



# State of Finland's Forests 2011

Based on the Criteria and Indicators of Sustainable Forest Management



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of Sustainable Forest Management

Compiled by the Finnish Forest Research Institute (Metla)

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# Foreword

Criteria and indicators have become an established instrument for assessing and monitoring sustainable forest management. Indicators have been used in Finland particularly in the presentation of and reporting on forestry as well as in the monitoring and preparation of the National Forest Programme and the Regional Forest Programmes. The indicators have also been used to steer practical silviculture and forest certification.

Ever since the Second Ministerial Conference on the Protection of Forests in Europe (MCPFE) in Helsinki in 1993, Finland has made an active contribution to the development of the criteria and indicators worldwide. The first set of Pan-European Criteria and Indicators for Sustainable Forest Management was produced in 1993–1995 under the leadership of Finland and Portugal. Finland's first national set of indicators was completed in 1996 and has since been updated. The Pan-European Criteria and Indicators currently applied is based on the decisions of the Ministerial Conference held in Vienna in 2003.

The present criteria-based and indicator-based report, *State of Finland's Forests 2011*, is the fourth of its kind; previous reports were published in 1997, 2003 and 2007.

The report has been revised in the same spirit of open cooperation as the National Forest Programme. It has been discussed and commented on by the Advisory Board for International Forest Policy appointed by the Ministry of Agriculture and Forestry. The collation of data for indicators and the production of texts were done at the Finnish Forest Research Institute (Metla), which, being in charge of the national forest inventory and of compiling forest statistics in Finland, has the necessary resources for the task.

The Finnish set of indicators is lent considerable weight by monitoring data on Finland's forests from time series up to 90 years old and by the taking of new, topical issues under review. Because the indicators are also used for presentation of and reporting on Finnish forests and forestry internationally, the present report also includes a short description of the development and diversity of Finnish forests and forest management and their significance to Finnish society. In addition the main characteristics of Finland's forests have been compared to the European situation.

I would like to extend my warmest thanks for those contributing to this report for a job well done. At the same time, I hope that its valuable content will be extensively used to communicate the state of Finland's forests and forestry during and after during the International Year of Forests 2011.

Helsinki, 25 May 2011



Sirkka-Liisa Anttila

Minister of Agriculture and Forestry

# State of Finland's Forests 2011 – Summary

The application of the indicators of sustainable forest management in Finland has produced a time series spanning more than 15 years. Although changes in forests are slow, the indicators enable us to distinguish certain trends and to make comparisons, especially on the impacts of forest policy on the forests and forest management.

## Principal messages

The state of Finland's forests has improved over the past 20 years. Over the past 40 years, the growing stock has increased by more than 40%. Over the same period, wood equivalent to the current volume of the tree stock, 2,200 million cubic metres, has been harvested and used. To safeguard biological diversity, nature management measures have been undertaken in commercial forests, and the area of protected forests has been tripled over the past 35 years; thanks to these efforts, the decline of certain forest species has been halted.

Because Finland's use of wood is far lower than annual growth, Finland's forests are a carbon sink, removing carbon from the atmosphere equivalent to about half of the carbon dioxide emissions from Finland's industry per year and binding it into trees and soil. Apart from the severe storm damage that occurred locally along narrow belts in summer 2010, there has been no widespread forest damage in Finland for 30 years. Climate change is estimated to increase forest growth, but on the other hand extreme weather phenomena will probably become more common and cause local damage more frequently.

Forests, forest bioproducts and ecosystem services are estimated to continue to form an important part of Finland's national economy in preparing to alleviate the impact of climate change and to produce wellbeing services for citizens. Being a low-energy and carbon-neutral raw material, wood is expected to be much in demand in the production of renewable forest energy, in wood construction and in new bioeconomy products. The forest sector contributes 4% of the GDP, but the percentage may be more than 10% regionally, for instance in southeastern and eastern Finland and in Kainuu. The economic recession of 2008–2009 caused a reduction of nearly 20% in production capacity in the pulp and paper industries, and jobs were lost in the forest industry in Finland.

The key conclusions on the state of Finland's forests in 2011 are as follows, by indicator:

## Forest policy

In recent years, forest policy debate and measures have tended to focus on increasing the use of forest energy and bioproducts as a corollary to the renewable energy and climate change debate. With the structural change in the forest industry, research in wood as a raw material for bioproducts and renewable energy solutions has been stepped up. The forest organisations subordinate to the Ministry of Agriculture and Forestry will be restructured as of 2012 with the aim of clarifying their functions and making them more efficient.

Appreciation of forests has increased among citizens, and accordingly a wider range of forest management alternatives, forms of forest use and services is being developed. Safeguarding the biodiversity of the forest environment has been established as a standard point of interest in forest management alongside wood production. By contrast, the economic viability of forest management has not improved, although the volume and annual increment of growing stock have increased continually.

The principal policy document in forest matters is the National Forest Programme, whose implementation is approved by the Government. Apart from the National Forest Programme (NFP), the Forest Biodiversity Programme for Southern Finland (METSÖ) and the Strategic Programme for the Forest Sector (SPFS) are also ongoing.

## Forest resources

Three fourths of the land area of Finland, 23 million hectares, is covered by forests. The forest area has remained almost unchanged over the last 50 years, whereas the volume of growing stock has increased by more than 40% in the same period, being 2,200 million cubic metres at the end of 2010. The age structure of forests has become equalised due to cuttings and systematic forest planning aiming at increased wood production.

Carbon stocks in forests, mires and the soil are extensive, and are constantly growing due to the increasing volume of growing stock. Since the annual volume of wood use is far less than the annual increment to the growing stock, the carbon balance is currently positive in Finnish forests, amounting to 30 million tonnes of CO<sub>2</sub> per year. The volume of carbon dioxide bound by Finnish forests per year is equivalent to about 50% of the carbon dioxide emissions of Finnish industries. Wood-based fuels account for about 20% of overall energy consumption in Finland, which is important for the reduction of CO<sub>2</sub> emissions. Being a renewable raw material with long-term carbon sequestration potential, wood is heavily promoted for use in construction, above all for building blocks of flats in wood.

## Health and vitality

The deposition load in Finland has decreased considerably compared to the 1980s. The greater part of the deposition of atmospheric pollutants in Finland – 71% of nitrogen deposition and 83% of sulphur deposition – comes from abroad. Measurements of the nitrogen and sulphur content in soil water show no significant changes in the acidity of forest land to date, and current levels pose no threat to forests.

Based on defoliation measurements, the health status of Finnish forests is satisfactory and has remained stable. There has been no widespread forest damage in Finland for 30 years. This is partly due to the enactment of the Act on Prevention of Forest Fungi and Insect Damage in 1991, restricting the storage of timber in the summer. Occasional local forest damage does occur from time to time; in economic terms, the most significant of these are damages caused by fungi and insects, storm damage, and damages to saplings caused by moose. Exceptionally warm weather in southern Finland in summer 2010 caused severe storm damage along narrow belts of forest, felling trees amounting to 8 million cubic metres of wood. Thanks to efficient monitoring, forest fires have remained extremely small in area in Finland. There are several hundred forest fires every year, but they are extinguished efficiently.

Climate change is estimated to increase forest growth, but on the other hand extreme weather phenomena will probably become more common and cause local damage more frequently. The most worrying threat factors are the spreading northward of insect pest damage from the temperate zone and improved breeding potential for the pine wood nematode and bark beetles due to warmer summers. Forest management according to experience-based best practices is the principal means for helping forests adapt to climate change. Forest tree breeding also provides tools for improving the adaptation of forest trees to climate change.

## Productive functions

The annual increment of growing stock has exceeded the total drain by one fourth since the mid-1970s. Over the same period, wood equivalent to the current volume of the tree stock, 2,200 million cubic metres, has been harvested and used. Sustainability of wood production is promoted systematically both by Government measures and the active participation of private forest owners, and through forest planning. Comprehensive forest planning has contributed to the sustainable management and use of forests. The average removal of roundwood in 2000–2009 was 59 million cubic metres annually, and the gross stumpage earnings about EUR 1,800 million, equal to EUR 88 per hectare of forest per year.

Forest-related services and the use and maintenance of non-wood products are a natural component of forest management in Finland. Everyman's Rights grant the universal right and opportunity to everyone to use forests for recreation, outdoor activities and collecting berries and mushrooms, insofar as this causes no damage or disturbance.

Non-wood forest products can have considerable importance locally and for individual households, although the value of forest services and non-wood products is slight compared to the sales value of timber nationally. Economically, the most important non-wood products of forests are game, mostly moose, and nature tourism. Traditional forest industry products are being joined by a wide range of new wood-based bioproducts such as biodiesel, composites, biopolymers, pharmaceuticals, cosmetics and wellbeing products.

## Biological diversity

Forest management oriented to the biological diversity by mitigating the natural development cycle of forests has been a statutory requirement in Finland for 15 years, ever since safeguarding biological diversity was enshrined as a parallel goal with wood production in the Forest Act of 1997. At the same time, the production of information about biodiversity and related research, discussion and consultation have been an important key area, with broad participation by forest owners and other actors and interest groups in forest management.

The main methods for safeguarding biological diversity in commercial forests are the protection of valuable habitats and biotopes, favouring of mixed tree stands in the management, and increasing the amount of decayed wood. The selected new forest management policy has brought measurable positive changes to commercial forests. The rate of decline of certain forest species has slowed down in Finland, or in some cases even stopped since the 1990s, although it has not been possible to halt the decline in forest species overall. An evaluation of threatened species conducted in 2010 showed that the decline has slowed down or stopped for 81 forest species but continued for 108 species. Retention trees at felling sites have been particularly important in curbing the decline trends.

Unlike in other European countries, strict forest protection is emphasised in Finland. Under various protection programmes and decisions, the area of protected forests has been tripled over the past 35 years. The total area of protected forests is currently 2.2 million hectares, or 9.6% of all forest land. The total area of protected forests and forests under restricted use is almost 3 million hectares, or 13.0% of all forest land. The percentage of strictly protected forests in Finland (5.2% of forest land) is the highest in Europe. In southern Finland, where the percentage of strictly protected forests varies between 1.0% and 3.6%, biological diversity and protection is being promoted through the Forest Biodiversity Programme for Southern Finland (METSÖ). The programme involves developing silvicultural methods, as well as voluntary measures by private forest owners to protect biodiversity, and restoration management of protected areas in State ownership.

Forest management in Finland is based on native tree species, and management measures are undertaken on a mosaic-like basis, followed the forest vegetation types formed by natural development. Each year, two thirds of the area of regenerated forest land (150 000 hectares, about 0.8% of all forest land) is planted with seedlings and one third is regenerated either naturally or by direct seeding.

## Protective forests

The land is fairly flat in Finland, and there are hardly any problems caused by soil erosion, avalanches or shifting of the ground. Protective functions therefore mostly focus on protective forests in the timberline area in Lapland.

The total area of protective forests in the northernmost part of Finland is 3.3 million hectares. In these areas, fellings are restricted by law to prevent the timberline from receding further south. According to monitoring of forest regeneration, there has been no change in the receding of the timberline so far.

Because of the great number of peatland forests and waterways – lakes, rivers, small water systems – in Finland, issues relating to waterways receive special attention in forest management. Forest management measures that may burden waterways include final fellings, soil preparation, drainage and fertilisation. Natural peatlands are no longer drained for commercial forest use in Finland, but the condition of already drained peatland forests that have growth potential is improved in ditch cleaning projects. Monitoring of the effects of silviculture on water systems over a period of 15 years indicates that the level of water protection has improved continuously at felling sites. The level of water protection regarding harvesting and soil preparation is excellent or good in over 90% of the sites.

The condition of small water systems requires continuous attention, and for this purpose water management plans and local restoration programmes are drawn up. Protective zones with trees are established alongside waterways in harvesting, sludge sumps are dug during drainage reconditioning, and waters from the area are passed to open waters through an infiltration area to prevent leaching of nutrients and sludge.

## Socio-economic functions

The forest sector remains important for the Finnish national economy. The forest sector contributes about 4% of Finland's GDP; regionally, however, the percentage may be as high as 10%, for instance in south-eastern and eastern Finland and in Kainuu. Forest industry products account for about 20% of Finland's total exports of goods.

The net result of private forests has remained the same on average over the past 10 years but with extreme fluctuations from EUR 53 to EUR 136 per hectare per year.

Domestic consumption of sawn wood is about one sq.m per capita annually, and that of paper and paperboard about 200 kg. The consumption of wood-based products per capita in Finland is one of the highest in Europe.

In 2010, the forest sector provided employment to about 69,000 persons, less than 3% of the entire employed labour force. The worldwide recession in 2008–2009 caused a collapse in employment particularly in the pulp and paper industries: in 2010, the average unemployment rate in the forest sector was 9.0%. Occupational safety and health of employees in the forest sector are well taken care of. Social security of employees in the forest sector is equal to that in other sectors of the economy.

Citizens have a wide variety of opportunities for participating in the various aspects of forestry. Methods of participatory planning have been developed especially in the case of State-owned forests. The National Forest Programme and Regional Forest Programmes are also always drawn up in broad-based cooperation with interest groups.

Forests have contributed to the evolving of the Finnish identity and to Finns' relationship to the natural environment. The cultural and spiritual functions of forests are therefore heavily featured in the preservation of forest traditions, silvicultural operations, timber construction, art, music, communications and landscape protection.

# Basic concepts and information sources

## The definition of forest

**FOREST** in this report denotes forest land and low productive forest land. As per the Finnish definition, there are 23 million hectares of forest in Finland. This classification has been in use in Finland since the 1950s, for over 60 years.

Finnish classification based on site productivity (growth during the rotation period):

- On **forest land**, the potential annual increment for the rotation period is at least 1 cubic metre per hectare per year.
- **Low productive forest land (scrub land)** is mainly exposed bedrock, scree or mires, where the annual increment is less than 1 but more than 0.1 cubic metres per hectare per year for the rotation period.
- **Other land areas for forestry (wasteland)** consist of completely or almost treeless areas with a growth potential of less than 0.1 cubic metres per hectare per year for the rotation period.
- **Forestry land** includes, in addition to the above: forest roads, permanent storage areas and plots reserved for the use of forest management, etc.

**The definition of forest used by the UN Food and Agriculture Organisation (FAO) in its forest statistics, based on crown density:**

- **Forest:** Land with tree crown cover of more than 10% and area of more than 0.5 ha. The trees should be able to reach a minimum height of 5 metres at maturity in situ. By this definition, the area of forest land in Finland is about 3% smaller than the sum of the aforementioned forest land and scrub land areas, i.e. 23 million hectares.
- **Other wooded land:** Land with either a tree crown cover (or equivalent stocking level) of 5%–10% of trees able to reach a height of 5 metres at maturity in situ; or a crown cover (or equivalent stocking level) of more than 10% of trees not able to reach a height of 5 metres at maturity in situ.

The Finnish National Forest Inventories have applied the international classification (FAO) parallel with the national classification scheme since the 9th inventory (1996–2003). The international classification is necessary for the preparation of international statistics and for international debate on forests.

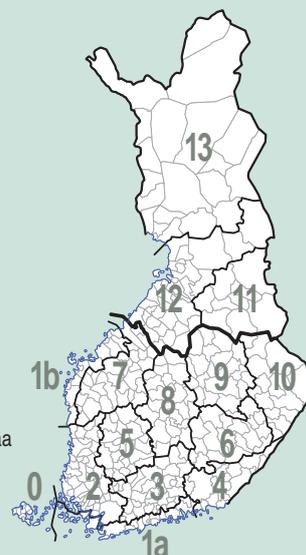
## Forest Districts of the Forestry Centres

In this report, results are presented by Forestry Centre district. 'Southern Finland' comprises the province of Åland and Forestry Centre districts 1a to 10. 'Northern Finland' comprises Forestry Centre districts 11 to 13 in the regions of Kainuu, North Ostrobothnia and Lapland.

The Forestry Centre districts function as the administrative division of forestry in Finland. Most of the information concerning forest resources, such as the data from forest inventories, is presented both as national averages and as averages for the individual Forestry Centre districts. Source: Finnish Statistical Yearbook of Forestry 2010.

### Forestry centres

- 0 Ahvenanmaa
- 1 Rannikko
- 1a Etelärannikko
- 1b Pohjanmaa
- 2 Lounais-Suomi
- 3 Häme-Uusimaa
- 4 Kaakkois-Suomi
- 5 Pirkanmaa
- 6 Etelä-Savo
- 7 Etelä-Pohjanmaa
- 8 Keski-Suomi
- 9 Pohjois-Savo
- 10 Pohjois-Karjala
- 11 Kainuu
- 12 Pohjois-Pohjanmaa
- 13 Lappi



## Key information sources

This report is based on the most up-to-date and accurate data and information available in each context. A great number of sources has thus been used. Sources are quoted with tables, illustrations and figures. The principal sources are the National Forest Inventory (forest resources monitoring system) and the Finnish Statistical Yearbook of Forestry.

The development of forest resources in Finland is monitored over a wide range in the **National Forest Inventory (NFI)** maintained by the Finnish Forest Research Institute (Metla). The first systematic inventory of forests was conducted as far back as in 1921–1924, and as a result Finland has exceptionally long time series on the development of forest resources. The forest resource data in the inventory are based on diverse on-site surveys conducted on test plots selected on the basis of a systematic statistical sample. There is a regular network of such test plots covering the entire country. When surveys are combined with satellite images and numerical data, findings can be calculated for smaller areas such as individual municipalities or discrete forest areas. Today, the NFI generates annually updated information on trends in forest resources and the state of the forests.

The **Finnish Statistical Yearbook of Forestry** published by the Finnish Forest Research Institute (Metla) is an annual summary of the key statistics in the Finnish forest sector. The Yearbook contains data on forest resources and also information and statistics on the natural environment in forests, on the multiple use of forests, on environmental issues, and on the production of and trade in roundwood and forest industry products. As with the NFI, many of the statistics are based on the findings of the extensive research conducted by the Finnish Forest Research Institute (Metla) and separate reports.

The statistics published in the Finnish Statistical Yearbook of Forestry and the findings of the NFI are available both in printed form and online at **Metinfo Services**<sup>1</sup>. The detailed NFI forest resources report is also published annually as a supplement to forest science journal **Metsätieteen aikakauskirja**.

The Finnish Environment Institute is commissioned by the Ministry of the Environment to conduct **assessments of the threatened species in Finland's** every 10 years and **assessments of the status of Finland's biotopes** at regular intervals.



The National Forest Inventory (NFI) maintained by the Finnish Forest Research Institute (Metla) generates annually updated information on the state of Finland's forests. Results from field measurements can be nowadays transferred wireless in real time to office data banks and computers.

<sup>1</sup> National Forest Inventory – Statistics of Forest Resources  
[www.metla.fi/metinfo/vmi](http://www.metla.fi/metinfo/vmi)

# What are the Criteria and Indicators for Sustainable Forest Management?

Criteria and indicators have become an established instrument for assessing and monitoring sustainable forest management. They are used in the preparation and monitoring of forest policies and strategies, reporting on the condition of forests, setting the direction of forest management, publishing information about forests and forestry to political decision makers and other interested parties, making initiatives for research, and forest certification.

The Pan-European Criteria and Indicators for Sustainable Forest Management are based on the **concept of sustainable forest management and use** adopted at the Second Ministerial Conference on the Protection of Forests in Europe held in Helsinki in 1993. Resolution H1, Article D states:

“ ‘sustainable management’ means the stewardship and use of forests and forest lands in a way, and at a rate, that maintains their biodiversity, productivity, regeneration capacity, vitality and their potential to fulfil, now and in the future, relevant ecological, economic and social functions, at local, national, and global levels, and that does not cause damage to other ecosystems.”

The first set of indicators for measuring sustainable forest management in Europe was developed between 1993 and 1995 and was adopted for use in Lisbon in 1998. The set of indicators was revised in 2002–2003, at which point the number of indicators was reduced. The state of Europe’s forests has been evaluated four times on the basis of these indicators, in connection with Ministerial Conferences on the Protection of Forests in Europe (Lisbon 1998; Vienna 2003; Warsaw 2007; Oslo 2011).

Sustainability in Finnish forests is evaluated using the frame of Pan-European Criteria and Indicators. There are further national indicators in some areas, and some of the Pan-European indicators have been adapted to the national circumstances. Four evaluations of the state of Finland’s forests have been conducted using these indicators: in 1997, 2000, 2007 and 2011.

The **six Pan-European criteria** for sustainable forest management (FOREST EUROPE) are:

- Maintenance and appropriate enhancement of **forest resources** and their contribution to global carbon cycles,
- Maintenance of **forest ecosystem health and vitality**,
- Maintenance and encouragement of **productive functions of forests** (wood and non-wood),
- Maintenance, conservation and appropriate enhancement of **biological diversity** in forest ecosystems,
- Maintenance and appropriate enhancement of **protective functions in forest management**, and
- Maintenance of other **socio-economic** and **cultural functions** and conditions.

The **indicators of sustainable forest management measure the fulfilment of the criteria**; they are divided into three categories: 1) indicators for overall policies, 2) qualitative indicators, and 3) quantitative indicators.

There are **17 qualitative** Pan-European indicators (five for overall policies and 12 for the six criteria). Qualitative indicators also include the description of other aspects of forest management which cannot be evaluated or measured numerically.

**Overall policies and qualitative indicators** can be steering instruments, measures or agreements for the promotion of sustainable development. They are used to describe a specific phenomenon and its status. Qualitative indicators include:

- regulatory instruments, such as the Forest Act, Nature Conservation Act, Land Use and Building Act, Act on Reindeer Husbandry, etc.
- institutional arrangements, including monitoring of compliance with the law, forest policy measures and forest programmes, international agreements, organisations, etc.
- economic instruments, including funding and subsidies, forest taxation, etc.

- informational instruments, including systems for information gathering, training and consulting, guidelines, inter-organisational cooperation, etc.

**Quantitative indicators**, currently the number of quantitative indicators is 35, represent numerically measurable parameters or other statistical data or sets of information on forests and forestry. Examples of quantitative indicators that can be measured or evaluated numerically are the area of land under forest, the volume of stock and the number of employees. Often a certain aspect includes both a qualitative and a quantitative indicator.

Data for the indicators can be obtained from surveys, inventories, statistics, monitoring systems and reports. Threshold levels or standards may be defined for indicators.

Long-term time series and permanent field experiment plots are extremely important for the monitoring of changes in forests, and they built up the basis for several indicators.  
Photo: © Metla/Risto Sarvas



The participation of various stakeholders is needed by setting of the goals for the steering instruments such as for the National Forest Programme.



## Finland's national indicators for sustainable forest management

The list below presents qualitative and quantitative indicators grouped by six criteria. Qualitative indicators are marked with the letter B and a running number (B.1 to B.12). Quantitative indicators have running numbering under each criterion (from 1.1 to 6.11). The order of indicators in the Finnish set is slightly different from that in the Pan-European set, as shown by the indicator numbering.

The principles of sustainable forest management and use, as applied to Finland, are as follows:

### A. Overall policy, means of control and instruments for sustainable forest management in Finland

- A.1 National Forest Programme and other forest-related programmes
- A.2 Institutional frameworks: forestry organisations
- A.3 Legislation and jurisdiction framework, and international treaties and conventions
- A.4 Financial steering: funding instruments and economic policy
- A.5 Informational means

### Qualitative (B indicators) and quantitative indicators by criteria

#### Criterion 1 Forest resources

Preservation and increase of forest land B.1

Forest area (1.1)

Growing stock (1.2)

Age structure of forests (1.3)

Maintenance of carbon balance in forests B.2

Carbon stock on forest land (1.4)

Use of wood-based fuels (6.9)

Building with wood (additional indicator)

#### Criterion 2 Health and vitality

Maintenance of health and vitality of forests B.3

Deposition of air pollutants (2.1)

Chemical soil condition (2.2)

Defoliation (2.3)

Forest damage (2.4)

Potential impact of climate change (additional indicator)

#### Criterion 3 Productive functions

Safeguarding wood production B.4

Increment and drain (3.1)

Quantity and value of annual fellings (3.2)

Coverage of forest planning (3.5)

Safeguarding and increasing services and non-wood products B.5

Ecosystem services (additional indicator)

Non-wood products (3.3)

Services subject to charge (3.4)

Accessibility of recreation services (6.10)

#### Criterion 4 Biological diversity

Safeguarding and protecting biodiversity of forests B.6

Tree species composition (4.1)

Forest regeneration (4.2)

Natural forests (4.3)

Introduced tree species (4.4)

Deadwood (4.5)

Genetic resources (4.6)

Forest cover in landscapes (4.7)

Threatened forest species (4.8)

Protected forests (4.9)

#### Criterion 5 Protective forests

Maintenance and increasing of the protective functions of forests B.7

Timberline forests (5.1)

Protective forests – infrastructure and managed natural resources (5.2)

Impacts of forest management on waters (additional indicator)

#### Criterion 6 Socio-economic functions

Maintenance of the economic viability of forestry B.8

Forest holdings (6.1)

Contribution of forest sector to gross domestic product (6.2)

Operating profit in wood production in private forests (6.3)

Public commodities of forests (6.4)

Consumption of products of the forest industries (6.7)

Foreign trade in roundwood and forest industry products (6.8)

Improvement of employment and occupational safety in the forest sector B.9

Forest sector workforce (6.5)

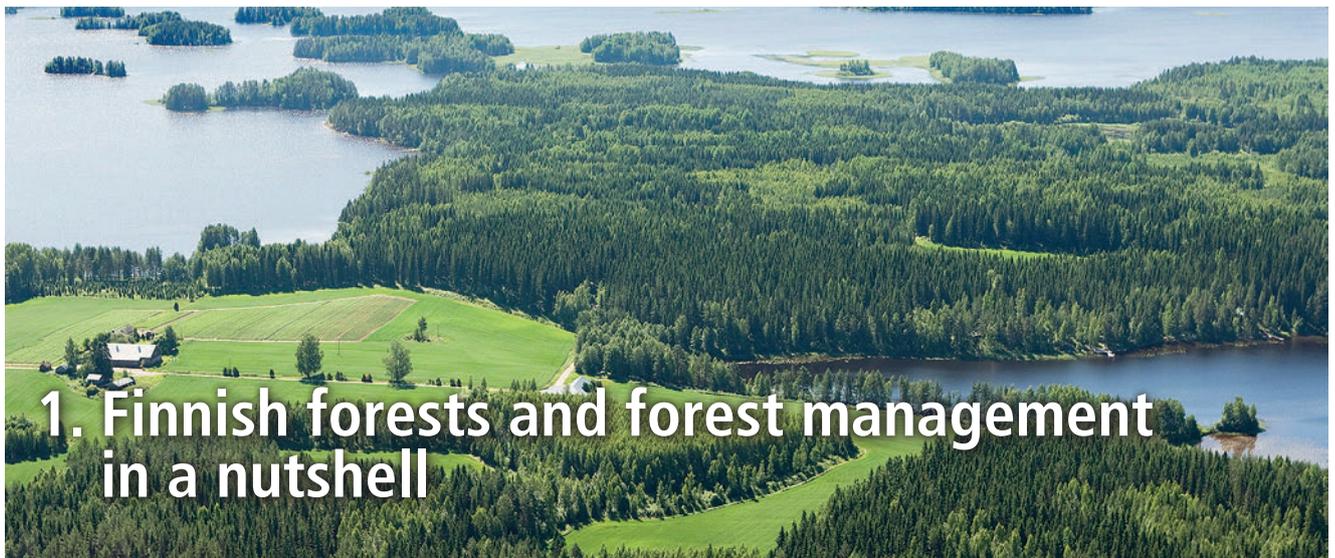
Occupational safety and health (6.6)

Safeguarding the opportunities of the public for participation B.10

Research, training and education in forestry B.11

Maintenance of cultural and spiritual values B.12

Cultural and spiritual values (6.11)



# 1. Finnish forests and forest management in a nutshell

Typical rural Finnish forest landscape with a private family farm consisting of agricultural and forest properties.

## The most extensive forest cover in Europe

Forests are part of the Finnish cultural heritage. The economic livelihood and material, cultural and spiritual progress of Finns has been dependent on forests for centuries. Manifold and biologically diverse forests constitute an important landscape element, an environment for recreation, and a habitat for flora and fauna.

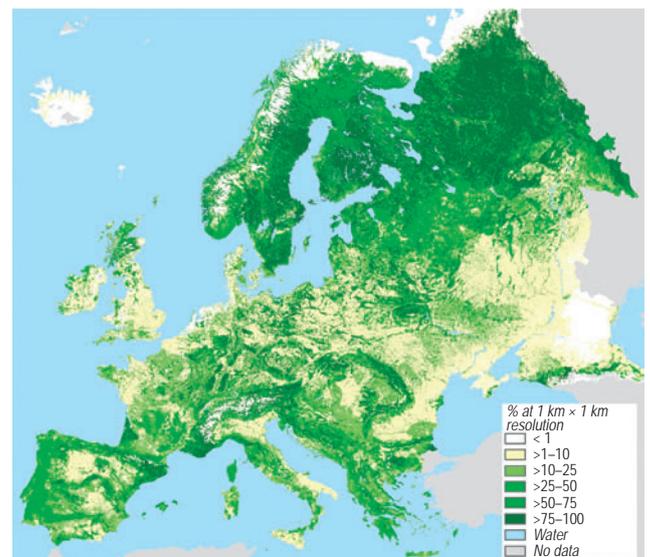
The forest cover in Finland is more extensive than in any other European country. Three fourths of the land area, some 23 million hectares (76%), is under forests. In addition, there are land areas under management where there are only few trees, such as open peatland and areas of exposed bedrock, over 3 million hectares altogether.

Because of Finland's northern location, forest management is practiced under exceptional climate conditions. Geographically, Finland lies in an intermediate zone between maritime and continental climates, belonging for the most part to the boreal vegetation zone.

Because of the warming effect of the Gulf Stream, however, the climate of Finland is in many respects more favourable than in areas at similar latitudes in Russia and Canada, for instance. Because Finland is over 1,100 kilometer long north to south, conditions for growth vary considerably between the southern and northern parts of the country. Towards the north, the climate gets increasingly colder and more humid, and precipitation exceeds evaporation. The growth period is about five months in the south and three months in the north. The average increment of growing stock in southern Finland, 6.1 cubic metres per hectare per year, is twice as much as in northern Finland.

The number of plant species in Finnish forests is low compared to the boreal zone in North America, for instance, or the temperate zone in central Europe. This is because of the high European mountain ranges running east-west, which prevented the return of plants to the north after the last Ice Age. There are only four coniferous tree species native to Finland, and fewer than 30 deciduous trees and arborescent shrubs. The majority of forests in Finland are predominantly coniferous, with broadleaves often growing in mixed stands.

The timberline in northern Lapland is a hemiboreal zone often several dozen kilometres wide. To the north of the timberline, the land is a mosaic of exposed ground, shrub and struggling

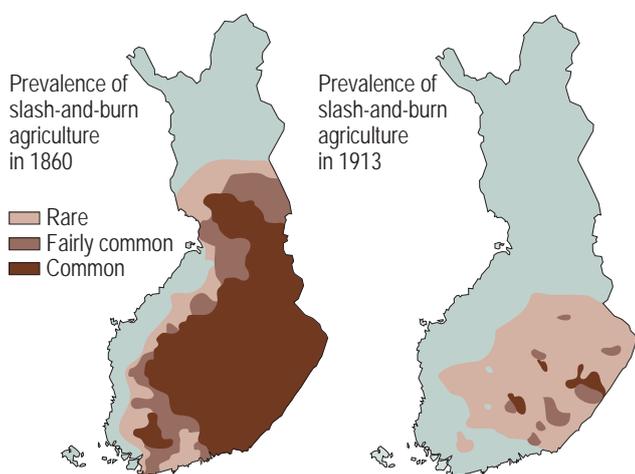


Forest cover in Europe, as percentage of land area. Source: Schuck, A., Van Brusselen, J., Päivinen, R., Häme, T., Kennedy, P. and Folving, S. 2002. Compilation of a calibrated European forest map derived from NOAA-AVHRR data. European Forest Institute. EFI Internal Report 13, 44 p. plus Annexes

trees or trees less than 2 metres tall. On the southern edge of the zone, the timberline is defined as the point where the height of individual trees exceeds 2 metres. To prevent the timberline from receding further south, an Act on Protective Forests was enacted as far back as 1922 to prevent unplanned use of forests and consequent shifting of the timberline. These provisions are now incorporated in the Forest Act.

## History of forest management

The history of human influence on Finland's forests is long and varied. People have lived in forests, using forests in many ways. Game, berries and mushrooms used to provide an important source of food. Here, the livelihood and cultural development of humans has been more dependent on forests than anywhere else in Europe: initially on hunting, slash-and-burn agriculture and tar burning, later on forestry and the forest industry, and



Areas in slash-and-burn agriculture in Finland in 1860 and 1913. Source: Heikinheimo 1915. Acta Forestalia Fennica 4.



Slash and burn agriculture on forested areas was practiced in Finland since 16th century until 1900's, which led to devastated areas nearby the small villages (photo: © Metla/Olli Heikinheimo, Heinävesi 1880). Rye cultivated after a slash and burn on the ash and humus mixture of boreal forest in Koli National Park, 1994).

more recently also on forest-based and wood-based bioeconomy and related businesses.

Hunting and the bartering of furs were the main livelihoods in this part of the world for thousands of years. Agriculture was first introduced in the form of slash-and-burn cultivation 4,000 years ago and developed into permanent agriculture 3,500 years ago. Along with the spread of slash-and-burn cultivation, human settlements spread to central and eastern Finland, especially from the 16th century onwards. In the 18th and 19th centuries, forests in Finland were also used for tar production, to meet the needs of the mining and shipbuilding industries, for home use and construction, and also for agriculture and grazing within the slash-and-burn culture.

Between 50% and 75% of the forests in southern Finland, depending on the area, had been subjected to slash-and-burn cultivation by the beginning of the 20th century. Since then, the greatest impact on the structure of forests has come from use of wood as raw material for the forest industry.

Owing to the various uses of forests, there are no completely untouched natural forests in Finland except for remnants of natural forests in certain protected areas in Lapland and eastern Finland. However, there are no intensively managed tree plantations either, because forest management in commercial forests makes use only of native tree species, and the development of mixed stands is actively promoted in management and harvesting.

## Private forest owners - family forests predominate

As in other countries in western Europe, forests in Finland are mainly owned by private people and families. In the principal growth area, southern and central Finland, about 3/4 of all for-



Forest land, growing stock, annual increment and commercial harvesting by forest ownership category.  
Source: Statistical Yearbook of Forestry 2009

Forest ownership category	Forest land area 2004–2008	Growing stock volume on forest and low productive forest land 2004–2008	Annual increment on forest and low productive forest land 2004–2008	Commercial roundwood removals 2000–2009
			%	
Private	60	64	73 <sup>1</sup>	83 <sup>1</sup>
State	26	21	27 <sup>2</sup>	9
Companies	9	9	..	8
Other (municipalities, parishes, associations and societies)	5	6	..	..

<sup>1</sup> private + other

<sup>2</sup> state + companies

ests are in private ownership, and in some areas in southern Finland the percentage can exceed 90%. State forests are for the most part situated in northern and eastern Finland.

Private forestry is in fact the linchpin of the Finnish forest economy, as the growing stock volume, annual increment and fellings in private forests each account for between 64% and 83% of the total. Private forests produce over 80% of the roundwood purchased annually by the forest industry in Finland.

Some 74% of private forests are family-owned. The average size of holdings is 30 hectares. There are 347,000 forest property entities of over two hectares. There are more forest owners than there are holdings, because spouses often have joint ownership of a holding. As estates and pools have an average of four partners, the number of people owning at least two hectares of forest is estimated to be about 739,000. In other words, one out of every eight Finns is a forest owner.

The fact that forests remain in the hands of families, passed on in inheritance from one generation to the next, is an indication of the predominance of rural habitation. With sweeping structural changes in society, however, the composition of forest owners is also changing, becoming urbanised. About 56% of forest owners live in sparsely populated areas and 44% in built-up areas, towns and cities. The number of forest owners is also growing, as holdings are split up in conjunction with the distribution of estates. Today, the largest single socio-economic group among private forest owners (about 45%) are pensioners.

## Forestry is long-term networking with multiple dimensions

Long-term sustainable wood production in private forests has been secured by forest legislation since 1886. The obligation to regenerate the forest after final fellings has been and remains to this day the basic principle of the law. This principle – which in practice amounts to an injunction against the destruction of



Old and young generation of the family thinking on the management of their own forest property.

forests – has remained in place, even though forest legislation has been revised to accommodate new needs of society.

Government actions, legislation, national and regional forest programmes as well as the actions of and cooperation among private forest owners have all supported the attainment of the goal of sustainability. The central government encourages forest owners to use good silvicultural practices in the management of their forests. Government support is available for safeguarding sustainable wood production, maintenance of forest biodiversity and improvement of the health of forests; recently it has also been made available for the harvesting of small-sized wood for bioenergy production.

Within the limits permitted by the law, forest owners make the decisions regarding all measures undertaken in their forests. Many forest owners or their family members engage in practical silvicultural work themselves, and some owners also harvest their own trees. However, the majority of fellings are carried out by wood procurement organisations on behalf of forest industry corporations under felling contracts (standing sales). The wood procurement organisations, in turn, purchase felling



The Nordic cut-to-length (CTL) felling system and machinery is suited also to the conditions of first thinning without causing damages to the remaining trees on the site.

and transportation services from forest machinery entrepreneurs and timber transportation companies, most of the latter being family enterprises.

The first associations of forest owners were established in Finland in the early 1900s to promote joint action. The forest management associations are organised regionally into unions of forest management associations. The basic function of the associations is to promote the profitability of forest management undertaken by private forest owners and the attainment of other goals they have set for their forests. The associations also pro-

vide advisory services and education for the forest owners. The operations of the forest management associations are financed by service fees and statutory forest management fees paid by the forest owners. Forest management fees account for 10% of the associations' income on average.

Thanks to long-term measures aiming at sustainable forest management, the annual increment of growing stock in Finland has over the last 40 years exceeded the drain by about one quarter, the fellings and wood use are smaller than the increment. In fact, the standing timber stock in Finland today is greater than it has ever been during Finland's independence, i.e. since 1917.

## Main lines of forest management in Finland's coniferous forest zone

The aim of forest management is multifunctional: to safeguard the production of high-quality roundwood, the biological diversity of forests and the potential for the multiple functions and services derived from forests. Because forest owners have widely differing needs and expectations, the range of forestry options has been broadened in recent years, and further development is ongoing.

The basic unit for forest management in Finland is the stand. Forest stands are classified according to their naturally occurring plant communities, based on a forest site type classification developed by botanist A.K. Cajander in the early 20th century. The



Natural regeneration of pine is most suitable in sites where the humus layer over mineral soils and surface vegetation does not prevent germination and later development of saplings.

surface vegetation at each individual site indicates the properties of the site and also the growth potential of trees. There are six main site types in southern Finland, and management and harvesting are directed according to their properties. The average size of managed stands in southern Finland is about 1.2 hectares, which is about the same as the average in Germany, Austria and France.

The big picture in landscape terms is fragmented and mosaic-like due to differences between individual stands in tree species composition, age structure and the timings of regeneration and management procedures. The principal silvicultural requirement is that forest regeneration after felling must be ensured. This is often difficult to achieve without soil preparation because natural forest fires are prevented; the special characteristics of the tree species, other flora and climate of the boreal zone lead to the formation of a layer of humus over mineral soil, inhibiting germination.

Stand-based forest management in Finland's boreal zone typically involves managing even-aged stands. Management is clearly divided into two phases, growth and regeneration. Depending on the tree species, geographical location and site characteristics, the recommended growth period varies from 50 to 120 years. At special sites, such as landscape areas and forest parks, cultural sites or forests dedicated for recreational use, uneven-aged management systems are also used. In uneven-aged management, different growth stages are concurrent, and stands are managed with single-tree selection.

In the growth phase, seedling stands are managed by cleaning and thinning. Young and advanced thinning stands are managed by intermediate fellings, which are carried out 1–3 times during the growth cycle of the stand. Each time, 25% to 30% of the then current growing stock in the stand is removed. The purpose of intermediate fellings is to direct the growth of the stand in favour of the best trees, to encourage their growth and thereby to produce harvesting income already prior to regeneration felling.

In the regeneration phase involving natural regeneration, seed or shelterwood trees are left standing to seed the site. Sometimes natural seeding may take place by trees on the forest edge surrounding the regeneration area, or several small regeneration clearings may be opened up by local felling in the stand. Artificial regeneration by seeding or planting is preceded by final felling that completely removes the growing stock. The success of regeneration is ensured by clearing the site and exposing mineral soil with mechanical soil preparation prior to regeneration, and ensuring that grasses will not endanger the early development of seedlings.

The goal is to create a fully productive stand with a suitable species composition in a reasonable period of time. The majority

of Finland's current forests have regenerated naturally; about 35% are planted or artificially seeded. However, even artificially regenerated stands have great numbers of naturally regenerated trees as well.

Biological diversity is promoted in fellings and other silvicultural measures by leaving dead, decayed and living retention trees in the forest and by managing valuable habitats in a way to preserve their natural characteristics. A mosaic-like variation in forest types at the landscape levels promotes biological diversity by creating habitats of different ages and at different stages of development.

