 sawmills utilising over 1000 m^3 y^{-1} of roundwood, having a combined consumption of UK grown wood of 3.7 M m^3 y^{-1} (49% of production) . A further 0.7 M m^3 of wood (9.5% of production) is utilised as fuel and firewood, in fencing, implements, horticultural and garden products, poles, turnery and craft products (FICGB, undated). In 1997 imports of wood and

Table 6. Distribution of Wood Harvest Methods (Forestry Authority (undated); Forestry Contractors Association pers. comm.)

Average annual harvest (1989-93)	33 661 ha [I]
Share of *standing* sales	86 % [I]
Share of *roadside or transported to mill* sales	14 % [I]
Share of *motor-manual felling*	30 % [II]
Share of *mechanised felling*	70 % [II]
Share of *log-length* harvesting system	99 % [II]
Share of *tree-length* harvesting system	< 1 % [II]
Share of *road* as a long-distance transport mode	98% [II]
Share of *rail* as a long-distance transport mode	2% [II]

[I] State forests only
[II] Estimated

wood products had a wood raw material equivalent of 47.7 M m^3 under bark compared with home production of 7.7 M m^3 under bark.

Investment in the forestry processing sector has been over £1300 M (»1900 M ecu) in the past ten years. The new and modernised processing mills are mostly foreign owned, using the increased supply of British grown timber and recycled paper.

Expansion has involved successful replacement of a wide range of previously imported wood products. Further expansion is expected with increase of home wood supplies.

2.5.4 Non-timber forest products

Formerly, common rights to gather firewood, cut peat, pasture pigs and graze other animals existed in forests (James, 1981). These rights, where they still exist, are now exercised only very locally. Unlike in many European countries, there is little tradition in the UK of gathering berries, mushrooms and other non-timber products.

2.5.5 Forest functions

Recreation in forests has had a steadily broadening base over the centuries, from exclusive use by the aristocracy for hunting to present-day access by a large proportion of both rural and urban population: this tends to be concentrated in woods owned by local government or charitable bodies close to cities, and in state forests in the remoter rural areas. There were an estimated 346 M recreational visits, mostly of a day's duration or less, to woodlands and forests in 1996. No legal right of access to private woodlands for recreation exists at present, though legislation is proposed to extend recreational access generally. Within the past few years, forest tourism has been promoted in the state sector.
The landscape effect of forestry is considered particularly important in the UK. Though it is difficult to quantify, both state and private sectors give detailed attention to this matter in forest design.

Despite their small percentage of land area, forests form an important wildlife habitat, and their expansion during this century has been associated with a gain of species and of numbers for some species formerly rare. On the other hand, loss of open and wetland habitat to plantations, and earlier conversion of native broadleaved woodland to exotic conifers have been considered detrimental. Current multipurpose forest policy emphasises diversity of habitat (species, age-class, open areas).

Protective forests have been planted particularly on reservoir catchments, and to some extent on the spoil heaps of extractive industries, in an effort to reduce soil erosion and prevent boulder avalanches. (Snow avalanches are not a problem.) Commercial forests have had a less benign effect. Mechanised cultivation prior to planting, and use of heavy machinery on steep slopes during harvesting, have increased sediment loads where forests have replaced sheep farming. In consequence particularly of their efficiency in "scrubbing" wet and dry particles from the atmosphere, conifer forests have been associated with increasing acidity of watercourses in western Britain. On the other hand, woodlands introduced on former arable farming sites have reduced ionic flows into watercourses.

Conifer afforestation has also adversely affected total volume of run-off from catchments, with detrimental effects for domestic and industrial water supply and hydroelectricity generation.

3 Forest economics

The UK official statistics do not split forestry from agriculture or hunting and fishing (Anon., 1996). It can be estimated that the contribution of forestry to GDP is less than 0.5%.

3.1 Forest and forest industries in the national economy

The situation of the United Kingdom has to be seen in the context of extensive deforestation in prehistoric and historical times, followed by a doubling of forest area through afforestation during the twentieth century.

