



Forests and Forestry in Sweden

Preface

Sweden is a country dominated by forests. Forestry is vitally important for the national economy, and most Swedes closely relate to forests and forestry pursuits. Sweden holds just under one percent of the world's commercial forest areas, but provides ten percent of the sawn timber, pulp and paper that is traded on the global market.

Forests and forestry are also important for climate change mitigation. Swedish forests have high rates of productivity and low rates of natural disturbances, thus allowing for large transfers of biomass from forests through the avoidance of emissions from emission-intensive products such as steel and concrete, and from fossil fuel and products. It also gives job opportunities for both men and women, especially in rural areas. One of the most popular Swedish outdoor activities is “forest walking”, according to opinion polls.

During the 18th and 19th centuries, many forests were heavily over-exploited for farming, housing construction, wood for fuel, charcoal for the iron industry, and later as a source of logs for timber and pulping. Cattle grazed the forests hampering tree regeneration. After decades of political debate about the declining state of Swedish forests, the first Forestry Act was passed in 1903, requiring owners to replant after harvesting. The Forestry Act has been updated several times since then, and today it balances economic, ecological and social interests.

Swedish forests and forestry are shaped by the country's natural conditions, its history, forestry research, the knowledge and experience of the forest owners, and the tradition of seeking solutions based on mutual respect, understanding and compromise.

This booklet provides an overview of the values and goals that are embodied in Swedish forest policy and practice today. It describes the nature and scope of the involvement of politicians, government agencies, research institutions, forest owners, industry, non-governmental organizations and other stakeholders in the forest sector.

It is produced by the Royal Swedish Academy of Agriculture and Forestry in close cooperation with the Swedish University of Agricultural Sciences, Umeå University, the Swedish Forest Industries Federation, the Federation of Swedish Family Forest Owners, the Swedish Forest Agency and the Forestry Research Institute of Sweden. This is the third edition; the first was published in 2001 and the second in 2009, with the title *The Swedish Forestry Model*.

The Academy is a forum for people who, for the benefit of Swedish society, are seeking to develop and improve Sweden's land-based industries: agriculture, forestry, fishing, hunting, reindeer husbandry and aquaculture.

Stockholm, August 2015
Royal Swedish Academy of Agriculture and Forestry

Carl-Anders Helander
Secretary General and Managing Director

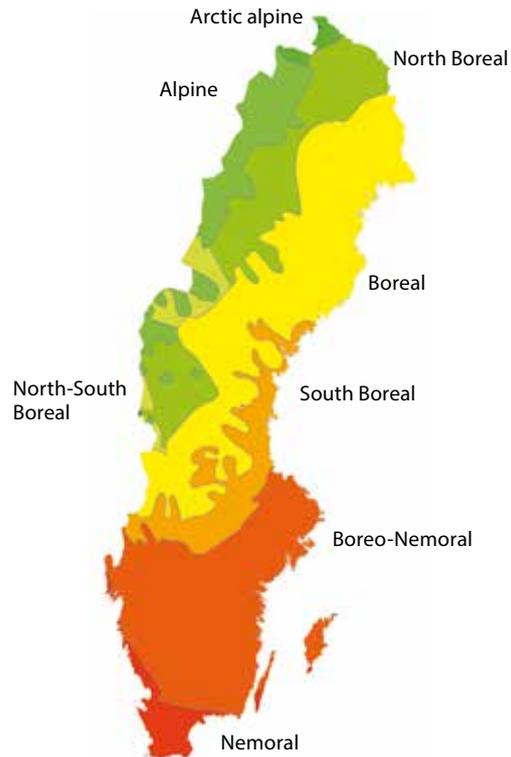


Photo: Michael Ekstrand, Swedish Forest Agency.

Natural Conditions

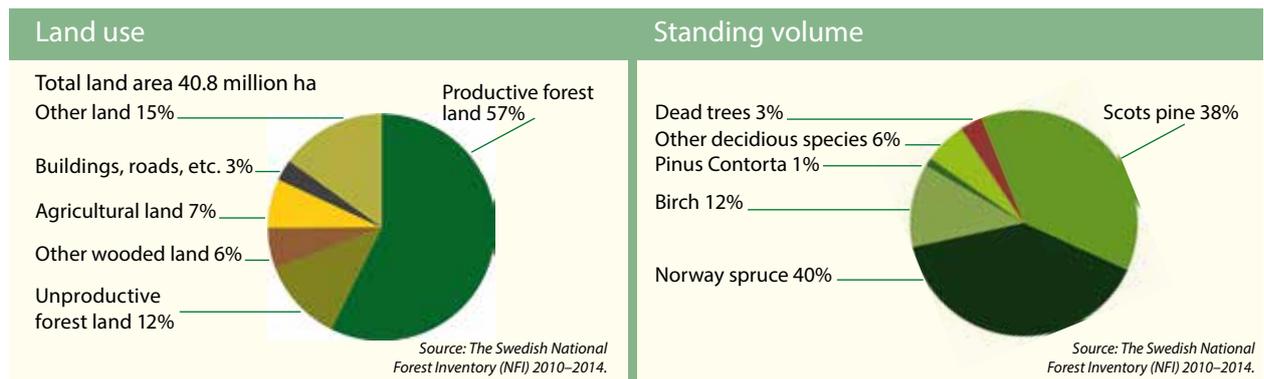
The Swedish landscape is characterized by lakes, wetland areas and shallow, nutrient-deficient soils. The country's natural forest ecosystems are strongly shaped by the particular conditions resulting from a relatively harsh but wet climate. Partly due to repeated glaciations, the number of species found is relatively small compared to similar ecosystems in other parts of the world. Most of the country is covered by boreal forest which in its natural state contains a patchwork of habitats shaped by various disturbance regimes, notably forest fires, flooding and storms. Owing to the large north-south extent of the country (the latitudinal range is from 55°N to 69°N), there is a considerable variation in climate and soil conditions, both of which are more favourable for tree growth in the south.