Trees are for the most part harvested using the Nordic cut-to-length system (CTL): logs are debranched and cut to appropriate length on site, according to their use. Branches and crowns are left in the forest to maintain an even nutrient cycle. There is a new trend to harvest branches and crowns in spruce stand fellings and in thinnings of young pine stands and of broadleaved stands to be used as fuel. The CTL system of cutting is particularly suited to conditions in Finland, as the land is fairly level. Fellings are carried out all year round to ensure a steady flow of wood, but mostly in winter, when the ground is frozen and covered by snow to minimise any detrimental effects of felling on the soil and the trees left standing.

## Potential impact of climate change on forests

The mean annual temperature is projected to increase by 2 °C to 6 °C, and rainfall by 5% to 25%, by the year 2100 compared with the past 30-year period. It is also assumed that various extreme weather phenomena such as storms, hot dry spells in summer and heavy snowfall and rainfall will become more common.

Gradual change may be measured by when trees begin their growth phase in the spring. The opening of buds on coniferous trees and flowering now occurs 3 to 11 days earlier in Finland than it did at the beginning of the last century, 100 years ago.

However, the most serious immediate threats to forest development are extreme weather phenomena. Drought, forest fires, storms and snow damage may cause widespread tree destruction, preventing forest regeneration, in addition to which the resulting large amounts of deadwood may prompt a massive proliferation of forest pests in surrounding healthy forests.

Research and long-term experiments with the transfer of tree species provenances from the north to the south lead to the following conclusions regarding future impacts of climate change in the boreal zone:

- The growing season will lengthen, and forest growth may actually increase. This increase could be as much as 20%

to 50%, depending on the tree species. The increase will be greatest in the north and in mires.

- Wind damage will probably become more common, although due to Finland’s geographical location the impact of winds coming in from the Atlantic is not as pronounced as it is in southern Sweden, Denmark or central Europe. Wind damage may be widespread in Lapland, and local and occasional in southern Finland. The spruce is the tree most susceptible to wind damage.
- As the climate becomes warmer and local forest damage occurs, the risk of mass proliferation of pests such as the large European spruce bark beetle (*Ips typographus*). Insect pests are expected to migrate north from the temperate zone, possibly causing massive damage.
- In forests along the timberline, climate change may cause the timberline to shift up or north, thereby precipitating the gradual extinction of certain species.

Forest management according to experience-based best practices is the principal means for helping forests adapt to climate change. Managing seedling stands in a timely manner, carrying out first fellings and avoiding excess density in the growth phase help secure the vitality of forests, along with genetic resource protection and tree breeding. Most of Finland’s forests are under continuous management, which is why their productivity and vitality remain good.

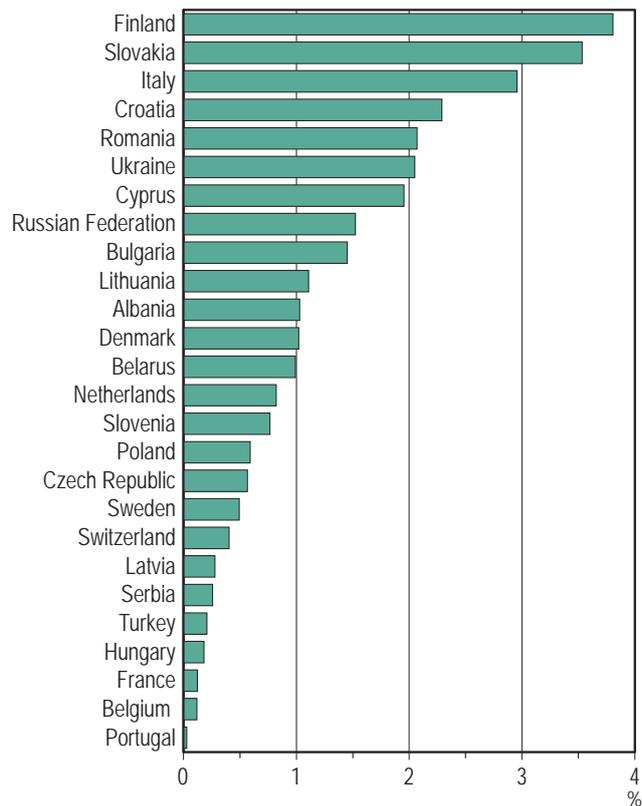
### Safeguarding and protecting forest biodiversity

The protection of most valuable forests and ensuring biological diversity in commercial forests are issues which have attracted special attention since the 1990s. Owing to many protection programmes and decisions, the area of protected forests has tripled in Finland over the past 35 years. The total area of protected forests is currently 2.2 million hectares, or 9.6% of all forest land. The total area of protected forests and forests under restricted use is almost 3 million hectares, or 13.0% of all forest land. The percentage of strictly protected forests in Finland is the largest in Europe.

Most of the protected areas are in northern Finland. The biological diversity and protection of the forests of southern Finland have been methodically addressed in conjunction with the National Forest Programme 2015 in the Forest Biodiversity Programme for Southern Finland (METSO) since the early 2000s. The programme involves developing voluntary forest conservation measures for privately owned forests. More sites safeguarding biological diversity will be set up in private forests, and conservation areas in State forests will be expanded. The goal is to increase the total of areas set for voluntary conservation

by landowners by 96,000 hectares by 2016. The METSO programme also incorporates restoration and management measures in already established conservation areas to enhance their biological diversity.

Biological diversity in commercial forests is promoted by means of forest legislation, recommendations and instructions for best practices in forest management, as well as conservation agreements and forest certification. The Nature Conservation Act lists nine protected habitat types, three of which are found in forests.



The share of strictly protected forests of all forest land (%) in certain European countries (MCPFE class 1.1).  
Source: State of Europe’s Forests 2011



Undisturbed forests located in strictly protected areas may contain often parcels with high amount of dead and decaying standing and laying wood material.

The Forest Act contains definitions of habitats of special importance (key biotopes) whose natural features must be conserved. According to surveys conducted by the Forestry Centres, at the beginning of 2010 key biotopes accounted for 95,000 hectares of forest land in private forests, 0.6% of the total.

Following recommendations, old broadleaved trees are left standing in the forest in fellings, and decayed trees or other trees that have special biological value are also retained. Following forest certification requirements, a certified site must have an average of 5–10 such trees per hectare. Certification also involves many other measures designed to increase biological diversity, such as increasing prescribed burnings and maintaining waterways.

About one half of the approximately 45,000 species known in Finland live in forests. The abundance of threatened species is monitored regularly, using the international IUCN criteria. According to the most recent survey (2010), there are 2,247 threatened plant and animal species in Finland, of which 36% are forest species. This percentage has changed very little since the previous survey, conducted ten years earlier. The most recent survey reveals that thanks to measures to promote biological diversity in forests, the decline of certain forest species has slowed down, although it has not been possible to halt the decline in the forest species overall. The situation has improved particularly for species that require retention trees and for fire-associated species.

Finland's first assessment of natural habitat types was conducted in 2008. The purpose of this assessment was to find out how habitat types had changed due to human action or other reasons over the past 50 years. Two thirds of the 76 forest habitat types were considered to be threatened on the basis of qualitative or quantitative changes. These endangered habitat types are typically small in size. The Nature Conservation Act and the Forest Act specifically list the habitat types and habitats identified as having special importance that must be left untouched in forest management.

The EU Natura 2000 network in Finland comprises 1,860 protected sites whose total area is about 5 million hectares, of which 3.6 million hectares, or three fourths, are land areas. The majority of the Natura 2000 areas, 97%, are nature conservation areas established under national decisions, or they are part of national conservation programmes or areas protected in some other way.

## Cultural and multiple use of forests

Forests are an important environment for recreation in Finland, especially as the population increasingly moves into population centres or towns. The most common forms of recreation



*Cucujus clavipes* (*Cucujus cinnaberinus*) is a famous and spectacular invertebrates, which is in Finland a critically endangered species, and protected by law and included in the Natura 2000 list. This species is depending on the old aspen trees. Photo: Erkki Oksanen/Metla, Juha Siitonen collection.

in forests are hiking, camping, picking berries and mushrooms, orienteering and cross-country skiing. Forests also provide a setting for relaxation, meditation and communing with nature. Forest owners have developed an interest in a new range of forest ecosystem services such as carbon sequestration potential, landscape values and safeguarding the peace of the natural environment.

Access to and recreational use of forests is free for all in Finland. 'Everyman's Rights' (rights of public access) guarantees everyone access to land owned by others to travel on foot, skis, bicycle or horseback, provided that they do not cause any damage. Other activities freely permitted on other people's land are temporary camping as well as picking wild, non-protected flowers, berries and mushrooms. The use of motor vehicles and making fire in forests, however, always require permission from the landowner. Everyman's Rights may not be exercised in such a way as to cause any disturbance or damage to the landowner.

The most important non-wood products which have economic value are game, berries, mushrooms and lichen. Game is of the greatest value in economic terms, particularly elk. Collecting fresh products of the forest is also an opportunity for hiking and enjoying nature. The volume of nature tourism has increased in recent years and is of great economic significance particularly in Lapland. On the national scale, however, the economic value of non-wood products and services is small compared to the income from the sale of wood products. Nevertheless, income from non-wood products and recreational services in forests may be substantial on a local scale and for individuals.

## Forest industry in Finland

The industrial use of forests for sawn timber and paper products began in the late 19th century. In 2010, forestry and the



Finns have a close relationship to nature. Nearly half a million Finns own leisure homes (10% of the population) with sauna, most of them in a forest and alongside waterways.

forest industry contributed about 4% of the GDP. Relative to its size, Finland is more dependent on forests and the forest industry than any other country in the world. As a consequence, Finland has accumulated an expertise in forestry and industrial manufacturing of forest products that is unique in Europe. For instance, the majority of Europe's paper industry engineers are trained in Finland, as are a considerable number of harvester drivers proficient in the Nordic CTL harvesting system.

The pressures of internationalisation, a reorientation of production in the pulp and paper industry and an extensive need for new investments triggered an intense process of change in the field of forest industry in the early 1980s. Through acquisitions and mergers, this led to the creation of huge international forest industry corporations, some of them among the largest in the world. The three largest corporations account for more than 90% of all production in the paper and pulp industry between them; two decades ago, the corresponding figure was about 35%.

The worldwide recession and the decline in the demand for paper products in industrialised countries have led to a cut of almost 20% in pulp and paper industry production capacity in Finland since 2008. At the same time, the gross value of the forest industry's output dropped to about EUR 16 billion. But whatever the economic situation, the forest sector is a key

player in promoting sustainable development in Finland. Indeed, the ongoing structural change in the forest industry focuses not only on improving existing products but also on developing new bioproducts and energy solutions based on forest resources and wood. In the wood product industry, the use of wood in construction in particular is expected to be a significant growth area, since wood is a low-energy, renewable construction material throughout its life cycle while providing long-term carbon sequestration.

Most of the products of the Finnish forest industries are exported. The most important market is the European Union. Exports there account for nearly 70% of the total exports of the sector. The major export countries are Germany, the UK, the USA, France and Spain.

A hundred years ago, forest industry products accounted for no less than 80% of Finland's total exports of goods; today, the figure is slightly about 20%. Products of the pulp and paper industries account for about three fourths of the exports of all products of the forest industry, while the percentage wood-products industries is about 25%.

Owing to new technology and advanced production processes, the forest industry's discharges into water and emissions into

air have been considerably reduced in the last 20 years, even though the volume of production has multiplied many times over during the same period. The emphasis on environmental factors has gradually shifted towards product life cycle issues, efficient use of natural resources, recycling and use of renewable energy. For instance, 70% of the paper used in Finland is recycled, which is a considerable achievement even in an international context, considering the low population density of the country: globally, the average recycling percentage for paper is 40% to 45%.

## Energy from wood

In addition to reducing greenhouse gas emissions, the use of wood for energy has the effect of increasing self-sufficiency in energy production, promoting good silvicultural practices and improving the employment situation. The use of wood-based fuels in Finland has been increasing since the 1990s and now accounts for 20% of Finland's total consumption of energy.

Finland aims to increase the percentage of renewable energy sources in energy consumption from the present 28% to 38% by 2020, as per the renewable energy requirements of the EU. This will mean a substantial increase in the use of wood-based fuels; the use of forest chips will have to be more than doubled from the present annual level of 6 million cubic metres to 13,5 million cubic metres.

Of the total consumption of energy by the forest industries, 75% comes from wood-based fuels. The majority of forest industry plants produce their own energy using bark, sawdust and chippings as well as logging residue from thinning and re-

generation fellings and waste liquors from industrial processes, which makes them energy self-sufficient. On the whole, however, the forest industry is a highly energy-intensive industrial sector: it consumes about one third of Finland's total electricity production.

Wood is also used increasingly in rural areas and population centres, especially for heating, either in individual heating systems for single homes or at district heating plants that convey heat to homes and other sites. The percentage of energy derived from wood is already quite high in some regions. In North Karelia Province, for instance, 70% of all energy consumed is wood-based. There has been a marked increase in recent years in research on the energy uses of wood for heating, electricity and biofuel production.

## Workforce in forestry and the forest industry

The importance of forestry and the forest industry as a source of employment continues to be an important factor in maintaining the vitality of rural areas and regional economies, although the number of jobs provided by the forest sector has diminished in the past few decades.

Forestry and the forest industry employ about 3% of all employed people in Finland, or 69,000 persons, three fourths of whom work for the forest industry. Forestry provides jobs for about 22,000 people, in addition to which a considerable part of silvicultural work in particular is done by private forest owners and their families. The forest sector continues to be male-dominated, women accounting for only about 20% of all employees.

Modern paper and pulp factories operate with integrated approach using industrial by-products (waste liquors and waste wood such as black liquor, bark, sawdust and process waste and recycled wood) for the production of heat and energy. Nowadays it is aimed also to produce biofuels and other products based on wooden fibre. The factories have also established the closed loop water recycling, where waste water used in production is thoroughly cleaned and reused.





Forest issues such as climate change and trade of wood are nowadays more global and need international discussions and commitments.

## National Forest Programmes and other forest-related programmes

Forest programmes have played an important role in Finland for more than 50 years both as an instrument of forest policy and in the provision of funding for forestry. The first actual forest programme was prepared in 1961, known by the initials of its authors as HKNL (Heikurainen-Kuusela-Linnamies-Nyysönen). It was followed by Teho programmes (1962 and 1964), the Mera programmes (1964, 1966, 1969), the Forest 2000 programme (1985) and the New Environmental Programme for Forestry in Finland (1994). Subsequently, National Forest Programmes have been drawn up.

The most recent forest programme is the **National Forest Programme (NFP) 2015**, which has been adopted by the Government. Because of rapidly progressing changes in the operating environment, NFP 2015 was revised and adopted for implementation by a Government Decision in December 2010. The purpose of NFP 2015 is to support the development of the forest sector into a pioneer in the bioeconomy field and to create an operating environment where livelihoods based on forests and wood are competitive and profitable yet where biological diversity and other environmental benefits are taken into account.

The new programme differs from its predecessors specifically in that it brings forest products and services considered to offer the greatest potential for success to the forest sector onto a par with the ensuring of sustainable forest management, i.e. ensuring basic production of forest resources. The National Forest Programme was prepared in extensively broad-based cooperation with interest groups and drawing on the operating strategies of those interest groups. The work was supported by the Forest Foresight project funded by the Ministry of Agriculture and Forestry.

Apart from the National Forest Programme, the **Forest Biodiversity Programme for Southern Finland 2008–2016 (METSO)** is also ongoing. The aim of the METSO programme is to consolidate the favourable trend in forest biodiversity by improving the maintenance of habitats and structural features of forests vital to the survival of threatened species. New areas and networks of areas that support forest biodiversity are being created, and the biodiversity of existing conservation areas is being improved. The principles of new protection methods are voluntary participation by forest owners, preservation of ownership and full compensation of economic losses. The current programme was preceded by a METSO pilot phase (2002–2007), the positive experiences from which motivated a continuation of the programme by a Government Decision in 2008.

**Regional Forest Programmes** are development plans for the forest sector in the districts of the Forest Centres. These are revised regularly in accordance with the policies outlined in the National Forest Programme. A Regional Forest Programme sets out the needs and aims for forest growth, management and use; forest-based business operations; and multiple use and protection of forests. It also sets out the measures and funding to attain the goals. They provide an overall view of the status and development needs of forests and forest management in the domain of each Forestry Centre. The programmes are prepared and reviewed by the Forestry Centres in cooperation with the forest owners and other interest groups in the region. These programmes were most recently revised in 2008, and the next revision will be completed in 2011.

The fixed-term **Strategic Programme for the Forest Sector (MSO 2009–2011)** set up by the Ministry of Employment and the Economy aims to launch and implement projects and initiatives to support strategic goals in the forest sector and to improve the profitability and competitiveness of the entire value

chain of the forest and wood sector. Some of the goals of these projects match and complement those in the National Forest Programme 2015.

The MSO focuses on improving the competitiveness of forestry and domestic production in the forest and wood product industries; developing entrepreneurship potential and business competence in the forest sector; improving the wood market; expanding the production of wood-based energy; the wood product industry and wood construction; and R&D and foresight projects. The programme includes projects such as the WoodFinland network project geared towards boosting the wood product industry and wood construction.

The following is a selective list of other national programmes and strategies related to forests and directly impacting forestry:

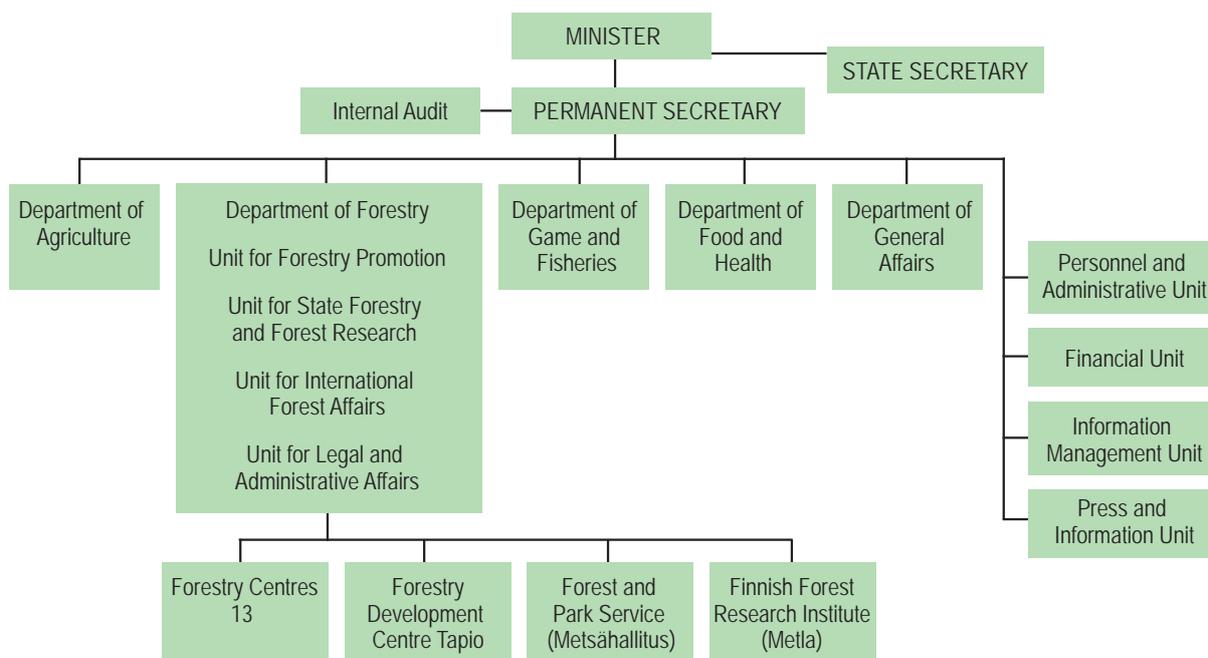
- **Finland’s National Strategy for Sustainable Development (2006)**
- **National strategy and action plan for conservation and sustainable use of biodiversity in Finland (2006–2016)**
- **National Climate and Energy Strategy (2008) and the related Foresight Report on Long-term Climate and Energy Policy (2009) and ‘renewable energy obligation package’ (2010)**
- **Finland’s National Strategy for Adaptation to Climate Change (2005, to be revised 2011)**

- **Natural Resource Strategy (2009), Sitra**
- **National Strategy on Invasive Alien Species (2011)**
- **National strategy for sustainable and responsible use and protection of mires and peatland (2011)**

## Forestry and environmental organisations in 2011

The supreme authority in forestry is the **Ministry of Agriculture and Forestry**, which sets policy on the sustainable use of renewable natural resources. The Ministry’s mandate is to create conditions for the sustainable and diversified use of renewable natural resources and to secure the quality of the commodities obtained from them. The Ministry participates in legislation and EU decision-making through the Government. The Department of Forestry in the Ministry is charged with directing and developing forest policy in Finland. The Forest and Park Service Metsähallitus, the Finnish Forest Research Institute (Metla), Forestry Development Centre Tapio and the regional Forestry Centres are all under the performance guidance of the Ministry. The Natural Heritage Services of Metsähallitus are also governed by the Ministry of the Environment.

The 13 **Forestry Centres and Forestry Development Centre Tapio** are responsible for promoting the sustainable management of forests, protecting their biological diversity and other activities within the forest sector. The Forestry Centres also



The organisation for the management and development of Finnish forests underlined to the Ministry of Agriculture and Forestry. Source: Ministry of Agriculture and Forestry, [www.mmm.fi](http://www.mmm.fi)

monitor compliance with forest legislation and carry out other administrative tasks.

Both the Forestry Centres and Forestry Development Centre Tapio will be reorganised as of the beginning of 2012. The present 13 Forestry Centres will be merged into a single National Forestry Centre, which will take over some of the duties of Forestry Development Centre Tapio too. The **National Forestry Centre** will have a public service unit and a business unit. Forestry Development Centre Tapio will be further reorganised in 2014 into a State-owned enterprise.

**Metsähallitus** manages, uses and protects the natural resources and other property on State lands and water areas (12 million hectares) under its administration. It is required to work efficiently and to follow the principle of sustainability. Metsähallitus is an unincorporated State enterprise that both engages in business activities and manages public administration tasks funded out of the central government budget. Preparation of a new operating model for Metsähallitus to convert it into a public law institution was begun at the beginning of 2011. The operating model will be developed to comply with modern competition policy: business functions will be undertaken transparently by subsidiaries. Metsähallitus is the responsible authority for managing the National Parks and other protected forest areas in Finland.

The **Finnish Forest Research Institute (Metla)** is a research and expert organisation that develops solutions for challenges and issues in forest use, products, services and immaterial values. As a sectoral research institution, Metla is required to carry out scientifically and socially effective work and to promote the competitiveness of forest-based businesses. Metla is also required to carry out official research services such as forest statistics.

Forests, forestry and wood use are studied besides Metla at several Finnish universities and research institutions, including the **Universities of Helsinki, Eastern Finland, Turku, Oulu, Rovaniemi** and **Jyväskylä, Aalto University**, the private R&D company **Metsäteho**, the **TTS (Work Efficiency Institute)**, the **European Forest Institute**, the **Finnish Environment Institute**, the **Finnish Game and Fisheries Research Institute**, and **VTT Technical Research Centre of Finland**. In all, there are 650 scientists involved in forest research in Finland, nearly half of them at the Finnish Forest Research Institute. The **forest industry companies** also have R&D functions of their own.

The function of the 105 **Forest Management Associations** in Finland (figure as of 1 January 2011) is to promote the profitability of forestry practised by forest owners and to support the attainment of objectives they set to their operations. The associations are funded and administered by the forest owners. The associations provide expert assistance in silviculture,

timber trade and forest planning. The Forest Management Associations are organised geographically into **Unions of Forest Management Associations** (8 unions as of 1 January 2011). The Unions in turn are members of the national interest group, the **Central Union of Agricultural Producers and Forest Owners (MTK)**.

The environmental administration promotes sustainable development, the sustainable use of natural resources, environmental protection, conservation of the diversity and vitality of nature, and the maintenance of the aesthetic and cultural values of the environment. It develops living environment and social structures and monitors the use and maintenance of water resources. The mandate of the **Ministry of the Environment** also covers tasks involving forests. These include the maintenance of biological diversity, prevention of environmental pollution and detrimental changes in the atmosphere, and management and funding of nature conservation areas.

The Ministry of the Environment has jurisdiction over the **Finnish Environment Institute (SYKE)**, which studies environmental phenomena and develops solutions to manage changes. The Ministry of the Environment also governs the Regional Centres for Economic Development, Transport and the Environment in matters within its domain. These Centres (13) are charged with implementing the functions of the environmental administration in their own districts, thereby promoting the improvement of the environment and the sustainable use of natural resources.

There are also a number of organised interest groups, professional associations and NGOs active in the field of forestry and forest industry.

## Legal framework and legislation

Since the first Forest Act of 1886, the basic principle of Finnish forest legislation has been the prevention of forest destruction. The most recent comprehensive reform of forest legislation was undertaken in the mid-1990s. This involved reforming practically all legislation on forests and nature conservation.

In the **Forest Act (1997)**, the requirement of safeguarding biological diversity in forests was raised alongside wood production as an important aim of forest management. The earlier Forest Improvement Act was revised and replaced with the **Act on the Financing of Sustainable Forestry**. In addition to traditional silvicultural works, it is today possible to receive government funding also for the maintenance of biological diversity and natural features, and for harvesting energy wood. As a result of the reformation of forest legislation, legislation concerning Metsähallitus, the Forestry Centres and the Forest Management Associations was also amended.



International commitments govern Finland's forest policy and forestry in many ways. Negotiations and meetings sometimes also include excursions to the forests.

Amendments have been enacted to the Forest Act in the 2000s pursuant to changes in the operating environment. Amendments to the Forest Act that came into force at the beginning of 2011 include additions and clarifications derived from the Finnish Constitution and pertaining to authorisation provisions concerning the legal protection of forest owners; also, some amendments to content and technical corrections were made with regard to forest regeneration. The Forest Act and Decree and the recommendations for forest management will be revised and clarified in 2011. Forest owners' aims and their decision-making power in the management of their own forests will be strengthened. Provisions governing the handling of forests contained in the Forest Act and Decree will also be simplified.

A new Act on the **Forest Information System** of the National Forestry Centre will enter into force at the beginning of 2012. The purpose of the Act is to improve the potential for leveraging forest information while allowing for the right-of-access principle and privacy protection. The Act will provide for the purpose of the information system, its information contents, use and disclosure of the information to third parties, and data retention and deletion.

Instruments affecting forest management also include **the Act on Trade in Forest Reproductive Materials, the Forest In-**

**sect and Fungi Damage Prevention Act, and the Act on Environmental Impact Assessment Procedure.** The Ministry of Agriculture and Forestry is revising the legislation on forest insect and fungi damage prevention during 2011. Such matters as zoning are governed by the **Land Use and Building Act.** The preparation of local plans and master plans involves coordinating different uses for forests at the regional and local levels. Water protection in the EU is harmonised by the **Water Framework Directive (2000).** The water policy provisions required by the Framework Directive are incorporated in Finnish legislation in the **Act on the Organisation of Water Management,** adopted in 2004, and three other acts concerning waterways.

Employment relations and occupational safety and health are covered extensively by legislation. Forestry is also covered by a special piece of legislation which applies to harvesting, among other things.

### International commitments to the promotion of sustainable forest management

Over the past 30 years, rapid internationalisation, the crucial importance of forests for the livelihood of people living in rural areas and for global environmental processes, and concern over



Discussions on climate change and bioenergy dominate present international and national forest policy discussions. The overwintering of trees may be influenced due to the changing climate in the boreal zone. A boreal forest in Autumn.

the disappearance of tropical forests have led to international negotiations and treaties on the environment and forests. These international commitments govern Finland's forest policy and forestry in important ways.

The **Framework Convention on Climate Change**, the **Convention on Biological Diversity (CBD)** and the **Convention to Combat Desertification** were concluded in 1992 at the **United Nations Conference on Environment and Development (UNCED)** in Rio de Janeiro, which also adopted principles for the management, use and sustainable development of forests, known as the '**Forest Principles**'.

Global discussion on forests has since then continued under the aegis of the **Inter governmental Panel on Forests (IPF)** and the **Inter governmental Forum on Forests (IFF)**, and from 2001 at the **United Nations Forum on Forests (UNFF)**. One of the aims of the talks has been to establish a binding worldwide forest convention. Agreement was reached at a meeting of the Forum on Forests in 2007 on a legally non-binding document applying to all the forests of the world. This document specifies four Global Objectives: reverse the loss of forest cover worldwide through sustainable forest management, and increase efforts to prevent forest degradation; enhance forest-based economic, social and environmental benefits; increase significantly the area of protected forests worldwide and other

areas of sustainably managed forests, as well as the proportion of forest products from sustainably managed forests; and reverse the decline in official development assistance for sustainable forest management. The intention is that these Objectives should be achieved by 2015.

The Convention on Biological Diversity (CBD) includes forest objectives in its 'programme of work on forest biological diversity', for instance regarding conservation, sustainable use, biodiversity indicators and ecosystem services of forests. At the latest **Conference of the Parties to the Convention on Biological Diversity** in Nagoya, Japan in 2010, a consensus was reached on shared goals for halting the depletion of the biological diversity of the natural environment by 2020. The genetic resources protocol (ABS) is intended to ensure availability of the world's genetic resources, specifying principles under which genetic material (genes and DNA) from plants, animals and microbes may be used in the process, pharmaceutical or cosmetics industries in such a way that the benefits are equitably distributed.

The international climate policy goal is to curb global warming so that the mean temperature may not rise by more than +2 °C from 20th-century levels. **Global conferences on climate change** have sought to establish a treaty binding upon all governments to reduce emissions, but so far no consensus has been established. At the latest conference in Cancún, Mexico,

in 2010, agreement was reached on a climate fund and on the necessity to limit global warming to two degrees, but no decisions were taken on concrete emission reductions or on post-Kyoto measures.

The **Kyoto Protocol (1997)**, which builds upon the UN Framework Convention on Climate Change (UNFCCC), commits industrial economies and economies in transition to reduce their collective emissions in 2008–2012 to 1990 levels. Individual states may implement emission reductions through their own actions, through cooperation with other governments, or through arrangements specifically designed for limiting emissions in industrialised countries.

The **Ministerial Conference on the Protection of Forests in Europe (MCPFE)** plays an important role in international cooperation on forests in Europe. At the initiative of France and Finland, the first conference was organised in Strasbourg in 1990. Since then there have been four conferences: in Helsinki (1993), Lisbon (1998), Vienna (2003) and Warsaw (2007). The sixth conference will be held in Oslo in summer 2011.

Resolutions adopted by the Ministerial Conferences have been used to call attention to important and topical issues in forest policy. Their main achievements have been to establish a consensus on the sustainable management and use of forests, to acknowledge the importance of national forest programmes to forest policy, and to develop indicators for monitoring the sustainability of forestry.

The Ministerial Conference in Oslo in summer 2011 is intended to begin preparations for a binding forest agreement for the purpose of ensuring sustainability in forestry in European countries. The Conference is also intended to outline a vision for European forests and to decide on short-term and long-term measures for attaining that vision.

The accession of Finland to the **European Union** in 1995 also entailed the incorporation of forest related regulations of the EU into national legislation. Although the EU does not have a similar uniform policy for forests as it has for agriculture, forest-related issues are incorporated in the functions of the various sectors of the EU, such as agriculture, rural development, the environment, trade, internal market, research, industry and energy, and development cooperation. In agricultural and environmental policy in particular, there are several regulations and directives which also have a direct or indirect effect on forestry and the forest industry.

An example of this is the Directive on Renewable Energy Sources (the RES Directive), whose requirement of using 20% renewable energy sources means a considerable increase in the use of forest bioenergy (heating, electricity and biofuels) for Finland. The Directive also contains several goals concerning sustainably pro-

duced forest biomass and the construction sector. The aim is to save energy and reduce emissions in materials production.

Forest matters are coordinated and organised through the **EU Forestry Strategy**. The Forest Strategy was adopted in 1998. On the basis of the Forest Strategy, a Forest Action Plan was prepared for forests in the EU. The Action Plan was adopted in 2006. Updating of the Forest Strategy will be begun in 2011. At the same time, there will be discussion at the EU level concerning the setting up of a uniform forest data gathering system to support the processing of forest issues.

The **EU Biodiversity Strategy for 2020** also includes aims concerning forests, such as the development of indicators to support the monitoring of forest biodiversity. Forest protection and biological diversity issues are also addressed by the **Natura 2000 directives**. The **FLEGT Action Plan (2003)** and the **Illegal Timber Regulation (2010)** are EU efforts to prevent illegal harvesting of timber in the EU and the importing of illegally harvested timber. Implementation of the Regulation will require amendments to the national legislation of EU Member States.

## Financial instruments

Financial instruments comprise subsidies for silvicultural and environmental works in the form of either government subsidies or loans, as well as tax policies.

Since silviculture is a sustained long-term process, many measures that are vital for the production of wood or the safeguarding of biodiversity have poor profitability from the viewpoint of private forest owners, and are therefore subsidised from government funds. The first **Forest Improvement Act** was adopted as far back as 1928. The latest change was in early 1997, when the Act on the Financing of Sustainable Forestry (KEMERA) entered into force.

Government subsidies (KEMERA support) are available for safeguarding sustainable wood production, maintenance of forest biodiversity and improvement of the health of forests.

An Act on **energy support for low-grade timber** was enacted towards the end of 2010. Energy support for low-grade timber is a subsidy that will be granted for harvesting energy wood from young forest management sites or first thinning sites. The purpose of the Act is to bring to market wood from sites where the profitability of harvesting is poor due to circumstances and the size of the trees.

The Forest Biodiversity Programme for Southern Finland (**METSO**, pilot stage 2003–2007) included many pilot projects to find economic incentives for increasing conservation projects undertaken by forest owners. New funding instruments concerning

natural values trading and establishment of cooperation networks were included in the Act on the Financing of Sustainable Forestry. The instruments are used as incentives for private forest owners to safeguard biological diversity in their forests.

In Finland, forest owners are **taxed on the basis of real income (revenue from wood sales) and expenses**. Taxation is an instrument with which the government can influence the profitability of forestry and the bringing to market of domestic wood. Partial tax exemption of income from the sales of timber was applied in 2008–2009 to secure supply for the forest industry as roundwood imports became complicated.

## Informational means

The Finnish Forest Research Institute, drawing on research findings, has set up official services for governing forestry, as required by the Ministry. These services include systems monitoring the state of Finland's forests and forestry, such as the **National Forest Inventory (VMI)**, **greenhouse gas reporting for forests**, **forest statistics** and **forest health monitoring**. The Finnish Environment Institute **monitors threatened species** and manages Finland's biological diversity information (Lumonet). Forestry Development Centre Tapio and the Forestry Centres perform regular evaluations of the **quality of nature values in the management of commercial forests** and compile statistics.

**Forestry education** is provided at the higher education level at the Universities of Helsinki and Eastern Finland and at the technical and vocational level at several institutes and colleges around the country. **Training for private forest owners** is provided by private forestry organisations, institutes and colleges of forestry, as well as various further training centres.

Forest Management Associations and Forestry Centres provide **advisory services for forest owners**. Advisory services may take the form of personal or group consultation, or consultation provided in conjunction with exhibitions, competitions or field trips. Group consultation services are also provided by institutes of forestry. Forest industry companies organise excursions and meetings for their forest owner customers.

There are several **journals** in Finland dealing with forestry. They publish information about forests primarily for interested parties, forest owners and forest professionals. Those with the widest circulation are Maaseudun Tulevaisuus and Metsälehti. One of the purposes of the **Finnish Forest Association** is to engage in active publicity concerning current forestry issues and to maintain a supply of basic information on Finland's forests and forestry. The Association has set up a general website (www.

forest.fi) and the campaign website 'Metsä puhuu' (The forest speaks) for the International Year of Forests 2011.

**Forest management plans for individual holdings** are an important instrument for systematic long-term forest management. A forest management plan is a report, based on on-site visits, on the forest resources of an individual holding and includes calculations for harvesting options and notes on forest management measures needed. Management plans for individual forest holdings are mostly prepared by the Forestry Centres and the Forest Management Associations. Metsähallitus, forest industry companies and other bodies that own large tracts of forest have drawn up corresponding plans for the forests administered or owned by them, plans that reflect their own needs.

**Forest certification** is a voluntary instrument for market actors. It serves as an adjunct to the implementation of sustainable forest management, ensuring the commitment by the actors to silvicultural instructions and standards. In forest certification, an independent third party grants a certificate (sustainable forestry certificate) vouching for the sustainable management and use of the forest holding in accordance with an agreed standard. The major international certification systems are the PEFC (Programme for the Endorsement of Forest Certification Schemes) and the FSC (Forest Stewardship Council).

Finland has its own national certification system, the FFCS (Finnish Forest Certification System), designed in the 1990s for family forestry. The system was accepted as part of the PEFC in 2000. Finland's PEFC forest certification standards have been updated twice since acceptance in 2000. Today, 95% (22 million hectares) of Finland's forests are certified under the PEFC system.

Finland's FSC certification standards were completed and approved by the international FSC in 2010. The number of forest holdings certified under the FSC system is expected to increase in Finland in the near future.

### 3. State of Finland's forests 2011 based on indicators



Typical mature mixed pine, spruce and birch forest stand in Southern-Finland.

#### Preservation and increase of forest land (B.1)

The use of forestry land is subject to a variety of widely different and simultaneous aims, needs and wishes. There is demand for forests to be available for wood production, recreation, nature protection, tourism and landscape management. These differing aims can be reconciled through the multiple-use principle, without having to segregate forest areas by function or purpose. Other simultaneous aims include the use of forestry land for the construction of housing or traffic routes, or as peripheral areas of settlement.

The percentages of different forms of land use have changed very little. The area of forestry land has decreased slightly owing to the construction of houses and roads and clearing of fields, whereas the afforestation of former agricultural land and areas which used to be utilised for peat production has increased the area available for forestry purposes.

#### *National programmes and legislation*

There are no legal restrictions concerning changes in land use in Finland. Forestry land may be converted to other use, and treeless areas may be afforested.

Land use is designed and controlled in Finland through the local planning process governed by the **Land Use and Building Act**. Regional land use plans and local master plans may have agricultural or forestry land areas marked with attributes indicating recreational use or environmental values as necessary.

The **Forest Act (1997)** requires that forest must remain forest even when harvested: after regeneration felling, a commercially viable stand must be created on the site within a reasonable time. The Act applies to all forests in commercial use. Compliance with the Act is monitored by the Forestry Centres. The main instrument for monitoring is the Forest Use Announcement, which must be completed prior to all fellings and contains information about the planned cuttings.

The Forest Act also contains provisions on protection zones where forests must be managed and utilised with special care to prevent the timberline from receding further south.

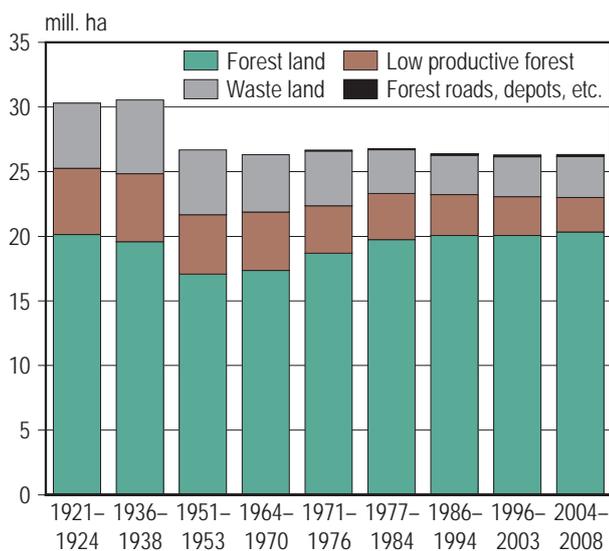
Under the **Act on the Financing of Sustainable Forestry**, private forest owners are eligible for a government subsidy. The Act promotes the increase and maintenance of the forest area, because funding is granted for the afforestation of previously treeless sites and sites where natural disasters have destroyed the growing stock.

#### Forest area<sup>2</sup> (1.1)

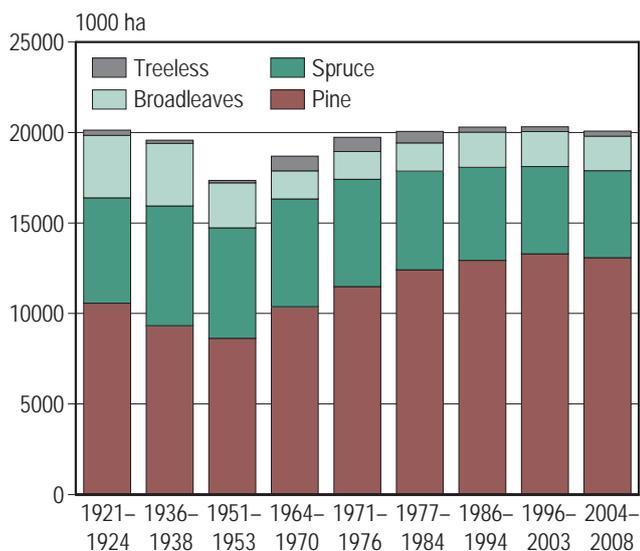
Forest area indicates changes in the land area covered by forests as well as in the percentage of forests compared to other types of land use.