Reliant as it is on imports of timber (about 85% of apparent domestic consumption), the UK's forest revenues are dominantly conditioned by world timber prices. Imports of conifer timber presently come largely from Scandinavia and the Baltic States; that of broadleaved timber, from tropical countries, the USA, France and Germany. There is little tariff protection for the industry. Most domestic production is directed towards bulk, rather than high-quality markets, and prices are accordingly low.

3.2 Employment in the forest sector

Employment in forestry, and in that part of the wood-processing industry which is directly related to domestic wood production, is only about 0.2%. According to a 1993-4 survey, the total number of people employed in the forestry and wood processing sectors is about 35 000 (18 185 actually in forests). The Forestry Commission employed 6650; private forest owners 10 750; forestry management companies 1910; timber harvesting companies 4295; and the wood processing industries 11 215 (FICGB, undated).

Although providing rural employment and stabilising rural populations have been explicit policy objectives of forestry, the evidence that it has been able to achieve them is equivocal. This is partly due to rapid mechanisation, and to the use of contractors who seek employment over a wide area (Johnson and Price, 1996). Farm forestry will not achieve its full potential for rural employment unless farmers acquire more forestry skills: currently most work is undertaken by contractors. Total forest-based employment is now declining, despite the increase in forest area and harvesting activity.

3.3 Profitability

3.3.1 The state sector

From the foundation of the Forestry Commission in 1919, until the forest policy statement of 1958, the main objective of UK forestry was strategic expansion: economic considerations were orientated towards achieving this at minimum cost. Since 1958 economics has played a more important role in defining *ends* as well as *means*. The normal economic criterion for Government departments and agencies in appraising investments, as in new planting, is a rate of return of 6%, or 8% for commercial activities (which may compete with the private sector) (Treasury, 1991). While a 6% discount rate is advocated to be used in silvicultural decisions (such as on fertilising, thinning and rotation length), rates of return on afforestation and restocking are generally in the range 1-5%. This is partly a consequence of the poor quality of land historically made available to forestry. On better quality land, e.g. that falling out of agriculture, rates of return up to 8% may be possible.

Since 1995, the state Forest Enterprise has been set a target of breaking even financially in its year-on-year operations, without the addition of interest. This target it has successfully met. The absence of a positive interest-earning requirement is variously attributed to the new circumstances of a shift from afforestation to restocking, and to the need to account for the additional values of non-market effects. Forest economists find neither of these arguments persuasive, since

- restocking remains a long-term investment in revenue from the *future* rotation, and
- the correct treatment of non-market benefits (and costs) is to value then as far as possible in monetary terms, or failing that to calculate the opportunity cost of decisions made to favour them, using the appropriate discount rate.

The debate about what *is* the appropriate discount rate for natural resource development and environmental values is a separate issue, which continues to be in active discussion (Price, 1993).

3.1.2 The private forest economy, taxation and grants

The active expansion of private forestry in the UK may be largely attributed to state-provided financial incentives. Until 1988, forest expenditures could be offset against income tax liabilities, while revenues from timber sales were effectively tax free. At one time this allowed rates of return up to 15%, tax free, to be earned on forest investment. Forestry has also benefited from advantageous treatment under capital taxation. Its products are subject to value added tax under normal rules.

Since 1988, the emphasis has been on grant aid, with particular incentives to farmers. The switch to grants reduced the available rate of return on planting, which may now be around 5% in commercial plantations. More important seems to have been the psychological effect on the private sector, and the fact that receipt of grant aid, unlike the reclaiming of tax, is dependent upon a time-consuming consultative procedure, after which award of grant may be conditional on compliance with certain costly stipulations.

Death duties in forestry received very favourable treatment up to 1975, and since 1992 no duties have been payable on transfer of a forest, provided that the donor survives for at least two years. Death duties themselves have unquestionably caused fragmentation of private estates and some premature felling of trees. However, the special arrangements for forestry should have alleviated these effects, and a well managed forest estate should always have been able to provide a sustainable post-tax surplus of income over expenditure.