Eight vegetation zones can be distinguished in Sweden. The boreal zone and its sub-zones cover the majority of the land area and are dominated by coniferous forests. In the south there is a small zone of mainly deciduous forests: the nemoral zone.



Sweden's forests are among the most northerly in the world. The warming effect of the Gulf Stream permits forest growth at latitudes that are characterized by treeless tundra in other parts of the world.

A wintry forest landscape in Sweden.
Photo: Stefan Örtenblad, SKOGENbild.



Historical Background

Swedish forests have been utilized by man for centuries. In early times, forest land was cleared for arable farming; large areas were claimed for shifting cultivation, and forest grazing was widespread. Furthermore, Swedish forests were a source of wood for fuel and timber for domestic use, and also served as hunting grounds. The forests also supported various secondary uses, e.g. the production of charcoal, tar and potash.

Wood-consuming industry

As early as the 13th century, the mining industry (largely concentrated in central Sweden) was a significant consumer of timber, gradually becoming a big consumer during the following centuries, until the end of the 19th century. Wood as fuel was needed for ore extraction, and charcoal was used for smelting and processing.

Meanwhile, in the more populated south of the country, forest raw materials were being used in the production of iron and steel, and for shipbuilding, glass-making, the extraction of train-oil and other industrial activities, as well as for meeting domestic needs.

In the mid-1800s, a growing forest products industry (mainly in the north) generated increasing demand for sawn logs and, some 50 years later, raw materials for the manufacture of pulp and paper. The utilization of

the forest resources in the north led to Sweden being transformed from an agrarian society into a rapidly developing industrialized nation.

Forest legislation

As a consequence of this intense exploitation and the absence of any reforestation measures, large areas of forest had been depleted by the end of the 19th century. This led to political action, and in 1903, after lengthy political debate, Parliament declared a national forest policy and passed a Forestry Act, which initially had a focus on regeneration. Regional forest service organizations were also established to support afforestation and reforestation policies. In the following decades this decision was supplemented by several other key decisions, which together created a viable policy environment for forest development. In 1905 a forestry authority was established in each county, university-level forest education was initiated in 1915 and the Swedish National Forest Inventory started in 1923.

Forest policy and the Forestry Act have been revised several times since 1903. Government regulation of the forestry sector intensified further after World War II, culminating with the very detailed legislation that was passed during the late 1970s.

*School children planting on deforested land in Halland, southwest Sweden, in the early 1900s.
Photo: Gunnar Schotte, Forest library archives, SLU.*



Increasing growth

During the 20th century, the forestry sector was able to meet the growing demand for timber from the expanding forest products industry through a large increase in the annual harvest. Despite this, the growing stock has been increased by about 85 percent from the time of the first National Forest Inventory in 1923. This growth has been due to a combination of factors: policy determination, forest science development and the creation of family forest associations all built on existing land tenure rights, with the aim of strengthening the market power of small forest landholders. Long-term economic drivers at national, industry and local forest-holding level, together turned formerly devastating forest practices into a Swedish success story.

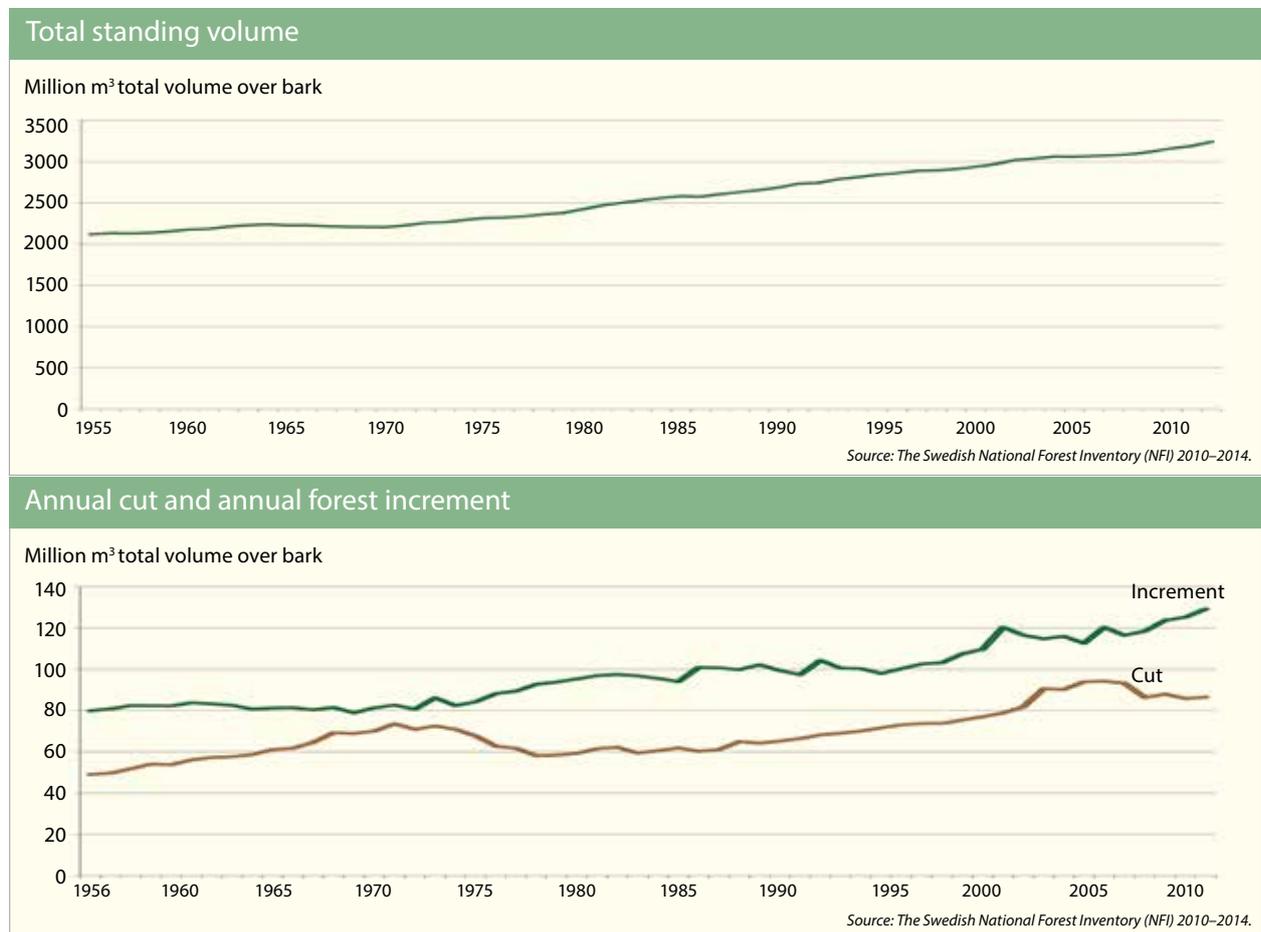
After World War II, an even-aged stand management system—consisting of final felling followed by planting or natural regeneration—became the most widespread forestry practice. As farming methods were rationalized, forest grazing became the first practice to disappear. Later on, pasture and poor-quality arable land were either left for natural regeneration or were