<sup>2</sup> The long time series in the NFIs on the development of forest resources use the Finnish classification based on site productivity. The data on forest area in this report are therefore presented using this classification. The NFIs have employed the international classification parallel with the national classification scheme since the 9th inventory (1996–2003).

Three fourths of the land area of Finland, 22.8 million hectares, is covered by forests (forest land and low productive forest). In addition, there are 3 million hectares of treeless or sparsely stocked other land areas (open mires, rocky grounds, etc.) as well as 0.2 million hectares of other forestry land (forest roads, storage sites, etc.). In total, forestry land covers 86% of the land area of Finland. Nature conservation areas are included in this figure (Fig. 1.1a).



**Figure 1.1a.** Forest area, 1921–2008. Areas ceded to the Soviet Union in 1944. The classification of forest land and low productive forest land in 1921–1953 does not correspond fully with the current classification. Source: Finnish Forest Research Institute, National Forest Inventory



**Figure 1.1b.** Predominance of tree species on forest land, 1921–2008. Areas ceded to the Soviet Union in 1944. Source: Finnish Forest Research Institute, National Forest Inventory

After the Second World War, Finland ceded about 12% of its land area to the Soviet Union. Since then, there have been slight changes in forest area due to afforestation and clearing of agricultural land, drainage works, the construction of communities, and other land use measures. Some of the increase in forest area after the 1950s is due to changes in the classification of forest land.

In 2009, there were 18.1 million hectares of predominantly coniferous forest land (89%) and 1.9 million hectares of predominantly broadleaved forest land (10%). The remaining 1% consists of temporarily open areas in between regeneration fellings and subsequent reforestation.

As a result of a preference for pine in forest regeneration and drainage of pine dominated peatlands, the percentage of forests dominated by pine has increased. Correspondingly, the area of predominantly broadleaved forests has decreased. However, the total volume of broadleaved stock in Finnish forests has increased at the same time (Fig. 1.1b) as mixed stands have become more common.

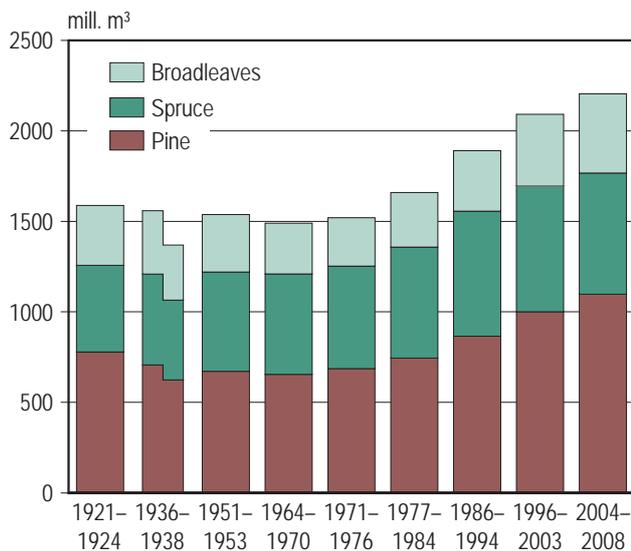
## Growing stock (1.2)

The volume of growing stock indicates the opportunities available for the use of wood and harvesting. The volume of growing stock is the basic input figure for several forestry planning calculations, as it is a close approximation of the total biomass in forests, forming the basis for instance for calculating carbon sequestration.

In 2009, the growing stock volume was 2,206 million solid cubic metres over bark (Fig. 1.2). The figure includes trees on low productive forest lands (64 million cubic metres) as well as trees on lands outside regular wood production<sup>3</sup> (183 million cubic metres).

The total volume of growing stock in Finnish forests has increased since the 1960s. This is due to the creation of new productive forest land by drainage and by afforestation of agricultural land, increased growth, a decrease in the number of low-yield stands, changes in the age structure of forests, and above all the fact that the increment has exceeded harvesting drain.

<sup>3</sup> In the NFIs, this category includes conservation areas based on the Nature Conservation Act and on other legislation, natural forests, recreation forests, park forests, recreational areas for short-range outdoor activities, training areas of the Defence Forces and other special areas where clear cuttings and other silvicultural measures are restricted.



**Figure 1.2.** Growing stock volume on forest and low productive forest land, 1921–2008. Areas ceded to the Soviet Union in 1944  
Source: Finnish Forest Research Institute, National Forest Inventory

### Age structure of forests (1.3)

The age structure of forests is an indication of the history of the development and use of forests, and of the structure of growing stock. The development of stand attributes is generally presented relative to stand age. Stand age is also an important factor in forest management planning. The aim in wood production is an age structure which maintains a high, even and sustainable yield. This aim can be attained with an even age structure, where the age of the oldest stands corresponds to the recommended rotation length. The recommended rotation length varies around

the country, being from 50 years to 150 years depending on the species and the site.

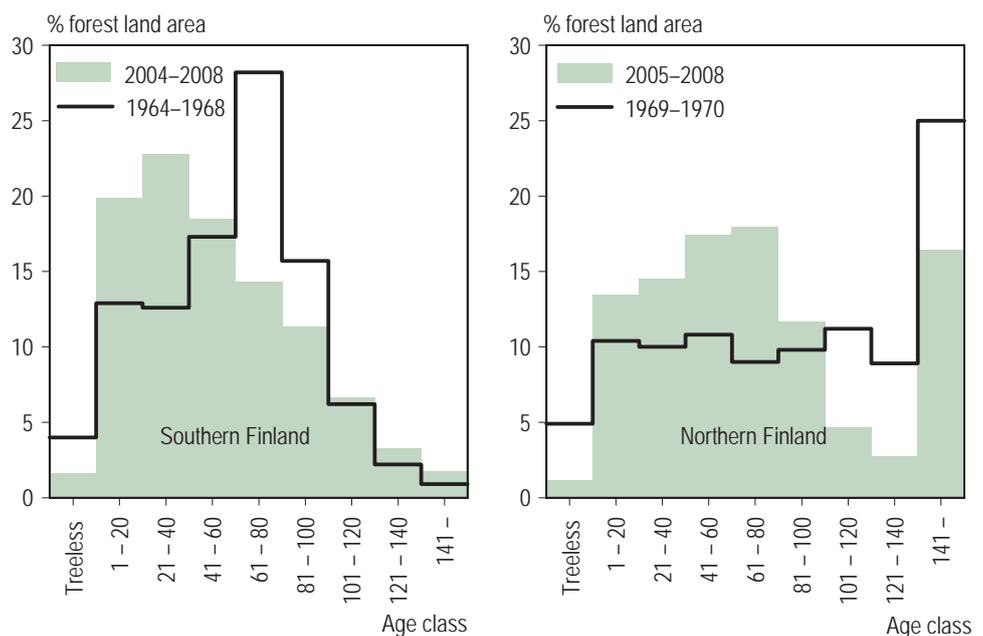
The age structure of Finnish forests is nowadays fairly even (Fig. 1.3). Looking at the situation by tree species, however, the age structure deviates from the recommended structure for wood production. Stands dominated by Scots pine or broadleaves are young, whereas those dominated by spruce are usually older. In recent years, spruce plantings have increased notably in relation to other tree species, and this will eventually be reflected in the relative age structure of tree species.

The age structure of forests has changed radically since the 1920s. The percentage of middle-aged forests has decreased especially in southern Finland, and that of old forests in northern Finland. Owing to large nature conservation areas in the north of Finland, however, there are a great many forests there that are over 140 years old. In the beginning of the 20th century, the effects of slash-and-burn agriculture and selection logging as well as the wide area of forests outside commercial management in Lapland were still clearly discernible. The current age structure is the result of the rise of forest industry and its increased need for raw materials, systematic silviculture and changes in harvesting methods.

### Maintenance of carbon balance in forests (B.2)

The concentrations of greenhouse gases in the atmosphere – carbon dioxide (CO<sub>2</sub>), methane (CH<sub>4</sub>), nitrous oxide (N<sub>2</sub>O) and halogenated hydrocarbons (F gases) – have increased over the last hundred years. Greenhouse gases prevent heat from radi-

**Figure 1.3.** Age structure of forests in the 1960s and the 2000s.  
Source: Finnish Forest Research Institute, National Forest Inventory





Small-sized timber from first thinning left alongside the forest road for delivering to bioenergy plants. A modern integrated bioenergy plant for the generation of heat (48 MW), industrial steam (10 MW) and electricity (21 MW) based on forest logging residues, the tree branches, crowns, stumps and small-sized trees (Kerava Energy Ltd., established 2009).

ating back into space, as a consequence of which they cause global warming.

The amount of carbon dioxide emitted into the atmosphere can be reduced by maintaining and increasing the area of forests and the volume of growing stock, by manufacturing long-lived wood products, and by ensuring the preservation of carbon stocks in the soil. The carbon pool increases when the annual increment of growing stock exceeds the drain, and more carbon is sequestered in trees than is released in harvests. In other words, forests function as a carbon sink.

However, the maintenance and increase of the capacity of the soil and trees to sequester carbon is only one factor in climate change. The main objectives in mitigating climate change are the reduction of greenhouse gas emissions and the substitution of non-renewable raw materials and energy sources with renewable biomass, such as wood based products and energy.

#### Policy instruments for the prevention of climate change

The **Kyoto Protocol (1997)**, which builds upon the UN Framework Convention on Climate Change (UNFCCC), commits industrial economies and economies in transition to reduce their collective emissions in 2008–2012 to 1990 levels. The greenhouse gas emission target specified for Finland under the EU-internal burden-sharing agreement is 71.0 million tons of carbon dioxide equivalent per year, a level that must be achieved by emission cuts between 2008 and 2012. Individual countries may implement emission reductions through their own actions, through cooperation with other governments, or through ar-

rangements specifically designed for limiting emissions in industrialised countries.

In 2008, the EU set itself the goal of increasing the percentage of renewable energy to 20% of end use of energy by 2020. For Finland, this translates into a requirement for substantial increases in the use of forest bioenergy (heating, electricity and biofuels), as Finland has committed to increase the percentage of renewable energy to 38% from the baseline level of 28.5% (2005).

Accordingly, the **National Climate and Energy Strategy** adopted by the Government in 2008 aims to reduce energy consumption and substantially increase the use of renewable energy sources<sup>4</sup> by 2020. These new goals were taken into account in revising the National Forest Programme 2015 (NFP). The aim now is to increase the use of forest chips per annum from about 7 million cubic metres at present (2010) to 13.5 million cubic metres in 2020.

To this end, the Government adopted a **renewable energy obligation package** in 2010. This specifies goals for various renewable energy sources and outlines instruments of financial control. Half of the increase in renewable energy that Finland needs to achieve by 2020 can be attained by increasing the use of forest chips. Three forms of support are proposed to increase

<sup>4</sup> Renewable energy sources are solar, wind and bioenergy, geothermal energy and energy from the motion of waves and tides. Bioenergy is energy from the combustion of biological fuels. Biofuels are made from biomass growing in forests, peatlands and fields, and from suitable organic waste produced by communities, agriculture and industry. Bioenergy accounts for 90% of all renewable energy sources.

the use of forest chips and other wood-based fuels for energy; energy support for low-grade timber for chipping; variable electricity production support; and feed-in tariffs for new, small combined heat and power (CHP) plants producing bioenergy. The proposed measures would translate into a reduction in carbon dioxide emissions of about 7 million tonnes per year.

**The use of wood in buildings and furniture** reduces fossil fuel emissions, as in these cases wood replaces other materials such as concrete that require more energy to produce and cause more emissions. Wood is a low-energy, renewable construction material throughout its life cycle while also providing long-term carbon sequestration. Of all common building materials, it requires the least energy to produce. One cubic metre of wood, when used to replace other building materials, reduces carbon dioxide emissions into the atmosphere by an average of 1.1 tonnes.

The international proliferation of wood building and the use of wood in construction is restricted by a lack of commonly accepted standards, instructions and certification criteria. An important precedent was set by France, the first EU Member State to pass a decree (2010) requiring the use of a certain percentage of wood in new construction. Building with wood has been promoted in Finland since the 1990s through a number of policy measures and action plans, and Government Programmes since the 1990s have systematically included goals on promoting building with wood.

The anticipated impact of climate change on forests is being researched in several studies, and contingency plans are in preparation to facilitate and evaluate forest adaptation. Contingency plans exist for instance to cope with storm damage. The **National Strategy on Invasive Alien Species** completed in 2010 sets out measures to control the spreading of harmful alien species to Finland.

**Finland's National Strategy for Adaptation to Climate Change** was completed in 2005. The Strategy describes the impacts of climate change on forestry, among other things, and outlines measures needed in forest management. On the basis of the Strategy, a research programme on adaptation to climate change was undertaken between 2006 and 2010. The Strategy will be revised during 2011.

#### Emissions trading

The EU emissions trading system, pursuant to the Emission Trading Directive (2003/87/EC), was launched at the beginning of 2005. The principle behind emissions trading is to reduce greenhouse gas emissions in locations where it is the most cost-effective to do so. The emissions trading system covers the carbon dioxide emissions of major industrial and energy produc-

tion facilities. In Finland, the system also includes district heating plants with an output of 20 MW or less.

Emission rights are allocated to operators either free of charge or by auction. One EU Allowance Unit in emission rights is equal to one tonne of carbon dioxide. Emission rights may be freely bought and sold anywhere in the EU. There are several stock exchanges in Europe that trade in emission rights, but there is also trade outside these stock exchanges.

The emissions trading system covers more than 40% of the greenhouse gas emissions of the entire EU, and about half of those of Finland. Finland's national Emissions Trading Authority is the Energy Marketing Authority. Emission rights have been allocated to 566 facilities for the period 2008 to 2012, amounting to 187.8 tonnes of carbon dioxide in total.

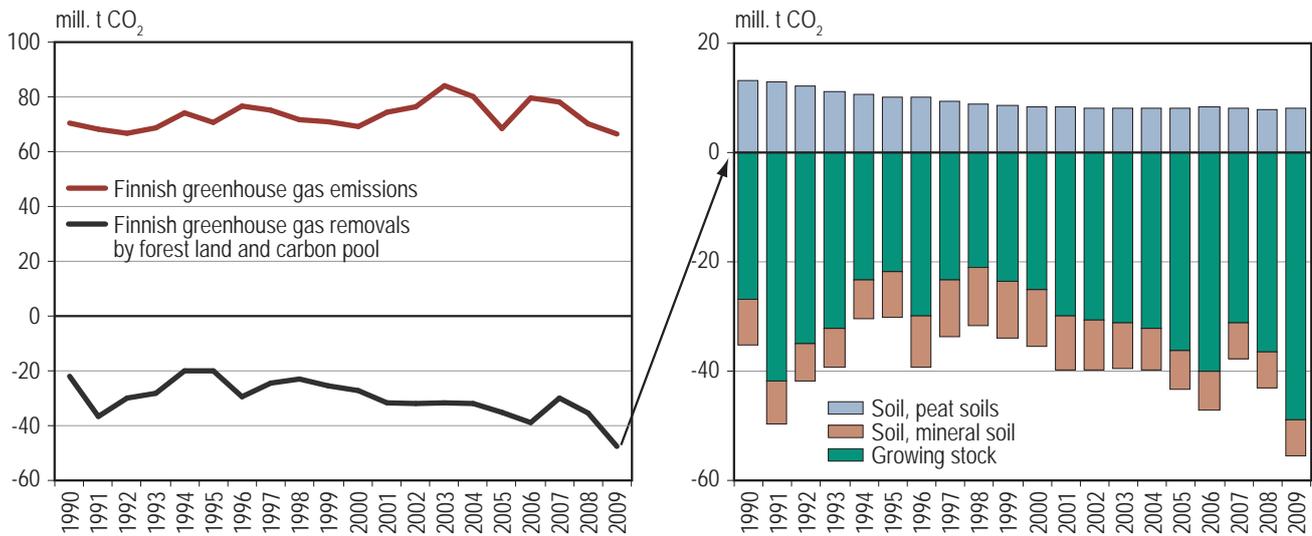
#### Reporting on greenhouse gas emissions

The parties to the United Nations Framework Convention on Climate Change (UNFCCC) are required to submit to the UNFCCC Secretariat a national **greenhouse gas inventory** each year, assessing and reporting on greenhouse gas emissions to and removals from the atmosphere due to human action. Forests come under the category of activities known as LULUCF, or 'land use, land use change and forestry'. This category constitutes a greenhouse gas sink in Finland: the volume of greenhouse gases sequestered is larger than that released. Greenhouse gases sequestered by LULUCF activities mainly consist of carbon dioxide removed by forests from the atmosphere.

The Finnish national inventory is prepared by Statistics Finland, which also participates in the preparation of the greenhouse gas inventory for the European Union. In addition to Statistics Finland, inventory calculations are made by the Finnish Forest Research Institute, the Finnish Environment Institute, VTT Technical Research Centre of Finland and MTT Agrifood Research Finland. The Finnish Forest Research Institute (Metla) calculates the carbon balance of wood biomass, i.e. the change in carbon dioxide sequestered in trees. Since 2005, changes in the volume of dead organic matter (deadwood, litter and soil) have also been reported, as well as the carbon sequestered by wood products. In addition to data on emissions by source and removals by sinks, the reports include accounts of the methods used in calculations and any changes made to them.

#### Informational means

Over the past five years, there has been an unusual upsurge in R&D in the field of forest bioenergy procurement, harvesting, use, and related new products and solutions. Forest bioenergy research is conducted at all major forestry research institutions and universities providing forestry education. In the region of North Karelia, considerable investments have been made in the



**Figure 1.4.** Carbon balance between emissions of fossil carbon dioxide and net changes in sequestration of carbon dioxide by forest land (left). Changes of carbon sequestration of forest land by share of wooden biomass, dead organic matter and soil organic matter (right), 1990–2009, Sources: Statistics Finland, Finnish Forest Research Institute

promotion of, advisory services for and research in the use of forest bioenergy; this is a strategic focus area at the University of Eastern Finland, and a network entitled WENET has been set up to connect partners, to transfer information and to provide a vehicle for advisory services in forest energy solutions.

Examples of Tekes-funded programmes currently in progress include BioRefine – New Biomass Products; Liito – Innovative Business Competence and Management; Groove – Growth from Renewables; ClimBus – Business Opportunities in Mitigating Climate Change; and Tuli – Creating Business from Research. Earlier programmes included Densy – Distributed Energy Systems; Harju – processing of thinning wood; Nemo – New energy and technologies; and the Wood Energy Technology Programme.

The Bio Research Programme of the Finnish Forest Research Institute (Metla) explores the potential of increasing energy use of biomass and its impact on the economy and operating potential of forest owners, the forest and energy industries and harvesting machine entrepreneurs. The programme also includes studying the properties of wood biomass as a raw material for biorefineries, taking the production requirements of energy and other products into account. The Finnish Forest Research Institute (Metla) is also involved in several international R&D projects as either coordinator or participant. These projects include for instance 'EUwood – Real potential for changes in growth and use of EU forests' and the Nordic FOREST POWER biomass project.

VTT Technical Research Centre of Finland is coordinating a project entitled 'Sustainability of biomass utilisation in a changing operational environment (SUBICHOE)'. The project includes

not only the Finnish Forest Research Institute (Metla) and VTT but also MTT Agrifood Research Finland, the Finnish Environment Institute and the State Institute for Economic Research. The project is funded by Tekes, the Ministry of Employment and the Economy, the Ministry of Agriculture and Forestry and the participating research institutions.

The three research areas of Forestcluster Ltd (intelligent production technologies that conserve resources; biorefineries that use wood in diverse ways; and future customer solutions) fall wholly or partly within the domain of forest bioenergy research.

On the research agenda of the Cluster for Energy and Environment, Cleen Ltd, 'Distributed energy systems' has a connection to forest bioenergy and related technological development.

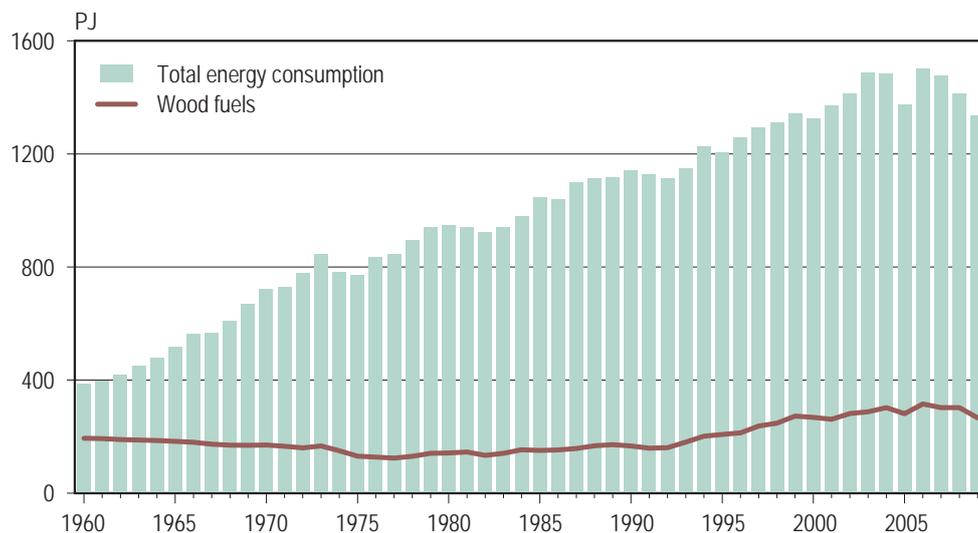
### Carbon stock on forest land (1.4)

The main greenhouse gas, carbon dioxide, is absorbed and stored (sequestered) into vegetation and the soil by forests.

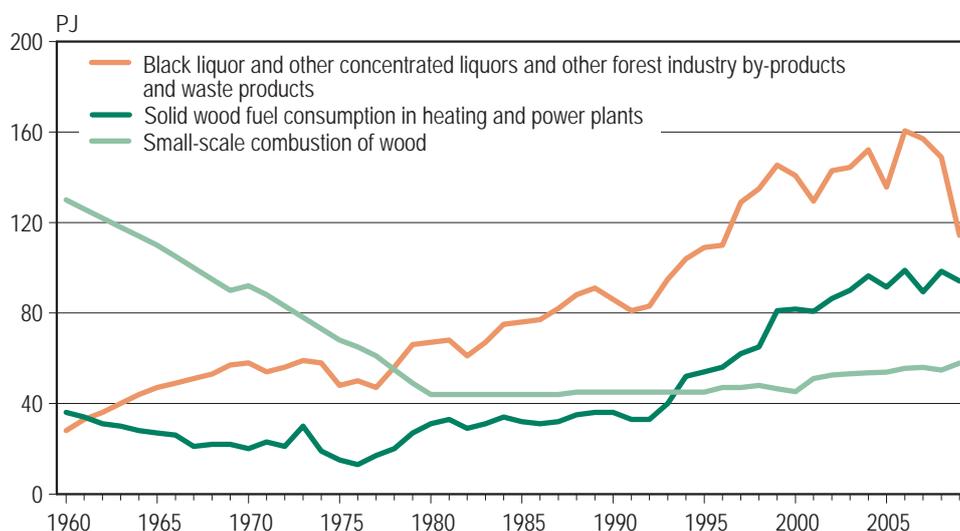
The amount of carbon sequestered in the soil in Finnish forests is currently estimated to be about 1,300 million tonnes in the mineral soil forests and about 5,500 million tonnes in the soil of peatlands. The amount of carbon sequestered in woody biomass is about 700 million tonnes.

The carbon stock in trees increases when the annual increment of growing stock exceeds the drain. The amount of the carbon stock in soil varies with changes in forest litter production, weather conditions and fellings. The carbon stocks seques-

**Figure 6.9a** Total energy consumption and consumption of wood-based fuels, 1970–2009.  
Source: Statistics Finland



**Figure 6.9b** Consumption of wood-based fuels, 1970–2009.  
Source: Statistics Finland



tered in forest vegetation and soil in Finland have increased; the forests have functioned as a carbon sink, even though part of their growth has been harvested for wood product production and for bioenergy.

In 2009, forests sequestered 47,2 million tonnes of carbon dioxide equivalent. Trees and mineral soil were sinks and peat soil a source of carbon dioxide (see Figure 1.4). The amount sequestered was 32% higher than in the previous year; the increase was due to a decrease in fellings. Finland's total emissions of greenhouse gases in 2009 were 66,3 million tonnes of carbon dioxide equivalent, of which land use, land use change and forestry (LULUCF) sequestered over 60%. LULUCF also includes the carbon dioxide sequestered on wood products. In all, Finland's emissions in 2009 were about 7% below the target level of the Kyoto Protocol.

### Use of wood-based fuels (6.9)

Carbon dioxide emissions and the threat of subsequent climate warming can be mitigated by replacing fossil fuels with renewable energy sources. In Finnish forest industry, waste liquors as well as bark, chips and sawdust provide a source of renewable energy. The same applies to logging residue, the branches and crowns of trees left in forests in regeneration fellings and thinnings. In addition to reducing greenhouse gas emissions, the use of wood for energy has the effect of increasing self-sufficiency in energy production, promoting good silvicultural practices and improving the employment situation.



The Metla House of the Finnish Forest Research Institute (Metla) built in Joensuu in 2004 is an outstanding timber construction reference building in Finland. About 2000 m<sup>2</sup> of wood were used to build the Metla House. This is equal, taking into account also the carbon emission savings by construction in compare to the similar concrete building, to a storage of 1900 tons of carbon for at least 200 years.

In 2009, wood-based fuels<sup>5</sup> accounted for 266 petajoule (PJ) of energy production in Finland, or 20% of Finland's total energy consumption. The use of wood-based fuels has increased in Finland since the 1990s. In 2009, however, the production of wood-based energy in the forest industry declined substantially due to a reduction in production capacity. Most forest industry installations are self-sufficient in terms of energy, as they can use all wood waste and waste liquors for energy production.

### Building with wood (additional indicator)

The choice of building materials and production methods has an impact on the sustainable use of natural resources, efficiency of energy use and thereby climate change. Globally, construction accounts for about half of all natural resources used and for about 40% of the waste generated.

<sup>5</sup> Wood-based fuels are waste liquors and other byproducts of the forest industry (tall oil and birch oil, soft soap, methanol, biosludge, paper), forest chips, industrial chips, sawdust, bark, recycled wood, pellets, briquettes and fuelwood. Most forest industry installations are self-sufficient in terms of energy as they can utilise all woody waste and waste liquors for energy production. The use of wood-based fuels has increased in Finland since the 1990s.

### Construction regulations

In Finland, construction is governed by the **Land Use and Building Act (132/1999)** and the **Land Use and Building Decree (895/1999)**. The Ministry of the Environment publishes the National Building Code of Finland based on this legislation and also coordinates regulations issued by other ministries and government authorities concerning construction.

These regulations address issues such as construction from the perspective of general safety and health, and energy economy. Current legislation provides in considerable detail for the construction stage and use of a building yet almost completely ignores the beginning and end of the life cycle, i.e. the procurement of building materials and the end use of construction waste. It would be feasible to draw up uniform standards for all building materials, covering their entire life cycle. Out of all raw materials for industrial construction, only wood is at the moment required to have transparent certification of origin, regardless of the fact that wood is the only renewable building raw material usable on an industrial scale, not to speak of the fact that it has a much smaller carbon and water footprint than any other industrial building material. The new standards will enhance the status of wood.

According to current practices, building regulations must be material-neutral; in other words, they must only specify properties required, not specific building materials. However, it has

also been proposed that requirements for specific building materials should be issued.

EU Member States are adopting a structural design scheme known as **Eurocode**, a set of harmonised technical regulations and dimensioning standards. Most EU Member States have not previously had such regulations for wood structures. The adoption of Eurocodes will make it considerably easier for instance to export Finnish construction products to the European market. By contrast, CE markings will become compulsory on construction products in 2013, and this will pose a challenge particularly for small and microenterprises in the wood product sector; there are more than 2,000 such enterprises in Finland. A CE marking indicates that the manufacturer has complied with the requirements of the relevant EU Directives and that the product has passed the required inspections.

Building design has been and will continue to be influenced to a great extent by notable upgrades to energy efficiency requirements and updated fire safety regulations. Adopting low-energy and passive construction requires considerable R&D investments in research and in the construction industry. It is commonly considered that fire safety regulations and their interpretation have been a disincentive to the use of wood, favouring concrete structures instead.

The revised fire safety regulations for Finnish building with wood were confirmed in spring 2011. These significantly improve the usability of wood as a building material, as they allow for high-rise buildings with wood frames and wood cladding up to eight storeys high.

#### Promoting building with wood

In Finland, wood accounts for about 40% of all building materials. Nearly 90% of detached houses and almost 100% of leisure homes have a wood frame, and usually wood cladding, too. In residential and office multi-storey buildings, however, concrete and steel are at least as dominant as wood is in smaller houses. Over the past 20 years, only some 500 homes have been built in blocks of flats built with wood. The fact that multi-storey buildings in wood are so rare has been attributed to a lack of cost-competitive construction solutions and shortcomings in legislation (e.g. fireproofing requirements).

Building with wood has been promoted since the 1990s through a **variety of policy programmes and action plans**, such as Wood Construction 2000, the Wood in Construction Technology Programme 1995–1998, the Year of Wood 1996, the Time of Wood 1997–2000, Wood Finland 1998–2005, the Programme for Promotion of Wood Construction 2004–2010, the Strategic Programme for the Forest Sector 2009–2011, the National Forest Programme 2015, and funding programmes such as the Rural Development Programme for Mainland Finland. Government

Programmes since the 1990s have systematically included goals on promoting building with wood.

**The Strategic Programme for the Forest Sector** (MSO 2009–2011) has had a major impact on the development of the wood product industry over the past two years. It was on the strength of this Programme that the reform of wood construction regulations, the Puuska programme to activate SMEs in the wood product sector and the relaunch of the WoodFinland programme were implemented.

Partly because of these measures and partly because of a general economic upturn, the use of wood in construction has increased, and production has more than doubled in financial terms over the past 20 years.

The Ministry of the Environment has studied public R&D investments in housing, construction and land use in Finland. The key findings were that investments were low considering the importance of the sector; resources were decreasing rather than increasing; and that the R&D field is fragmented, which breeds inefficiency and explains why there have not been many internationally competitive outcomes.

The most significant R&D actors in the wood construction sector are **Aalto University, the Universities of Helsinki, Eastern Finland and Oulu, and the Tampere University of Technology**. The major funding provider is Tekes, which supports the Puuska programme among others. The properties of wood, the use of wood and wood construction are studied at the Finnish Forest Research Institute, the Finnish Environment Institute, the Finnish Institute of Occupational Health and VTT. The Finnish Forest Research Institute (Metla) is currently running the PUU Research Programme, which involves for instance a multi-faceted study of ways to increase the use of wood and of solutions for building with wood.

Moreover, many universities of applied sciences and organisations in the sector contribute to the development of building with wood through degree theses and development projects. The most significant funding provider for research in the construction sector in Finland is Tekes, which spends some EUR 10 million per year in public-sector funding on construction research.



## Criterion 2 Health and vitality

The long-term monitoring of air quality and meteorological characteristics is crucial in a changing climate. Especially in the northern part of Finland this information is required to follow possible changes in forests near the timber line. A Global Atmosphere Watch (GAW)-monitoring site in Pallas (Sammaltunturi), Finland maintained by the Finnish Meteorological Institute and the Finnish Forest Research Institute (Metla). Photo: © Metla/Päivi Pietikäinen.

### Maintenance of health and vitality of forests (B.3)

Forest health is affected by several factors simultaneously. Forest health can decline due to abiotic agents such as atmospheric pollutants, exceptional weather conditions or careless harvesting or timber storage. Deteriorating health can also be due to biotic agents such as diseases caused by fungi and insects. Climate change is expected to increase the risk of local damages caused by snow, storms and insects.

International treaties for reducing atmospheric pollutants and for curbing climate change

Atmospheric pollutants present a global problem, because they are transported far and wide across borders and have a detrimental effect on many things, including the vitality of forests. The **Convention on Long-Range Transboundary Air Pollution (CLRTAP)** entered into force in 1983. It seeks to reduce the emissions of substances that have deleterious effects, such as sulphur, nitrogen, heavy metals, volatile organic compounds and persistent organic pollutants, or to restrict their use.

In 2002, the Finnish State adopted the Air Pollution Control Programme 2010 implementing EU Directive 2001/81/EC on national emission ceilings for certain atmospheric pollutants.

At the Earth Summit in **Kyoto in 1997**, an agreement was reached on the reduction of greenhouse gas emissions. Finland also participates in the work of the **Intergovernmental Panel on Climate Change (IPCC)**, the body of climate experts established in 1988. The **EU Climate and Energy Legislative Pack-**

**age** adopted by the European Parliament in December 2008 contains several legislative decisions pertaining particularly to reductions in emissions of greenhouse gases.

International climate policy has significantly helped the environment recover from acidification. However, climate change places additional demands on research and monitoring, as global warming will cause complex new trends in the natural environment and ecosystem balance.

Legislation, national programmes and other instruments for the protection of forests

**The Act on Protection of Plant Health (702/2003)** provides for measures aimed at maintaining a good state of plant health and preventing the use and spreading of herbicides. The Act applies to forests and forest trees too.

**The Forest Insect and Fungi Damage Prevention Act (1991)** restricts the storage of coniferous timber in forests and other permanent outdoor storage areas in the summer. It also stipulates that damaged coniferous trees must be removed from the forest whenever their amount exceeds a certain minimum, and it provides for the possibility to control damage caused by insects and fungi in conjunction with fellings and the tending of seedling stands. The Ministry of Agriculture and Forestry is revising the legislation on forest insect and fungi damage prevention during 2011. The Forest Insect and Fungi Damage Prevention Act working group appointed for this purpose is exploring issues such as how energy wood harvesting and the fact that insect swarming is occurring earlier in the spring because summers are now warmer will be taken into account in legislation.

The **Act on Trade in Forest Reproductive Material (2002)** applies to the production, sale, import and export of seedlings and seeds of forest tree species. The Act requires producers and marketers of forest reproductive material to give forest owners sufficient information on the origin and characteristics of such material.

The importance of using indigenous tree species in forest regeneration after harvesting is stressed in the **Forest Act**. Seeds and planting stock must be suitable for the intended site in terms of their species and origin, as well as viable and otherwise suited to the purpose. Under the **Act on the Financing of Sustainable Forestry**, funding can be granted for forest remedial fertilisation, afforestation of areas suffering from natural catastrophes, and for the control and prevention of root-rot fungus in risk areas.

Under **decisions of the EU Commission (2001–2009)**, efforts are made to prevent the spread of pine wood nematode (PWN) from Portugal and from outside the EU along with imports of coniferous wood products, sawn wood or coniferous packing material. Under the decision, all coniferous goods imported into the territory of the EU are inspected by the plant inspection authorities of the Member States. Finland has been granted a derogation concerning the inspection of coniferous wood coming from the European part of Russia. Coniferous wood coming from that area is inspected by taking samples from at least 3% of the goods.

The **National Plant Protection Strategy 2004–2013** includes an estimate of the current status of plant protection as well

as changes and development needs in the operating environment. The Strategy provides the basis for the setting of protection goals for forest trees as well as determining actions for their attainment.

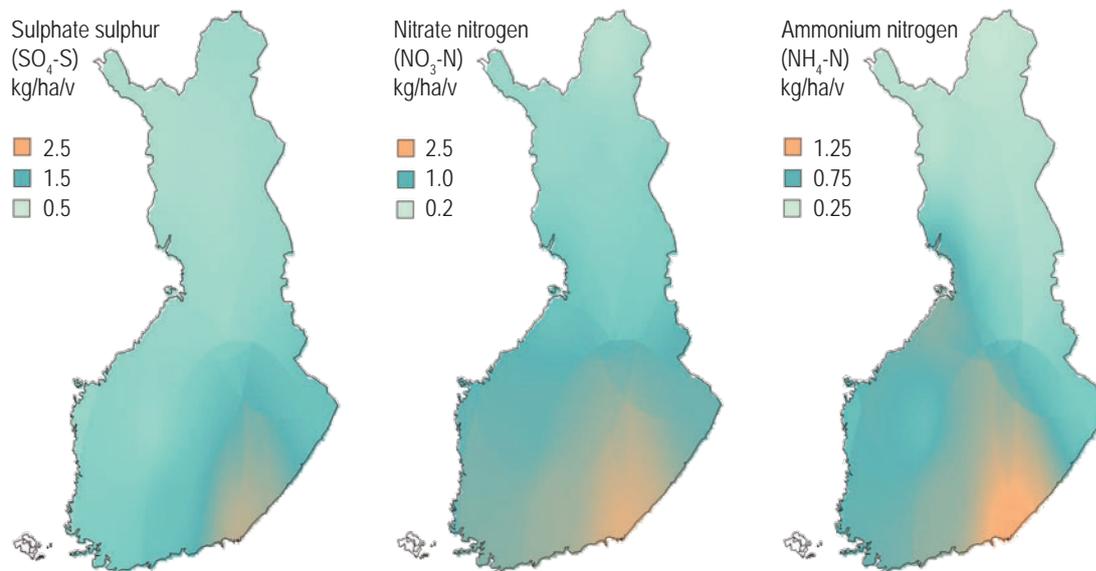
The moose population is regulated regionally under a system of hunting permits. Under **the Hunting Act**, moose populations must be kept at a level where the damages caused by the animals to traffic, agriculture and forestry remain moderate. The income from game management and hunting permits is used by the Ministry of Agriculture and Forestry to compensate damages to traffic, agriculture and forestry.

#### Monitoring systems

The Finnish Meteorological Institute has 14 stations that monitor long-term changes in air quality, and the Finnish Environment Institute has 29 stations for observing the quality of precipitation and depositions. Since 1985, Finland has participated in the International Co-operative Programme on Assessment and Monitoring of Air Pollution Effects on Forests (ICP Forests). In the EU countries, monitoring is based on EU regulations (Forest Focus programme). In 2007, Forest Focus was converted into a monitoring programme (FutMon), which in addition to forest health also monitors biodiversity indicators and is eligible for Life+ funding. Continuation of the monitoring is being explored. The EU Standing Forestry Committee set up a working group in 2011 to find out what forest-related information it would be feasible to compile for the needs of the EU and how information collecting and reporting could be harmonised. The Finnish Forest Research Institute (Metla) conducts annual inventories of



Crown defoliation indicates reduced tree vitality. From the left to the right degree of defoliation (the loss of needles): no defoliation 0-10%, slight 10-25%, moderate 25-60%, and severe >60-99%.



**Figure 2.1** Total deposition of sulphate sulphur and nitrogen (nitrate nitrogen and ammonium nitrogen) in 2009.  
Source: Finnish Environment Institute

the health of individual trees in about 850 permanent sample plots following internationally agreed methods. The effects on forest health of atmospheric pollutants as well as other stressors are studied in detail in 18 stands across Finland.

Forest health is also monitored continuously in the National Forest Inventories. The Finnish Forest Research Institute (Metla) prepares annual forecasts on changes in the populations of certain insect pests and voles, and provides expert assistance in matters involving forest damage.

## Deposition of air pollutants (2.1)

Atmospheric pollutants impair the vitality of forests by affecting trees and other organisms both directly and indirectly, as well as through soil. Trees suffering from pollutants are also susceptible to damage from extreme weather conditions and to destruction.

Gases resulting from the combustion of fossil fuels contain sulphur and nitrogen oxides which react chemically in the atmosphere and fall to the earth as acid deposition. Thanks to international efforts in reducing emissions, sulphur deposition began to decrease conspicuously in the late 1980s and has continued to do so, being now 40% to 60% of what it was at its peak. Nitrogen deposition has also decreased, but not as much as sulphur.

A considerable part of acid deposition comes with long-range pollution transport. Around 2000, 71% of nitrogen deposition and 83% of sulphur deposition measured in Finland originated abroad.

There is as yet no information on the long-term cumulative effects of acid deposition on soils, and the capacity of forest soils to neutralise acid is not completely known.

The decrease in sulphur deposition is the result of reductions of emissions from energy production, reduced use of industrial fuel oil, the introduction of new alternative energy sources, and improvements in the production methods of pulp and paper plants and metal and chemical industries.