4 Forest and forest-related policies

The UK's forest policy is of a rather informal kind. Rarely, specific Forestry Acts of Parliament are promulgated (the last in 1967). The most important was that of 1919 which established the Forestry Commission and set its strategic objective. Since that time there has been a movement towards a multiplicity of objectives, driven largely by more general legislation, for example the Wildlife and Countryside Act of 1981. From time to time, ministerial statements presage a change of emphasis within the multipurpose framework.

Both Forest Enterprise and Forestry Authority have a detailed set of diverse and more specific objectives.

4.1 Legislation

Specific forestry legislation, enshrined in the various Forestry Acts, empowers the Forestry Commission to purchase land compulsorily (a power scarcely used), to control felling and impose conditions (usually replanting) on the granting of felling licences, and to perform other regulatory functions.

Tree Preservation Orders are applied under the Town and Country Planning Act, 1971, usually by local planning authorities to individual trees, groups of trees or whole woodlands. These are trees of intrinsic beauty, large contributors to the landscape, are scarce or have important wildlife habitats. They must not be felled, pruned or topped. Conservation Areas (designated by local authorities), Sites of Special Scientific Interest (Wildlife and Countryside Act, 1981) and Historic Parks and Gardens (National Heritage Act, 1983) also have various regulations preventing disturbance, felling or damage to individual or groups of trees.
A whole web of contingent legislation affecting issues from health and safety at work, through plant health and pest control to wildlife conservation impinges significantly on the practice of forestry.

4.2 Actors in forest and forest-related policies

4.2.1 Government forestry bodies

The Forestry Commission is the Government body advising on and implementing forest policy, responsible to the Minister of Agriculture, Fisheries and Food and the Secretaries of State for Scotland and Wales. In 1992 the Forestry Commission devolved its major functions to the Forestry Authority and Forest Enterprise. The Forest Enterprise is an executive agency which manages the Britain's state forests. The Forestry Authority is the regulatory arm of the Forestry Commission, responsible for implementing control of tree felling under the Forestry Act 1967, awarding grants to private woodland owners under the Woodland Grant Scheme and ensuring that relevant legislation and standards are complied with. Both have a territorial hierarchy, which gives scope to develop distinctive regional emphases. The devolved Scottish Parliament and Welsh Assembly will take over national forestry policies in 1999. Since 1997 the Forestry Commission Research Agency undertakes research contracts, both for public and private bodies.

The Ministry of Agriculture (and soon its Welsh and Scottish counterparts) has a second route of influence, through the growing importance of farm forestry. Its advisory service to farmers now incorporates some forestry expertise.

4.2.2 Private forestry bodies

A number of trade associations look after the interests of the private sector, providing information, some marketing services, and political lobbying. Among those representing the forest owners are:

- the Timber Growers Association representing about 2000 private woodland owners and businesses, who hold most of the commercial private woodland in the UK;
- the Country Landowners Association representing (usually large) landowners;
- in future, the farming unions may come to have a greater importance.
- The British Timber Merchants Association has more than 100 members in the sawmilling and merchant sectors, utilising British-grown timber.

The wood processing industry is represented variously by the Wood Panel Industries Federation, the Paper Federation of Great Britain, the UK Wood Processors Association and the UK Softwood Sawmillers Association.

The Forestry Industry Council of Great Britain, the Timber Industry Alliance and the Timber Trades Federation bring together these interests, with a general view of promoting the cause of the forestry industry.

4.2.3 Statutory forest-related organisations

Under the 1967 Forestry Act, the Forestry Authority is required to consult with other relevant statutory authorities, such as local planning authorities, on applications for felling licences or woodland grants). In Scotland, local authorities are required to draw up Indicative Forestry Strategies, giving guidance about where (and to an extent, how) forest expansion would be encouraged, or unwelcome. Such strategies also exist in other UK local authorities.

A number of other agencies, semi-independent of Government, can influence the nature of forestry, especially when forests are within designated areas. Particularly influential are the Countryside Commission and English Nature (England), the Countryside Council for Wales, and Scottish Natural Heritage. These can award their own grants to aid or influence forestry operations.