planted with forest trees. These developments led to increased tree growth in the Swedish forests.

Forest ecosystem

During the past century many of the natural disturbance regimes such as fire and flooding have been controlled, something which in combination with organized forestry has put many of the processes of the natural ecosystems under pressure. In historic times, land use mainly related to agriculture also created disturbances which further altered the ecosystem by creating new habitats supporting rare species of flora and fauna.

Most nature conservation efforts are aimed at preserving existing areas with high biodiversity values, and, with various methods, simulate and recreate the effect of the natural disturbance regimes or historic land use. Old growth or untouched forests are rare, but different histories and topographies contribute to diverse forest ecology.



Forest Ownership and Structure

The ownership structure of Swedish forestland—a combination of family enterprises and widespread corporate ownership, with most of the state-owned forest managed commercially—contrasts sharply with the ownership structure of forests in the rest of continental Europe.

Land tenure

A country's land tenure regimes are intimately coupled to its historical and current land use forms. They are often a combination of possession rights and user rights, and a range of tenure concepts and practices may exist side by side in any one country. In Sweden, there are at least three layers of tenure regimes influencing forest use and forestry: private land tenure, usufructuary rights held by the Sami people in the northern parts of Sweden and the right of public access.

Private ownership of forests has been a reality for farmers and hence forest owners in Sweden for centuries. Private ownership acquired a strong legal basis early on, and farmers were guaranteed seats in the Swedish Parliament. This was a way for the King to develop the country while at the same time increasing the tax base; historically, soldiers could also be billeted on some farms, which was also beneficial for the Swedish state.

But first and foremost private ownership has been an important basis for sustainable land use and long-term planning and investments in the regeneration of forests.

The forest is a family asset due to a well-functioning and respected cadastral system; this is an absolute prerequisite and driver for sustainable forest management.

While the private ownership of forests is based on possession rights, the two other forms, described elsewhere in this booklet, relate to user rights. To avoid conflicts due to these parallel rights the stakeholders in the forest have initiated collaboration and dialogue projects.

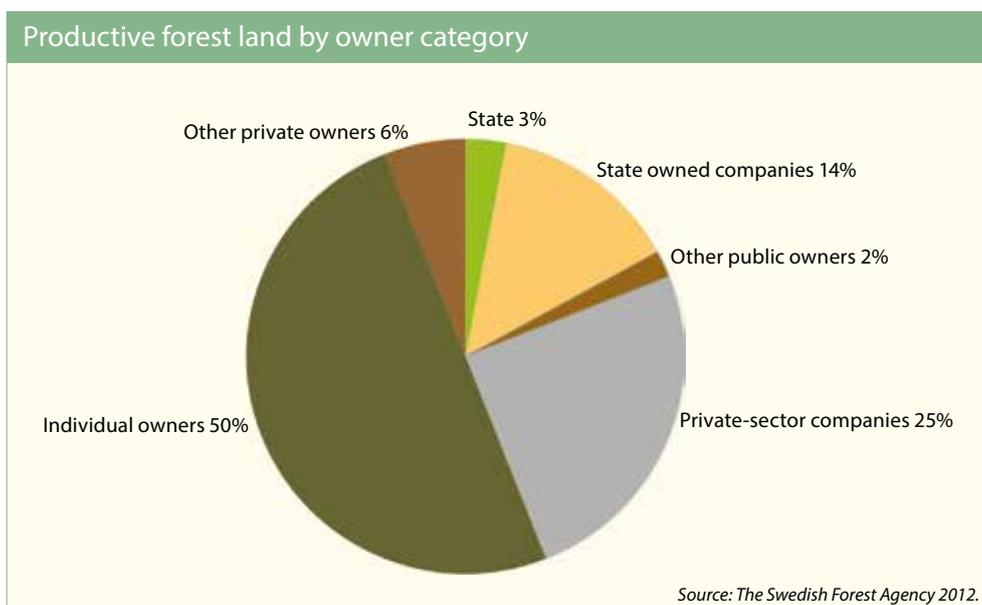
Industrial forest enterprises

A small number of large industrial forest enterprises own some 25 percent of all forest land in Sweden.

There are some 50 pulp and paper manufacturers in a total of 23 groups of companies, and around 115 sawmills in a total of 60 groups/companies in Sweden. Only a few Swedish companies have forest holdings that are integrated with industrial capacity. Industrial enterprises tend to buy wood on a stumpage basis from private forest owners, and act as advisers to family enterprises.