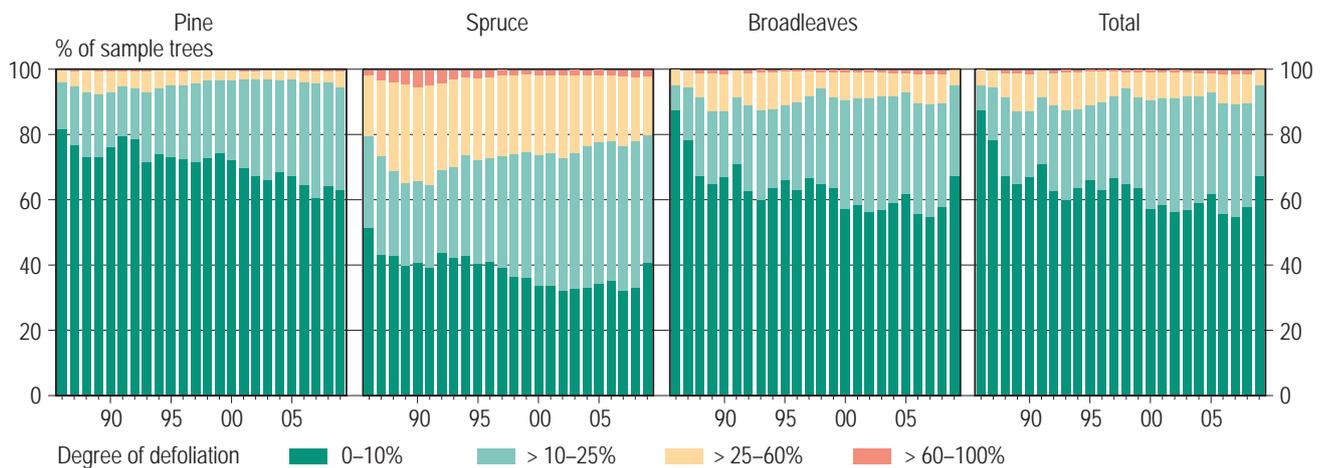
## Chemical soil condition (2.2)

Changes in the chemical composition of the soil, such as acidification<sup>6</sup> and eutrophication<sup>7</sup>, affect trees either directly or indirectly, through the process of decomposition of organic matter by organisms in the soil.

The soil in coniferous forests is acid by nature. The most favourable pH range for conifers is 4.7–5.5. If the soil is any more acid, the rate of growth of trees slows down as their nutrient uptake becomes more difficult. When soil pH falls below 4, the leaching of nutrients vital to trees increases. On the other hand, acidity changes contribute to the leaching of substances toxic to tree roots such as aluminium.

<sup>6</sup> Acidification = In acidification, the capacity of the soil to resist, or neutralise, acid deposition deteriorates. Acidifying compounds can be deposited in the soil with rain (wet deposition) or as particles or gases (dry deposition).

<sup>7</sup> Eutrophication = Eutrophication means the increase of primary productivity caused by increased amounts of nutrients. In a soil ecosystem, eutrophication can manifest as increased growth of standing stock, for example. Increased growth is caused especially by nitrogen deposition, but increased concentrations of CO<sub>2</sub> in the atmosphere also increase the growth of trees.



**Figure 2.3** Defoliation frequency distribution for pine, spruce and broadleaves in mineral-soil sites, 1986–2008 (from 2004 the figures also include reference trees on peatland) Source: Finnish Forest Research Institute, annual monitoring of forest vitality

The decomposition of organic matter also slows down in acid soils, reducing the nitrogen supply of plants. Increased soil acidity destroys many easily decomposing plants which produce nitrogen-rich litter in the forest. However, acidification reduces the productivity of forest land only very slowly.

The eutrophication of forests is not a problem for the health of trees and vegetation in the short term. If eutrophication is widespread and prolonged, the biological diversity and species composition of forests change as a result of a reduction in the area of nutrient poor sites and their species.

The deposition of acidifying and eutrophying compounds has been monitored since 1996 on sample sites for intensive monitoring under the Forest Focus programme. No changes in the concentrations of sulphur or nitrogen in soil water have been observed during the monitoring period. In other studies conducted by the Finnish Forest Research Institute, only weak signs of acidification in forest soils have been observed. The decrease of sulphur concentrations in the organic layer of soils is linked to the decrease in sulphur deposition that started in the 1980s. The stability of nitrogen concentrations in the soil or their decrease over the monitoring period implies that the current nitrogen deposition will not constitute a health risk for forests in southern Finland in the near future.

### Defoliation (2.3)

Defoliation<sup>8</sup> is an indicator of the general condition of trees. A decrease in the biomass of photosynthesising needles or leaves affects the vital functions of trees and reduces their growth.

<sup>8</sup> Defoliation, the loss of needles or leaves, is an indicator of vitality. The degree of defoliation is classified as slight when it is 10–25%, moderate >25–60%, severe >60–99%, and dead 100%.

Defoliation is assessed visually. In mineral soil in 2009, 6% of pine, 20% of spruce and 5% of broadleaves were classified as damaged.<sup>9</sup> Forest defoliation is considerably less severe in Finland than it is in most other European countries.

The proportion of undefoliated pines (defoliation less than 10%) decreased and the proportion of slightly defoliated pines (10–25%) grew slightly during the monitoring period 1986–2009. However, the proportion of damaged trees in all tree species had remained nearly unchanged over the past few years.

In Finland, defoliation is primarily caused by ageing, unfavourable weather and climate conditions and damage due to fungi and insects. In the vicinity of local emission sources, in built-up areas and along roads, defoliation is also caused by atmospheric pollutants.

### Forest damage (2.4)

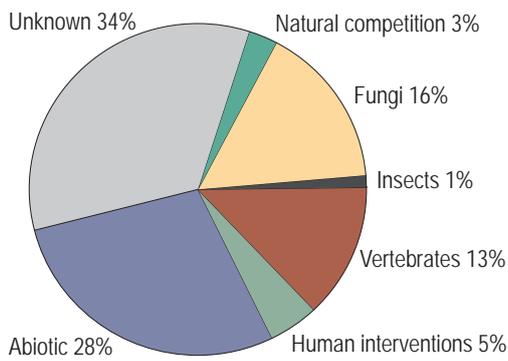
Forest damage can be caused by various abiotic<sup>10</sup> and biotic<sup>11</sup> agents. Damage caused by diseases or other damaging agents to individual trees is normal in forests, but if biotic agents succeed in spreading over large areas, forest damage is considered to have occurred. The prevalence of damaging agents and the resultant damages vary depending on pest populations and weather conditions.

No extensive forest damage has occurred in Finland in the last few decades. This is partly due to the strict legislation on insect

<sup>9</sup> A tree is classified as damaged when defoliation is greater than 25%.

<sup>10</sup> Abiotic agents are wind, snow, sub-zero temperatures, other climate and weather conditions, forest fires, soil-related factors, logging, atmospheric pollutants, and other human activities.

<sup>11</sup> Biotic agents are fungi, insects and vertebrates.



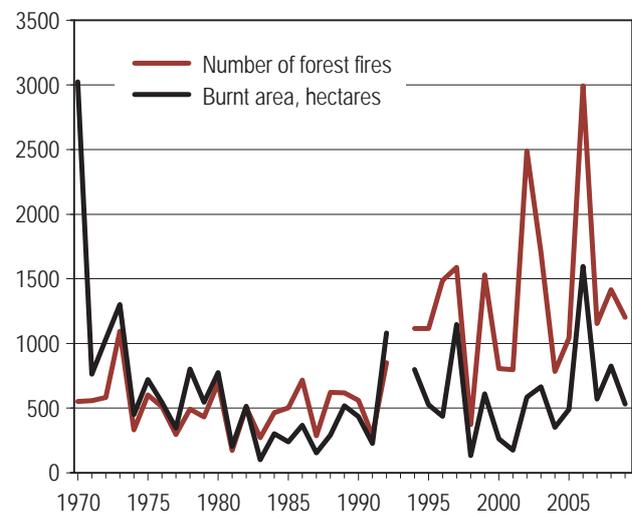
**Figure 2.4a.** Occurrence of damaging agents reducing stand quality in timber production, 2008.  
Source: Finnish Forest Research Institute, National Forest Inventory

and fungi damage prevention, restricting the storage of timber in the summer. Between 2004 and 2008, damages requiring immediate regeneration occurred over a total of 38,000 hectares. Lesser damages occurred in larger areas. Damages necessitating regeneration were caused above all by snow, wind and moose, as well as *Scleroderris* canker and resin-top disease. Most of the causal agents remain unidentified, however.

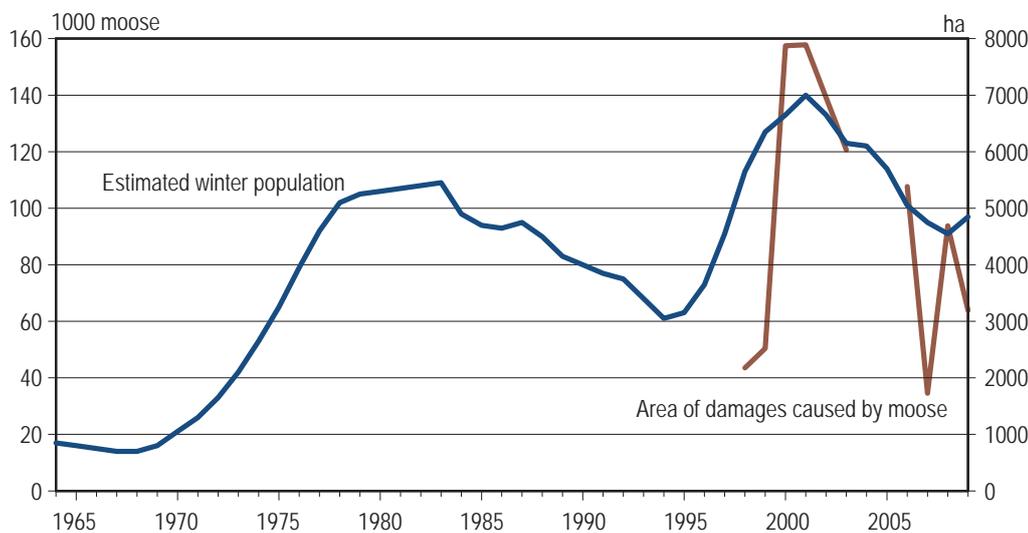
Continuous damage is caused in southern and central Finland by *Annosus* root-rot, which primarily attacks conifers. The increased moose population causes damage to seedling stands of pine and birch in particular, but also of spruce. There are also local epidemics of *Scleroderris* canker, pine sawfly, autumnal moth and voles. Wind and snow can also cause significant damages locally.



Root-rot (*Heterobasidion parviporum*) is the most destructive fungus of conifers in southern Finland. In worse cases the whole forest stand has to be harvested and the tree species change is necessary.



**Figure 2.4b.** Forest fires 1970–2009.  
Source: Ministry of the Interior, Department for Rescue Services, Pronto database



**Figure 2.4c.** Moose winter population and area of damages caused by moose, 1964–2009.  
Source: Finnish Game and Fisheries Research Institute

Moose (*Alces alces*) is an important game species in Finland, but it also causes serious damages to seedling stands. Moose populations are therefore regulated systematically.



In summer 2010, an exceptionally long spell of warm weather in southern Finland led to violent storms proceeding along two or three narrow corridors, damaging and felling trees with a volume of about 8 million cubic metres. This was the most extensive storm damage seen in Finland in decades. In 2001, the storms named Pyry and Janika felled 7.3 million cubic metres of wood in South Ostrobothnia and Häme. Hundreds of small forest fires occur in Finland every summer, but thanks to efficient monitoring, a dense network of forest roads and a smoothly functioning fire-fighting system, fire damage remains slight.

### Potential impact of climate change on forests (additional indicator)

The mean annual temperature in Finland is projected to increase by 2 °C to 6 °C by the year 2100 compared with the past 30-year period. The temperature rise is estimated to be greatest in the winter (3 °C to 9 °C) and slightest in the summer (1 °C to 5 °C). The region with the greatest variation is expected to be northeastern Finland.

Rainfall is also projected to increase by 5% to 25% compared with the past 30-year period. It is also assumed that various extreme weather phenomena such as storms, hot dry spells in summer and heavy snowfall and rainfall will become more common.

Climate change will have two kinds of effect on forests. If the climate gradually becomes warmer or dryer, for instance, trees will have to adapt to it. The progress of such adaptation and measures contributing to it can be planned, to a certain extent. Adaptation of trees may be jeopardised in northern areas because their growing rhythm will change as the growing season lengthens, and they may not be able to cope with the shorter period of rest (winter).

Gradual change is indicated by changes over the past century in the time when tree growth begins in the spring each year. The opening of buds on coniferous trees and flowering now happens 3 to 11 days earlier in Finland than at the beginning of the last century. Similarly, it has been observed that bilberry and cowberry flowering in Finnish forests now begins up to 7 days earlier than just 15 years ago.

However, the most serious immediate threats to forest development are extreme weather phenomena. Drought, forest fires, storms and snow damage may cause widespread tree destruction, preventing forest regeneration, in addition to which the resulting large amounts of deadwood may prompt a massive proliferation of forest pests in surrounding healthy forests. Extreme weather phenomena are impossible to predict accurately, but advance planning helps prepare for them. Among Finland's trees the spruce is the most vulnerable to drought, especially in rocky terrain where the humus layer is thin and low on organic material.

Research and long-term experiments with the transfer of tree species proveniences from the north to the south lead to the following conclusions regarding future impacts of climate change in the boreal zone:

- The growing season will lengthen, and forest growth may actually increase. This increase could be as much as 20% to 50%, depending on the tree species. The increase will be greatest in the north and in mires.
- Wind damage will probably become more common, although due to Finland's geographical location the impact of winds coming in from the Atlantic is not as pronounced as it is in southern Sweden, Denmark or central Europe. Wind damage may be widespread in Lapland, and local and occasional in southern Finland. The spruce is the tree most susceptible to wind damage.
- As the climate becomes warmer and local forest damage occurs, the risk of mass proliferation of pests such as the large European spruce bark beetle (*Ips typographus*). Insect pests are expected to migrate north from the temperate zone, possibly causing massive damage. Spreading of the pine wood nematode (PWN) is also expected to increase in probability due to improved breeding conditions. In forests along the timberline, climate change may cause the timberline to shift up or north, thereby precipitating the gradual extinction of certain species.

Forest management according to experience-based best practices is the principal means for helping forests adapt to climate change. Managing seedling stands in a timely manner, carrying out first fellings and avoiding excess density in the growth phase help secure the vitality of forests. Genetic resource protection and forest tree breeding also provide tools for improving the adaptation of forest trees to climate change. Most of Finland's forests are under continuous management, which is why their productivity and vitality remain good.



Storm damages in forests occur mainly locally, but may cause severe losses in wood production by bending and destroying the logs totally. Storm damages of pine seed trees in natural regeneration area.



Tending of young forest is necessary to ensure future wood production. Harvested small-sized trees can be used for wood energy purposes.

## Safeguarding wood production (B.4)

The basic requirement of sustainable forest management is to safeguard the continuity and profitability of wood production while taking into account the biological diversity of forests as well as other forest products and services. It is also important to safeguard the health and growth potential of forests as well as the infrastructure required for harvesting and management, such as the network of forest roads and their condition.

### Legislation

Wood production is governed and steered by the Forest Act, the Act on the Financing of Sustainable Forestry, the Act on Trade in Forest Reproductive Materials, the Forest Insect and Fungi Damage Prevention Act, the Act on the Environmental Impact Assessment Procedure and the Act on the Organisation of Water Management.

The **Forest Act** stipulates that after regeneration felling, a new economically viable seedling stand must be established in the area within a reasonable period of time. Thinnings must be made in such a way that a sufficient number of trees is left to the harvesting area to guarantee satisfactory growth potential. The Forest Act defines habitats of special importance to forest biodiversity, areas whose natural features must be conserved.

The **Act on Trade in Forest Reproductive Materials** ensures that the seeds and seedlings used in silviculture are of appropriate origin for the site, of good quality and healthy. The purpose of the **Forest Insect and Fungi Damage Prevention Act** is to avoid damage to trees growing in forests by insects and fungi; it includes provisions for instance on the storage of

timber and on the removal of damaged trees (see also the section Forest health).

The **Act on the Environmental Impact Assessment Procedure** applies to projects that may have a significant adverse impact on the environment, such as first drainage projects with an area of more than 200 hectares. The **Act on the Organisation of Water Management** aims to protect, improve and restore waterways so as to prevent the deterioration of both surface water and groundwater and to keep them in good condition at the least.

### Forest programmes

Forest programmes specify policies to steer wood production and use. The **National Forest Programme 2015 (NFP)** sets concrete quantitative and qualitative goals for instance for the annual production of roundwood, the use of forest chips and forest management investments. The **Forest Biodiversity Programme for Southern Finland 2008–2016 (METSU)**, which is ongoing alongside the National Forest Programme, involves several measures to promote voluntary forest conservation.

A **Regional Forest Programme** sets out the needs and aims for forest growth, management and use; forest-based business operations; and multiple use and protection of forests for the Forest Centre Area. It also sets out the measures and funding to attain the goals.

### Financial instruments

Private forest owners are eligible for public funding for some silvicultural and forest improvement measures. The funding is justified by the social benefits gained from supporting the least

profitable investments in private forestry, investments which will only yield earnings in the next generations. Silvicultural works covering large areas which are carried out jointly by forest owners are also supported. In addition to silvicultural aims, other factors affecting funding include employment and environmental issues. Public funding for forestry is today based on the **Act on the Financing of Sustainable Forestry**. Other measures supported under the Act on the Financing of Sustainable Forestry include the maintenance of forest biodiversity and the management of forest ecosystems.

A new **Act on energy support for low-grade timber** was enacted in 2011, replacing the former energy wood harvesting and chipping support in the Act on the Financing of Sustainable Forestry. This support is available to parties other than private forest owners too, but not to the state-owned forests. Energy support will be granted for harvesting energy wood from seedling stands, young stands or first thinning sites.

Forest owners pay taxes **on the basis of their stumpage revenues**. Taxation is calculated on the basis of real income and expenses. The difference between earnings and expenses is treated as capital income, and is taxed at the general rate for capital income, 28% (2011).

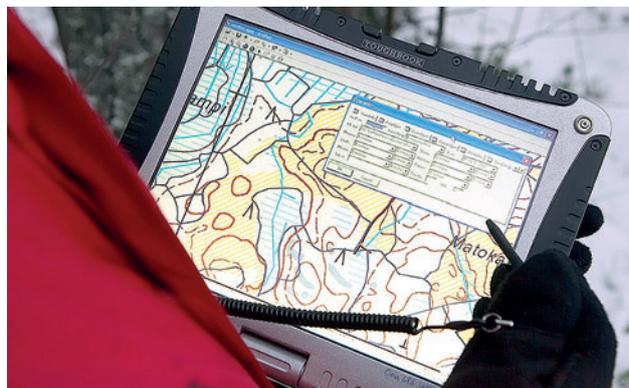
**Work performed for the delivery sales** of timber by the forest owner or his/her family is regarded taxable earned income insofar as the volume of wood gathered from the forest exceeds 125 m<sup>3</sup> per year.

#### Forest planning

Forest planning is the most important practical tool for implementing sustainable forest management, taking into account harvesting potential, the safeguarding of biological diversity and other goals that forest owners may have for their forests. Baseline information on forests is needed for comparing calculations based on various scenarios in planning. Forest planning is undertaken at many levels: by individual holding, by region, by municipality, by parish, by forests owned by Metsähallitus and the forest industry companies, or for the entire country (see fact box). The completed forest plan is a document usually spanning 10 years in Finland.

#### Production of information

In a forest management regime based on private forests, it is important that forest owners have access to sufficient information about methods and practices for safeguarding the welfare of their forests. **Forest advisory services** and information are important factors in ensuring that the changing group of forest owners have sufficient information about the significance and potential of their forests.



Forest management plans for an individual private forest holding are prepared according to the forest owner's preferences and needs by weighing and focusing on timber production, nature values or recreation.

Private forestry organisations and research institutions producing information have in recent years increased their efforts to provide advisory services for private forest owners and to publish information about forest management. Issues which affect the safeguarding of wood production are also key research topics. Recommendations and manuals for practical silviculture have been produced.

Environmental and quality assurance systems are used to improve the quality of silvicultural works and to mitigate negative environmental impacts. Forest industry corporations and Metsähallitus have adopted a certified environmental management system based on the international ISO 14001 standard.

The PEFC (Programme for the Endorsement of Forest Certification Schemes) and FSC (Forest Stewardship Council) forest certification systems promote sustainable forest management by committing actors in forestry to act in compliance with requirements. Certification criteria include several requirements that promote sustainable wood production.

### Increment and drain (3.1)

The balance between annual increment and drain of growing stock<sup>12</sup> is the principal indicator of the sustainability of wood production. The total drain may not exceed the increment in the long term.

In the National Forest Inventories, the increment of stock is measured for increment estimation periods, which comprise

<sup>12</sup> The total drain consists of roundwood removals (=commercial roundwood felled for industry and exports, firewood used by small residential houses, and wood for contract sawing), logging residue left in the forest (slash) and the residue of naturally died trees (natural drain). The amount of logging residue left in the forest varies annually depending on the roundwood removals. In 2009 the amount of logging residue accounted to 7,3 million m<sup>3</sup> and the natural drain to 4,7 million m<sup>3</sup> or 7% of the total drain.

## Forest planning tools and levels in Finland

**Management plans for individual forest holdings** help and guide private forest owners in management and use of their forest holdings. The plans are always based on the forest owner's objectives and the characteristics of the stands in question. Individual forest management plans include data on the current status of the forest, opportunities for harvesting, silvicultural needs and their economic effects, as well as forecasts on the development of growing stock and comprehensive maps. Forest management plans are also available online. Management plans for individual holdings are usually prepared for a period of 10–15 years and they are updated after the silvicultural works have been performed in the forest. The new airborne laser altimetry method has speeded up the collecting of forest data and also helps reduce planning costs because fewer ground surveys are required.

**Forests owned by the State and by forest industry companies, and some jointly-owned forests** are all covered by planning which corresponds to individual forest management plans, even though in terms of area they may be up to 1,000 times larger than private holdings.

**Regional forest management plans** are prepared for larger uniform areas which consist of several individual private forest holdings, for example, forests within the area of a village, municipality or other coherent area. Regional management plans for private forests are usually drawn up by the Forestry Centres. The planning data are used in estimating the forest resources or work goals of a Forestry Centre, a Forest Management Association or a local authority. Information on individual forest owners cannot be read from regional calculations.

There are various expectations regarding the state lands and waters administered by Metsähallitus, which places great demands on planning in these areas. The most extensive planning process for lands, forests and waterways administered by Metsähallitus is the **regional natural resources planning process**, which is where protection and recreational use and the extent of forestry measures undertaken are decided. Local interest groups participate in natural resources planning. **Management and use plans** are drawn up for nature reserves, wilderness reserves, outdoor recreation areas and Natura 2000 areas administered by Metsähallitus. Their purpose is to coordinate the aims of nature conservation, recreational use and other use. **The geographical information system of Metsähallitus** contains all of the above planning data and also data on the terrain, the tree stock and the management measures required for the tree stock.

The **National Forest Inventories** prepared by the **Finnish Forest Research Institute (Metla)** provide information on the current state of Finland's forests, and **national and regional trend forecasts for forest resources** are derived from them. The forecasts, calculated using MELA software, are based on assessments of the current state of forests and on alternative scenarios on how forest resources, increment of growing stock and potential for wood production may develop, given various options in the management of forests and their protection programmes. Alternative trends in national forest resources have been calculated for instance for the National Forest Programme and for Regional Forest Programmes.

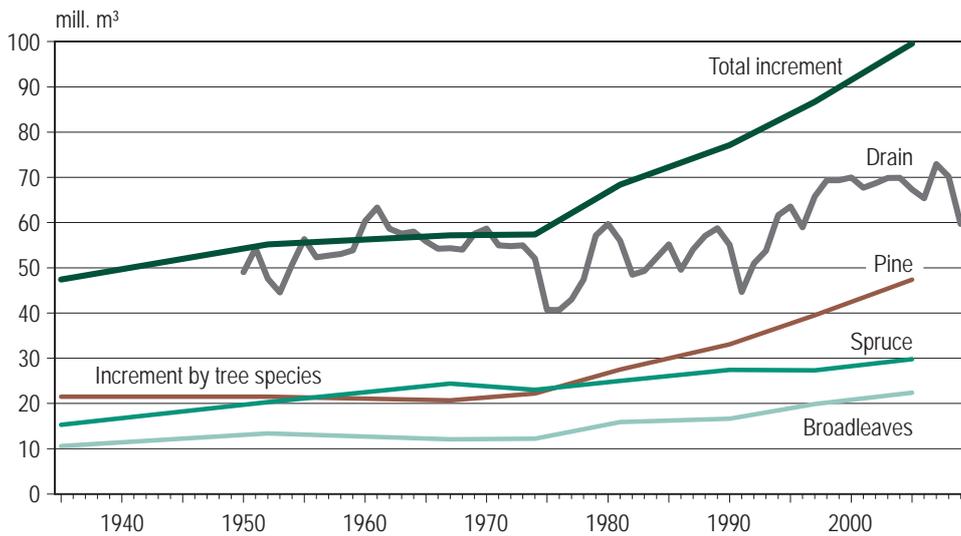
the preceding five growing seasons. One of the reasons for using 5-year periods is to reduce the effect of annual variation on the estimation due to such factors as weather, for instance. There is, therefore, a temporal difference between figures for increment and drain.

The annual increment of growing stock has exceeded the total drain by one fourth on average since the mid-1970s. The balance between increment and drain varies between tree species and by region. According to the latest forest inventory (NFI 10), the annual increment in 2004–2008 and was 100 million cubic metres, of which 97 million cubic metres in commercial forests. The annual drain has been 68 million cubic metres on average in the 2000s. The growing stock has continuously increased in volume since the 1970s (see indicator 1.2).

## Quantity and value of annual fellings (3.2)

The amount of commercial roundwood removal<sup>13</sup>, depends above all on how much regenerative felling and thinning is done, according to demand for forest industry products and thereby the demand for domestic wood raw material in the industry. A forest owner's revenue from wood sales depends on the structure of his/her forests, the incidence of regenerative fellings and thinnings, and the prices paid for the wood.

<sup>13</sup> Roundwood removals is the sum total of wood felled in forests during the year in question. It comprises wood felled for industry and for exports, firewood for small residential houses, and wood for contract sawing.



**Figure 3.1** Annual increment of growing stock (1935–2009) and annual drain (1950–2009). Source: Finnish Forest Research Institute



Thinning with harvesters are often carried out in winter time, when the ground is frozen and covered by snow in order to avoid damages on the soil and trees left on site.

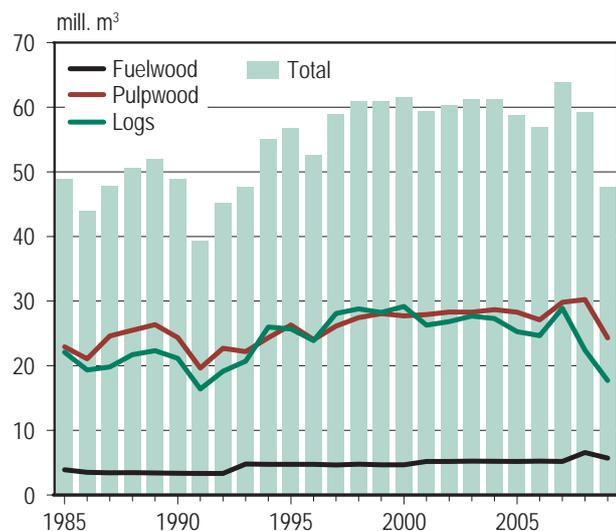
Between 2000 and 2009, the annual roundwood removal was 59 million cubic metres on average, consisting of 48% pulpwood, 43% logs and 9% fuelwood.

The mean annual gross stumpage earnings<sup>14</sup> in Finland for the period were EUR 1,800 million, or EUR 88 per hectare of forest land per year. Logs accounted for 71% of total wood sales revenue.

### Coverage of forest planning (3.5)

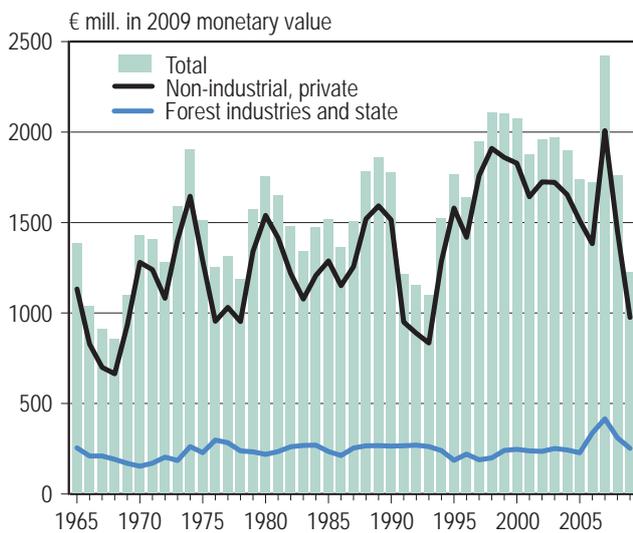
Holding-specific plans for private forests are more common with large holdings than with small ones. In fact, a comprehensive forest plan is often not even necessary in a small holding, such as those less than 10 hectares in size. Regional plans for private forests cover areas extending beyond individual holdings. Regional forest plans are generally prepared for areas 2,000 to 5,000 hectares in size, such as the forests of a village, for example.

The coverage of forest planning varies from one owner group to the next. Forests owned by the State, corporations and other legal bodies are nearly all covered by forest planning. Regional forest planning in 2009 covered 10.0 million hectares in private forests, or 67% of the area of forestry land in private ownership. Valid plans for individual forest holdings covered a total of about 6.8 million hectares of forestry land (46%). The coverage of forest planning has increased from about 40% in the previous report.

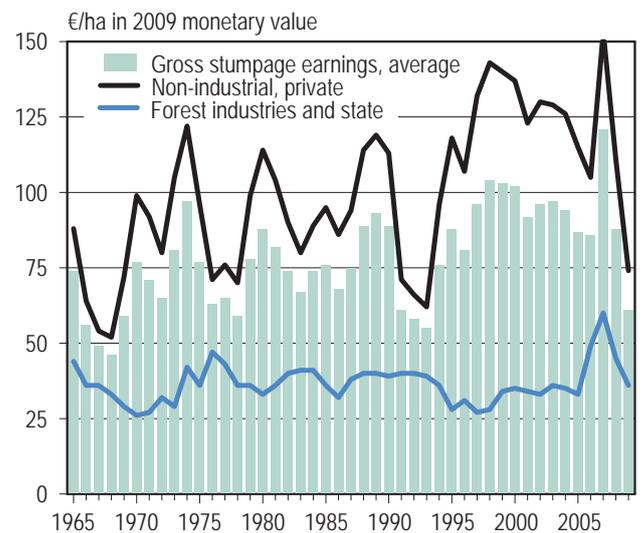


**Figure 3.2a.** Total roundwood removals, 1985–2009 Source: Finnish Forest Research Institute

<sup>14</sup> Gross stumpage earnings is the sum of the value of stumpage earnings and of wood felled by forest owners for their own use. The majority of earnings come from wood felled for industry and for exports.



**Figure 3.2b.** Gross stumpage earnings, 1965–2009.  
Source: Finnish Forest Research Institute



**Figure 3.2c.** Gross stumpage earnings per ha of forest land, 1965–2009.  
Source: Finnish Forest Research Institute

## Safeguarding and increasing services and non-wood products (B.5)

### National programmes

The **National Natural Resources Strategy (2009)**, headed by the Finnish Innovation Fund (Sitra) and compiled by an extensive group of experts, looks at the big picture in the use of natural resources and seeks to find new operating models for business, politics and everyday life. A report entitled *Building an Intelligent and Responsible Natural Resource Economy*, based on the National Natural Resources Strategy, was published in 2010.

The **Natural Resources Strategy of the Ministry of Agriculture and Forestry** includes objectives pertaining to the use of game animal populations, products collected from forests and forest landscapes in the development of business activities and by households.

The **National Forest Programme 2015** also addresses non-wood forest products and envisages growing opportunities for economic activity in nature tourism and natural products, among other things. The commercialisation of intangible commodities available from forests as well as research and development initiatives relating to wellness and health benefits will be promoted.

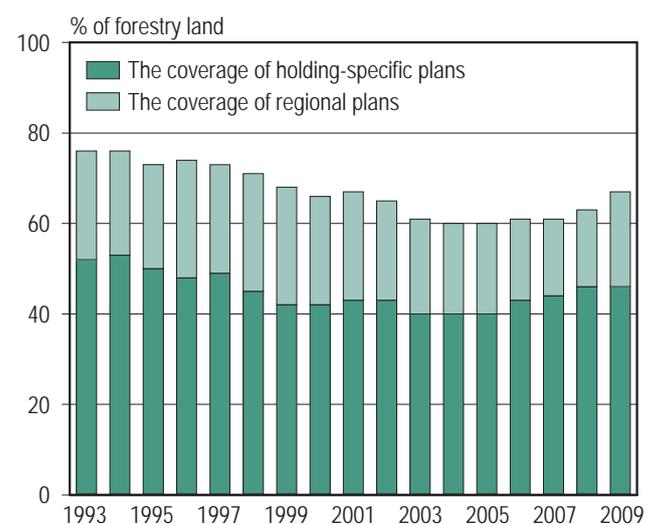
The **Rural Policy Programme 2009–2013** rests on the diverse use of natural resources in the development of rural areas, placing a special emphasis on the networking of different actors, such as natural resources entrepreneurs. Under the Rural Policy Committee composed of representatives of the various ad-

ministrative sectors, there are several theme groups which also promote the multiple use of forests.

The purpose of the **Sitra Landmarks Programme in 2010–2014** is to identify interest in the countryside and changes therein, and to conduct local experiments to generate new business.

### Legislation

The freedom to move in forests and to collect berries and mushrooms in Finland derives from what are known as *Everyman's Rights*. *Everyman's Rights* are an established and accepted prac-



**Figure 3.5.** Coverage of forest planning in private forests, 1993–2009.  
Source: Forestry Development Centre Tapio



Cross-country skiing is a popular winter sport in Finland. It also provides an opportunity to develop nature tourism, especially in Lapland.

tice, even though not provided for by law. The **Off-Road Traffic Act** governs motorised vehicle traffic in forests. The **Outdoor Recreation Act** governs the setting up and management of recreational routes, State hiking areas and camping areas.

Under the **Forest Act**, forests that are valuable in terms of scenery, multiple use or scientific research can be managed in a way that suits the particular characteristics of the site. The various uses of forests are reconciled in zoning based on the **Land Use and Building Act**. Recreational areas as well as primarily agricultural and forestry areas in need of recreational supervision are indicated in the land use plans, as well as the needs for transportation between areas.

The **Hunting Act** specifies the times for the hunting seasons for game animals and the procedure for granting hunting permits. Hunters are required to pass a hunting examination. Hunting rights belong to the landowner. However, inhabitants in the Lapland region and in certain municipalities in the Province of Oulu have free hunting rights on State land within their municipality of residence.

With certain restrictions, reindeer herding in the reindeer herding area defined in the **Reindeer Husbandry Act** is permitted on all land regardless of the ownership of the land. The Act also includes provisions on the prevention of and compensation for damage done by reindeer, and on the maximum permitted number of reindeer. Rights relating to reindeer husbandry are also addressed in the **Skolt Act**. The **Act on the Financing of Reindeer Husbandry and Natural Economy Industries** supports the livelihoods and living conditions of persons engaged in reindeer husbandry and natural economy industries.

#### Economic incentives

The collecting of wild berries and mushrooms is encouraged by **exempting income from their sales from tax**. The further processing of products collected from forests is supported through many funding channels.

The **agri-environmental support scheme** compensates farmers for costs and loss of income incurred through environmental protection and landscape management measures. Measures qualifying for compensation include the management of filter strips and riparian zones. Special support is available for establishing wetlands, filter strips and sedimentation ponds and for preserving traditional biotopes and landscapes.

In granting business support for setting up enterprises based on natural produce and nature tourism, related investments and product development are considered on a par with those of other **small and medium enterprises**. Various funding channels are available for educational and network development projects, as well as village **development projects**. Funding is granted primarily by the regional Centre for Economic Development, Transport and the Environment. Other major funding bodies include the Finnish Funding Agency for Technology and Innovation (TEKES); Regional Councils, which have an interest in emphasising regional development; and the Rural Policy Committee.

#### Forest planning

Non-wood products and services are covered in all national and regional programmes and action plans on forests, and also

in the natural resources plans of Metsähallitus (see Indicator B.4). The multiple uses of forests are coordinated not only in forest planning but also in zoning. The certification criteria for forests also promote the multiple use of forests and facilitate reindeer husbandry.

#### Monitoring, research and advisory services

The Finnish Forest Research Institute studies non-wood forest products in several of its projects and also monitors the supply and demand of recreational use and nature tourism. An extensive inventory, the National inventory of recreational use of nature (LVVI), was conducted in 1998–2002 and again in 2008–2011. Regional forecasts for berry and mushroom harvests are prepared by the Finnish Forest Research Institute in the summer in cooperation with 4-H organisations and trained berry and mushroom consultants. Metsähallitus monitors the recreational use of state lands and keeps relevant statistics.

The Finnish Game and Fisheries Research Institute and the Finnish Museum of Natural History study questions relating to game management, compile nationwide statistics on game bags, and evaluate the development of game populations together with the National Game Management Centre. Elk and reindeer husbandry are studied at the Finnish Game and Fisheries Research Institute and the Finnish Forest Research Institute.

Sustainable management of game in Finland is the responsibility of the Ministry of Agriculture and Forestry. Hunting licences are also granted and monitored by State Provincial Offices and on State land by Metsähallitus. The National Game Management Centre and the 15 game management districts under it are also statutory authorities in this field. Local game management associations provide education and advisory services regarding hunting and game management. Their work is funded by the game management fees paid by hunters. Matters relating to hunting and game management are also dealt with in hunting associations and national hunting organisations, whose membership is voluntary.

Many educational institutions and voluntary organisations promote the use of natural resources by organising training events and courses and by producing educational material. Increasing nature tourism has also increased training in this area. There are numerous trained wilderness guides who work as private entrepreneurs and in the growing tourism businesses.

#### Ecosystem services (additional indicator)

Forests yield not only wood but also other material and immaterial benefits for human needs. In Finland, unlike in many other countries, forests are open to everyone every day under

Everyman's Rights<sup>15</sup> for recreation and as a source of a variety of non-wood products. Forest products that can be collected on the basis of Everyman's Rights include wild berries, mushrooms and herbs. By contrast, e.g. collecting lichen, hunting, cultivating Christmas trees and burning tar are all activities based on land ownership.

The material and immaterial products and services gained from forests are now internationally being grouped together under the heading of 'ecosystem services'. Ecosystem services are divided into provisioning services, regulating services, cultural services and supporting services. Examples of ecosystem services available in Finnish forests are listed in the following figure:

<b>Provisioning services</b> Wood Bioenergy Berries, mushrooms and other natural produce Game Trees and wild plants as a source of raw materials for the food, medicine and cosmetics industries Pure water
<b>Regulating services</b> Combating climate change, carbon sequestration Water purification and breathable air Prevention of flooding, storm damage, erosion Maintaining soil fertility Noise abatement Plant pollination services Disease and pest control
<b>Cultural services</b> Landscape Hiking, recreation and nature tourism Education and training Forests in art Cultural heritage
<b>Supporting services</b> Photosynthesis, cycle of nutrients, carbon and water, soil conditioning

<sup>15</sup> Everyman's Rights refers to the right of everyone staying in Finland, foreign nationals included, to roam freely in the countryside and in forests regardless of who owns the land. Everyman's Right bestows the right to move freely on land by foot, ski or bicycle, stay temporarily in areas where roaming is allowed, pick wild berries, mushrooms and flowers, fish with a rod and line or a jig, travel on water, swim or wash in inland waters and the sea, and move on ice. Despite Everyman's Right one may not cause disturbance or damage to the land or landowner.



Collecting mushrooms and berries for private consumption is popular and common in Finland. The abundant crop can also provide significant earnings locally.

Non-wood forest products and forest-related services offer opportunities for additional income and business. Forest-related marketable services at the moment include hunting, the maintenance of recreational areas and related services, and nature tourism. Forest-related public goods include scenery and recreation benefits. Public goods benefit society as a whole, and their value is usually demonstrated in public debate or in political decisions rather than on the market.

Ecosystem services often have great local and regional importance for employment, the wellbeing of the population and the permanence of habitation. Also, local natural products and the immaterial values in natural resources contain substantial potential for increasing wellbeing. There is an increasing demand for services derived from natural beauty, purity, silence, health impacts, etc., as the standard of living rises and the amount of available leisure time increases.

Determining the financial value of ecosystem services is a key current research topic. This research requires methodological development, but on the other hand it should be noted that the value of ecosystem services is determined by agreement, based on the goals set by society at large. For example, the value of carbon sequestration by forests is largely dependent on the international carbon trade, and as such is determined relative to the promotion of various forms of energy production and support and taxation mechanisms.

### Non-wood products (3.3)

Apart from wood, forests also yield other products such as berries, mushrooms, herbs, lichen, game, reindeer meat and skins, and Christmas trees. Picking berries and mushrooms and hunting are also classified as recreational uses of forests. Secondary products of wood include tar, bark bread, sap, birch bark, conifer branches and cones. Commercial health products derived from forests include xylitol and various fats. The economic significance of non-wood products is small compared to the income from sale of wood products. Income from non-wood products can, however, be significant for private households.

Game species in Finland include 34 species of mammals and 26 species of birds, most of which have their habitats in forests. Economically the most important game species is elk. The estimated winter population and elk bags peaked in 2002–2003 but have declined significantly since then. The annual bag of moose and other cervids in the 2000s was about 94,000. Other important game species are forest game birds, hare and fur animals. However, populations of forest game birds and hence their bags have declined in recent years.