4.2.4 Charities and pressure groups

The Councils for the Protection of Rural England/Wales and The National Trusts have leaned towards maintaining the landscape *status quo*, as has the Ramblers Association. The Royal Society for the Protection of Birds is involved in forestry issues due to its interest in habitat for birds and as an owner of several woodlands. It has opposed afforestation when valued open habitats have been involved. The World Wide Fund For Nature has been actively involved in the setting up and running of the Forest Stewardship Council's and other certification schemes.

Although these groups, and others more temporary and local, have in the past campaigned actively against afforestation, they now operate in more collaborative mode, with representation on some forestry committees.

Increasingly, local residents are consulted on forest issues, though they do not yet have statutory powers in decision making.

4.3 Forest policy tools

Forest Enterprise pursues policy by management of its own forests. The Forestry Authority does so by seeking to secure compliance with policy, in both public and private forests, using a mixture of regulations and laws (already alluded to), moral persuasion and advice, and financial incentives. Advice was formerly available free from both Forestry Commission and Ministry of Agriculture, but the mood of the times is for such advice to be made commercially available by consultants.

To obtain planting, restocking and management grants, owners must comply, as appropriate, with the guidelines laid out in a series of Forestry Commission publications (on nature conservation, recreation, water, landscape design, community woodland design and archaeology. If guidelines are not followed then the grant money may be reclaimed (with interest).

There are also prescriptive guides to the management of eight recognised types of semi-natural woodland. Owners of this type of woodland, if grant aid or felling permission is sought, need to follow the guides unless there are good management reasons for not doing so. The creation of new native woodlands on open land by natural colonisation or planting, where species composition and site are suitably matched, is encouraged by grant aid, especially on areas close to existing semi-natural woods.

Higher grant levels are available for planting of broadleaves, of woods suitably located for community recreation, and on better quality agricultural land (as part of the policy to reduce agricultural surpluses).

No long-term forest management plan is required, but agreement of a shorter-term plan of operations (typically, for five years) is a condition for grant aid and felling licences. The possibility of financial assistance for longer-term forest design plans is now being discussed.

The Forestry Authority also exerts control over Forest Enterprise, by requiring its approval be given for forest design plans for state forests.

As yet there is no official National Forestry Programme. The original strategic objective, to achieve a 2 M ha area of productive woodlands, could have been so considered, and the movement towards a formal programme is discussed in section 5.3.

4.4 Forest policy in relation to other national policy areas

Policy matters not explicitly directed to forestry – particularly those related to access to the countryside for recreation, the visual appearance of the countryside, and nature conservation – have been pivotal in inducing changes of orientation of forestry activities. However, the Town and Country Planning Act of 1947, which closely controls most aspects of land use change and development, does not apply to afforestation, felling or any other forest operations. Recent development are discussed in 5.2.

4.5 European Union forest and forest-related policies

Between 1979 and 1997 successive Conservative governments were generally opposed to the development of a forestry strategy for the UK – though other bodies advocated one. This, and Britain’s generally equivocal relationship with the European Union over this period, led to lack of official enthusiasm about a European Forest Policy. However, European legislation and policy, particularly on agriculture and on the environment, affects UK forestry.

Changes in the Common Agricultural Policy in consequence of over-production of food have strongly redirected the UK's forest expansion towards farmland. Grants from the Forestry Authority are favourable to the planting of arable land, while the Farm Woodland Premium Scheme, in line with European policy, gives annual payment for land diverted into forestry, according to the amount of agricultural productivity decommissioned. Grant-aided planting in Environmentally Sensitive Areas is also within the Ministry of Agriculture's policy remit.

A number of EC and EU directives on environment are applied. Of these the most prominent concerns environmental impact assessment. In general planting schemes under 10 ha do not require an environmental statement, those between 10 and 100 ha *may* do, if likely to affect ecology or landscape, while those over 100 hectares or affecting statutorily designated areas *will* do.

4.6 Forest education and research

Up to the 1990s, four UK universities offered undergraduate or postgraduate degrees, or both, in forestry subjects, with three higher education colleges providing technical diplomas. Recent developments in UK higher education have led to a proliferation of forestry degrees, and a blurring of the distinction between professional and technical qualifications.

The Institute of Chartered Foresters sets its own examinations for recognition of professional competence.