Sawmills, which for the most part are owned by private enterprises or groups of companies, do not normally have forests of their own.

Most of the state forest belongs to the state-owned company Sveaskog, which accounts for 14 percent of all forest land. Wood from state or public owned forests is also an important source for the industry.



Other forest owners

Besides the state-owned Sveaskog, the rest of the public-sector-owned forests account for five percent of the forest land, of which three percent is state-owned and two percent is owned by other public bodies such as local and county councils.

Other private forest owners account for six percent, and include, for example, the Swedish Church and for-profit and non-profit associations.

Family enterprises

About half of all forest land in Sweden is owned by family enterprises. There are some 200,000 families with farms of more than five hectares of forest land, and most farms are passed on from one generation to the next. The average holding is 50 hectares, but the size varies greatly. The traditional farms consist of both agriculture and forest land. Family owners have different objectives and also different priorities, which leads to a rich diversity of forestry practices. However,

one goal is common to all: sustainable long-term forest management.

Forest cooperatives or associations were originally established by forest owners during the first decades of the 20th century in order to give their members a stronger market position and a better chance to obtain a fair share of the wood value. Some 90,000 family farms, which together account for roughly half of all family forest enterprises, are members of a forestry cooperative. In addition to marketing and sales services, the cooperatives also offer forest management services and advisory services, and represent the interests of family forestry in consultations at the political level. Through their membership, family enterprises also own industrial facilities – principally pulp mills and sawmills but also installations for the rapidly growing energy sector (heat and electricity). The cooperatives together form a National Federation of Family Forest Owners, a body which seeks to influence national and international forest policy.



Photo: Pär Fornling.

The Forest Products Industry

The forest products industry plays a major role in the Swedish economy, and accounts for between nine and 12 percent of Swedish industry's total employment, exports, sales and added value. It includes companies within the pulp and paper industry, as well as the wood-mechanical industry. Close to 90 percent of paper and pulp production is exported, and the corresponding figure for sawn-wood products is almost 75 percent. As the raw material is mostly domestic, the forest products industry makes a significant contribution to Sweden's trade balance.

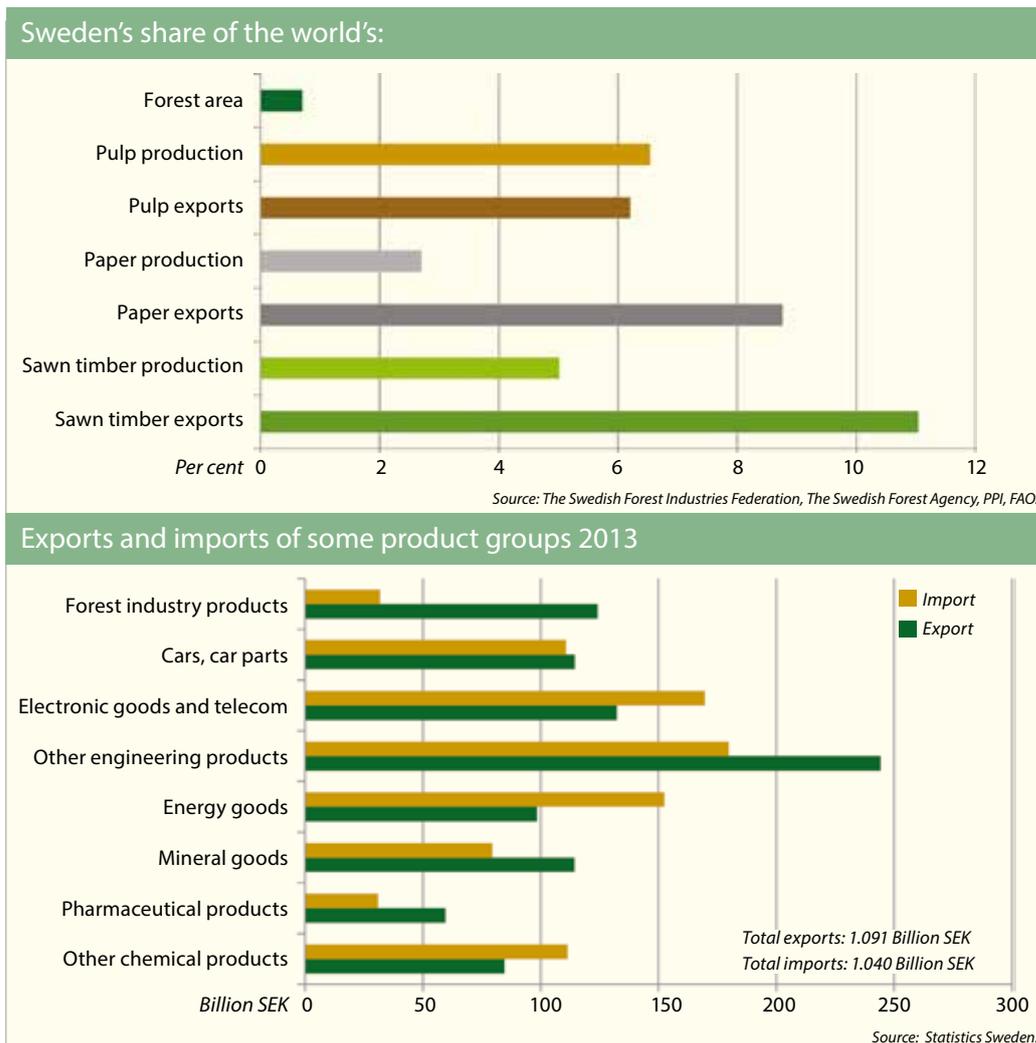
The forest products industry is technology and know-how intensive with high-tech processes and products with a high knowledge content. The pulp and paper industry is particularly capital intensive, and investments in new pulp lines or paper machines total several billion Swedish kronor.