The calculated meat yield of the entire combined game bag on average per year over the ten-year period 2000 to 2009 was about 11 million kg, of which 10 million kg was from cervids. The estimated value of the bag was about EUR 70 million per year.

**Table 3.3.** Amount and value of various forest products, 2009.  
Sources: Finnish Forest Research Institute; TNS Gallup Ltd. Food and Farm Facts; Finnish Game and Fisheries Research Institute; Reindeer Herders' Association; Boards of Customs

Product	Amount	Unit	Value € mill.
Wood from forests			average 2004–08
Industrial roundwood	41.0	mill. m <sup>3</sup>	1,129 1,797
Household timber	1.0	"	42
Fuelwood of small-sized residential housing	5.9	"	58
Forest chips, amount and price in heating and power plants	4.4	"	157
Hand-picked nature products			
Wild berries, purchased by companies	6.8	mill. kg	9
Wild mushrooms, purchased by companies	0.6	"	2
Lichen, exports	0.2	"	1
Game meat			
Mammals	10.2	mill. kg	66
Game birds	0.5	"	12
Reindeer products			
Reindeer meat	2.4	mill. kg	17
Christmas trees			30

Some material forest products have been excluded from this table due to the lack of information, and some figures presented here are estimates. In this table, fuelwood includes roundwood and forest residues, and forest chips include only wood of Finnish origin. Information concerning wild berries and mushrooms are from companies trading them. A major part of outdoor market trade as well as picking for personal use are not included in the figures. The amount and value of this kind of use has been for berries 6–9 times, and for mushrooms 2–6 times that of commercial picking during the first decade of the 2000s.

Because the majority of game hunted or trapped is kept by the hunters themselves and only a small percentage ends up being sold commercially, the monetary value of the game bag can only be estimated. The number of registered hunters has tripled since the 1930s, and is currently about 300,000. The expenditure on hunting equipment and the value of time used for hunting are much greater than the value of the bag.

About half of all Finns gather wild berries or mushrooms every year. Nevertheless, only a small part of the crop is collected, most of it for private consumption. There are 37 species of edible wild berries in Finland. The most important ones are bilberry (*Vaccinium myrtillus*), cowberry (*Vaccinium vitis-idaea*) and cloudberry (*Rubus chamaemorus*). The overall annual berry crop is estimated at between 500 and 1,000 million kg. In a good year, the cowberry and bilberry harvest picked is about 50 million kg and that of other berries 10 million kg. Increasingly, foreign labour is hired to pick berries.



Many tree species are a rich source of bioactive compounds. Caries-inhibiting xylitol is extracted from birch trees.

There are about 200 species of edible mushroom in Finland, of which 23 are accepted as marketable. In a good year, the crop of edible mushrooms available for picking can be in the vicinity of 360 million kg. The harvest of edible mushrooms is usually between 5 and 9 million kg, but in the best years it can be more than 13 million kg.

There are 28 wild herbs in Finland which are collected commercially. They are used for food products, herbal remedies and cosmetics. Star reindeer lichen (*Cladonia stellaris*), which is collected for ornamental purposes, is an economically significant source of income in the Oulu area.

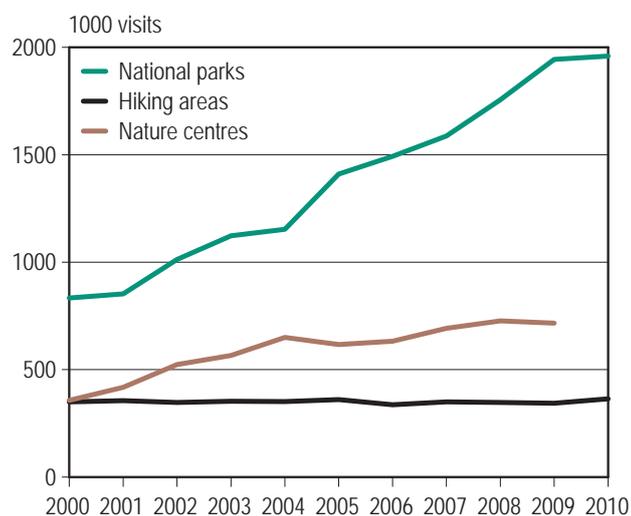
The reindeer herding area in northern Finland covers 36% of the total land area of the country. In 2009, there were about 4,600 reindeer herders, and their winter herds (i.e. animals not intended for slaughter) numbered about 196,000 reindeer in all. In the 2000s, some 107,000 reindeer were slaughtered annually, three fourths of them calves. The average annual meat yield was 2.5 million kg, with a market value of EUR 13 million. The main products of reindeer husbandry are meat and meat products. By-products are skins, horn and bone. Reindeer are also used in tourism.

### Services subject to charge (3.4)

There are services subject to charge related to the recreational use of forests<sup>16</sup> and nature tourism that are estimated to be of economic significance. The National Forest Programme 2015 estimates the added value of nature tourism in 2008 at about EUR 800 million, one fourth of the added value of tourism as a whole. Indeed, the natural environment is one of the strongest attraction factors in tourism in Finland.

According to Metsähallitus statistics, the financial impact of national parks, State hiking areas and certain other conservation

<sup>16</sup> Recreational use comprises all outdoor leisure activities undertaken in forests.



**Figure 6.10.** Visits to national parks, hiking areas and nature centres, 2000–2009.  
Source: Metsähallitus



Orienteering in the forest gives new experience for every hobbyist regardless of the level of the skills.

areas with tourism significance on local economies amounted to EUR 143.5 million in 2010. Converted into employment, this is the equivalent of 1,840 person-years.

However, the vast majority of the recreational use of forests in Finland is free of charge for private persons under Everyman's Rights.

### Accessibility of recreation services (6.10)

Hiking and other outdoor activities in the forest as enabled by Everyman's Rights are part of the Finnish way of life and leisure time. Areas designated for outdoor activities, extensive conservation areas and large tracts of forest provide excellent opportunities for outdoor recreation. Movement in forests is only restricted in military areas and strictly protected nature reserves, where access requires a permit. Strict nature reserves are princi-

**Table 6.10.** Participation in outdoor recreation activities in Finland, 1998–2000 and 2009.

Source: Finnish Forest Research Institute, National inventory of recreational use of nature.

Outdoor activity	Participation rate		Number of participation	
	1998–2000	2009	1998–2000	2009
	% of the population		Number during one year	
<b>Hand-picking of berries and other nature products</b>				
Picking wild berries	56	56	8	7
Picking mushrooms	38	41	7	7
Picking herbs and flowers	17	25	9	6
<b>Forestry work</b>				
Harvesting of household and fuelwood	30	43	12	13
Forest management in leisure time	10	16	9	12
<b>Hunting and game</b>				
Bird hunting	6	7	10	14
Small game hunting	5	7	15	14
Game management	4	5	13	13
Moose hunting	3	4	12	15
<b>Activities on snow and ice</b>				
Skiing	46	43	17	14
Snowmobiling	10	10	13	9
<b>Other activities in forests</b>				
Hiking	23	27	26	14
Camping on the terrain	8	12	6	5
Orienteering	4	5	11	12
<b>Other outdoor activities</b>				
Walking	68	71	113	66
Bicycling	55	54	48	33
Sightseeing in nature	35	51	34	21
Activities with children	30	33	40	28
Picnicking	30	37	7	7
Walking the dog	25	28	213	166
Running and jogging	16	30	50	39
Birdwatching	14	21	56	44

pally closed to the public, although some of them have marked paths for public access. Restrictions to free access apply to about 0.4% of the area of forestry land in Finland.

About half of all outdoor recreation excursions in forests occur on privately owned land. Two fifths occur in local municipal recreation areas, which are important particularly for the residents of large cities and other built-up areas. One fifth occurs on State land.

Finns own 485,000 leisure homes in Finland, most of them in a forest and along a waterway. Leisure homes are popular: in 2009, 64% of the population spent time at a leisure home, and the average number of visits per year was 38.



## Criterion 4 Biological diversity

Spring pascue flower (*Pulsatilla vernalis*) is a rare vascular plant in Finland, and protected by the nature conservation decree.

### Safeguarding and protecting biodiversity of forests (B.6)

The biological diversity of forest ecosystems encompasses 1) the abundance and diversity of different forest habitats, communities of organisms, and ecosystems; 2) the abundance and diversity of forest organisms; and 3) the diversity within the genotype of each organism.

The principal instruments for safeguarding biodiversity are protection of the most valuable forest ecosystems through the establishment of protected areas, and the management of forests at stand and regional level in a way that takes biological diversity into account.

#### International and national agreements and programmes

Finland has ratified several international conventions whose signatories are committed to promoting the protection of biological diversity and sustainable management. These conventions include the **Convention on the Conservation of European Wildlife and Natural Habitats (Bern convention 1979)**, the **United Nations Convention on Biological Diversity (CBD 1992)**, the **Pan-European Biological and Landscape Diversity Strategy of the co-operation process between European environmental ministries (PEBLDS 1995)**, and the **resolutions of the Ministerial Conferences on the Protection of Forests in Europe from 1993 to 2011 (FOREST EUROPE)**.

The first extensive national programme addressing biological diversity was the **National Action Plan for Biodiversity in Finland 1997–2005**. The **National Strategy for the Conservation and Sustainable Use of Biodiversity in Finland 2006–2016** was adopted by the Government in 2006. One of

the aims of this strategy is to halt the decline of biodiversity in Finland and establish a favourable development of biodiversity in the long term. The strategy will be updated in 2011.

Since the 1970s, the Government of Finland has adopted **seven programmes for the conservation of nature** covering national parks and strict nature reserves, mires, waterfowl habitats, eskers, herb-rich forests, shorelines and old-growth forests. The programmes set out the objectives for the establishment of conservation areas. The degree of implementation of the programmes varies: the programme for national parks and strict nature reserves is almost completed, while there is still work to be done on, for example, the old-growth forest conservation programme. Compensation issues concerning private lands and conservation programmes have been almost fully resolved. In the next decade, programme sites in State ownership and earmarked for protection will be converted into statutory conservation areas totalling about 0.7 million hectares, or 16% of the overall area target for conservation programmes.

The **Natura 2000 network** safeguards the biotopes and habitats of species defined in the Habitats and Birds Directives of the EU. The European Commission has accepted the Natura 2000 areas of Finland: the alpine zone areas in 2003 and those of the boreal zone in 2005. With the exception of the northernmost parts of Lapland, the majority of areas in Finland belong to the boreal zone. The majority of the Natura areas – 97% – are nature conservation areas established under national decisions, or they are part of national conservation programmes or areas protected in some other way.

The **Forest Biodiversity Programme for Southern Finland 2008–2016 (METSU programme)** is implemented along with Finland's National Forest Programme, and its objective is to es-

establish the positive trend of forest biodiversity by conservation methods voluntary for forest owners. The total target for areas voluntarily offered for conservation by the landowners is 96,000 hectares by 2016. Moreover, the total area of sites safeguarding biodiversity in private forests will be increased by 82,000 to 173,000 hectares, including 400 to 800 nature management projects.

## Legislation

The administrative and executive powers in safeguarding biological diversity belong to the Ministry of the Environment and in part also to the Ministry of Agriculture and Forestry. The practical execution is the responsibility of the Regional Centres for Economic Development, Transport and the Environment, as well as the Forestry Centres. In matters pertaining to biodiversity, all these centres are under the performance guidance of the two ministries mentioned above.

The central legal instruments safeguarding forest biodiversity are the **Nature Conservation Act**, the **Act on Wilderness Reserves** and the **Forest Act**.

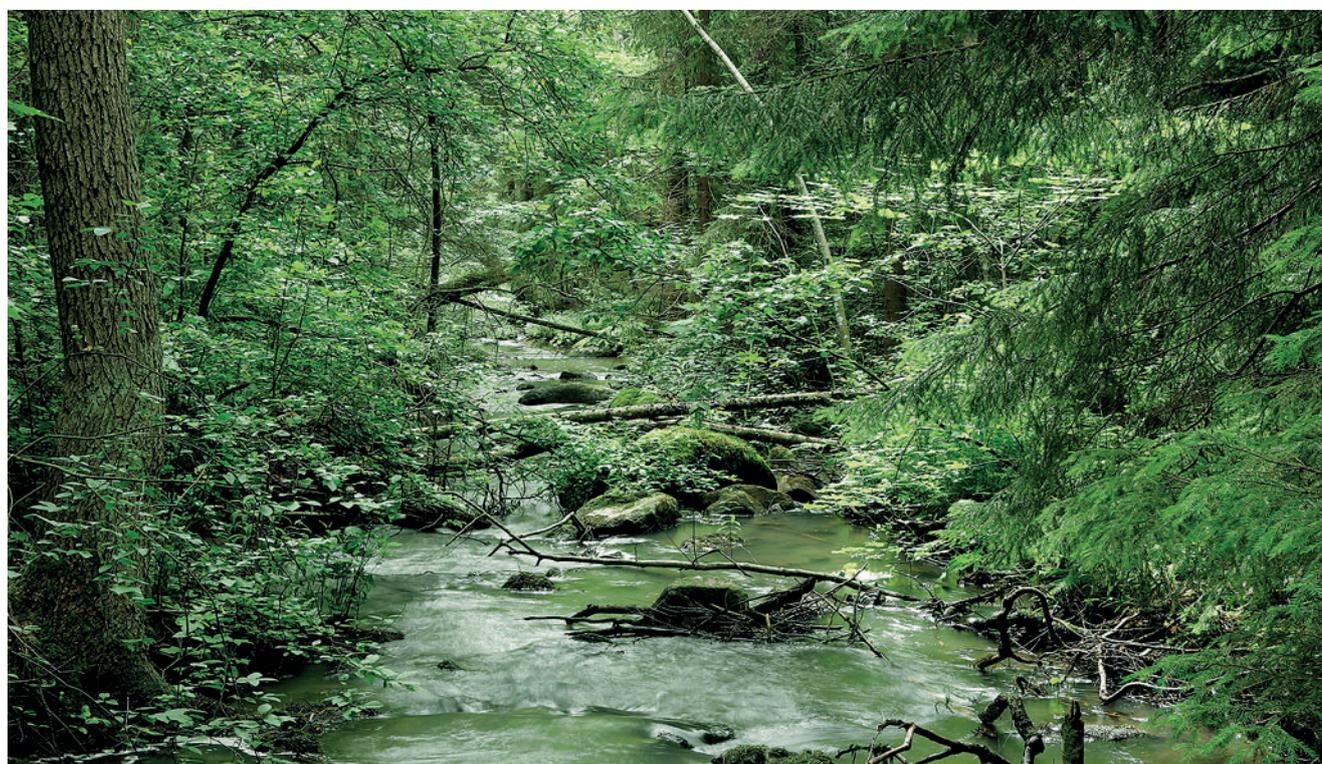
The **Nature Conservation Act** aims to achieve and maintain a favourable level of protection for habitats and wild species. To achieve this aim, nature conservation areas can be established to conserve protected habitats, three of which are forests: wild woods rich in noble broadleaves, hazel woods and common al-

der woods. The act also includes provisions on threatened species, their protection and international trade in them.

Under the **Act on Wilderness Reserves**, 12 wilderness areas have been established in northern Finland. Some of the areas are completely protected from harvesting, while limited forestry is allowed in others.

The Forest Act defines **habitats of special importance** to forest biodiversity – areas whose natural features must be conserved. These habitats are clearly delimited and generally fairly small areas in natural or semi-natural state, including the following: 1) the immediate surroundings of springs, brooks, rivulets constituting a permanent water flow channel, and small ponds; 2) herb-rich and grassy hardwood-spruce swamps, ferny hardwood-spruce swamps, eutrophic paludal hardwood-spruce swamps, and eutrophic fens located to the south of the Province of Lapland; 3) fertile patches of herb-rich forest; 4) heathland forest islets in undrained peatlands; 5) gorges and ravines; 6) steep bluffs and the underlying forest; and 7) sandy soils, exposed bedrock, boulder fields, peatlands with sparse tree stand and flood meadows which are less productive than nutrient-poor heathland forests.

According to the national land use guidelines (VAT 2000) adopted by the Government under the **Land Use and Building Act**, land use planning is used to promote the conservation of the biodiversity in areas which are important for nature and suscep-



According to the forest law the natural characteristics of habitats of special importance, such as this small waterway in forests, must be preserved during silvicultural works and fellings.

tible to damage. Another aim is to preserve ecological corridors between conservation areas. One particular aim is to prevent the fragmentation of large forest areas by other land use without a special reason.

Under the **Act on Environmental Impact Assessment Procedure** and the Act on the Assessment of the Impacts of the Authorities' Plans, Programmes and Policies on the Environment, the impacts of certain plans, programmes and policies on biological diversity must be assessed.

The **Act on Metsähallitus** defines the tasks of Metsähallitus as including the sustainable and profitable management, use and conservation of natural resources and other property under its care. There are various possible uses for State land, including nature conservation, forestry, recreational use, nature tourism, property development and land extraction. The use of land and water areas under the care of Metsähallitus is planned in regional natural resources planning (see the fact box on Forest planning).

#### Financial instruments

**The Forest Biodiversity Programme for Southern Finland 2008–2016 (METSO)** offers voluntary measures for forest owners to protect their forests or to enhance natural values of the forests by management and receive compensation for these activities. The options the METSO programme offer are permanent protection, temporary protection and management of forest habitats. Permanent protection can be implemented by establishing a private conservation area, by selling the area to the State or by exchanging the area with the State. If protection is agreed on a temporary basis, an environmental support agreement is made for the area in accordance with the Act on the Financing of Sustainable Forestry for a period of ten years at a time.

Typical sites covered by environmental support include valuable habitats protected under the Forest Act. With the help of the support, the area protected can form a more extensive entity than what is protected by the law. Temporary protection can also be implemented under the Nature Conservation Act, in which case the maximum term of the protection agreement is 20 years. Management of forest habitat can be maintaining or enhancing natural values, or restoring the forest to a more natural state. The management work is planned in cooperation with the forest owner, and the management will not cause costs to the forest owner.

The **Act on the Financing of Sustainable Forestry** promotes sustainable forest management by granting government support for private forestry measures which aim at the maintenance of forest biodiversity and ecosystems. Financing is also used to support projects for the management of forest ecosystems. These include ecosystem surveys, management and restoration

of habitats extending over the area of several forest holdings, and landscape management projects.

Special support under the agri-environmental support system for sites other than agricultural land is available for farmers who undertake to maintain traditional biotopes, wetlands, or forest edges bordering on fields.

Under the **Nature Conservation Act**, landowners are compensated for the establishment of conservation areas on their lands. A conservation area can be established in three ways: 1) by establishing a private conservation area under the Nature Conservation Act, in which case the area remains property of the landowner, who receives compensation which corresponds to the economic loss caused by conservation; 2) by purchasing the area for the State; or 3) by exchanging the area for an area owned by the State.

#### Active information services

Safeguarding forest biodiversity receives special emphasis in all forest management recommendations and guidelines prepared for the various actors in forestry. Along with promoting wood production, safeguarding biodiversity is an integral part of forest planning undertaken on different levels and in different ways. The requirements regarding voluntary forest certification also contain several measures designed to safeguard biodiversity, such as increasing the number of prescribed burnings, leaving retention trees in forests and safeguarding the characteristic features of valuable habitats.

**A National evaluation of threatened species** has been conducted four times by the Ministry of the Environment, in 1983–85, 1987–91, 1997–2000 and 2007–2010. The last two evaluations are based on the IUCN criteria by the International Union for Conservation of Nature, and therefore the results from these evaluations are comparable. The evaluations produce information about the number of threatened species, the causes of decline, risks, and proposals for improving their protection.

One key way of safeguarding forest biodiversity outside conservation areas is to maintain the natural characteristics of valuable habitats. Habitats protected under the Nature Conservation Act have been mapped by the regional Environment Centres. **Surveys of habitats of special importance** mentioned in the Forest Act and of other forest habitats are conducted by Forestry Development Centre Tapio, the Forestry Centres, Metsähallitus and the forest industry companies. A nationwide report was completed in 2005.

**Finland's first assessment of natural habitat types** was conducted by the Finnish Environment Institute in 2008. The purpose of this assessment was to find out how habitat types had changed due to human action or other reasons over the past

50 years. Two thirds of the 76 forest habitat types were considered to be threatened on the basis of qualitative or quantitative changes. These habitat types are typically small in size. The Nature Conservation Act and the Forest Act specifically list the habitat types and habitats identified as having special importance that must be left untouched in forest management. The expert groups also compiled the first list of the habitat types for which Finland has a particular international responsibility.

The preservation of biological diversity in private forests, forests owned by corporations and those administered by Metsähallitus has been monitored regularly since 1995 in conjunction with the monitoring of the quality of nature management in commercial forests by Forestry Development Centre Tapio. The National Forest Inventories conducted by the Finnish Forest Research Institute (Metla) also produce data on forest biodiversity.

**Forest tree breeding and the management of the genetic resources of forest trees** are the responsibility of the Finnish Forest Research Institute. The Institute maintains a register on forest genetics which covers information about selected trees and plus trees, experimental plantations, gene reserve forests and gene resource archives. The purpose of long-term forest tree breeding programmes is to identify and enrich genes that influence desirable properties in tree species, and also to maintain a sufficient level of genetic diversity in the material being bred. Compliance with the **Act on Trade in Forest Reproductive Material** is monitored by the subsection for forest reproductive material of the **Finnish Food Safety Authority Evira** to ensure that the basic genetic material used to produce reproductive material for forests is of a high quality.

In addition to universities, forest biodiversity is studied in research institutes operating under the Ministry of the Environment and the Ministry of Agriculture and Forestry. The principal research organisations are the Finnish Forest Research Institute (Metla) and the Finnish Environment Institute (SYKE).

Steered by the Ministry of Agriculture and Forestry, the Biodiversity and Monitoring Programme MOSSE was implemented in 2003–2006, and it contributed to the informational needs during the preliminary phase of the METSO programme (2002–2007). The research programme of deficiently known and threatened forest species (PUTTE) was coordinated by the Ministry of the Environment, and it was implemented during 2003–2007. The second stage of this programme started in 2009, and it includes 10 research projects. A large research programme of the Finnish Forest Research Institute (Metla), Safeguarding forest biodiversity – policy instruments and socio-economic impacts (TUK, 2005–2010), was completed in 2010, but the Institute continues to monitor the METSO programme and related research with help of separate funding.

## Tree species composition (4.1)

The number of indigenous tree species in Finland is small: four conifers and 27 broadleaved species of trees, bushes or small trees. Some of the broadleaves have a very narrow area of distribution. Many sites are dominated naturally by just one species, such as pine in upland forests. Mixed stands and predominance of broad-leaves are common in fresh mineral soil sites and upland forests with grass-herb vegetation. The most common species growing in mixed stands is downy birch.

Pine predominates on 65% of forest land, spruce on 24% and broadleaves on 10%. Broadleaves, which are important to forest biodiversity and the soil and grow mostly in mixed stands, account for 20% of the total volume of growing stock, which is clearly more than the total area of predominantly deciduous stands.

Tree species composition changes slowly. Since the beginning of the 1950s, the share of pine dominated stands has increased as a result of regeneration with pine. The most significant change is the reduction of the area of predominantly deciduous stands by a half in southern Finland. The species composition has changed

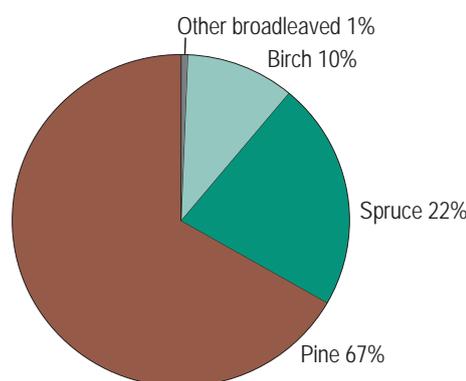


Figure 4.1a. Tree species dominance on forest land, 2009. Source: Finnish Forest Research Institute, National Forest Inventory

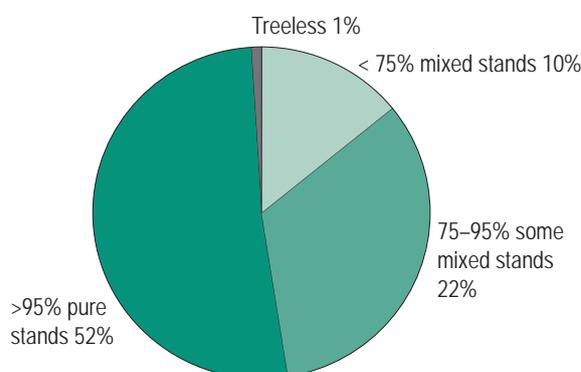


Figure 4.1b. Pure and mixed forest stands on forest land, 2009. Source: Finnish Forest Research Institute, National Forest Inventory

less in terms of growing stock volume than in terms of species predominance.

Pure stands<sup>17</sup> account for 55% of all forest land, stands with some mixing<sup>18</sup> account for 31%, and actual mixed stands account for 13%.

#### Conifers (4)

- Scots pine (*Pinus sylvestris*)
- Norway spruce (*Picea abies*)
- Common juniper (*Juniperus communis*)
- European yew (*Taxus baccata*)

#### Broadleaves (27)

- Silver birch (*Betula pendula*)
- Downy birch (*Betula pubescens*)
- Common alder (*Alnus glutinosa*)
- Speckled alder (*Alnus incana*)
- Aspen (*Populus tremula*)
- European rowan (*Sorbus aucuparia*)
- Oakleaf mountain ash (*Sorbus hybrida*)
- Swedish mountain ash (*Sorbus intermedia*)
- Swedish rowan (*Sorbus teodori*)
- Bird cherry (*Prunus padus*)
- Littleleaf linden (*Tilia cordata*)
- Norway maple (*Acer platanoides*)
- Common oak (*Quercus robur*)
- European ash (*Fraxinus excelsior*)
- Wych elm (*Ulmus glabra*)
- European white elm (*Ulmus laevis*)
- Crab apple (*Malus sylvestris*)
- Buckthorn (*Rhamnus catharticus*)
- Glossy buckthorn (*Rhamnus frangula*)
- Hawthorn (*Crataegus monogyna*)
- Hawthorn (*Crataegus rhipidophylla*)
- Goat willow (*Salix caprea*)
- Bay-leaf willow (*Salix pentandra*)
- Black maul (*Salix triandra*)
- Dark-leaved willow (*Salix myrsinifolia*)
- Boreal willow (*Salix borealis*)
- Pyrolavide (*Salix pyrolifolia*)

Source: Hämet-Ahti, L. et al. 1992. Suomen puu- ja pensaskasvio (Woody Flora of Finland). Finnish Dendrological Society.



Mixed stands are preferred especially in more productive sites where the natural characteristics of a site provides favourable conditions for growth. The share of broadleaves is often 10-30% of the volume of the stock.

## Forest regeneration (4.2)

Under the Forest Act, after regeneration felling a new economically viable seedling stand whose development is not directly threatened by other vegetation must be established in the area within a reasonable period of time. Reproduction takes the form of natural regeneration<sup>19</sup>, provided that the site has the potential for the production of natural seedlings. This is judged on the

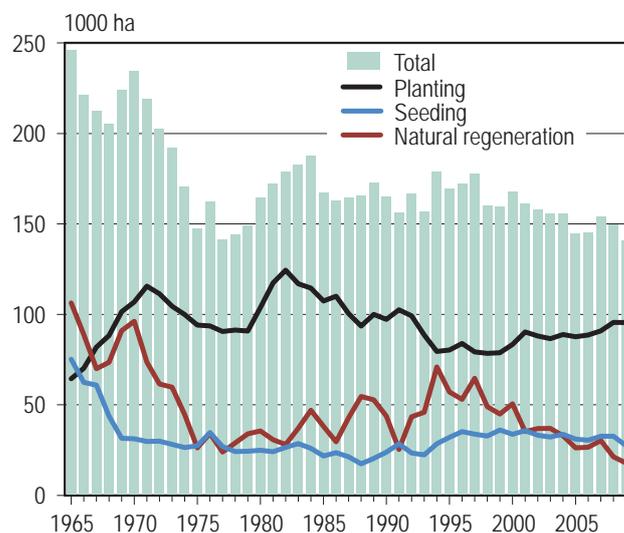


Figure 4.2. Natural and regeneration by planting and seeding, 1965-2009.

Source: Finnish Forest Research Institute, Forest Statistics Information Service

<sup>17</sup> Pure stand: the proportional share of the dominant species of the volume (in seedling stands, the proportional share of the number of viable seedlings) is over 95%.

<sup>18</sup> Stand with some mixing: the proportional share of the dominant species of the volume (in seedling stands, the proportional share of the number of viable seedlings) is between 75–95%. Mixed stand: the proportional share of the dominant species of the volume (in seedling stands, the proportional share of the number of viable seedlings) is below 75%.

<sup>19</sup> Forms of regeneration: In natural regeneration, the new generation of trees is established naturally from the seeds of seed trees or shelterwood left standing in the felling site, or from seed in the woods adjacent to the felling area. In artificial regeneration, the new tree generation is established by seeding or planting. Even in artificially regenerated stands there are lots of naturally grown trees.



A typical boreal natural (undisturbed by man) coniferous forest at the end of its life span in southern Finland (Padasjoki).

basis of growing stock, soil and surface vegetation. Otherwise, clear felling is used – all trees are removed and the site is seeded or planted with reproductive material of local origin.

In 2009, some 141,000 hectares of forest were regenerated. The total area of regeneration was the smallest in 30 years, which was partly due to the decrease in the amount of fellings. Fellings aiming at natural regeneration were carried out on 18,000 hectares, planting was used on 95,000 hectares, and 27,000 hectares were seeded. In the period 1996–2009, the total area of forest regeneration has varied from 141,000 to 178,000 hectares annually. The proportional share of natural regeneration of all forest regeneration was about one fourth, that of seeding one fifth, and planting more than a half.

Altogether about 35% of the present Finnish commercial forests are regenerated by seeding or planting. The rest are established either by natural regeneration or assisted natural regeneration. Even in artificially regenerated stands there are lots of naturally grown trees, promoting the formation of a mixed species composition.

### Natural forests (4.3)

In the last twenty years, naturalness has developed into an international indicator of forest biodiversity. Human activities change the structure and species composition of forests. Naturalness

is thus an indication of human impact in forests, as well as an indication of earlier, historical use of forests. When left unmanaged or actively restored, forests grow into stands whose structure resembles forests in their natural state. Unmanaged, strictly protected conservation areas can be used to gain information about the natural development of forests.

On the basis of their naturalness, forests are internationally (UN-ECE/FAO 2002) roughly classified into three classes: 1) forests undisturbed by man<sup>20</sup>, 2) semi-natural forests<sup>21</sup>, and 3) plantations<sup>22</sup>. Due to differences in interpretation, there is as yet no common, functioning European classification and measurement

<sup>20</sup> Undisturbed forests contain features belonging to the natural growth cycle of forests. Such features include natural species composition, deadwood, natural age structure and natural regeneration. The site is large enough to maintain natural succession. There are no recognisable signs of human activity in the area, or a sufficiently long time has passed from human intervention to allow the re-emergence of natural tree species composition and its development dynamics.

<sup>21</sup> A semi-natural forest displays all those characteristics which are not included in forests undisturbed by man and plantations.

<sup>22</sup> Plantations are forest stands established by planting introduced species or intensively managed stands of indigenous species which meet the following criteria: one or two species at plantation, even age class, and regular spacing. The exception is stands which were established as plantations, but which have been without intensive management for a long time, allowing the stand to develop naturally. In Finland, only afforested fields are classified as plantations. Sites of normal forest regeneration are established at irregular intervals and, because of supplementary natural regeneration and thinnings, they usually develop into mixed stands containing a great number of naturally established trees.

Table 4.5. Volume of deadwood in forest and low productive forest, 2008.  
Source: Finnish Forest Research Institute, National Forest Inventory

Forestry centre	Dead trees								
	Standing			On the ground			Total		
	Conifers	Broadleaved	Total	Conifers	Broadleaved	Total	Conifers	Broadleaved	Total
	m <sup>3</sup> /ha								
Whole country	1.3	0.3	1.7	3.5	0.6	4.2	4.8	0.9	5.9
Southern Finland	0.9	0.3	1.2	1.6	0.4	2.1	2.5	0.7	3.3
Northern Finland	1.8	0.4	2.2	5.9	0.7	6.8	7.7	1.1	9.0

system for naturalness. The current classification allows also planted stands to be classified as semi-natural forests if they are left unmanaged for over 30–40 years. With the exception of Austria, no country-specific assessments of naturalness have been made so that they would correspond to the system of, for example, national forest inventories.

Owing to long-term human intervention, no extensive natural forests have survived in Finland, except for some small stands in certain conservation areas.

According to the 9th National Forest Inventory, there were a total of 170,000 hectares of old forests resembling natural forests (forests over 140 years old with observed indicators suggesting naturalness) in the hemiboreal, southern and middle boreal zones. Of these, 40% were in conservation areas. In the northern boreal zone there were 716,000 hectares of such forests, 56% of them in conservation areas.

The structure of vegetation even in managed forests in Finland has remained largely similar to natural forests, thanks to forest management based on the natural site type classification and the use of indigenous species in regeneration. Monocultures are established only in the afforestation of fields (about one per cent of all forests), but in them, too, the species and their origin are Finnish. The total area of fields afforested during the last 25 years is about 100,000 hectares.

The naturalness of forest sites has been altered by peatland drainage. In wooded drained mires, however, the original tree species composition generally remains unaltered. Altogether 55% of all mires, or some five million hectares, have been drained. In the last 15 years, practically no new drainage projects have been carried out. Some of the drained mires revert to natural development, as it is not justifiable economically to maintain the network of drains.

An increasing number of stands in Southern Finland remain uncut. The number of forests exceeding 140 years of age and where no fellings have been done in the last 40 years has grown continuously.

## Introduced tree species (4.4)

Introduced tree species<sup>23</sup> change forests, their mix of species, structure and diversity. Introduced species have been planted in Finland only for research and experimental purposes, or as decorative trees and stands in arboretums, for example.

There are about 9,500 hectares of forests in Finland composed of introduced species. Of these, 9,000 hectares are stands of lodgepole pine.

The number of stands with introduced species is not growing as the Forest Act and forest certification both require that, apart from special cases, only indigenous tree species must be used in regeneration. Siberian larch is considered an indigenous species. In the forest certification standards, the special cases in which introduced species may be used include the establishment of park forest stands, the production of Christmas trees and conifer twigs, stands and trees planted for landscape management, and the cultivation of hybrid aspens. Hybrid aspen is a cross-breed between Finnish and North American aspen, which has been cultivated in Finland already since the 1950s.



Deadwood left in the forest after a felling helps the survival of certain species on the site across tree generations.

<sup>23</sup> Introduced tree species are other than indigenous species occurring naturally in Finland. The Siberian larch and the hybrid aspen are treated as indigenous species.

Table 4.6a. Gene reserve forests, 2011. There are several tree species living in some gene reserve forests.  
Source: Finnish Forest Research Institute, register on forest genetics

Species	Holdings		Material		
	Number	Area,ha	Stands	Clone/family	Grafts/trees
Norway maple – <i>Acer platanoides</i>	2	1.19	41	262	1,836
Common ash – <i>Fraxinus excelsior</i>	3	0.74	17	84	1,177
Common juniper – <i>Juniperus communis</i>	2	0.44	60	192	1,529
Bird cherry – <i>Prunus padus</i>	1	0.04	6	11	76
Pedunculate oak – <i>Quercus robur</i>	1	0.46	17	132	895
Rowan – <i>Sorbus aucuparia</i>	2	0.79	20	69	690
Small-leaved lime – <i>Tilia cordata</i>	1	2.05	81	341	458
European white elm – <i>Ulmus laevis</i>	1	0.81	19	120	225
Wych elm – <i>Ulmus glabra</i>	2	1.79	36	92	177
Total	15	8.31	297	1,303	7,063

## Deadwood (4.5)

Certain forest organisms rely on dead or decaying wood for their survival. Many of these species are threatened. According to the latest report on threatened species, published in 2010, the reduction in decaying wood is the main factor threatening the survival of 164 species, representing 11% of all threatened species.

According to NFI 10 (2004–2008), the average volume of dead and decaying wood with thickness exceeding 10 cm in forests (commercial forests and nature conservation areas) is 3.3 cubic metres per hectare in southern Finland and 9.0 cubic metres per hectare in northern Finland. Compared to the previous inventory (NFI 9, 1996–2003), the amount of decaying wood has increased in southern Finland and decreased in northern Finland. Old-growth forests in natural state may have 60–120 cubic metres of dead and decaying wood per hectare, but the amount varies a great deal depending on the fertility of the site, the development state of the forest and natural disturbances.

The amount of deadwood in forests will increase as retention trees are left standing in regeneration sites to maintain biodiversity and the amount of decayed wood in the forest. In 1995–2009, the average total volume of green trees left standing in regeneration fellings in private forests and the forests of the forest industry companies was 3.1 cubic metres per hectare. The volume of deadwood in felling sites varied from 1 to 1.4 cubic metres per hectare. An average of 11 green retention trees were left standing in each felling site.

Under forest certification criteria, at least 5–10 dead or live retention trees with a breast height diameter of over 10 centimetres must be left standing in certified regeneration sites. Also individual fallen trees are nowadays often left in the forest. Broad-leaves of slight economic value are left uncut in all fellings.

Table 4.6b. Gene resource archives, 2002.  
Source: Finnish Forest Research Institute, register on forest genetics

Species	Number	Area,ha
Scots pine	20	3,803
Scots pine and birches	1	187
Norway spruce	8	1,708
Norway spruce and birches	1	111
Silver birch	2	299
Downy birch	3	274
Small-leaved lime	2	19
Small-leaved lime and Norway maple	2	15
Common ash	1	30
Pedunculate oak	1	22
Total	41	6,468



A gene reserve forest (in situ conservation) established in the naturally regenerated pine stand in southern Finland. This typical natural, single tree pine forest can be managed following the regular practices if the regeneration with the seeds of this particular forest can be secured.

**Table 4.6c.** Seed orchards, 2011.  
Source: Finnish Food Safety Authority (Evira)

	Number	Area, ha
Pine	104	1781,6
Spruce	28	318,8
Silver birch	2	0,26
Curly birch	1	0,1
Larch	8	59,4
Common alder	2	4,1
Total	145	2164

## Genetic resources (4.6)

The purpose of protecting the natural genetic resources of forest trees<sup>24</sup> is to safeguard the internal diversity of the species and the capacity of stands to adapt to changes in the environment. Genetic diversity is taken into account in tree breeding, the production of forest reproduction material, regeneration and forest management.

The natural genetic resources of the main tree species in Finland – pine, spruce, silver birch and downy birch – are maintained in gene reserve forests<sup>25</sup>, which have been selected to represent the variability of the species within their distribution area. The network of gene reserve forests is almost completed. The genetic resources of rare species are protected in gene banks<sup>26</sup> established specifically for the purpose. Nature conservation areas also contribute to the safeguarding of the genetic diversity of forest trees.

Genetically improved seed produced in seed orchards<sup>27</sup> is mainly used in forest tree nurseries for seedling production. The use of improve seed in seeding pine trees in forests has increased in recent years. In addition to seed orchard production, seeds are collected in forests in connection with fellings in commercial forests selected by forestry professionals. Registered seed collection forest stands are of minor importance nowadays. Pine seed from seed collection areas<sup>28</sup> is mainly used for stand seeding.

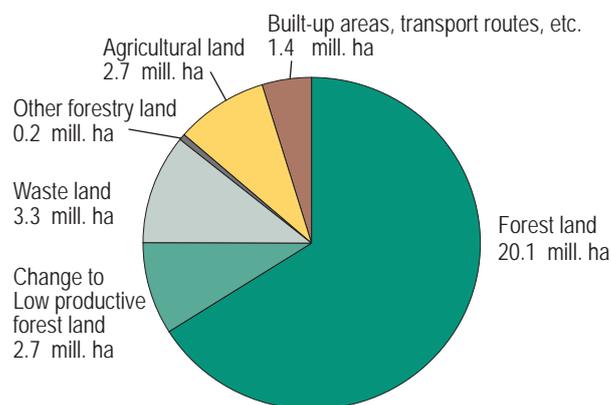
<sup>24</sup> The genetic resources of forest trees comprise their genetic variability, the various species and varieties, and intra-species variation.

<sup>25</sup> A gene reserve forest (in situ conservation) is a living gene bank, which is allowed to develop under evolutionary pressure. Gene reserve forests are usually regenerated naturally and are managed following the regular good silvicultural practices.

<sup>26</sup> Genetic resource archives (ex situ conservation) contain genetic material from several different stands. The archive is tended with intense management.

<sup>27</sup> Seed orchards are tree plantations established specifically for the production of seed. The trees in a seed orchard are plus trees, the best individuals selected from natural populations using the methods of tree breeding.

<sup>28</sup> Seed collection areas are natural stands which have been selected for the purpose of collecting seeds. The stands are of high-quality growing stock and suitable for seed production both in terms of the age and management history of the stand.