As well as by the Forestry Commission's Research Agency, forestry and forest-related research is undertaken in a number of university departments besides those offering forestry qualifications, and including disciplines in the social as well as the biological sciences. Similarly, wood-processing-related research is undertaken in, for example, chemistry departments.

5 Current conflicts and challenges

5.1 Relations between actors and interests

Historically, conflicts have arisen from reduction of forest area as a result of agricultural expansion (over many centuries) opposition between what may be broadly termed "production" and "environmental" interests – periodically through the last millennium, and particularly during the past 60 years.

The first has led farmers to show a lack of understanding of and antipathy towards forestry, which is not found in those European countries with a strong tradition of farm forestry. Obversely, foresters have felt ill-treated, as the recipients of land that "even the sheep farmers don't want", and have regarded farmers as an enemy force.

This situation has begun to change, slowly, as a result of over-production of agricultural products within the EU, with concomitant financial incentives to divert land out of food production and into forestry; the near-cessation of land acquisition by the state's Forest Enterprise, and severe curtailment of tax-driven private planting since 1988 – these changes leaving farmers as a major source of land for forestry activity.

An outcome of these combined changes has been that farmers began planting in the late 1980s with what appeared to be largely environmental objectives (Price and Willis, 1994). The proportion of broadleaved species planted by farmers was 71% during the period 1992-4, and the average size of planting scheme only 6.8 ha. There has been some concern in the wood-processing industries about the implications of block size, low accessibility and species mixture for future raw material supplies (though a trend to larger plantations, with a predominance of conifers, is notable in Scotland).

Conflict between production forestry and environmental values reached a peak between 1970 and 1990. Rather in opposition to the situation elsewhere, the *planting* of forests, rather than their *felling*, has been viewed as the environmental problem. During the expansion in the uplands, the strongest objections were initially based on the visual appearance of plantations, usually monocultures of unfamiliar species planted in shapes unsympathetic to the topography. In the lowlands, replacement of native or long-naturalised broadleaves by exotic conifers drew objections on grounds of both landscape and ecological impact. The ecological objections spread to the uplands, especially when large open moorland or wetland habitats were afforested. Indeed, the large-scale afforestation of a notable wetland habitat in North Scotland was a major trigger for the tax changes of 1988.

At a more technical level, water supply agencies and the electricity boards have expressed concern about the adverse impact of forests on water quality and quantity. However, this has not appeared to move into the political arena.

The conflict is more muted at present, with the reduction in upland forest expansion. The movement of planting to the lowlands, often on sites of environmentally damaging intensive agriculture, has been generally, though not universally, welcomed. In this setting diversification of landscape and ecosystems with a variety of broadleaved species, planted on a small scale, represents a considerable environmental gain. The English Countryside Commission has now become a committed supporter of major forest expansion, in the lowlands at least.

Environmental objectives have now been internalised, to a greater or lesser extent, in both public and private sectors. A consensus notion of good practice is embedded in the Forestry Standard, further referred to in 5.2.3.

5.2 UNCED, multipurpose forestry and sustainability

The Rio Earth Summit of 1992 both reflected prior trends in the UK, and provided a focus for their further development. Since the mid 1980s, the UK had placed a high priority on the development of codes of good environmental practice in forestry. The private sector has supported these developments, and sometimes played a pioneering role (Timber Growers' United Kingdom, 1985).

5.2.1 Sustainable development

High public commitment to sustainability is explicit in the statement of the then Secretary of State for the Environment that "The United Kingdom is determined to make sustainable development the touchstone of its policies" (Gummer, 1994). (It is less easily discerned in successive Governments' advocacy of heavily discounting the value of future costs and benefits.)

Following the 1993 Ministerial Conference on the Protection of European Forests in Helsinki, the Government formally adopted a forestry policy to promote sustainability. This was expressed in the following terms:
- sustainable management of our existing woods and forests;
- and a steady expansion of tree cover to increase the many diverse benefits that forests provide.

The UK's international commitments were spelled out in *Sustainable Forestry – the UK Programme*, one of four linked plans, the others covering sustainable development, biodiversity, and climate change.