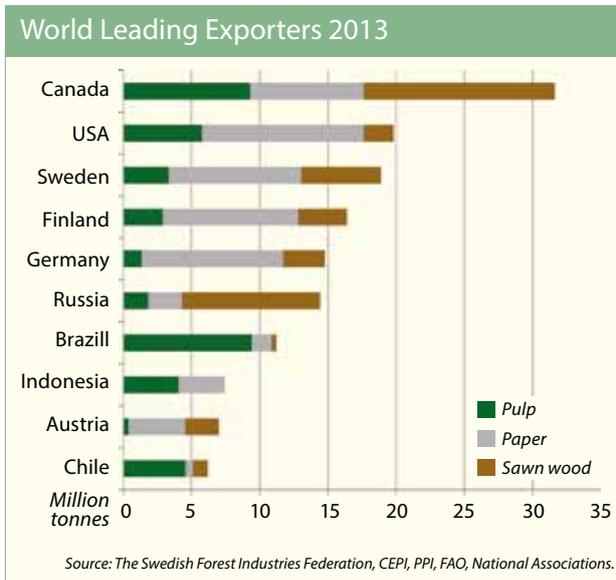
Making logging operations, transport and manufacturing more efficient, increasing forest growth and

developing new products with a high refinement value are prioritized areas for research and development. Ultimately, it is the capacity to continually improve productivity and the product value that determines the level of profitability and activity in forest operations and associated industries.

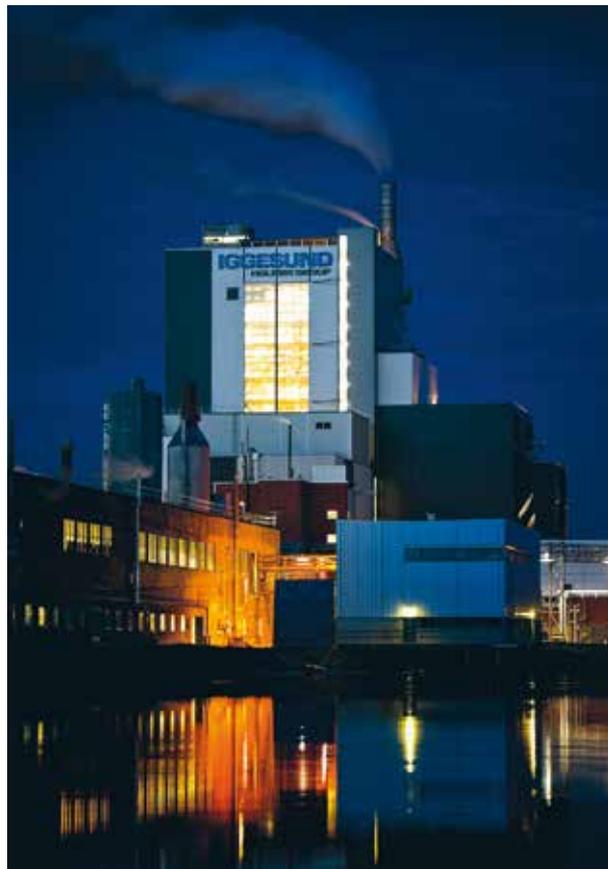
The global economy is currently characterized by uneven and slow recovery with major differences between countries and regions. The emerging markets have stronger growth which makes them more and more important for sales of the forest industry's products.

The timber market in Sweden is less regulated than in most other countries. The need to establish reliable and impartial measurement of timber was recognized at an early juncture by the forest products industry, forest owners and the government: independent measurement bodies and a reliable and widely recognized wood measurement law are basic principles for ensuring trust on the timber market.





A sulphate pulp mill is also a big energy producer. Iggesund Paperboard's pulp mill in Iggesund has a black liquor boiler which produces steam and operates at the highest pressure and temperature known at integrated board mills. This allows Iggesund Paperboard (which belongs to the Holmen Group) to produce 0.5 TWh of green electricity in a turbine, far more than the consumption of the mill. In total, pulp mills in Sweden produce six TWh/year of green electricity.
 Photo: Rolf Lavergren, info@bildbolaget.nu.

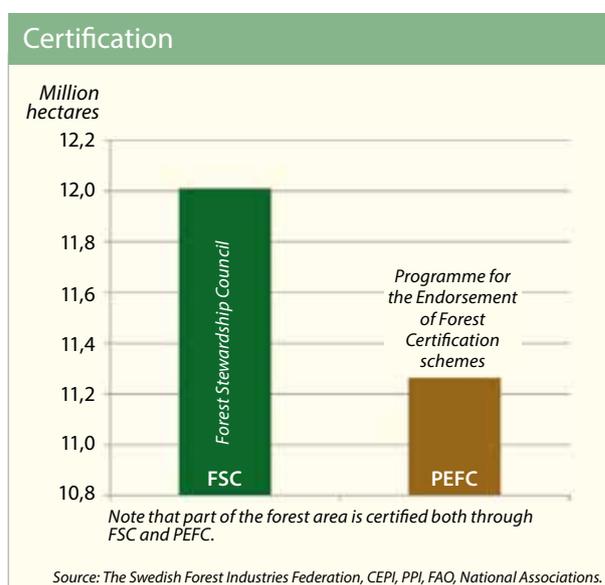


Certification

There is an increasing awareness among consumers that their consumption has an impact on the environment and society. This means that forest managers and the forest products industry need to provide the market with assurance that forest products stem from sustainably managed forests (i.e. those that are environmentally appropriate, socially beneficial and economically viable). One way in which this is done is through forest certification; this means that the forest manager undertakes to follow the guidelines and criteria for responsible management set by the certification system, and provides assurance that the specific standards ensured by a third party certification have been met. Forestry certification in Sweden takes place within the Forest Stewardship Council (FSC) system and in the Programme for the Endorsement of Forest Certification (PEFC).