**Figure 4.7.** Land use in Finland, 1999.  
Source: Statistical Yearbook of Finland 2005

No forests are established in Finland of clones from a single individual tree, as the reduction of genetic variability would weaken the survival of tree species as the climate changes.

## Forest cover in landscapes (4.7)

In the long term, the development of forest species depends on the forest cover, i.e. whether it is preserved or whether unbroken cover is fragmented permanently as a result of other land use. Observation of land use on the landscape level produces information on the integrity of forests, their size, form and location. Landscape-level observation also enables us to assess what kinds of habitats are available for forest species.

The dominant landscape element in Finland is forest. About 78% of the total area of Finland is forest or forestry land. Mires account for 34% of the land area. The second most dominant landscape element is lakes and other small water bodies. There are more than 180,000 lakes or ponds that are at least 500 sq.m in area. Their total area is 3.4 million hectares, which is 10% of the total area of the country. The rest, i.e. 12% of the total area, is agricultural land, constructed areas, traffic areas, or other open land areas.

No major changes have taken place in the relative share of forest cover in Finland over the past few decades. Changes in forest cover on the landscape level have mainly been caused by construction and changes in agriculture, such as the afforestation of abandoned meadows and fields or the conversion of drained peat-lands into wooded land. Because of dispersed settlement patterns, the permanent road network in Finland is rather dense. However, the majority of roads are narrow and do not pose much of an obstacle to the spreading of species.

Table 4.8. Number of threatened forest and mire species.

Source: Rassi, P., Hyvärinen, E., Juslén, A. & Mannerkoski, I. (eds.) 2010: The 2010 Red List of Finnish Species. Ympäristöministeriö & Suomen ympäristökeskus, Helsinki. 685 p.; Rassi, P., Alanen, A., Kanerva, T. & Mannerkoski, I. (eds.) 2001. Suomen lajien uhanalaisuus 2000. [Endangered species in Finland 2000]

Primary habitat of species	Vertebrates		Invertebrates		Vascular plants		Cryptogams		Fungi and lichens		Total		
	Year	2000	2010	2000	2010	2000	2010	2000	2010	2000	2010	2000	2010
Number of species													
Species, grand total		383		26,600		3,200		5,900		6,906		43,000	
The data was considered sufficient for evaluation of threatened species		346		8,599		1,208		901		4,027		15,081	
Threatened species, total		50		759		180		142		374		1,505	
Forests		12	14	252	476	35	32	15	18	250	274	564	814
Old heathland forests		4	2	69	80	-		1	8	70	76	144	166
Other heathland forests		3	4	10	37	3	4	1		24	18	41	63
Old herb-rich forests		1	1	58	66	-	1	8	7	32	32	99	107
Other herb-rich forests		2	1	64	140	26	21	4	3	120	112	216	277
Old-forest, general					4						8		12
Esker forests		-		15	104	6	6	-		-	2	21	112
Forest-fire areas		-		29	6	-		-		-	4	29	10
Birch stands in mountains					2								2
Other forests		2		7		-		1		4		14	
Forests general			6		37						22		65
Peatlands		1	6	14	46	18	21	25	18	9	13	67	104
Fens		-		3	14	17	19	13	12	4	8	37	53
Bogs		1	4	2	8	1	2	1	2	2	1	7	17
Pine mires		-	1	5	13	-		-		1	1	6	15
Spruce mires		-		2	5	-		9	3	2	3	13	11
Other peatlands		-		2		-		2		-		4	
Peatlands general			1		6				1				8
Watercourses		20		48		11		21		3		103	
Shoreline areas		5		98		37		9		13		162	
Exposed bedrock		-		11		14		56		44		125	
Fells		6		16		15		16		10		63	
Man-made environments etc.		6		320		50		-		45		421	

There are as yet no methods or indicators to monitor changes in the landscape level with sufficient accuracy for practical applications.

### Threatened forest species (4.8)

Monitoring of threatened<sup>29</sup> species yields information about changes in forest ecosystems. It is estimated that there are about 45,000 species living in Finland, about half of which have their habitat in the forest. In the latest evaluation from 2010 21,400 species were assessed. About one tenth of them – 2,247 species – were classified as threatened. This percent-

age has not changed significantly from the previous evaluation. Forest is the primary habitat for 814 threatened species (36% of the total). Of the threatened forest species, 82% live in herb-rich forests and old-growth heathland forests. The taxonomic groups with the greatest number of threatened forest species are invertebrates and fungi. Changes in the forest habitat, especially the reduction in decaying wood, is the most common threat for forest species.

The Finnish evaluation of threatened species is the among of the most extensive assessments in the world. Similar evaluations have been made only in Sweden and Norway. The evaluation of 2010 made – for the second time – use of the international classification of threatened species, the IUCN classification. Based on the two consecutive, comparable evaluations carried out between a period of 10 years, comparison of development was possible for the first time.

<sup>29</sup> Endangerment refers to the probability of the species becoming extinct. Anthropogenic and non-anthropogenic causes of endangerment are not distinguished in the assessment of endangerment. All threatened species are classified as critically endangered, vulnerable and endangered.



Grey snail (*Bulgarica cana*) is an extremely endangered species in Finland.

The rate of decline of certain forest species has slowed down in Finland, or in some cases even stopped since the 1990s, although it has not been possible to halt the decline in the forest species overall. Actual taxonomic changes in the number of threatened forest species between 2000 and 2010 demonstrate that positive changes in threatened status had occurred in 81 species. About half of these are beetles, many of which have benefited from retention trees at harvesting sites, particularly aspen.

By contrast, 108 species whose primary habitat is the forest have experienced a deterioration. The trend was particularly significant for lichen. The classification of 34 species of lichen was upgraded, and none were downgraded. Similar negative trends were found among species of butterfly, beetle and hymenoptera.

Factors in forest use constitute the principal cause in the decline for 606 species, or 74% of all threatened forest species. Forest management measures may have reduced the number of certain habitat types such as old-growth forests in their natural state while also weakening the quality of some forest habitats. The number of threatened species is growing the fastest in traditional rural biotopes, of which wooded pastures and grazed forests are wooded land.

### Protected forests (4.9)

Conservation areas are in most cases established through legislation. They are areas where forests are allowed to develop naturally, or where fellings are severely restricted. Most nature conservation areas are on forestry land and are owned by the State.

The area of protected forests (forest and low productive forest) is currently 2.2 million hectares (9.6% of the total area of forests). In addition, there are 0.8 million hectares of forests under restricted forestry use. This brings the total area of forests under different protection restrictions to 3.0 million hectares, 13% of the total area of forests. The majority of protected forests are in northern Finland.

Table 4.9. Protected forests and forests in restricted forestry use, 2008.  
Source: Finnish Forest Research Institute, Forest Statistics Information Service

Forest protection category	Forestry land											
	Forest and low productive forest				Total							
	Forest land		Low productive forest		Total		Waste land		Other		Total	
	1,000 ha	%	1,000 ha	%	1,000 ha	%	1,000 ha	%	1,000 ha	%	1,000 ha	%
Total land area	20,085	100.0	2,735	100.0	22,820	100.0	3,259	100.0	184	100.0	26,263	100.0
Protected forests and areas under restricted forestry use, total (1+2a+2b)	1,686	8.4	1,277	46.7	2,963	13.0	1,766	54.2	34	18.4	4,763	18.1
Protected forests(1+2a)	1,118	5.6	1,062	38.8	2,181	9.6	1,589	48.8	29	16.0	3,799	14.5
Strictly protected forests (1)	1,041	5.2	1,007	36.8	2,048	9.0	1,534	47.1	28	15.0	3,609	13.7
Protected forests where cautious fellings are possible (2a)	77	0.4	56	2.0	133	0.6	56	1.7	2	0.9	190	0.7
Areas under restricted forestry use (2b)	568	2.8	214	7.8	782	3.4	177	5.4	5	2.5	963	3.7

Statistics on protected forests in Finland are prepared on the basis of the national classification. The assessment guidelines (MCPFE classification) used in the classifications and statistics on forest protection in Europe are compiled and accepted by FOREST EUROPE, the Ministerial Conference on the Protection of Forests in Europe (2010). When compared with other European countries, the area of strictly protected forest in Finland (5.2% of all forest land) is the highest of all. Active management of conservation areas to enhance biodiversity is emphasised in other European countries.

#### Extensive statutory conservation areas

The area of protected forests in Finland has tripled since the 1970s. The establishment of statutory conservation areas has been based on conservation programmes for national parks, strict nature reserves, mires, waterfowl habitats, eskers, herb-rich forests, shorelines and old-growth forests adopted by the Government in the 1970s–1990s. The first national parks and strict nature reserves in Finland were established in 1938. There are currently 37 national parks with a total land area of 799,000 hectares. Many national parks have been extended in recent years. There are 19 strict nature reserves with a total area of 153,000 hectares. Wilderness areas (12 areas, total 1.4 million hectares) were established in Lapland in 1991. The Natura 2000 network in Finland is almost complete.

An international team of experts carried out an assessment of the management of Finnish nature conservation areas in 2004. The assessment concluded that the level of management of conservation areas was good and, apart from a few exceptions, the aims of safeguarding biodiversity were achieved.

#### Other statutory forest protection areas

The Forest Act lists habitats of special importance for forest biodiversity, whose natural features must be preserved in the management. A total of over 120,000 of such small sites have been found in surveys of private forests. Their total area is about 95,000 hectares, which is 0.6% of the area of private forestry land. In their surveys, the forest industry companies have found about 11,000 hectares of habitats of special importance listed in the Forest Act, and Metsähallitus has found about 43,000 hectares of such habitats.

A preliminary survey suggests that there is a total of 674 hectares of protected wooded biotopes listed in the Nature Conservation Act (wild woods rich in noble broadleaves, hazel woods and common alder woods).

The Forest Biodiversity Programme for Southern Finland (METSO) lists several voluntary measures for the conservation of forest biodiversity in private forests. As a result of the programme, a total of 1,300 new protected areas were established in private

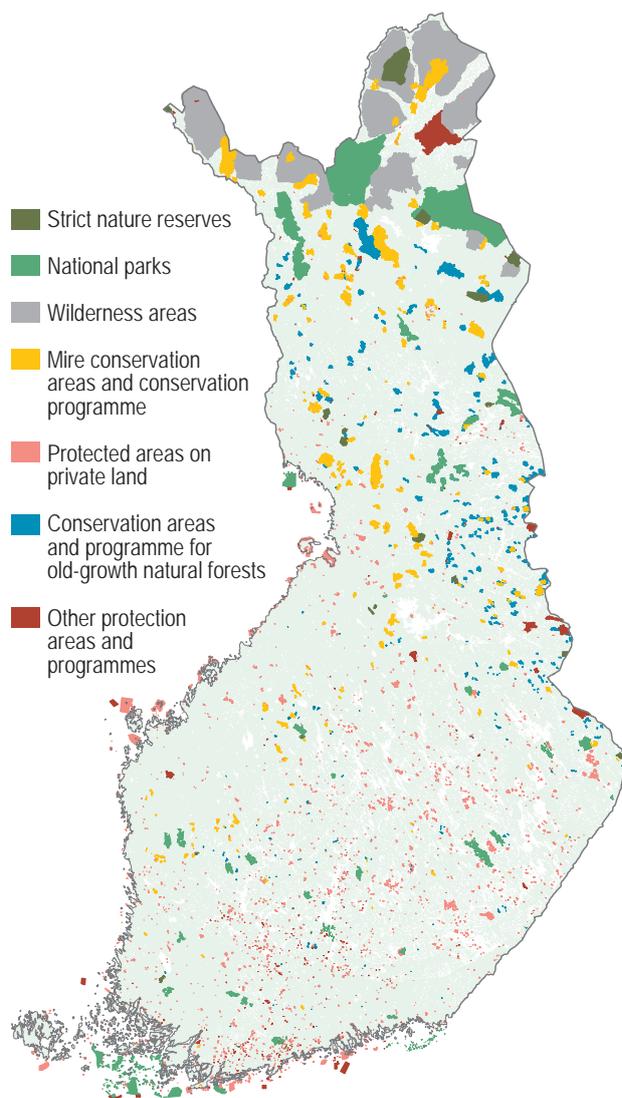


Figure 4.9. Nature conservation areas by forest vegetation zone, 2005. Sources: Finnish Environment Institute, Metsähallitus

forests in 2005–2010. Their total area is about 12,500 hectares, and most of these areas are permanently protected. The combined value of the land and growing stock of the approximate area of 10,000 hectares to be placed under protection is about EUR 35 million.

Under funding from the METSO programme, Metsähallitus has restored<sup>30</sup> a total of 31,000 hectares of heathland forests and drained peatlands located in the protected areas under its management by 2010.

<sup>30</sup> Restoration refers to a process where an ecosystem changed by human activity is restored as near to its natural state as possible. In the restoration of forest ecosystems, the primary goal is to restore natural tree species compositions, structural stand characteristics and ecological processes. The methods used in restoration are prescribed burning, production of deadwood, establishment of small open areas, and stopping up ditches.



The management of timberline forest in northernmost part of Finland is strictly restricted by law in order to prevent the timberline from receding further south.

## Maintenance and increasing of the protective functions of forests (B.7)

Owing to the flatness of the topography and the lack of mountainous areas, forests in Finland do not have the same kind of protective function against erosion and avalanches as they do in many other European countries. Therefore, protective functions mostly focus on protective forests in the timberline area in Lapland. In the protective forest zone<sup>31</sup>, the special aim of forest management is to prevent the retreat of the timberline and to maintain the vitality of forests in the area.

Under the **Forest Act**, forests in the protection zones must be managed with special care to prevent the timberline from retreating further south.

Under the **Government Decision on Protective Forests**, the Finnish Forest Research Institute (Metla) is required to monitor the regeneration of forests in the protective zone and in the high-altitude areas in the Provinces of Lapland and Oulu.

The supreme administrative and executive powers in matters pertaining to protective forests belong to the Ministry of the Environment. Policies are implemented by Metsähallitus and the Forestry Centres. The Finnish Forest Research Institute (Metla) monitors the regeneration of the protective forest zone and the high-altitude forests in the Provinces of Lapland and Oulu, and prepares a report on these every ten years for the Ministry of Agriculture and Forestry.

<sup>31</sup> The protective forest zone consists of the municipalities of Enontekiö and Utsjoki in their entirety, and areas in the municipalities of Inari, Kittilä, Kolari, Muonio, Salla, Savukoski and Sodankylä whose boundaries are marked in the terrain in the land survey operation.

Environmental protection is taken into account when planning the management of protective forests. In the protective zone, fellings for any other purposes than household use are only permitted if covered by harvesting and regeneration plans specifically approved by the relevant Forestry Centre.

## Timberline forests (5.1)

The total area of the protective forest zone in the north is about 3.3 million hectares, of which State forests administered by Metsähallitus account for 2.8 million hectares. 380,000 hectares of State forests are under commercial management without any felling restrictions.

According to the latest report by the Finnish Forest Research Institute, published in 2003, the regeneration of forests in the protective zone has been fairly successful. Unless the climate changes suddenly, no changes are expected in forest regeneration.

Table 5.1. State forestry lands in the protective forest zone. Source: Metsähallitus

	1,000 ha		
	In forestry use	In forestry	Total
Forest land	211	382	593
Low productive forest land	79	896	973
Waste land	90	1,143	1,233
Total	380	2,421	2,801

## Protective forests – infrastructure and managed natural resources (5.2)

As regards topography, Finland is a level country. Agricultural land only covers 8.9% of the total area and field parcels are small and surrounded by forests, which is why there is hardly any need to establish hedges or wooded zones on fields as windbreaks.

Forests have local significance in mitigating the damages caused by traffic. Major arteries are generally routed through forests far away from population centres, and even in built-up areas residential districts are set off from traffic routes with wooded buffers as wide as possible. Trees are efficient in capturing dust and exhaust fumes. For a noise barrier, a wooded band several dozen metres wide is needed, depending on the structure of the wood. The visual barrier trees present has also been observed to reduce the subjective experience of noise disturbance.

Wooded protective areas in communities are planned in conjunction with land use planning. For example, green belts along busy roads which shelter adjacent areas from the damaging effects of traffic and which cannot be used for recreation because of their location are marked as such in local and master plans.

### Impacts of forest management on waters (additional indicator)

Because of the great number of lakes, rivers, small water systems and peatland forests in Finland, issues relating to water systems receive special attention in forest management.

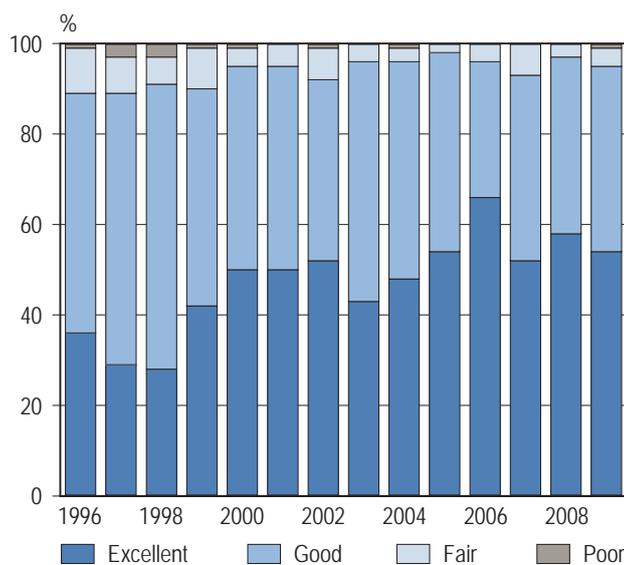


Figure 5a. The quality of water protection in harvesting, 1996–2009.

Source: Assessment of the quality of nature management in commercial forests, The Forestry Development Centre Tapio.

The greatest impacts of forest management on waters are caused by ditch cleaning and supplementary ditching, regeneration fellings and related soil preparation, as well as fertilisation. The environmental load from forest management weakens the condition of otherwise clean headwaters, brooks and other small water bodies. Important groundwater areas are taken into consideration in forest management and fellings, and the quality of groundwater is not compromised.

The phosphorus load from forest management accounted for about 6% of the total anthropogenic nutrient load in 2008, and the nitrogen load accounted for about 4.4%. The nitrogen load from forestry has decreased as a consequence of the decrease in new drainage projects. The fertilisation of peatlands has increased the phosphorus load caused by drained mires.

The national water protection programme, **Guidelines for water protection to 2015**, specifies some targets for the reduction of the environmental load on waters from forestry. The measures for the implementation of the policy guidelines for water protection are defined and targeted in detail in water management plans. Forest management measures included in water management plans include the increased use of surface runoff fields, submerged dams, drainage dams and wetlands in ditch cleaning and supplementary ditching and in the combating of erosion in forests (nature management projects); enhanced waterway protection planning; training for contractors and planners; and advisory services for forest owners in water protection issues.

Forest management measures must be planned so that they do not adversely affect the condition of small water systems, and

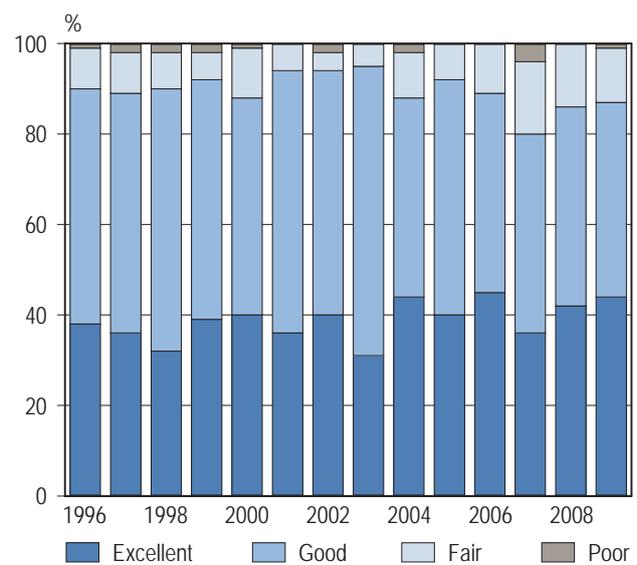


Figure 5b. Quality of water protection in soil preparation, 1996–2009.

Source: Assessment of the quality of nature management in commercial forests, The Forestry Development Centre Tapio.

small water systems whose natural values have declined must be restored. A small water system restoration programme is to be drawn up with reference to implementing water management plans, and this will involve forest management measures too.

**Finland's National Forest Programme 2015** sets out targets for the reduction of the environmental load on waters from forestry. Under the **Act on Environmental Impact Assessment Procedure**, the environmental impacts of large-scale peat production and drainage projects must be assessed.

Knowledge about the environmental impacts of forest management and ways for reducing it has increased substantially in the last 30 years, and new information has been applied on a broad scale.

According to **the Act on the Financing of Sustainable Forestry**, measures for water management which receive funding must be based on a duly prepared plan. A water protection plan must always be included in plans concerning ditch cleaning and supplementary ditching.

Guidelines and recommendations on water and soil protection in forest management have been prepared by private forestry organisations, Metsähallitus and forest industry companies in co-operation with environmental authorities. In 2011, the Regional Centre for Economic Development, Transport and the Environment of Central Finland will be coordinating the launch of a broad-based three-year project piloting water protection nationwide in peat production and forestry, known as the **TASO project**. The purpose of this project is to generate new information at the national level and to find practical solutions for the management of water protection problems in peat production and forestry.

Water protection is also addressed in the forest certification standards: an unbroken riparian zone must be retained along waterways and small bodies of water, natural mires are not drained, a water protection plan is drawn up in conjunction with ditch cleaning and supplementary ditching, no chemical pesticides or fertilisers are used in groundwater areas, and the use of chemical pesticides is avoided in general.

In harvesting and silvicultural work, riparian zones with an unbroken forest cover are left along waters, digging breaks and sludge sumps are established in soil preparation, and felling residue is handled so that no nutrients are washed into ditches or waters. Logging roads are planned so as to ensure that no channels for water are created between ditches and small water bodies.

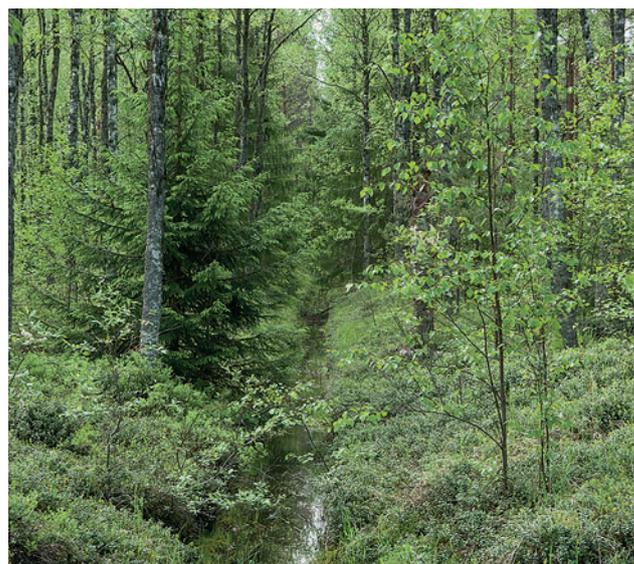
Since 1995, the quality of water protection in harvesting and soil preparation works in private forests and forests of the forest industry companies and Metsähallitus has been monitored



An unbroken riparian zones must be retained along waterways and small bodies of water during fellings and silvicultural measures for the protection of waters.

by **Forestry Development Centre Tapio** in conjunction with the assessment of the quality of nature management in commercial forests. The quality of waters is also monitored by the environmental administration. Statistics on the nutrient load, runoff into waters, etc. are compiled by the Finnish Environment Institute.

Water protection in conjunction with harvesting and soil preparation improved during the monitoring period 1995–2009. In 2009, the quality of water protection in private forests was rated either excellent or good in over 95% and over 87% of the assessed roundwood harvesting sites and soil preparation sites, respectively. On average, the quality of water protection has been good or excellent in over 90% of the harvesting and soil preparation sites.



Natural peatlands are no longer drained in Finland, but the conditions of already drained peatlands is improved in ditch cleaning and supplementary ditching projects. A water protection plan is drawn up in conjunction with these operations.



Installation of wooden wall elements for a private single house.

## Maintenance of the economic viability of forestry (B.8)

Economic viability is a basic requirement of sustainable forest management. Without an economically viable forest economy, there can be no ecologically or socially sustainable forest management, either. Unlike in many other European countries, in Finland wood of all forest products has by far the most important effect on the economic viability of forestry. Forest industry products account for almost 20% of Finland's total exports.

The key factors affecting the economic viability of forestry are the market price of timber and sales volumes. Because most of the production of the Finnish forest industry is exported, the domestic market for roundwood is dependent on the international demand and prices for the exported products. The price of roundwood is also affected by the volume and price of imported roundwood.

Profitability can be improved by exploiting the current logging potential, by carrying out timely forest management works, by developing the methods available for forest management and improvements, by promoting competition in the forest-based services market, and by chaining forest management and logging sites. Forest advisory services aim to ensure that this is the case. Moreover, the recommendations for commercial forest management have been reviewed and rotation recommendations have been revised to improve economic viability.

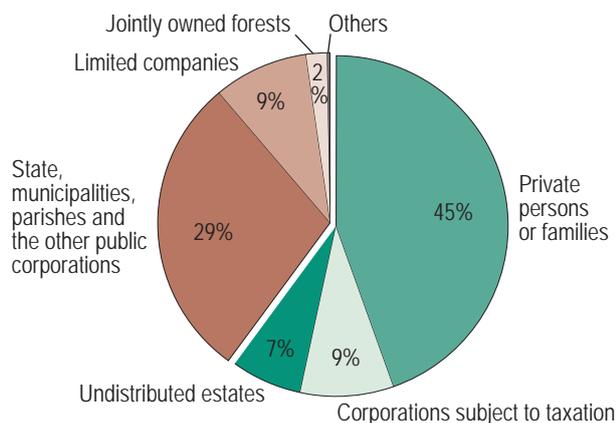
The key objectives of **Finland's National Forest Programme 2015** include strengthening forest-based business and increasing the value of production, as well as improving the profitability of forestry. The selection of means is extensive, ranging from

measures aiming at increasing the size of holdings to developing business skills of entrepreneurs.

The **Strategic Programme for the Forest Sector (MSO 2009–2011)** supports the objectives of the NFP 2015 with, for example, its development measures for enhancing the competitiveness of domestic production in Finnish forestry and the forest products industry, and for enhancing the business opportunities and business expertise of the forest cluster.

Since the economic viability of forestry is vital to the maintenance of habitation, employment and entrepreneurship in rural areas, forestry is supported by several measures in regional policy. Entrepreneurial operations are encouraged by taxation and by granting start-up subsidies to new businesses. Regional activities in forestry and the wood sector are also supported through the structural funds of the European Union and by the Centre of Expertise Programme.

Forest owners can also improve profitability by performing management works on their own holdings. Increasing the use of wood for energy also help to improve profitability. The government can affect the economic viability of forestry with support and taxation measures. Under the Act on the Financing of Sustainable Forestry, private forest owners are eligible for public funding for silvicultural and forest improvement works. The funding is justified by the social benefits gained from supporting the least profitable long-term investments of private forestry and from joint projects of forest owners.



**Figure 6.1.** The share of forest land area by forest ownership category, 2008.

Source: National Board of Taxes

## Forest holdings (6.1)

Finnish forestry is mainly in the hands of families, and the properties are mainly quite small. Private forest owners own 12 million hectares of forest land; the State, 5 million hectares; companies 2 million hectares; and others (municipalities, parishes and other public corporations) own 1 million hectares of forest land.

In private forests, the number of forest property entities<sup>32</sup> of over 2 hectares is about 347,000, and the total number of owners of these entities, including the stakeholders of estates and partnerships, is almost 739,000. Some 74% of private forests are family-owned. The average size of a forest property entity is 30 hectares. The average size has not changed in recent years, but the size distribution has changed so that the number of both small (less than 10 hectares) and large (over 200 hectares) properties has increased.

Two kinds of structural changes take place in forest ownership: changes amongst owner groups and internal changes within a group. Changes amongst owner groups have been very small, and have generally involved the purchase of holdings. Some forests change hands through the exchange of land or, in the acquisition of conservation areas, also by expropriation by the government.

Changes within a group of forest owners mainly happen in the private forestry sector. The most characteristic features are the slow pace of change of forest property ownership and the aging of the forest owners – the average age of forest owners is 60 years, and pensioners are the largest single group of forest owners.

<sup>32</sup> The number of forest property entities includes forest properties owned by the same forest owner across the country.

Regional differences in the structure of forest ownership are high. The share of State-owned forests increases towards the north and east, whereas private ownership is more common in the southern parts of the country. For this reason, the importance of private forests in terms of roundwood production is higher than might be concluded from their share of the total area. Moreover, a higher share of State forests are protected.

## Contribution of forest sector to gross domestic product (6.2)

The contribution of the forest sector to the gross domestic product GDP<sup>33</sup> reflects the importance of the sector for the national economy. The contribution can be used in regional analysis to evaluate the significance of the forest sector as a source of employment in rural areas and a factor in economic development.

In 2009, the year of economic recession, the Finnish GDP at market prices was EUR 171 billion. The value added (gross at current prices) was EUR 149 billion, of which forestry accounted for 1.7%, the wood-products industry for 0.7%, and the pulp and paper industry for 1.7%.

The absolute value and value added of the output of the forest industry have been declining in recent decades, and correspondingly the contribution of the forest industry to the national economy has been decreasing since the early 1980s. The decline became particularly sharp in the 2000s due to weak growth in the forest sector but also to the poor profitability of the pulp



Plywood industry has a history of over one hundred years. Finland is the biggest producer of plywood and veneer sheets in EU.

<sup>33</sup> Gross Domestic Product (GDP) is the sum of the added value of the goods and services produced in the national economy. In addition to production for the market, GDP also includes products and services which are not valued on the market (e.g. services produced by the State, municipalities and the Social Insurance Institution). GDP is presented by industry sectors.

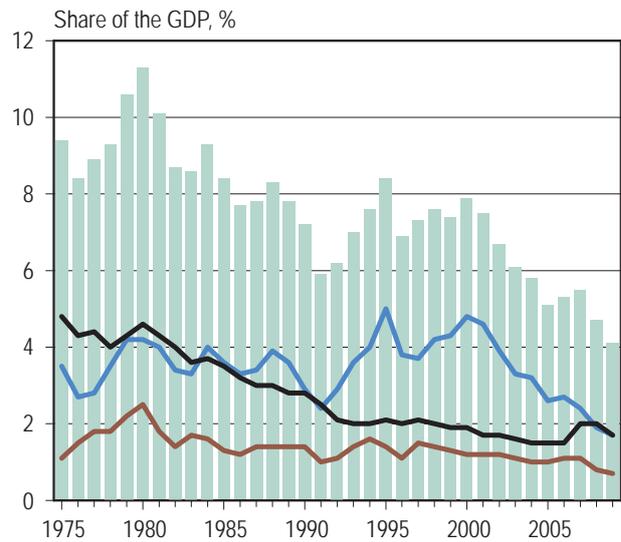
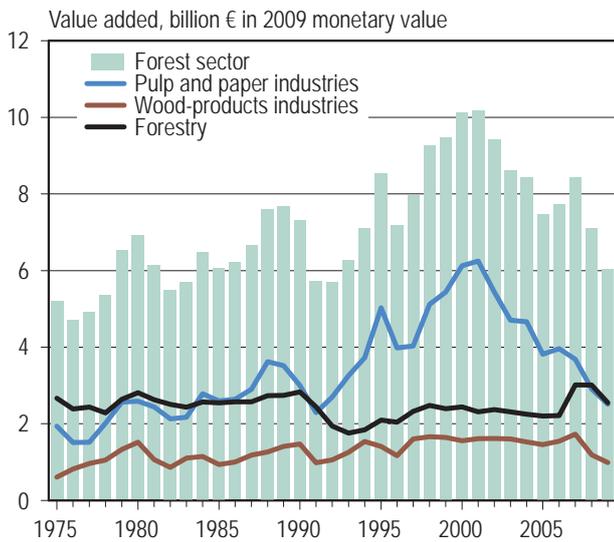


Figure 6.2a. Value added in the forest sector and its share in gross domestic product (GDP), 1975–2009.  
Source: Statistics Finland

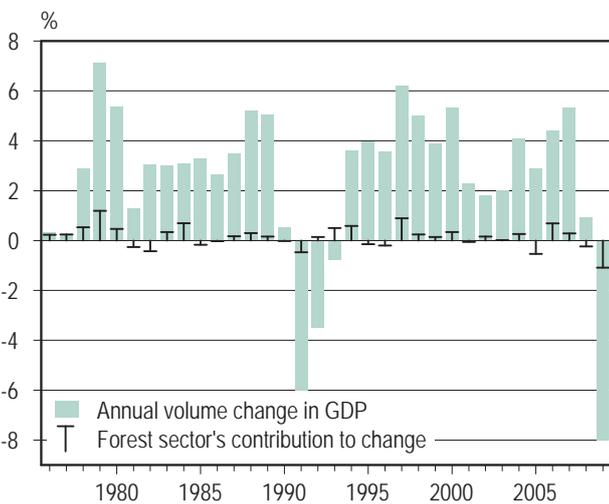


Figure 6.2b. Annual changes in the total GDP and forest sector's contribution to change, 1976–2009.  
Source: Statistics Finland

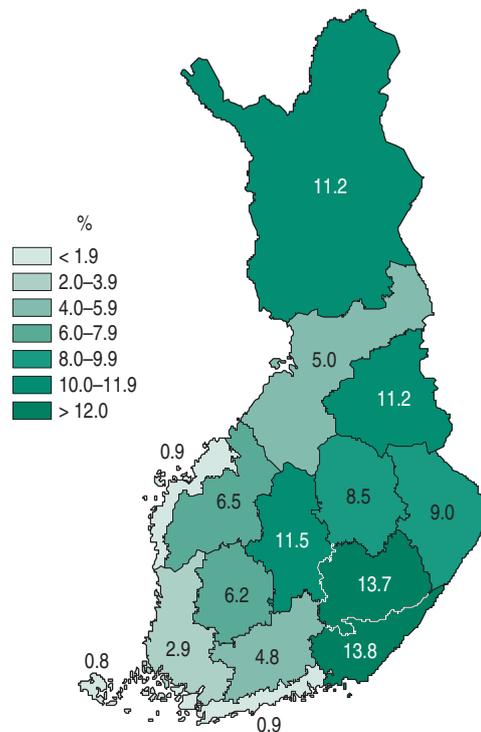


Figure 6.2c. The share of forest sector in the total regional GDP by forestry centre, 2008.  
Source: Statistics Finland



The main part of the Finnish forest chemical industry production is exported, consisting mainly of paper and paper board.

and paper industry, which has discouraged new investments in the sector in Finland. The forest sector has also an indirect effect on other industries, such as transport and mechanical industry. In addition to direct added value, the forest sector contributes to the national economy through multiplier effects.

The contribution of the forest sector to the GDP varies by region. Regions with a high concentration of forest industry are south-eastern and central Finland, Lapland and Kainuu. The contribu-

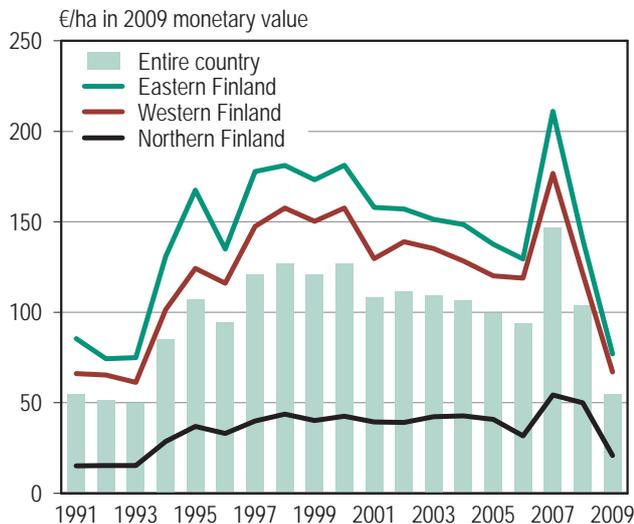
tion of forestry to the economy it the greatest in Kainuu, South Savo and Lapland. The high regional differences in the contribution to the GDP are mainly due to high concentration of pulp and paper industry, and the changes in these figures are usually small. However, the ongoing upheaval in the forest industry will change the industry's contribution to the GDP notably.

### Operating profit in wood production in private forestry (6.3)

The result of private forestry is measured with operating profit, which is the difference between income and costs<sup>34</sup>.

The operating profit depends primarily on the volume of harvest and the price of timber. To ensure regional comparability of data, the operating profit is often reported relative to the area of forest land. The operating profit alone is not a sufficient indicator of sustainable forest management; it needs to be supplemented with data on the sustainability of the amount of felling.

Over the past 10 years, the operating profit in private forestry has varied from EUR 53 to EUR 136 per hectare. In 2009, the year of economic recession, the operating profit was EUR 698 million, EUR 53 per hectare of forest land area, which was the lowest seen in the 2000s. Regional differences were consider-



**Figure 6.3.** Operating profit per ha of forest land in private forests, 1991–2009. Sources: Finnish Forest Research Institute; Forestry Development Centre Tapio; Statistics Finland

<sup>34</sup> The operating profit from wood production (before taxes) is calculated by subtracting the total cost of wood production from the sum of gross stumpage earnings and subsidies paid by the State to forest owners. Income from delivery sales is not included. The operating profit measures only cash flows, and does not take into account savings in wood cuttings or the capital value of the effect of reduced cuttings on the overall timber production performance.

able. The operating profit in eastern Finland was EUR 75 per hectare, in western Finland EUR 66 per hectare, and in northern Finland EUR 20 per hectare. Because only one fifth of income in wood production of the private forest owners goes outside the region, the importance of this income to the region where the forest is located is significant.

### Public commodities of forests (6.4)

Forests produce many products and immaterial services which benefit all citizens and which are important contributions to the quality of life. Most of the universal public goods are free, and commercialisation of all of these goods is not possible or reasonable. In some cases, society compensates the production of a public good to the landowner.

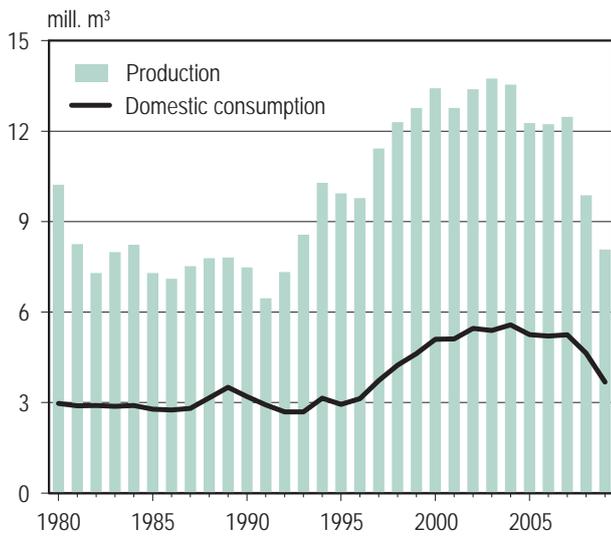
The Forest Biodiversity Programme for Southern Finland (METSO) offers options for forest owners to protect their forests or to enhance natural values of the forests by management and receive compensation for these activities. The options the METSO programme offer are permanent protection, temporary protection and management of forest habitats. Permanent protection can be implemented by acquiring the area into State ownership or by establishing a private conservation area. An area may be placed under temporary protection for a maximum period of 20 years pursuant to the Nature Conservation Act. Also, pursuant to the Act on the Financing of Sustainable Forestry, an area may be placed under temporary protection for 10 years at a time by concluding an environmental support agreement.

Typical sites covered by environmental support include valuable habitats protected under the Forest Act. With the help of the support, the area protected can form a more extensive entity than that protected by law. Management of forest habitat can be maintaining or enhancing natural values, or restoring the forest to a more natural state. Natural environment management projects most commonly involve water protection, habitat surveys and management, or landscape management. The management work is planned in cooperation with the forest owner, and the management will not cause costs to the forest owner.

The Government has set as a target that the total of areas voluntarily offered for conservation by the landowners will be 96,000 hectares by 2016, either set up as private conservation areas or acquired into State ownership. Moreover, the total area of sites safeguarding biodiversity in private forests will be increased by 82,000 to 173,000 hectares. Between 2005 and 2010, 11,893 hectares of forest have been placed under permanent protection and 636 hectares under temporary protection in the METSO programme. The total amount of environmental support for forest management granted under the Act on the Financing of Sustainable Forestry in 1997–2009 was EUR 31 million, and agreements valid at the end of 2009 covered a total of 39,643

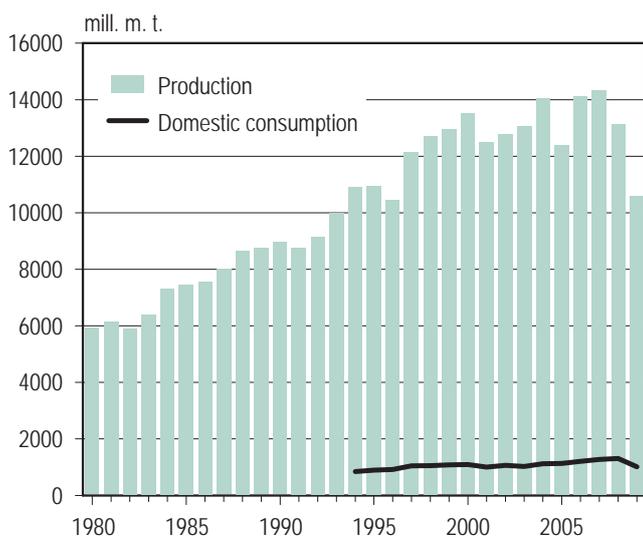
hectares. In all, EUR 32 million has been used on natural environment management projects.