As well as direct pursuit of sustainability through forest management, pressures were being built from the demand side. Some of these are based on protocols such as those of the International Standards Organisation. Other initiatives are non-governmental in origin, such as the certification scheme promoted by the Forestry Stewardship Council. This aims at certificating wood products, where these can be shown to come from sustainably managed forests.

5.2.2 The UK Forestry Accord

In 1996, many organisations representing a wide range of business and environmental interests in UK forestry adopted *The UK Forestry Accord* (Forestry Commission, 1998). Its signatories shared objectives and principles for the future management and development of forestry in the UK, while interested non-signatories indicated a broad approval for its ethos. Its six summary principles are:

- Forestry is a uniquely sustainable land use and investment in all types of sustainable forestry should be encouraged.
- conservation of biodiversity and natural resources should lie at the heart of forest management.
- Forest management should safeguard and enhance landscape and heritage resources.
- Sustainable productive forestry to provide timber benefits should be encouraged.
- Research, education and training should cover all aspects of sustainable forestry.
- The public should be widely involved in and consulted on forestry matters.

5.2.3 The UK Forestry Standard

In 1995 the UK Government began work on preparing a UK Forestry Standard (Forestry Commission, 1998) whose purpose was "to set out the criteria and standards for the sustainable management of all forests and woodlands in the UK." While the standard was intended to be compatible with previous international commitments, it recognised that emphases and constraints would differ in the light of the country's particular conditions. For example, it explained that:

"… some issues (such as soil erosion and fire) … are globally important but not usually critical in the UK. The use of native species is also an area of different emphasis: only one native conifer species (*Pinus sylvestris*) is commercially utilisable for timber, and as a consequence, non-native trees play a major part in UK forestry. Hence, the UK Forestry Standard has less to say about fire and forests for soil protection, and more about non-native species, than might be expected in other European countries".

It aimed to develop detailed criteria and indicators, so that general international agreements could be readily interpreted in practical terms by managers on the ground, without being too heavily prescriptive. To facilitate its integration into policy, weight was given to previously existing guidelines.

There were two rounds of consultation with the public, agencies and individuals with known forestry interests, and the final version was published in 1998, with a foreword by the Prime Minister indicating the importance placed upon it.

5.3 The future

The change of government in 1997 has not led to a palpable discontinuity in the long-running antipathy to public ownership and management, nor have statements on this theme made prior to the election been determinedly adhered to. In these circumstances, the state's Forest Enterprise will probably confine itself to defending what it holds, with expansion occurring largely in the private sector, and probably driven by the search for the "least-cost" method of maintaining rural employment and farming population.

Politically, the environment has at least a superficial ascendancy within the multipurpose framework, with biodiversity much talked of, even if landscape is closer to the British heart. The efficacy of forestry in averting global warming will continue to be misunderstood by the population as much as by their political representatives.

All this has brought some reappraisal of silviculture and harvesting. That broadleaves are beautiful and conifers less so, that small is beautiful and big not at all so, are beliefs enshrined in popular wisdom, and gently underwritten by the *UK Forestry Standard*. There will be diversification of species planted, with broadleaves occupying a statutory minimum area. The age classes of the extensive even-aged plantations will also be diversified, as a natural consequence of different growth rates and patterns, and, at some cost, as a deliberate attempt to meet environmental objectives. Forest operations on a large scale will be generally frowned upon, although some concession to matching the scale of landscape may now be permitted. Uneven-aged silvicultures, and soil-friendly harvesting techniques will be proposed widely, and adopted locally.

Public consultation, one of those self-evidently good things which one should not oppose, will be undertaken on topics which are appropriate, and also on some where experts are actually better able to inform a good decision. Many university researchers will prosper on grants to undertake psychometric and contingent valuation studies of the benefit the public expects from forests.

The traditionally dominant timber seems, for the moment, almost consigned to the role of by-product of the environmentally beneficent forest, though there will no doubt be a gentle swing of the pendulum back in due course. However, the most recent enlargement of the European Union brings the question of what is the appropriate political entity within which to pursue a movement towards self-sufficiency in timber supplies – which was the point of departure for the UK's forest policy this century.