In 1998 Sweden became the first country in the world to get a national FSC standard approved, and the major forestry companies soon certified their forest operations. It was quickly followed by the introduction of the PEFC, a system more suited to private forest

owners. More than 60 percent of forest areas are certified, and some forest lands are certified both through the FSC and PEFC.



National Forest Policy: Principles

In 1993 Sweden changed its forest policy to integrate ecological considerations with modern forestry practices. The policy focuses on two major objectives, one for production and one for environmental concerns. Both of these objectives are ambitious. In contrast, the legal demands on forest management, mainly set by the Forestry Act and the Environmental Code, are much less demanding. The policy is often described as ‘freedom with responsibility’, and presumes a willingness of forest owners and users to make larger investments in their forest management—both concerning conservation efforts and measures to improve production—than what is stipulated by law. The change marked an important shift from a more government-oriented into a more governance-oriented policy, opening the way for a more decentralized forest sector. In 2008 the Act was amended to also include the social values of the forest.

In parallel to this policy change, Swedish forest management has also become influenced by market-driven processes of forest certification in which the practices of forest owners are assessed against certification standards, see page 9.

The overarching intention of forest policy is, in line with international agreements, to ensure sustainable forest management. In 2014 the government decided to establish a National Forest Programme in order to meet the increasing demands for public participation in forest policy development, and to increase the efficiency of implementing forest-related policies and international commitments.

Legislation on timber mensuration stipulates that sawlogs, pulpwood, chips and fuel wood measurements

must be carried out in accordance with the directions of the Swedish Forest Agency.

Global mega-trends such as demographic developments, energy use and climate change have evoked further changes in Swedish forest policy to actively meet the need to move the entire economy towards a bio-economy.

The forest sector is seen as a commercial sector which should be economically self-sustained. In principle, no direct subsidies for wood production exist. There are, however, some state subsidies for measures in forestry in order to enhance the sector’s environmental value. Net income from forestry is taxed essentially in the same way as other branches of the economy.

International agreements influencing national policies

EU regulations and international agreements are both influencing Swedish forest and environmental policies. The EU Timber Regulation, the Habitats Directive and the Water Framework Directive are examples of EU regulations which are currently under implementation. In addition, there are several other international agreements and processes that deal with forests and conservation issues, e.g. the Convention on Biological Diversity (CBD), the UN Framework Convention on Climate Change (UNFCCC) and the United Nations Forum on Forests (UNFF). These agreements and processes also exert an influence on forest and environmental policies in Sweden.

A moraine-dominated mosaic landscape from south/mid-Sweden with a long land use history. The areas of agricultural land and forest have fluctuated over time. During the past century forest land has expanded, reducing arable and grazing lands.

Photo: Erik Sollander, Swedish Forest Agency.



National Forest Policy: Implementation

In accordance with the Swedish Constitution, national policy in various fields is formulated by the government, which in turn is dependent on support from Parliament in order to formally decide and establish the policy. To implement policy, the government formally gives the task to one or more government agencies. The details of the task are normally for the agencies to decide upon, guided by a generalized set of requirements, e.g. the need for efficiency, transparency, gender equality, cooperation, consultations with stakeholders and so on. In legal matters, the role of the agencies is to independently interpret and uphold the law. Possibly illegal activities are investigated, and suspect cases turned over to public prosecutors within the court system.

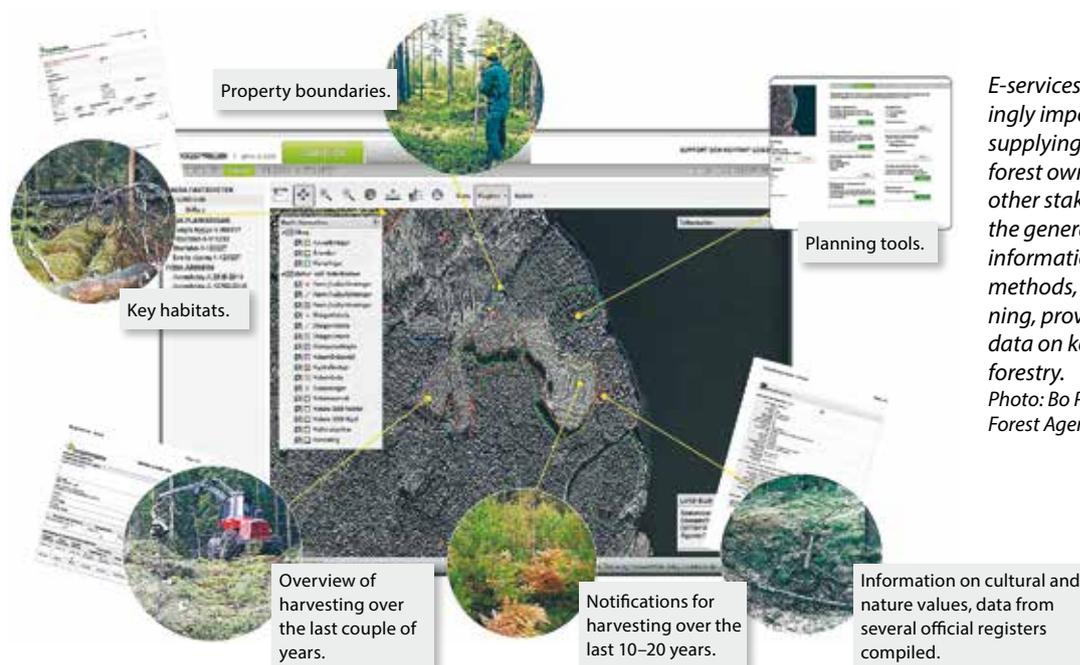
The Swedish Forest Agency is the main government agency for forests, forestry and associated environmental and conservation issues. Major tasks include ensuring observance of the relevant laws and regulations and improving capacity-building within the forest sector at large. The Agency conducts various forest inventories and uses an array of electronic services to distribute information to stakeholders. Geographical Information Systems (including databases, maps, satellite images, aerial photos and laser-scanning information) are widely used along with user-friendly systems to visualize the information and to enable forest owners to upload notifications of final felling and other activities. The idea is that relevant existing information related to the forest should be available to forest owners, and, to a

large extent, also to the general public. Field-checks for monitoring and so forth are normally used only when other methods are deemed inadequate. The Swedish Forest Agency also provides training, planning and extension services.