Recreational value trading presents an opportunity to combine the needs of landowners and others interested in the recreational value of nature. In recreational value trading, the landowner surrenders certain rights relating to the use of the property or undertakes to maintain the land he/she owns so that its recreational values (for example, landscape values) are kept to an agreed standard, or accords agreed rights for the recreational use of the land to the purchaser of the recreational value.



**Figure 6.7a.** Production and domestic consumption of sawn goods, 1980–2009.

Source: Finnish Forest Industries Federation; Finnish Forest Research Institute



**Figure 6.7b.** Production and domestic consumption of paper and paperboard, 1980–2009.

Source: Finnish Forest Industries Federation; Paperinkeräys Oy

## Consumption of products of the forest industries (6.7)

The per capita consumption of products of the forest industries gives an idea of the economic significance of wood and forest industry products, but it is also an indication of the status and appreciation of wood in society at large.

Because wood is a renewable natural raw material, its use is recommended instead of non-renewable raw materials (plastic, metal, concrete, etc.) due to environmental and energy-related benefits. Above all, factors in favour of the use of wood are its capacity to sequester carbon, the good eco-balance of its procurement and production chains (especially in wood production), and life cycle issues.

The consumption of sawn goods per capita in Finland is the highest in the world. In 2009, the consumption was 0.7 cubic metres per capita, but the average consumption in the 2000s was about one cubic metre per capita. The consumption of sawn goods is connected especially to the use of timber in housing construction and in the repair of old residential buildings. Domestic consumption of paper and paperboard<sup>35</sup> was 190 kg per capita in 2009. Domestic consumption has remained around a little over 200 kg per capita for the last decade.

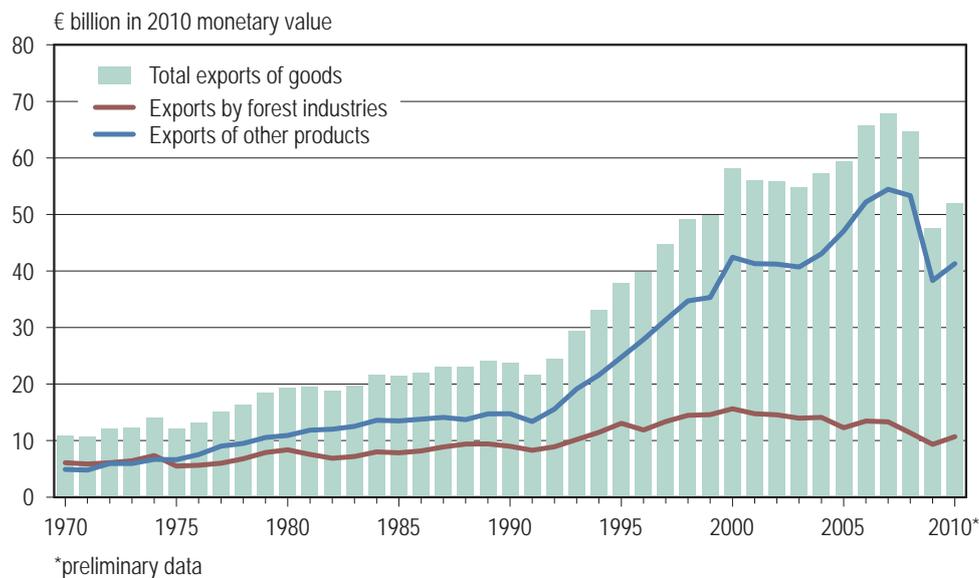
Most of the production of forest industry products in Finland is exported. In the last decade, the shares of domestic consumption of the paper, wood products and sawmill industry production were about 10%, 30% and 40%, respectively.



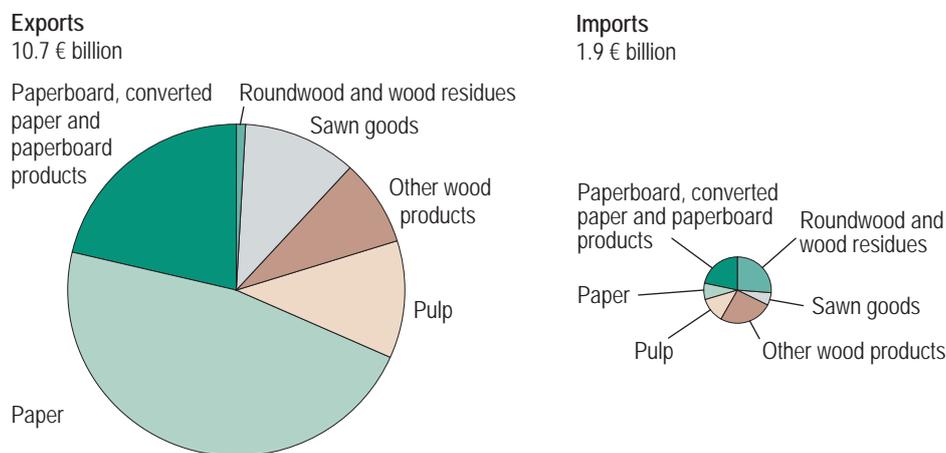
Demand for printing and writing papers is predicted to decrease due to the rapid development of electronic communication technology.

<sup>35</sup> Calculated domestic consumption of paper and paperboard is the sum of domestic deliveries plus imports minus exports of converted products and net exports of printed products.

**Figure 6.8a.** Total real value of exports and exports of forest industry products, 1970–2010.  
Sources: Boards of Customs; Finnish Forest Research Institute



**Figure 6.8b.** Foreign trade in roundwood and forest industry products by product group, 2010.  
Sources: Boards of Customs; Finnish Forest Research Institute



## Foreign trade in roundwood and forest industry products (6.8)

Foreign trade in roundwood and forest industry products gives an idea of the contribution of the forest industry to the national economy. It is also an indication of the degree of domestic origin of wood as raw material and of the forest industry products. Foreign trade with wood-based products is important for the Finnish economy because one fifth of the total value of Finnish exports of goods comes from them. The value of wood-based goods imported to Finland is low, only 4% of the total value of imports of goods.

In 2010 the total value of the export income of the forest industry was EUR 10.7 billion, of which 80% was from products of the pulp and paper industries, 19% from the wood-products industries, and 1% from the export of roundwood. The total value of the imported wood and forest industry products in 2010 was EUR 1.9 billion, of which 42% was from products of the pulp

and paper industry, 32% from the wood products industries, and 26% from the import of roundwood. In 2010, 12.2 million cu.m of roundwood was imported to Finland. This figure was one third higher than in the previous year, but still one fourth lower than average value during the preceding 10-year period.

## Improvement of employment and occupational safety in the forest sector (B.9)

The importance of forestry and the forest industry to the vitality of rural areas and for regional economy continues to be great, although the number of jobs provided by the forest sector has decreased. Improved productivity of work and technological development have led to the mechanisation of forestry work – especially harvesting – and the processes of the forest industry, which has diminished the need for labour.

Intense mechanisation of harvesting took place in the 1980s and 1990s. It is no longer possible to increase the degree of mechanisation in harvesting, but the functionality of wood harvesting chains and the fleet of harvesting machines are continuously being improved and renewed. At the same time, the conditions of forestry work have improved substantially and the number of occupational accidents has fallen.

Forest management still requires a great deal of human labour. Especially management of young stands, and harvesting of energy wood, will provide job opportunities in the future. Part of forestry work is performed by the forest owners themselves, but aging and urbanisation of the forest owners will reduce the amount of this kind work.

In addition to the major forest companies, there are a great many small and medium-sized enterprises (SME) in the forest sector, which engage in forest machinery and transportation, sawmills, manufacture of wood products, and other forest-related activities. Efforts have been made to improve the operative conditions of SMEs in particular through research programmes in wood products and national and regional expert networks in the field of wood products. Networking among SMEs has increased, which has also had positive repercussions on employment.

The supply of labour and occupational safety and health in the forest sector fall within the domains of several different ministries. The Ministry of Agriculture and Forestry and the Ministry of Employment and the Economy participate in maintaining and steering the operating conditions of forestry and forest industry. The Ministry of Social Affairs and Health administers and monitors issues involving occupational safety, the Ministry of Employment and the Economy is responsible for the implementation of labour legislation and the coordination of employment programmes, and the Ministry of Education is responsible for ensuring that education and training correspond to the needs of the labour and business sectors.

#### Improvement of employment and labour legislation

One of the primary aims of education and employment policy is to improve the match between supply and demand on labour markets both locally and regionally. The supply of labour in the long term is secured by ensuring that education and training meet the needs of employment. The aim is to increase attractiveness of the forest sector among young people so that a sufficient number of students would find their way into forest machine operator and forestry worker education in particular. Functions relating to the supply and sufficiency of labour include education (both youth and adult education), career guidance and employment exchange services.

**Finland's National Forest Programme 2015 and the Strategic Programme for the Forest Sector 2009-2011** include

numerous objectives for enhancing competitiveness and business expertise of the forest sector companies, which in turn will contribute to maintenance or creation of jobs.

The **Employment Contracts Act** contains provisions on the rights and obligations of employees and employers in an employment relationship, the commencement and termination of employment, and many other terms and conditions related to employment. General binding of collective labour agreements is also enacted in the act. The **Working Hours Act, Annual Holidays Act, Study Leave Act** and **Act on Job Alternation Leave** lay down provisions on working hours, holidays and leaves.

Other statutes regulating working life include the **Collective Agreements Act, Act on Mediation in Labour Disputes, Act on Equality between Women and Men, Non-Discrimination Act, Act on Co-operation within Undertakings, Act on Personnel Representation in the Administration of Undertakings, Act on Personnel Funds, Young Workers' Act, Act on the Protection of Privacy in Working Life, Employees Pensions Act, and Act on the Contractor's Obligations and Liability when Work is Contracted Out.**

**Collective labour agreements** concluded within the individual sectors of the economy regulate the wages and other terms and conditions of employment in the sector. In the forest sector, the parties to the collective labour agreement are the employer and employee organisations in forestry and the forest industries.

#### Improving safety at work and legislation on occupational safety

The main goal of occupational safety and health is to maintain and promote the health, safety and working capacity of employees, and to prevent accidents and occupational diseases. Special goals for improvement include the prevention of work-related musculoskeletal diseases and the promotion of mental health and coping at work among employees. To improve occupational safety and health, an Occupational Safety and Health Strategy was drawn up in 1998, with monitoring reports prepared at three-year intervals. The forest sector has had its own development projects for promoting safety and wellbeing at work, and Metsäteho is currently preparing a research and development programme on wellbeing at work in forestry. General provisions concerning occupational safety and health also apply in the forest sector.

Under the **Occupational Health and Safety Act**, employers are required to take care of the safety and health of their employees while at work. The purpose of the Act is to improve work environments and working conditions in order to safeguard and maintain employee's capacity for work and to prevent occupational accidents and diseases and other damage to the physi-

cal and mental health of employees resulting from work and the work environment.

The **Occupational Health Care Act** provides for the duty of employers to arrange occupational health care and on the content and organisation of the occupational health care provided.

The **Act on Occupational Safety and Health Enforcement and Cooperation on Occupational Safety and Health at Workplaces** provides for a procedure to be followed by occupational safety and health authorities in monitoring occupational safety and health and for cooperation on occupational safety and health between employers and employees at workplaces.

Other legislation relating to occupational safety and health includes the **Working Hours Act** and **Employment Accidents Act**. There are legislative instruments specifically for the forest sector, such as the **Government Decree on Safety of Harvesting in Forest Management**. Collective agreements also include provisions on occupational safety and safety equipment.

#### Occupational safety and health organisations

Compliance with the legislation on occupational safety and health is monitored by **Occupational Safety and Health Inspectorates** under the Ministry of Social Affairs and Health. The inspectorates also support measures to ensure occupational safety in the workplace.

The objective of the **Centre for Occupational Safety** is to improve the conditions of occupational safety and wellbeing at work, productivity, personnel management and cooperation in organisations. The Centre for Occupational Safety provides training, publications and development services for organisations. The Centre publishes manuals and instructions on occupational safety, also for the forestry sector.

The **Finnish Institute of Occupational Health** is a multidisciplinary research and expert organisation dedicated to improving occupational safety and health and the wellbeing of employees by means of research, communication, specialist services and training.

### Forest sector workforce (6.5)

The number of people employed in the forest sector is an indication of the social impacts and benefits of forestry and forest industry. The employment contribution of the forest sector is an important indicator, especially in assessing economic and social development in rural areas.

In 2010, there were 69,000 people employed in the forest sector. Of this number, 22,000 were in forestry – 14,000 as salaried

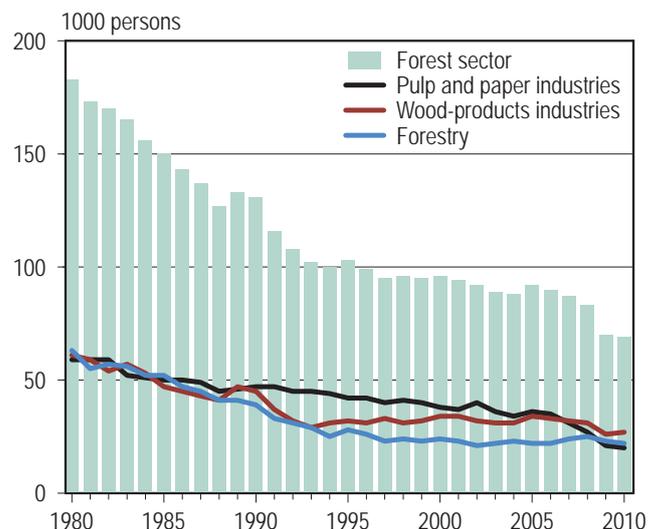


Figure 6.5a. Employed persons in the forest sector, 1980–2010. Source: Statistics Finland

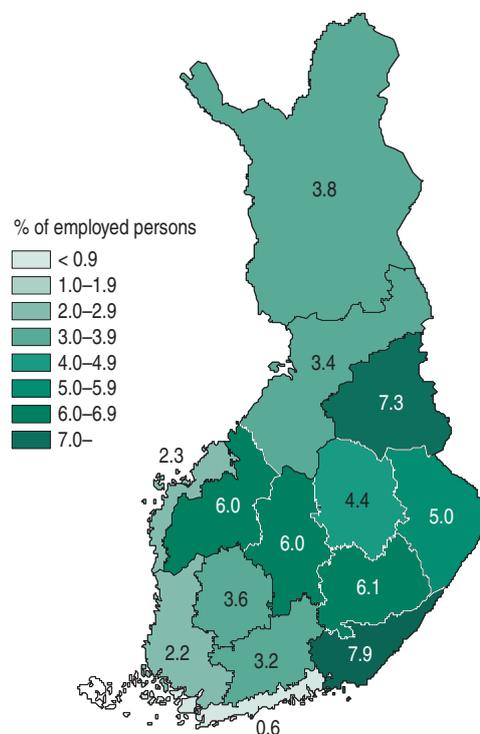


Figure 6.5b. Proportion of forest sector (incl. furniture industry) of employed persons by forestry centre, 2010. Source: Statistics Finland

employees and 8,000 as entrepreneurs. In addition to them, a considerable number of forest owners worked in their forests, mainly in silvicultural work. The number of people employed in the wood-products industry was 27,000 and in pulp and paper industry 20,000. The forest sector employed less than 3% of all people employed in Finland.



Using the correct equipment and accessories for the job is one of the most important things in preventing accidents and damage at work. Planting tube for planting containerised seedlings is an ergonomic way of sparing the back.

As a result of the mechanisation of harvesting and automation of the production processes of the forest industry as well as outsourcing, the number of people employed in the forest sector has decreased considerably since the early 1980s, when the sector still employed about 8% of the national workforce. The global economic recession caused especially the number of people employed in the pulp and paper industry to collapse in 2008–2009. In 2010, the average unemployment rate was 9.0% in the forest sector – 7.9% in forestry and 9.6% in the forest industry. The overall unemployment rate at that time was 8.4%.

In 2010, there were 13,000 women employed in the forest sector (19% of the employed people in the sector), of whom 3,000 worked in forestry, 5,000 in the wood-products industry, and 5,000 in the pulp and paper industry. Women account for a high percentage of the workforce in Finland by international standards – 49% of all employed people in all sectors of the economy. However, the forest sector remains clearly a male-dominated sector.

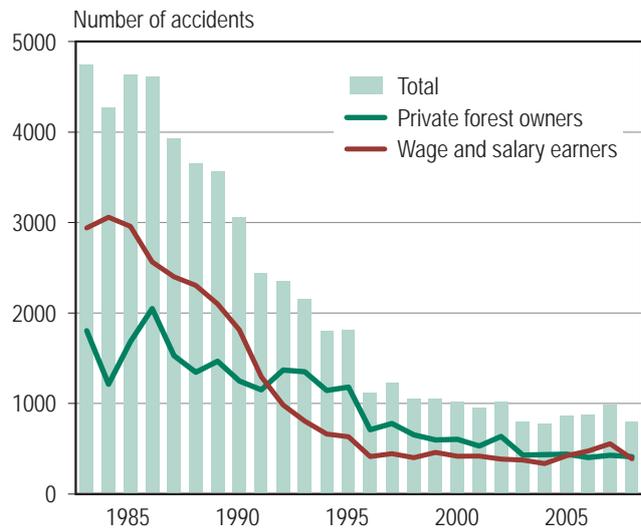


Figure 6.6. Accidents at work in forestry, 1983–2008. Sources: Statistics Finland; Farmers’ Social Insurance Institution (Mela)

## Occupational safety and health in forestry (6.6)

Forestry work is hard and dangerous. Risks can be mitigated by developing work methods, adopting preventive measures and mechanising the work. The recognition and monitoring of occupational accidents and diseases helps developing better working methods and improving safety.

In 2008, there were 800 accidents at work in forestry, 388 of which occurred to paid employees and 412 to forest owners working in their own forest. Accidents in the forestry have decreased during the last 20 years. This is mainly because of the mechanisation of harvesting, but also because of better education and training and advances in protective equipment. There were 2,455 accidents at work in the forest industry in 2008, two thirds of them in the wood-products industry.

The prevention of occupational diseases and promotion of occupational health and wellbeing at work are also taken into account in the development of working methods and conditions. Occupational health care and rehabilitation are used to maintain the working capacity of the workforce.

An increasing proportion of employees in forestry are clerical employees and work is increasingly subject to profit targets and schedules. This has the effect of increasing the psychological stress of work and the consequent susceptibility to disease. The maintenance of wellbeing at work is becoming more and more diverse.

## Safeguarding the opportunities of the public for participation (B.10)

One commonly recognised aspect of social sustainability is the opportunity of stakeholders and the public to participate in decision making. Experience shows that transparency and co-operation between different stakeholders already in the planning stage is an efficient way of preventing conflicts.

In Finland, extensive forest programmes and projects are usually prepared in working groups with representation from various interest groups, including forest owners, forest industry, trade unions, tourism and nature conservation organisations, youth organisations, hunters, reindeer herding associations and public authorities. Typical forms of participation include stakeholder hearings and requesting statements from interest groups in the planning stage of projects and programmes.

### International conventions and commitments

The international instrument safeguarding opportunities for public participation is the Convention on Access to Information, Public Participation in Decision-making and Access to Justice in Environmental Matters, known as the Aarhus Convention (1998). Issues concerning public participation are also addressed in commitments made by the UN Conferences on Environment and Development and the Ministerial Conference on the Protection of Forests in Europe.

### National programmes and legislation

The established practice of governance includes the provision of opportunities for public participation. The **Administrative Procedure Act** and the **Act on the Openness of State Activities** contain general provisions governing public administration. They are applied to promote the opportunities of citizens to receive information about matters that involve them and to participate in decision making.

The special rights of local inhabitants in Lapland and the archipelago to traditional livelihoods, hunting and berry collecting are enshrined in the **Act for Traditional Means of Livelihood**, the **Hunting Act**, and the **Off-Road Traffic Act**. The preservation of the cultural heritage and livelihoods of the Sámi is addressed in the **Act on Wilderness Reserves** and the **Skolt Act**.

The right of public participation and associated procedures have been reinforced in recent comprehensive reforms of legislation on environmental management. Extensive opportunities for public participation are ensured especially in land use planning, nature conservation and the procedure for environmental impact assessment and permits.

## Information dissemination and interaction

The democratic system of decision-making in Finland supports public participation. The key development goals are to increase opportunities for interaction and enhance the use of information networks. Attitude surveys and opinion polls are used to find out about popular attitudes towards and views on forest management and forests. The activities of NGOs are supported by granting funds for their operation from government funds.

Forest owners' and civil organisations participate in many preparatory and decision-making processes. Direct channels of participation have also been established. For example, an Internet forum for consultation with citizens is used for finding new ways to form a foundation for reviewing the national strategy and action plan on promoting biodiversity. Regional forest programmes are drawn up by the Forestry Centres in cooperation with the stakeholders of forestry in their area. The regional natural resources programmes and landscape-ecological plans of Metsähallitus are drawn up in a participatory process where local inhabitants and stakeholders have an opportunity to take part in the preparation of the plans.

Local inhabitants have the opportunity to influence the management of forests and woods in built-up areas through participatory processes incorporated in land use planning procedures. Many municipalities use surveys and questionnaires to monitor outdoor activities and the wishes of the public, organise public discussions on the management plans for municipal forests and publish information about harvesting.

Because of the great importance of forests for Finnish society, discussion about them is lively and very broad. Forest issues are also dealt with in Government programmes. Because forest ownership is broad-based, approximately 739,000 Finns have a direct contact with forests as forest owners. The protection of forests and the interests of forest-dependent industries in northern Lapland have necessitated the greatest efforts to reconcile the different views.

## Research, training and education in forestry (B.11)

### Trends

Because of the great importance of forests for Finnish society, Finland has invested in forest research and forestry education and training. The forest cluster is one of the most important national clusters of expertise. Finland also aims at becoming an international cluster of excellence in the forest and wood sector.

In the last few years, particular focal areas of forest research in Finland have been changes in the operating environment



Field experiments such as forest seed collection for measuring the annual seed crops are necessary for studying forest regeneration processes.

of the forestry and forecasting. The purpose is to direct the research from forest ecosystem-based research with main focus on growing tree stands and forest management towards a more customer-oriented research approach that serves the business sector. It is estimated that for the forest sector, the best future potential for success lies in bioeconomy based on renewable natural resources. Based on this vision, research has been increased especially on forest bioenergy and new opportunities for the use of wood.

The role, structural aspects and position of sectoral research institutes have been studied in a working group on sectoral research. With key expertise in natural resources and environment, the **Consortium of Natural Resources and Environmental Research (LYNET)** has been set up to provide a new operational model. This consortium is formed by research institutes under the administrative sectors of the Ministry of Agriculture and Forestry and the Ministry of the Environment, and its members are the **Finnish Food Safety Authority Evira**, the **Finnish Geodetic Institute**, **MTT Agrifood Research Finland**, the **Finnish Forest Research Institute (Metla)**, the **Finnish Game and Fisheries Research Institute (RKTL)**, and the **Finnish Environment Institute (SYKE)**. The institutes will harmonise their data policies and environmental monitoring. Moreover, operations of the member institutes are improved by combining and centralising operations and services.

The **Strategic Centres for Science, Technology and Innovation (SHOKs)** are innovative Finnish partnerships whose main goal is to promote cooperation and communication between companies, universities, research institutes and funding organisations operating in Finland. The actors commit themselves to the objectives of the Strategic Centres and target their resources to strategic, high-quality, long-term research and develop-

ment projects which are internationally important. The Strategic Centres correspond to the thematic Joint Technology Initiative projects defined in the Seventh EU Framework Programme, such as the **Forest-Based Sector Technology Platform** for the forest sector.

Currently, there are three forestry-related Strategic Centres for Science, Technology and Innovation in Finland. One is **Forest-cluster Ltd**, which focuses on three fields: intelligent and resource-efficient production technologies, biorefineries which utilise wood in various ways, and customer solutions for the future. Forest is also linked to the operation of **Cleen Ltd.**, the energy and environment competence cluster. Its objective is to promote business and internationalisation of companies in the energy and environment sector. Of its strategic research areas, distributed energy systems are connected to forest bioenergy and related development of technology. **Finnish Wood Research Oy** promotes research on the mechanical wood-processing sector.

The national **Centre of Expertise Programme 2007–2013** is also under way. Among the programme's 13 competence clusters, there are three clusters in which forest research plays an important role. These clusters are Energy Technology, Forest Industry Future and Living Cluster Programme.

The successful functioning of the system of expertise clusters means that practical research needs are communicated to research without delay, and that the new information and expertise produced by research is put to use efficiently. The interaction between researchers and actors in the field is enhanced, above all, by improving procedures and structures and increasing the usability of information services.

#### Research organisations and actors

There are about 650 researchers in Finland working on subjects involving forest and wood. About 300 of them work at the **Finnish Forest Research Institute (Metla)**, distributed among four regional units (Southern, Western, Eastern and Northern Regional Units). Forestry research is also conducted at the **University of Eastern Finland** and the **University of Helsinki**, which have about 100 forest researchers along with forestry education.

Research teams working on subjects closely related to forestry and wood sector are also found at **Aalto University**, at the **Universities of Jyväskylä, Turku, Oulu and Lapland**, and at the **Tampere University of Technology** and the **Lappeenranta University of Technology**. There are also a number of small research units in forest issues in establishments such as the **TTS (Work Efficiency Institute)**, **Pellervo Economic Research PTT** and **Metsäteho Oy**.

The strongest concentrations of research in forestry and its environmental impacts are in the Helsinki region and in eastern Finland.

Mechanical processing of wood and paper and pulp manufacture are studied at **VTT Technical Research Centre of Finland** and at several universities of technology. The **Finnish Environment Institute (SYKE)** and Centres for Economic Development, Transport and the Environment operating under the Ministry of the Environment also conduct surveys and studies on forests and research serving the administration.

The headquarters of the **European Forest Institute (EFI)** is located in Finland. EFI is a network organisation whose purpose is to compile information for forest policy and forestry decision-making in Europe. In addition to the headquarters in Joensuu, EFI has six project centres in different parts of Europe.

#### Research funding

The principal source of funding for forest research in Finland has for decades been the annual appropriations in the central Government budget. In the last ten years, however, the share of other funding has grown to about 30% of all research funding today.

**The Finnish Funding Agency for Technology and Innovation, Tekes** is the tool of the Ministry of Employment and the Economy for implementing the national innovation programme, and it also funds forest-related research programmes and projects independent of the Strategic Centres. Funding from the **Academy of Finland** is mainly targeted at basic research, and it is an important funding source for university researchers in particular.

Increasing numbers of Finnish forest researchers participate in international research projects and projects funded by the European Union, as well as in network cooperation, such as COST (Cooperation in the Fields of Scientific and Technical Research in Europe). EU-funded research projects focus on themes important from a European perspective, but they often have a great significance nationally as well. Also the number of research and development projects implemented in cooperation with developing countries has increased, including, for example, forest resource inventories and carbon sequestration assessments. Bilateral research cooperation is carried out with, for example, Russia and China.

#### Education and training

A competent workforce is a central factor for success in the forest sector. The integration of the qualitative and quantitative goals and future needs of education calls for continuous

interaction between forestry and forest industry businesses and those making plans for education.

Education in forestry in Finland is provided on three levels: universities, universities of applied sciences and vocational colleges.

The degree of Master of Forest Science, M.Sc.(Forestry), can be completed at the **Universities of Helsinki** and **Eastern Finland**. In 2012, the University of Eastern Finland will start an international wood science programme, which is a new degree parallel to the forest science degree.

There are eight universities of applied sciences providing education in forestry. The forestry degree that may be completed there is Forest Engineer. In the labour market, Forest Engineers work within the forest sector and related organisations in positions that involve planning, consultation, management, education, training, marketing and research, and as private entrepreneurs.

The three-year Vocational Qualification in Forestry includes a wide range of fields for specialisation. Students can choose to specialise as a e.g. forest worker, a forest machine operator or a forest ecosystem worker.

About 1,500 people study subjects in the field of forest industry annually. The majority take an upper-secondary degree, leading to a career in the mechanical wood products industry and the pulp and paper industry. A university-level degree in wood processing technology is completed annually by about 60 students.



Modern harvesters are highly developed products where the steering of fellings is done by a driver from the cabin with the help of computers. There is a gap of skilled harvester drivers in Finland and internationally. Therefore campaigns to get young people interested to start an educational harvester driver training are needed.

Further and Specialist Qualifications based on skills testing focus on the student's actual competence in mastering the special tasks of the profession. Further Qualifications are available in the fields of multiple use of forests, forest work, forestry entrepreneurship, operating forest machines, timber lorry transport and peat utilisation. Specialist Qualifications are available in nature surveying, multiple-use of forests, operating forest machines and forest advice.

Some further professional training is provided by employers, the rest is supplied by education institutions and universities providing forestry education.

The need for further education has grown constantly along with changes in the operating environment and priority areas in the work.

## Maintenance of cultural and spiritual values (B.12)

Forests play an important part in the construction of the Finnish identity. The settlement of Finland and the emergence of Finnish culture were based on forests. The identification of the cultural heritage<sup>36</sup> and landscape values of forests and their preservation are therefore important for future generations. By taking cultural values into account it is possible to ensure that the traditional ways of using and tending forests are passed on to future generations. Forest culture can also be used in commercial operations and leisure activities.

### International conventions and commitments

The sustainable management of natural resources and the preservation of cultural and landscape values are also included in the aims of the **UN Convention on Biological Diversity (CBD 1992)**, the **Pan-European Biological and Landscape Diversity Strategy (PEBLDS 1995)**, and the **European Landscape Convention (2000)**.

The Ministerial Conference on the Protection of Forests in Europe in Vienna in 2003 recognised social and cultural dimensions of forests in the separate resolution. The Convention Concerning the Protection of the World Cultural and Natural Heritage is an international convention adopted by UNESCO in 1972.

### National legislation and programmes

Cultural heritage, landscapes and the associated values are extensively taken into account in Finnish legislation.

<sup>36</sup> Cultural heritage consists of the immaterial and material heritage created by human activity. Material cultural heritage can be movable (e.g. books and objects) or fixed.

Local planning based on the **Land Use and Building Act** can be used to issue instructions for planning, protection and construction that take cultural, historical and landscape values into account. In land use planning, the cultural impacts of the plan must be assessed. According to the Land Use and Building Act, actions altering the landscape may not be taken without a permit. A landscape work permit may be required in master plans instead of the Forest Use Declaration set down in the Forest Act. Trees in areas covered by a detailed land use plan may not be felled without a permit.

According to the **Forest Act**, forests must be managed in an economically, ecologically and socially sustainable way. The Act provides for the opportunity to manage forests in a way which takes into account the special characteristics of sites in terms of landscape, multiple use and research.

Under the **Antiquities Act**, antiquities are automatically protected. Prehistoric and historic relics must be taken into account in all land use. This requirement is also incorporated in forest certification. The National Board of Antiquities has, together with organisations in the forest sector, produced guidelines for forest management in areas containing antiquities.

The **Nature Conservation Act** allows the establishment of landscape conservation areas for the conservation and management of the natural or cultural beauty of the area, its historical characteristics or other special values.

Other statutes linked to cultural and landscape values of forests are: the **Act on Wilderness Reserves**, the **Land Extraction Act**, the **Act on Environmental Impact Assessment Procedure**, the **Act on the Assessment of the Impacts of the Authorities' Plans, Programmes and Policies on the Environment**, the **Act on the Financing of Sustainable Forestry**, and **decrees on agricultural support systems**.

The objectives of **Finland's National Forest Programme 2015** include strengthening the aspects of forests that promote human wellbeing and culture. Cultural and landscape functions of forests are also covered in the **Natural Resources Strategy of the Ministry of Agriculture and Forestry**, in **agricultural policy programmes and sectoral programmes for agriculture**, as well as in various **regional and local development and environmental programmes**.

In addition to forestry and regional policy programmes, the main strategic instruments governing the management of forest landscapes and land use changes are the **Government Resolution on national land use guidelines (VAT 2000)** and the **Government Resolution on nationally valuable landscape areas and development of landscape management (1995)**. Metsähallitus has drawn up a **cultural heritage strategy** for its Natural Heritage Services for the period 2007–2015.



One of Finland's National landscapes at Punkaharju. The 200 hundred years old seven kilometres long road on the narrow ridge, has been created from gravel deposits along the edge of the continental ice sheet and is separating two lakes.

#### Other steering instruments

The **management and use plans** for national parks, wilderness areas and nature conservation areas promote not only nature conservation but also the management of landscapes and cultural heritage in these areas. Many nationally valuable landscape conservation areas are also covered by **management and use plans**. Regional management plans are prepared also for heritage landscapes, i.e., traditional biotopes. Regional and municipal programmes on the cultural environment basically govern the planning, protection and management of the built environment and landscape, but they can also include aims that involve forests.

Agricultural and forest areas of special environmental value are designated as such in land use plans. Scenically valuable fields should not be afforested or allowed to grow over. Nationally and regionally valuable cultural landscape areas and sites are also marked in land use plans. Only recommendations on forest management may be given in the plans.

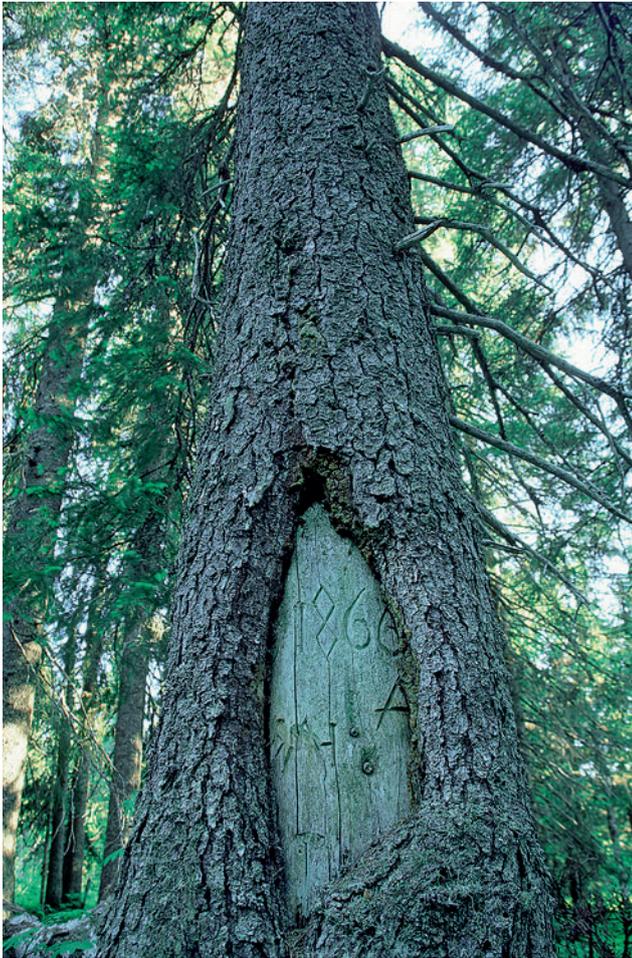
Forests near settlements, cultivated areas and shorelines are taken into account in management plans if the forest owner so wishes. The **Act on the Financing of Sustainable Forestry** can be applied to finance joint nature management plans which take

landscape values into consideration and extend to the area of several holdings. Under the **Rural Development Programme**, farmers are eligible for special support to offset the cost of managing wooded heritage landscapes or loss of income caused by such management. Management recommendations for forest landscapes are issued in the Forest Landscape Management manual published by Tapio and Metsäteho Oy.

**Metsähallitus is conducting an inventory of the cultural heritage sites in State forests in 2010–2015.** This ongoing inventory is the most extensive inventory of cultural heritage sites in Finland, and it is one of the targets of Finland's National Forest Programme 2015.

#### Cultural and spiritual values (6.11)

Forests are the most characteristic feature of the Finnish landscape and the origin of our culture. Every era and every generation have left their mark in the forests. Forests are an integral part of our cultural environment. Forests have also provided artistic stimuli and themes for the visual arts, music and literature.



Important family events such as a birth or death of a person were marked in old times on the bark of a tree. The marking on the bark of this tree over is over one hundred years old and indicates the border of the slash and burn area.

Forests occupied an important place in ancient religions. There were sacrificial trees in the forest, magical places and sacrificial groves, where gods were worshipped in ancient times. Ancient monuments are constantly being discovered in forests, dating from a time when forest was home, source of food and a place of worship. Many areas associated with forestry and agriculture, other livelihoods and also military history are discovered in forests, areas with ancient structures and mounds of stone.

Nearly all buildings in rural areas are still constructed of timber. Efforts are made to maintain the tradition of timber construction also in population centres. Wooden furniture, vessels, tools, utensils and decorative objects are part of both everyday life and the valuable handicrafts traditions.

Museums have been founded for the preservation and restoration of forest and hunting culture. Various kinds of events are organised for the same purpose, including competitions in traditional skills in forestry, hunting and log floating. Performances for displaying traditional logging methods and timber construction are also arranged.

Forests and trees contribute to the spiritual welfare and health of Finns in many ways. Studies suggest that merely by looking at pictures of nature people recover more quickly from stress and illnesses. The favourite place of Finns is often outdoors in nature, where they can calm down, relax, enjoy their surroundings and forget their problems for a while.

#### Cultural and landscape sites

There are seven sites in Finland that have been inscribed on the UNESCO World Heritage list. One of them, the Bronze Age burial site of Sammallahtenmäki in the municipality of Lappi, is situated in a forest. The environs of the Verla Groundwood and Board Mill are a magnificent milieu from the early days of the Finnish forest industry. Old Rauma town and Petäjavesi Old Church represent old timber construction.

There are 37 National Parks in Finland. One aspect of the maintenance of the parks is the promotion of the preservation of cultural heritage and landscape values. The Kuivajärvi-Hietajärvi area in Suomussalmi is the only landscape conservation area established under the Nature Conservation Act. It includes large tracts of forest, which are an integral part of the White Karelian culture of the area. National urban parks have been established in Hämeenlinna, Heinola, Pori, Hanko and Porvoo.

The number of natural monuments protected under the Nature Conservation Act is about 3,500. Most of them are located in forests; in some cases, the monuments themselves are trees or groups of trees growing in built-up cultural environments. The Finnish Dendrological Society has identified over 1,200 large or otherwise exceptional trees. The many arboretums (over 80 in Finland) are part of the cultural history of forest research.

Prehistoric monuments are found in cultural environments, but also far away from current settlement areas, in the middle of commercial forests. The Register of Ancient Monuments kept by the National Board of Antiquities is being constantly updated. There are currently about 18,000 sites listed in the register. Antiquities are protected under the Antiquities Act, even if they are not entered in the register.

The term 'national landscape' is used to describe the most famous landscapes in Finland. To commemorate the 75th Independence Day in 1992, 27 areas from around Finland were designated national landscapes. Many of the national landscapes are located either completely or partially in nature conservation areas.

Finland has 156 landscape areas which were identified as nationally valuable in a Government Resolution in 1995. Key areas are vital agricultural landscapes that have remained traditional in appearance and that are diverse in their nature and cultural heritage. Most of them are located in agricultural regions

in southern and western Finland, but even on these areas the margin forests along fields and waters and the general landscape provide an important framework for the site. The Ministry of the Environment has launched an inventory project for updating and supplementing the nationally valuable landscape areas in 2010–2014.

A survey of built cultural heritage completed in 1993 covered 1,477 valuable sites and areas whose value stems from architectural heritage. The environments of these areas also include trees and margin forests. The National Board of Antiquities has launched a project for revising the list of cultural heritage sites, and it will be completed in the near future.

The national inventory of heritage landscapes (1991–1998) was conducted in 1992–1998. The inventory identified 3,700 valuable heritage landscapes, which had developed as a result of traditional agricultural practices. Wooded heritage landscapes are wooded pastures, grazed forests, wooded meadows and old burnt-over woodlands. Such sites are often part of a larger milieu, which also includes traditional farmhouses or other struc-

tures. Metsähallitus maintains traditional farmsteads where the buildings, fields and environs are managed with traditional methods.

The Finnish Road Administration has conducted surveys of historical roads and roadside landscapes. The most striking roads have been designated scenic routes, and the woods and cultural sites along the routes are managed under a special management plan.

A total of 12 museums have been founded to preserve and make known traditional silvicultural practices. The largest of these is the Finnish Forest Museum Lusto founded in 1994 in Punkaharju as a national museum and science centre. Events presenting forest culture are organised in Lusto. The Sámi Museum, today named Siida, was founded in Inari in 1959 to showcase Sámi culture and Lapland nature.