From time to time economists have deliberated on whether the UK has comparative advantage in timber production. While the forests are highly productive by north and central European standards, their establishment is relatively expensive, and the processing industries lack economies of scale and transportation. UK foresters have less frequently compared their growth rates with those of southern Europe.

In a strange way, it may be that the existence of a forest resource, for dominant environmental (and secondary social) objectives, provides the justification for a home-based wood industry. However, a more critical and site-specific approach to the evaluation of environmental benefits, and to natural resource economics generally, will be needed before that can be confirmed as an appropriate destiny for UK forestry.

Addresses of organisations related to forestry (all in UK)

Research and Educational establishments

Buckinghamshire Chilterns University College, Queen Alexandra Road, High Wycombe, Buckinghamshire HP11 2JZ , Tel: +44-1494 522141; Fax: +44-1494 524392; http://www.bcuc.ac.uk/

CAB International Forestry Bureau, Wallingford Oxon OX10 8DE, Tel: +44-1491-32111; Fax: +44-1491-33508; e-mail: 84:CAU001

Cumbria College of Agriculture and Forestry, Newton Rigg, Penrith, Cumbria CA11 0AH, Tel: +44-01768-863791; Fax: +44-01768-867249: e-mail: info@newtonrigg.ac.uk

De Monfort University, School of Agriculture & Horticulture, Risehome Hall, Lincoln LN2 2LG, Tel: +44-1522-895317; Fax: +44-1522-545436

Department of Agriculture for N. Ireland, Room 615, Dundonald House, Upper Newtownards Road, Belfast BT4 3SB, Tel: +44-1232-524068; Fax: +44-1232-525546

Forestry Commission, 231 Corstorphine Road, Edinburgh EH12 7AT, Tel: +44-131-3340303; Fax: +44-131-3343047; e-mail, URL: http://www.forestry.gov.uk

Forestry Commission Forest Research Station, Alice Holt Lodge, Wrecclesham, Farnham, Surrey GU10 4LH, Tel : +44-1420-22255; Fax: +44-1420-23653

Institute of Terrestrial Ecology, Bush Estate, Penicuik, Midlothian EH26 OQB, Tel: +44-131-4454343; Fax: +44-131-4453943; e-mail: bush.ite.mgrc@mail.nerc-bush.ac.uk

Institute of Terrestrial Ecology, Merlewood Research Station, Grange-over-Sands, Cumbria LA11 6JU, Tel: +44-15395-32264; Fax: +44-15395-34705

Institute of Terrestrial Ecology, Monks Wood, Abbots Ripton, Huntingdon PE17 2LS, Tel: +44-14873-381; Fax: +44-14873-467

Macaulay Land Use Research Institute, Craigiebuckler, Aberdeen, Scotland AB9 2QJ, Tel: +44-1224-318611; Fax: +44-1224-311556

Oxford Forestry Institute, South Parks Road, Oxford OX1 3RB, Tel: +44-1865-275000; Fax: +44-1865-275074; e-mail: ofi@plants.ox.ac.uk, URL: http://www.plants.ox.ac.uk/ofi/index.htm

School of Agricultural and Forest Sciences, University of Wales Bangor, Gwynedd LL57 2UW, Tel: +44-1248-351151; Fax: +44-1248-354997; URL: http://www.bangor.ac.uk/safs/

Shell Research Limited, Forestry Research Unit, HRI East Malling, Kent ME19 6BJ, Tel: +44-1732-843833; Fax: +44-1732-874779

Sparsholt College, Sparsholt, Winchester, Hampshire SO21 2NF, Tel: 44-1962-72441

University of Aberdeen Department of Forestry, MacRobert Building, 581 King Street, Aberdeen AB24 5UA, Tel: +44-1224-272677; Fax: +44-1224-272685, URL: http://www.abdn.ac.uk/forestry/index.hti

University of Abertay, Kydd Building, Dundee DD1 1HG, Tel: +44-1382-308000; URL: http://www.tay.ac.uk