On strategic level, the Agency manages several processes to improve policy implementation within the sector, e.g. concerning the reduction of damage to the forest, reforestation where necessary, improving retention in forest management, etc.

Forestry is influenced by numerous policy areas, many of which are often supervised by different government agencies; this has led to an increasing need to improve cooperation. Today, the Swedish Forest Agency cooperates closely with many other agencies, notably the Swedish Environmental Protection Agency, the Swedish National Heritage Board, the Swedish Agency for Marine and Water Management and the county administrative boards. Better cooperation and coordination systems between government agencies have led to improved communication between forest owners and the agencies. In many cases it means that a forest owner only has to be in contact with one agency on any issue related to land use.

With regard to supervision of the law, major efforts are being made to reduce costly field-checks at an operations level and move towards supervision of the managerial systems of the relevant companies and organizations.



E-services are an increasingly important tool for supplying information to forest owners as well as other stakeholders and the general public. New information-gathering methods, e.g. laser-scanning, provide high-quality data on key aspects of forestry.
Photo: Bo Persson, Swedish Forest Agency.

Investing in Knowledge

In many ways, specifically forest-related science has advanced in tandem with the evolution of forestry practices and the forest sector. At the beginning of the 20th century, society demanded that forestry should increase forest productivity to enable increased extraction of woody biomass. Accordingly, forest science developed with a focus on forest production. In order to monitor the development of the forest biomass resource over time, the Swedish National Forest Inventory was started in 1923, covering all ownership categories. The current Forestry Act that was passed in 1994 states that forestry should promote forests' production and environmental and social values equally. Simultaneously extracting woody biomass resources for renewable materials and products while preserving and enhancing forest environments, biodiversity and social values is a challenging task. Hence, today's forest science encompasses a very broad range of subjects, and research is carried out by a number of knowledge-producing organizations, including both universities and research institutes. Likewise important for science, policy and practice are the long-term environmental monitoring programmes that continuously monitor Swedish forest biomass resources as well as key environmental variables.

Increasingly, integrated knowledge drawn from economic, technological, social, political and ecological perspectives will be needed to find effective and pragmatic answers to today's complex problems to which there are no simple or optimal solutions.

Forest science has changed and will continue to develop, reflecting rapid overarching societal changes. The existing foundation of excellent disciplinary forest science that has been laid needs to be secured and further developed. Indisputably, interdisciplinary

approaches will continue to be an important tool in addressing the problems and possibilities of the forest sector. Most important, however, is to acknowledge that sound interactions between science, environmental monitoring and forestry practice and policy can contribute to ensuring that society's decisions about the forest are scientifically based.

Research and development in forestry

There is a long tradition in Sweden of collaboration in research and development between the government and the forestry sector. Most Swedish universities have research departments and taught courses related to Swedish forests. However, the government has specifically assigned to *the Swedish University of Agricultural Sciences* (SLU) the twin tasks of providing suitably qualified professionals to the forestry sector and pursuing innovative forestry research.

The Forestry Research Institute of Sweden (Skogforsk) conducts mainly applied research and is financed jointly by the government and the forestry sector. The Institute aims to publish its research findings promptly, so that they can be applied in practice as quickly as possible. Skogforsk has also been responsible for tree breeding activities in Sweden since the 1930s.

The Royal Swedish Academy of Agriculture and Forestry (KSLA) is an active and independent forum for sharing science and practical experience, and is important for all those with an interest in the field: researchers, forestry and agricultural professionals and organizations, as well as government agencies.



Photo: Marie Larsson-Stern, KSLA Committee for Silviculture.

Sustainable and Efficient Forestry

Even-aged forestry has been the dominant silvicultural system in Sweden since the 1950s. The silvicultural system follows a cyclic harvest-and-regeneration pattern on the stand level. To obtain a long-term sustainable flow of timber from the forest, an even age-class distribution on the regional and national level has been a long-term target in forest policy.

High and sustainable production of forest raw material combined with environmental considerations is the primary goal for many forest owners. Scots pine and Norway spruce are the dominant tree species, standwise supplemented with naturally regenerated broadleaved trees. Lodgepole pine is used to some extent in northern Sweden, while larch, Douglas fir and Sitka spruce to some extent in the southern part of the country. The broadleaved tree species used are birch, aspen and alder, and in southern Sweden oak and beech. The greater part of the broadleaved species cover is naturally regenerated.

Forest management plans

Voluntary forest management planning has evolved into an effective tool for production and implementing conservation measures in everyday forestry. These plans are also important instruments for forest certification.

Regeneration

The regeneration methods used are planting, sowing and natural regeneration, of which planting is by far the most common. Almost 400 million seedlings are planted each year. Soil preparation is often a prerequisite for approved regeneration. It is carried out primarily by continually or intermittently working units such as disc trenchers and mowers, with a forwarder used as a base machine.

Trees have been continuously genetically improved during the last 60 years. The main goal is to provide

forestry with improved seed and seedlings with high levels of genetic variation and preparation for climatic change, resulting in forests with enhanced growth, vitality, wood quality, and resistance to damage.

The most common and best developed method of mass propagation is seed-orchard production, although rooted cuttings of Norway spruce are to some extent used in southern Sweden. Somatic embryogenesis is a vegetative propagation method with great potential, albeit one that is not yet used commercially in Sweden.