National Landscape Koli with Ukko Koli the highest hill in North Karelia, located on the shore of Lake Pielinen. The landscape has inspired many Finnish artists and writers belonging to the movement Karelianism such as Jean Sibelius, Juhani Aho, I.K Inha and Eero Järnefelt at the beginning of 1900.



## Finnish Forests in European context demonstrated with selected indicators

The majority of forests in Finland are predominantly coniferous, with broadleaves often growing in mixed stands.

### Forest area

Forest area is the traditionally most obvious indicator of changes in forests. Forest area indicates changes in the land area covered by forests as well as in the percentage of forests compared to other types of land use. The use of forestry land is subject to a variety of widely different and simultaneous aims, needs and wishes: wood production, recreation, nature protection, tourism and landscape management. These differing aims can be reconciled through the multiple-use principle, without having to segregate forest areas by function or purpose. Forests, however are very different in their composition and structure, and need a detailed analysis by many aspects to provide a true picture.

The forest cover in Finland is more extensive than in any other European country. Three fourths of the land area, some 23 million hectares (76%), is under forests. In addition, there are land areas under management where there are only few trees, such as open peatland and areas of exposed bedrock, over 3 million hectares altogether. Nearly 90% of the forests are predominantly coniferous forests of pine or spruce. Nearly all (96%) the Finnish forests are classified as semi-natural forests showing characters of human impact. The amount of undisturbed forests is 4%, of which nearly 60% are locating in protected areas.

The forest area of Finland represent about 11% of the forest area in Europe (210 million ha). Half of the European forests are predominantly coniferous, a quarter a predominantly broad-leaved and a quarter are mixed. About 87 percent of the European forests is classified as semi-natural. Undisturbed forests and plantations cover 4 percent and 9 percent, respectively, of the forest area in Europe.

### Growing stock and carbon sequestration in wood and soil

Growing stock is one of the basic figures of any forest inventory, and is useful for various purposes. The volume of growing stock indicates especially the opportunities available for the use of wood and harvesting forming also the basic input figure for several forestry planning calculations. The growing stock is further closely related to the above ground woody biomass in forests, and provides the data basis for calculating carbon sequestration and carbon budgets.

#### Growing stock in European countries

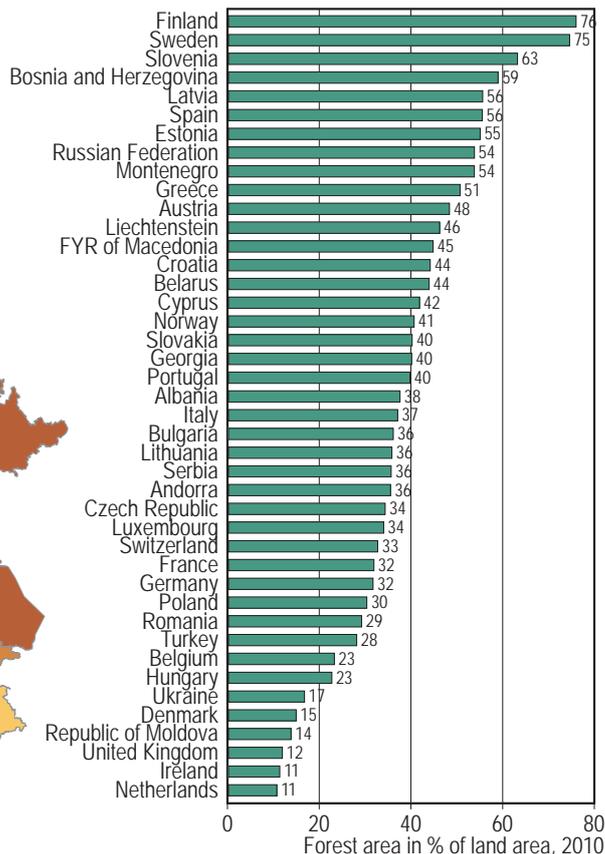
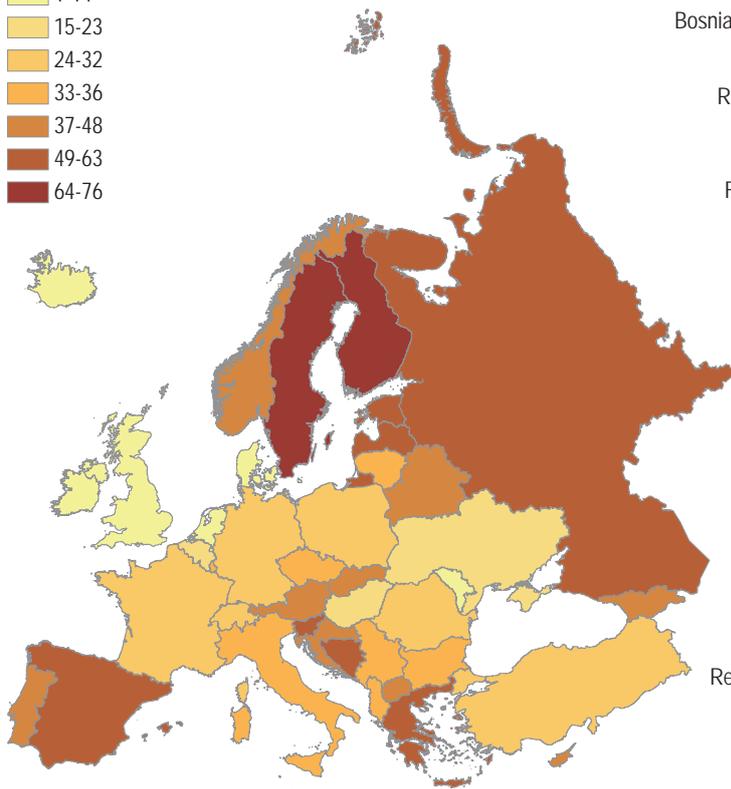
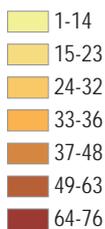
The most abundant growing stocks in Europe are in Germany, Sweden, France, Poland and Finland. Although Finland has an extensive forest area, the volume of wood per hectare is about the half of the volume of wood per hectare in Germany, Switzerland or Slovak Republic. This is due to the different climatic and soil conditions and partly due to the different tree species. The trees such as spruce (*Picea abies*) are in Germany 10–15 meters higher and 10–20 cm thicker than in Finland.

The total growing stock in Europe is 32,690 million m<sup>3</sup>, and the increase of the volume has been 1,2% or 356 million m<sup>3</sup>/year during the last 20 years. In Finland the corresponding figures are 2 206 million m<sup>3</sup> and 1,0% or 22 million m<sup>3</sup>/year.

#### Carbon sequestration

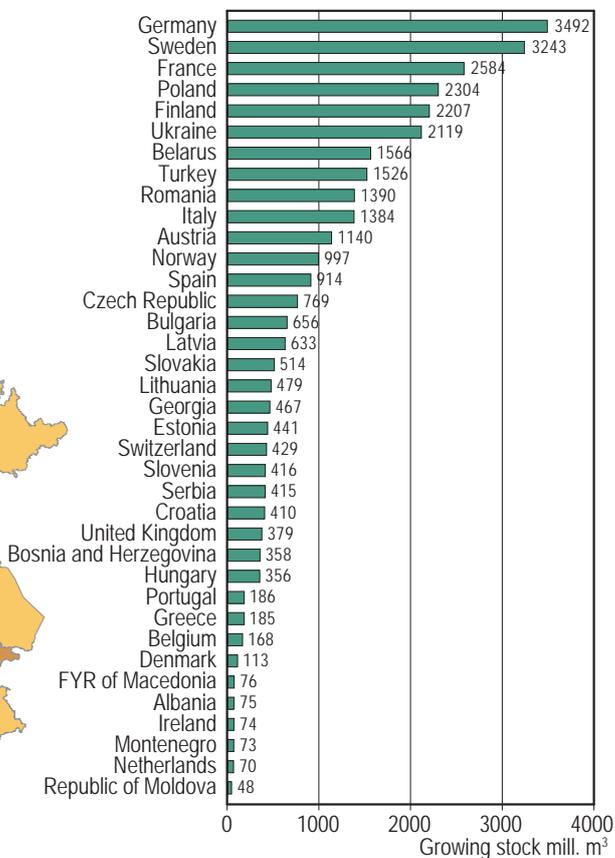
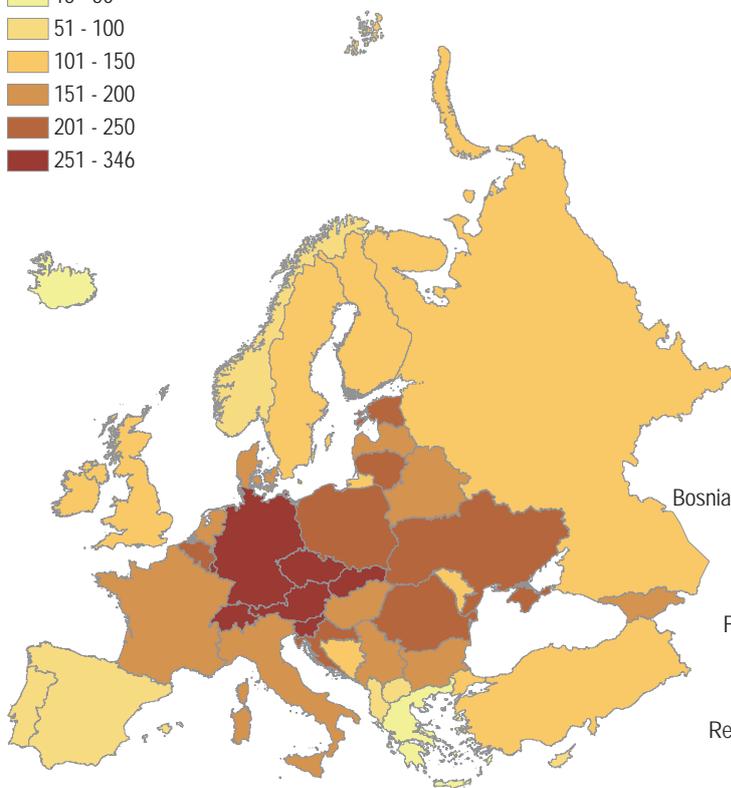
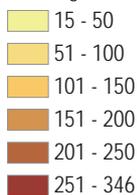
Europe's and Finland's forests are major carbon sinks, as they absorb large amount of CO<sub>2</sub> from the atmosphere. Carbon stock of forest biomass (above and below ground) in EU 27 is 9,900 million metric tons of carbon. In EU-27 the annual sequestra-

Forest area in % of land area, 2010

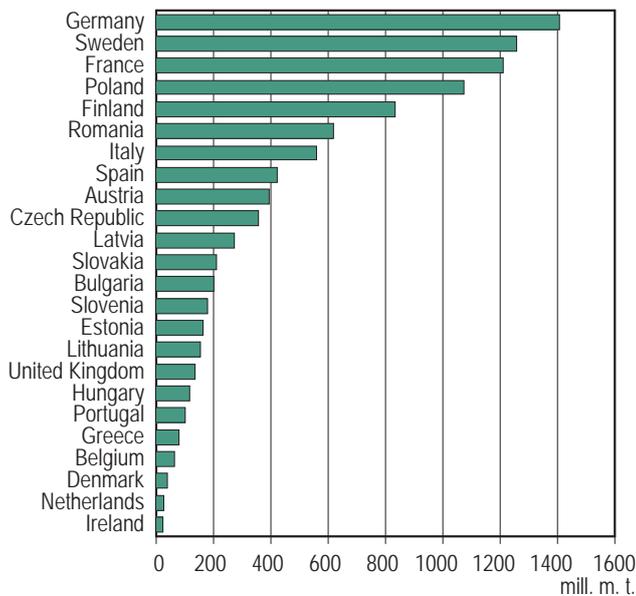


Forest and other wooded land as% of land area. Source: State of Europe's Forest 2011.

Growing stock on forest in m<sup>3</sup> per ha



Growing stock volume per hectare (left) and volume (right) on forest, 2010. Source: State of Europe's Forest 2011.

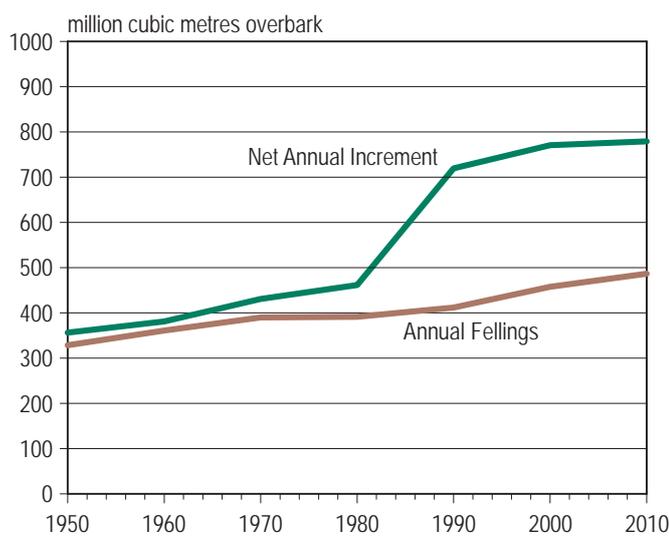


Carbon stock on forest biomass (above ground and below ground) in million metric tonnes. Source: State of Europe's Forest 2011.

tion of CO<sub>2</sub> in forest biomass is 430 million tons, which corresponds to 9% of the greenhouse gas emissions of these EU-27 countries. In Finland forests sequestered in average 35 million tonnes of CO<sub>2</sub> per year during the last 10 years, which is equivalent to about 50% of the carbon dioxide emissions of Finnish industries.

### Increment and fellings

The balance between annual increment and drain of growing stock is the principal indicator of the sustainability of wood



Net annual increment of growing stock and annual fellings in Europe(1950–2010). Sources: Kuusela (1994). Forest Resources in Europe 1950–1990; State of Europe's Forest 2011.

production. The total drain may not exceed the increment in the long term.

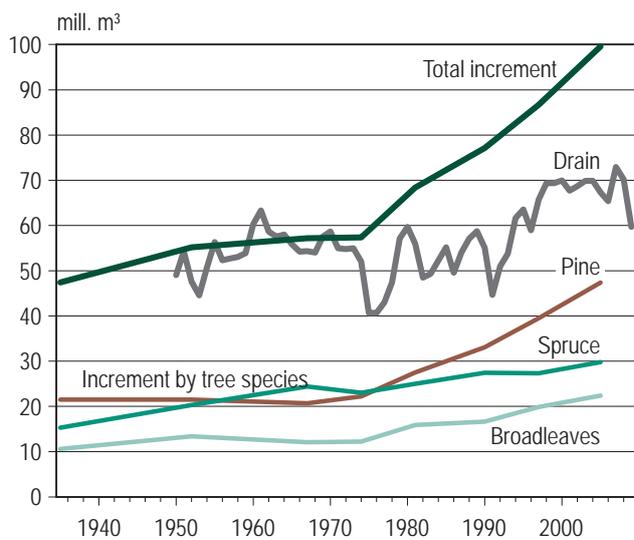
Both in Europe and in Finland the annual increment of growing stock has exceeded the fellings of wood from forests at least by one fourth on average since the 1970s. Over the same period the growing stock has increased by more than 40%. In the last years the wood market has been in crisis and this influences the trend of marketed roundwood removals.

In Finland during the last 40 years period wood equivalent to the current volume of the tree stock, 2,200 million cubic metres, has been harvested and used. This leads to the conclusion that systematic work on sustainable forest management, forest planning, active participation of forest owners and governmental support are been successful.

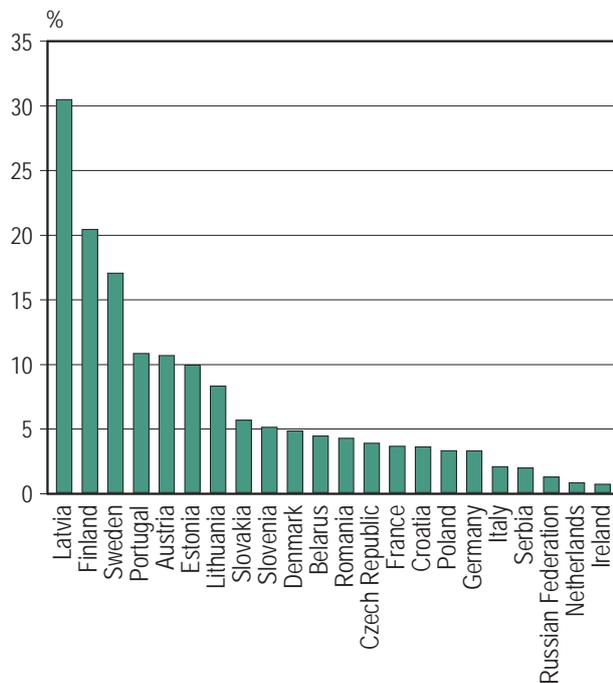
### Wood –based energy

The objective of this indicator is to measure the relative importance of wood in compare with other sources of energy. Wood is one of the major sources of renewable energy. Wood's importance is increasing especially across Europe due to the EU commitments and decisions on the increase of the share of renewable energy from the total energy consumption in EU-27.

At European level 2007 wood energy contributed 3,7% of the final energy consumed. In Finland 2009, wood-based fuels accounted for 266 petajoule (PJ) of energy production in Finland, or 20% of Finland's total energy consumption. The use of wood-based fuels has increased in Finland since the 1990s. Most forest industry installations are self-sufficient in terms of energy,



Annual increment of growing stock (1935–2009) and annual drain in Finland (1950–2009). Source: Finnish Forest Research Institute



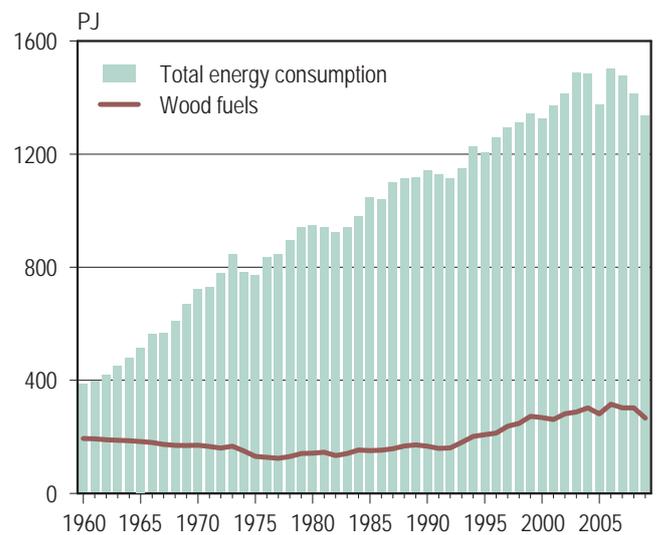
Total energy production from wood as percent of the total national primary energy consumption.  
Source: State of Europe's Forest 2011.

as they can use all wood waste and waste liquors for energy production.

Wood-based fuels are waste liquors and other byproducts of the forest industry (tall oil and birch oil, soft soap, methanol, biosludge, paper), forest chips, industrial chips, sawdust, bark, recycled wood, pellets, briquettes and fuelwood. Most forest industry installations are self-sufficient in terms of energy as they can utilise all woody waste and waste liquors for energy production.

The theoretical biomass potential from the European forests in 2010 is nearly 1.3 billion m<sup>3</sup> including bark. Approximately half of the potential is made up of stemwood and the rest consists of logging residues, stumps and woody biomass from early thinnings in young forests. The potential is, however, reduced to about 750 million m<sup>3</sup> due to various environmental, technical and social constraints. The constraints affect especially residues, stumps and biomass from early thinnings. The use of wooden biomass from forests for energy applications in Europe was in 2009 about 720 million m<sup>3</sup> consisting mainly (over 85%) from stemwood.

In Finland the use of wooden biomass from forests as logging residues, branches, small-sized timber and stumps was in 2010 about 7 million m<sup>3</sup>. Over 90% of the biomass consist of small-sized trees and logging residues. The sustainable potential on wooden biomass from forests is estimated to be about 15 million m<sup>3</sup> per year.



Total energy consumption and consumption of wood-based fuels, 1970–2009.  
Source: Statistics Finland

## Non-wood goods

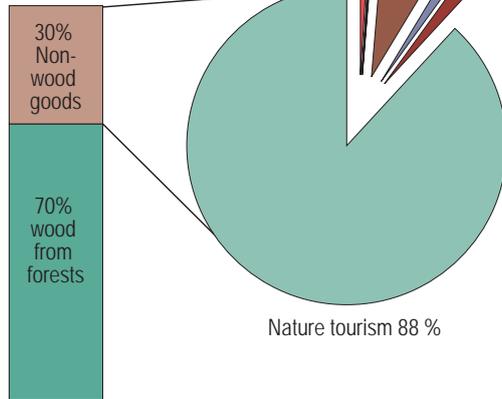
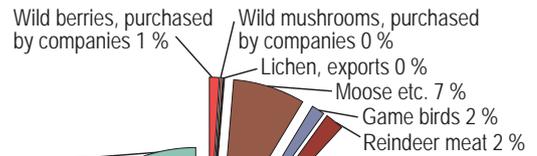
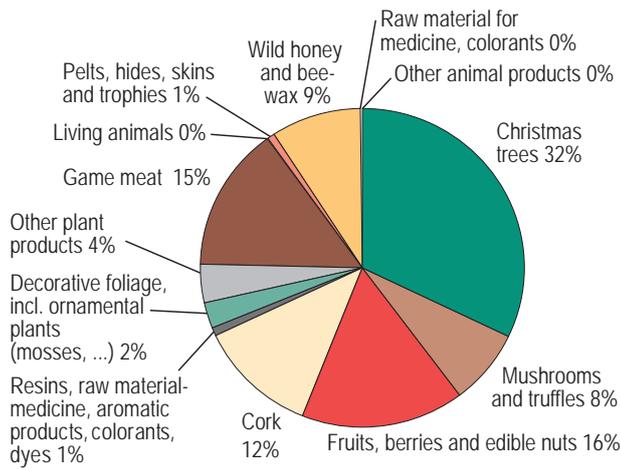
By quantity and monetary value, industrial roundwood and woodfuel are most important forest products in Europe. Non-wood goods and services are, however, gaining more importance, which is reflected in their increasing value. In Europe overall 2010 Christmas trees, fruits and berries, game meat and cork were the most important non-wood goods. The total value of marketed non-wood goods represented 15 percent of the roundwood value when comparing countries reporting both values.

In Finland the most important non-wood goods are game meat, reindeer meat, Christmas trees and berries and mushrooms. The highest monetary value brings the nature tourism. In all the non-wood goods represent 30 percent of the total value of roundwood and non-wood products.

## Maintaining biodiversity

There are two approaches to conserve or generally to maintain biodiversity in forests: the protection area network created in the country, and the orientation of the forest management outside the actually protected areas in such a way that it secures the maintenance of biodiversity on a large-scale. The current approach suggests that biodiversity targets can best be reached by the integration of segregated protection areas with close-to-nature forest management. This success can be monitored by the numbers of threatened species, which can be seen as indicators of change in the forest ecosystems.

Value of various forest products in Europe, 2005



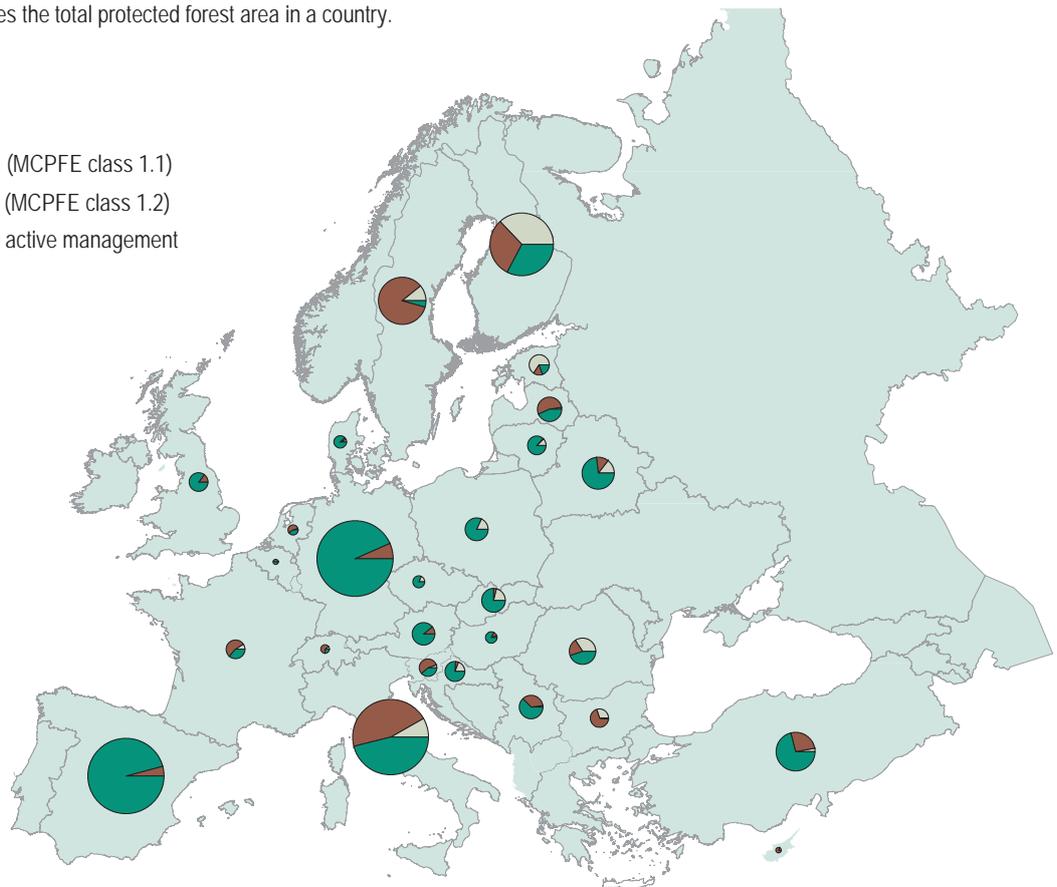
Value of marketed non-wood forest goods, marketed plant product/raw material, 2005. Source: State of Europe's Forest 2011.

Amount and value of various forest products, 2009. Sources: Finnish Forest Research Institute; TNS Gallup Ltd. Food and Farm Facts; Finnish Game and Fisheries Research Institute; Reindeer Herders' Association; Boards of Customs

Size of the pie chart indicates the total protected forest area in a country.

Scale: 1 million ha

- No active intervention (MCPFE class 1.1)
- Minimum intervention (MCPFE class 1.2)
- Conservation through active management (MCPFE class 1.3)



Total forest area protected (size of the pie) and the share of the protected area by MCPFE Classes 1.1–1.3 (1.1 no active intervention, 1.2 minimum intervention, 1.3 conservation through active management) for biodiversity by countries in Europe (1,000 hectares and percent), 2010/12. Germany and Spain: included Natura 2000 forest areas in the MCPFE class 1.3. Source: State of Europe's Forests 2011.

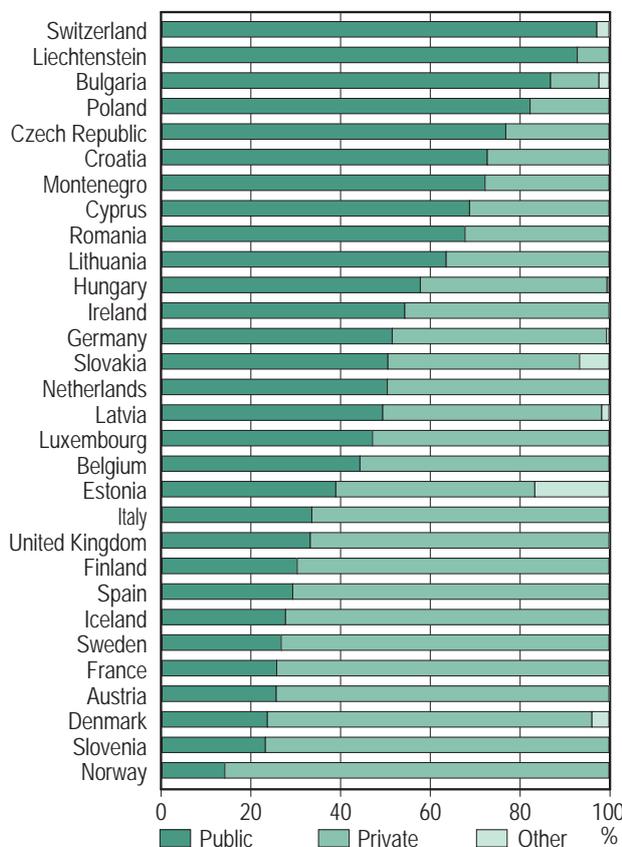
## Protected forests

Protected areas are one of the oldest instruments for protecting nature and natural resources, and are included as a main pillar in nature conservation laws across Europe. Explicitly designated protected areas focus mainly on conserving biological diversity, landscapes, natural monuments and protective functions of forests.

The MCPFE Assessment Guidelines for Protected and Protective Forest and Other Wooded Land in Europe were created in 2001–2003 especially for European conditions where protected forests areas are often small, most of which are located in fragmented landscapes with other land use categories and are protected with various management options and regimes. The MCPFE classes for biodiversity are no active intervention, minimum intervention, and conservation through active management.

Over the last 10 years, Europe’s forest area designated for biodiversity and landscape protection has increased by half a million hectares annually. About 10 percent of European forests are protected with the main objective of conserving biodiversity.

The strictness of protection for biodiversity varies considerably within Europe: in North Europe and in some Eastern European



Ownership of forest in Europe, 2010.  
Source: State of Europe’s Forest 2011.

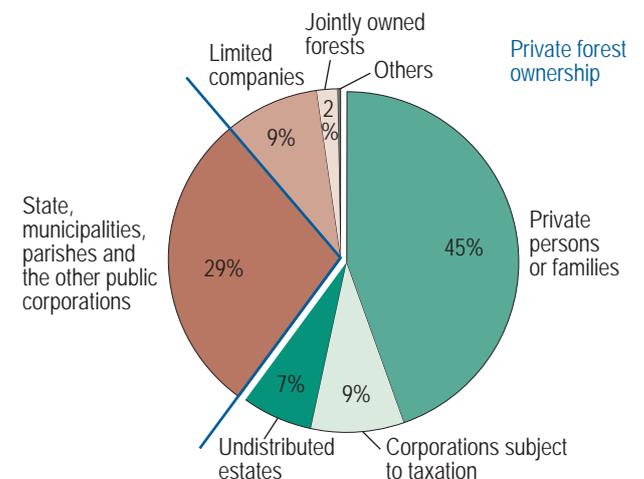
countries, restrictive protection with no or minimal intervention dominates, whereas in Central and Southern European countries, active management in protected areas is emphasized. This shows the different policies applied across Europe due to natural conditions, traditions and population density.

Strict forest protection is emphasised in Finland. Under various protection programmes and decisions, the area of protected forests has been tripled over the past 35 years. The largest areas with no active intervention of the total area of forests protected for biodiversity in Europe are located in Finland – nearly half (841 000 ha) of the area.

## Forest management practices

Forest management practices have changed in Europe towards greater integration of biodiversity aspects, such as deadwood components and important vulnerable small biotopes being left in the forests alongside measures for wood production.

The main methods for safeguarding biological diversity in commercial forests in Finland are the protection of valuable habitats and biotopes, favouring of mixed tree stands in the management, and increasing the amount of decayed wood. The selected new forest management policy has brought measurable positive changes to commercial forests. An evaluation of threatened species (IUCN classification) conducted in 2010 showed that the rate of decline of certain forest species has slowed down in Finland, or in some cases even stopped since the 1990s, although it has not been possible to halt the decline in forest species overall. Retention trees at felling sites have been particularly important in curbing the decline trends.



The share of forest land area by forest ownership category, 2008.  
Source: National Board of Taxes

## Forest holdings

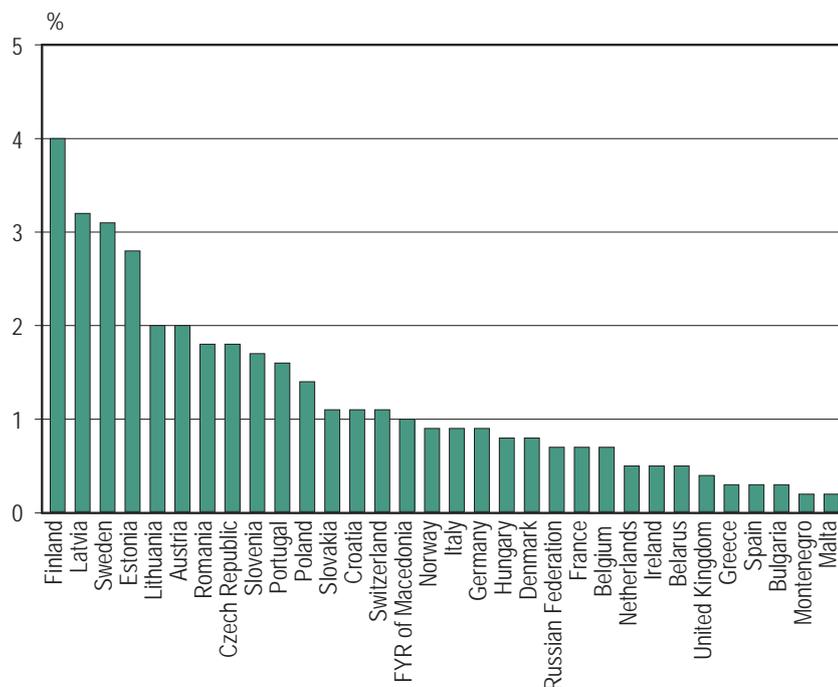
The number of forest holdings is an important social indicator, especially for the sustainable development in rural areas.

Within Europe significant change in number of holdings was caused during the last decades by political decisions on the restitution and privatization of forest land to former owners and their heirs in a number of countries in Central, South East Europe and in the Baltic countries. The size of the public and the private forest area in Europe are both about 100 million ha in 2010.

Finnish forestry is mainly in the hands of families, and the properties are mainly quite small. Private forest owners own two thirds of forests in Finland equalling 12 million hectares of forest land; the State, 5 million hectares; companies 2 million hectares; and others (municipalities, parishes and other public corporations) own 1 million hectares of forest land.

## Contribution of forest sector to gross domestic product (GDP)

The contribution of forestry and the manufacturing of wood and paper products to GDP indicates the forest sector's macro-economic importance. It can also be used for the assessment of how forest management contributes to overall sustainable development, more specifically in regional analysis to evaluate the significance of the forest sector as a source of employment



Contribution of forest sector to GDP, 2010.  
Source: State of Europe's Forest 2011.

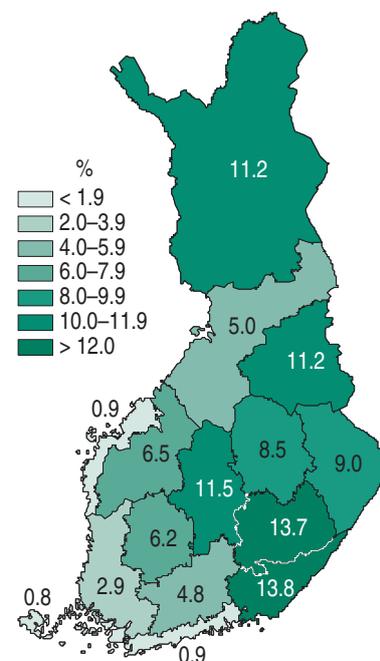
in rural areas and development, and whether this contribution is sustainable.

Forest activities, wood processing and the pulp and paper industry combined contribute one percent to GDP in Europe as a whole, but the significance varies considerable among the countries. The contribution of the forest sector to GDP is decreasing as other sectors of the economy grow faster. Europe's pulp and paper industry has experienced a steep decline over the past decade.

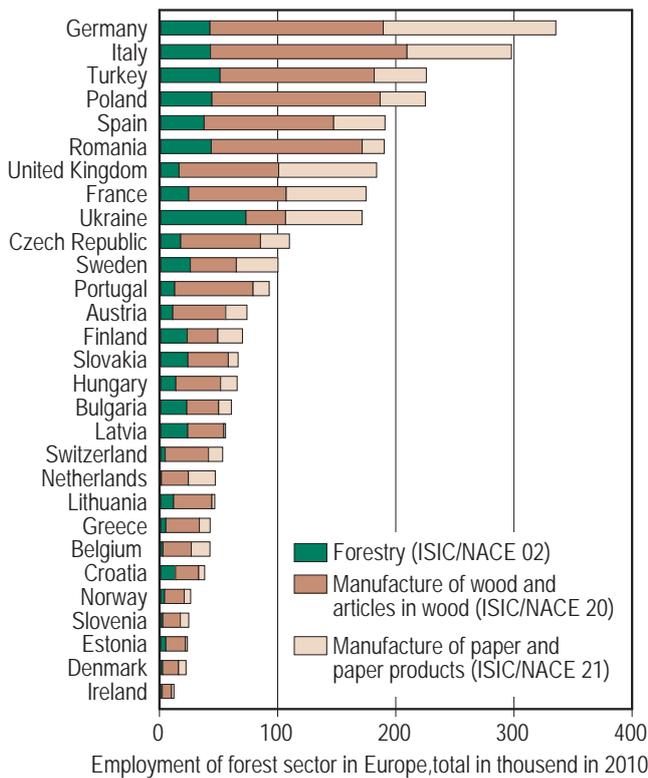
In Finland the forest sector contributes about 4% of Finland's GDP. Regionally, however, the percentage may be as high as 10%, for instance in South-Eastern and Eastern Finland and in Kainuu region. The economic recession of 2008–2009 caused a reduction of nearly 20% in production capacity in the pulp and paper industries, and jobs were lost in the forest industry in Finland. In 2009, the year of economic recession, the total contribution of the forest sector to the GDP was EUR 6 billion.

## Forest sector workforce

Employment provided by the forest sector is an important indicator of the social benefits generated by forests, especially for the rural areas. An adequate workforce in terms of numbers and qualifications is a critical input to sustainable forest management.



The share of forest sector in the total regional GDP by forestry centre, 2008.  
Source: Statistics Finland



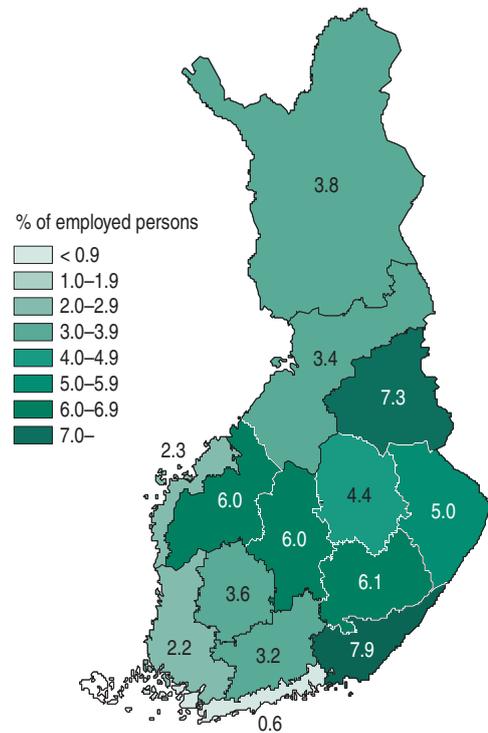
Employment of forest sector in Europe, total in thousand in 2010. Source: State of Europe's Forest 2011.

In Europe forest sector employment is still decreasing, mainly in countries where there is still a high potential for mechanisation of forest operations like in Central-East Europe. Whereas in Central-East Europe a reduction in numbers due to productivity continues, West Central and North European forestry seems to have stabilised the work-force at a rather low level, where most job reductions have been reached.

In Finland 2010, the forest sector provided employment to about 69,000 persons, less than 3% of the entire employed labour force. The regional distribution of employed people in forest sector follows the location of manufacturing installations of forest products. The number of employed people in forest sector is stabilized, but the worldwide recession in 2008–2009 caused a collapse in employment particularly in the pulp and paper industries. In 2010, the average unemployment rate in the forest sector was 9.0%.

## Health and vitality

Maintenance of health and vitality of forests is crucial for the existence of forests and corresponding to the all products and services form forests. Forest health is affected by several factors simultaneously. Forest health can decline due to abiotic agents such as atmospheric pollutants, exceptional weather conditions or careless harvesting or timber storage. Deteriorating health



Proportion of forest sector (incl. furniture industry) of employed persons by forestry centre, 2010. Source: Statistics Finland.

can also be due to biotic agents such as diseases caused by fungi and insects. Climate change is expected to increase the risk of local damages caused by snow, storms and insects.

Insects and diseases are the damaging agents most frequently observed in Europe, followed by wildlife and grazing. Six percent of the European forest area is affected by one or more damaging agents. Damage due to storms, wind and snow was mainly observed in Central, North and South-West Europe, while damage due to forest fires was mainly reported for South-West and South-East Europe.

Apart from the severe storm damage that occurred locally along narrow belts in summer 2010, there has been no widespread forest damage in Finland for 30 years. Occasional local forest damage does occur from time to time; in economic terms, the most significant of these are damages caused by fungi and insects, storm damage, and damages to saplings caused by elk. Climate change is estimated to increase forest growth, but on the other hand extreme weather phenomena will probably become more common and cause local damage more frequently.



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