University of Edinburgh Institute of Ecology and Resource Management, Darwin Building, Kings Building, Mayfield Road, Edinburgh EH9 3JU, Tel: +44-131-6501000; Fax: +44-131-6672601, URL: http://helios.bto.ed.ac.uk/ierm/

Forestry, timber trade and environmental organisations

Arboricultural Association, Ampfield House, Ampfield, Romney, Hampshire SO51 9PA, Tel: 44-1794-68717

Council for the Protection of Rural England, Warwick House, 25 Buckingham Palace Road, London SW1W 0PP, Tel: +44-171-9766433; Fax: +44-171-9766373

Country Landowners Association, 16 Belgrave Square, London SW1X 8PQ, Tel: +44-171-2350511; Fax: +44-1712354696

Countryside Commission, John Dower House, Crescent Place, Cheltenham, Glos GL50 3RA, Tel: +44-1242-521381; Fax: +44-1242-584270

Forestry Industry Council of Great Britain, Golden Cross house, 3/8 Duncannon Street, London

WC2N 4JF, Tel: +44-171-9309422; Fax: +44-171-9309426

Institute of Chartered Foresters, 7a St Colme Street, Edinburgh EH3 6AA, Tel: +44-131-2252705; Fax: +44-131-2206128

National Trust, 36 Queen Ann's Gate, London SW1H 9AS, Tel: +44-171-2229251; Fax: +44-171-2225097

Paper Federation of Great Britain, Papermakers House, Rivenhall Road, Westlea, Swindon, Wilts SN5 7BD, Tel: +44-1793-886086; Fax: +44-1793-886182; URL: http://www.paper.org.uk

Royal Forestry Society for England, Wales and Northern Ireland, 102 High Street, Tring, Herts HP23 4AF, Tel: +44-01442-822028; Fax: +44-01442-890395; e-mail: rfshq@rfs.org.ul; URL: http://www.rfs.org.uk

Royal Scottish Forestry Society, The Stables, Dalkeith Country Park, Dalkeith, Midlothian EH22 2NA, Tel: +44-131-6609480; Fax: +44-131-6609490

Timber Growers Association Ltd, 5 Dublin Street Lane South, Edinburgh EH1 3PX, Tel: +44-0131-5387111; Fax: +44-0131-5387222; e-mail: tga@ednet.co.uk; URL: http://www.timber-growers.co.uk

Timber Trades Federation, Clareville House, 26/27 Oxendon Street, London SW1Y 4EL, Tel: +44-171-8391891; Fax: +44-171-9300094; URL: http://www.ttf.co.uk/

UK Forest Products Association, John Player Building, Stirling Enterprise Park, Springbank Road, Stirling FK7 7RP, Tel: +44-1786-449029; Fax: +44-473112

Wood Panel Industries Federation, 28 Market Place, Grantham, Lincs NG31 6LR, Tel: +44-1476-563707; Fax: +44-1476-579314; e-mail: wpif.panelboards@virgin.net

Woodland Trust, Autumn Park, Dysart Road, Grantham, Lincs NG31 6LL, Tel: +44-1476-574297; Fax +44-1476-590808

WWF-UK, Panda House, Weyside Park, Godalming, Surrey GU7 lXR, Tel: +44-1483-426444; URL: http://www.wwf-uk.org

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Useful URLs

British Trees Home Page http://www.u-net.com/trees
Financial Information on Forest Products, Pulp & Paper, and Other Wood Related Companies http://www.forestdirectory.com/stocks.htm
Forestry Commission Information and Publications http://www.forestry.gov.uk
Forest Resources http://www.forestsource.com
Forest Sector Homepage http://europa.eu.int/comm/dg06/fore/index_en.htm
Forestry http://www.metla.fi/info/vlib/Forestry
Forest Products, Wood, Trees, and Sustainable Forests Marketplace http://www.forestworld.com/marketplace/marketplace_home.html
International Union of Forestry Research Organizations http://iufro.boku.ac.at
Timber http://www.unece.org/trade/timber

Acknowledgements

We are grateful to Christine Cahalan, Roger Cooper, Alister Henderson, Graham Mayhead and David Jenkins for supply of information, comments and suggestions.

Map of Europe