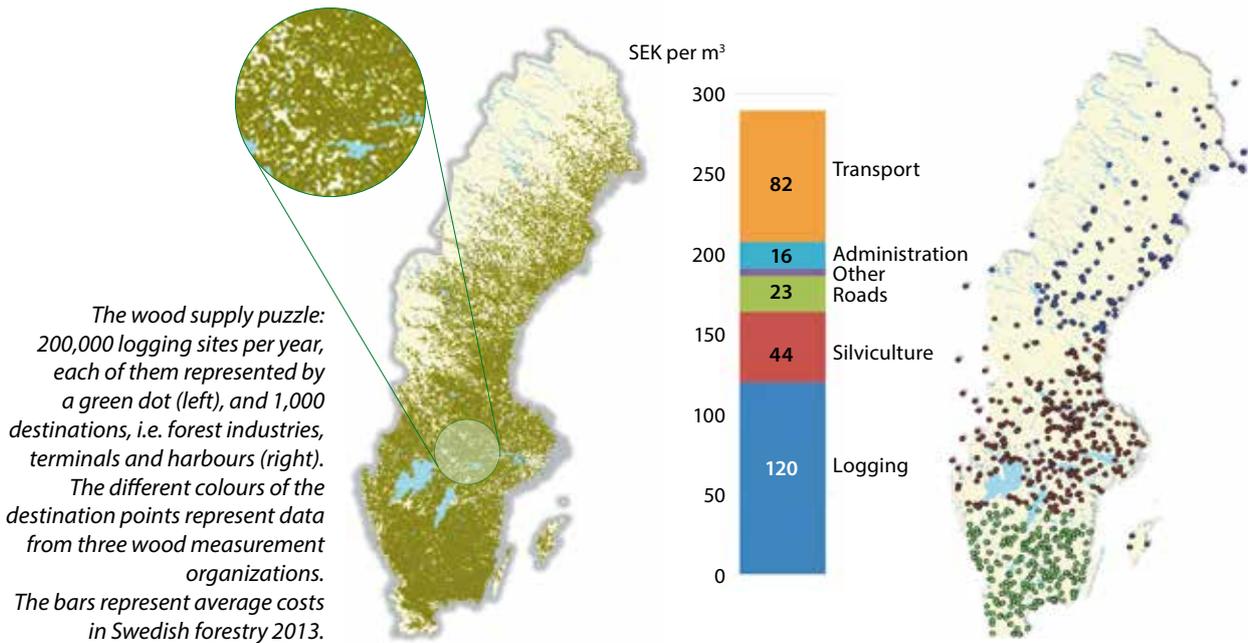
Most of the seedlings used are containerized and rather small, but bare-rooted seedlings are still quite common in southern Sweden.

Almost all planting is carried out manually, mainly by contractors. Research on mechanized tree planting in inverted soil preparation is undertaken cooperatively by forestry companies, researchers and manufacturers. The purpose is to obtain a more gentle soil preparation that is at the same time more efficient. To avoid damage from pine weevils, the seedlings have to be protected: this was previously done with chemicals, but nowadays mechanical protection, which is more environmentally friendly, is used to a greater extent. →

*Reforestation, normally planting, sowing or natural regeneration, is compulsory after final felling.
Photo: Per-Anders Sjöquist, SCA.*



Forestry Data	
Final felling at the end of the rotation period (ha/yr)	190,000
Thinning (ha/yr)	380,000
Scarification (ha/yr)	170,000
Regeneration (ha/yr)	185,000
Forest tree seedlings produced (no/yr)	380,000,000
Cleaning (ha/yr)	270,000
Average 2009–2013	
Source: Statistical Yearbook of Forestry 2014. Swedish Forest Agency.	



Source: Skogforsk (the Forestry Research Institute of Sweden).

Cleaning

Cleaning is important for future forest economic yield. It is used to regulate the tree species that compose future stands. It also has a positive effect on the pattern of diameter growth and wood quality. Cleaning is carried out almost exclusively using motor-manual methods with a brush saw; it is mostly done by contractors. Development of mechanized cleaning is focusing on the harvesting of biomass for energy purposes in young stands.

Logging and wood supply

There is a strong tradition of wood procurement from forest owners by the industry—more than half of the annual industrial supply originates from private woodlot owners. More than 70 percent of the yearly wood volume procured originates from final felling, with the rest coming from thinning operations. Besides wood, forest biomass for energy purposes is produced, mainly originating from tops and branches.

The production system from logging of round wood to delivery at mill can be divided into components:

– **Planning.** Forest stands suitable for harvesting are chosen. Operations in each stand are carefully planned with consideration to natural and cultural features. In many cases, the yield of various assortments (forest products) is forecast.

– **Harvesting** is almost totally mechanized. Trees are cut with a single-grip harvester (picture next page). This machine incorporates high-tech solutions for felling, processing and measuring both length and diameter, thus optimizing the wood revenue. This sophisticated equipment allows for assortments to be produced to

narrow specs according to industrial demand at stump in one go. On-board and on-line computers are important tools, and there are high operator environment requirements.

– **Terrain transport.** A forwarder (picture next page) loads the round wood assortments (normally 6–10). The wood is then hauled to a landing at roadside, where each assortment is piled individually. The forwarder capacity is up to 20 tons per load, and the average distance from stump to roadside is relatively short (about 400 meters) due to a dense network of forest roads.

– **Secondary haulage.** A timber truck picks up the wood at roadside and continues to the industrial site, typically a sawmill or a pulp/paper plant. The average hauling distance is around 100 km. Trains are used for longer distance transportation, with the trucks being trans-loaded at railway terminals.

Throughout the entire process, vital production information is collected and transferred further along the value chain; in this way, communication is maintained between the planner, harvester, forwarder and timber truck.

Biomass for energy purposes are normally chipped at the landing point and delivered directly to the customer – often a combined heat and power plant.

More than 90 percent of harvesting and transport is carried out by contractors. The need for development in productivity measures and value recovery is constant. The developmental work that takes place follows a tradition of collaboration in which forest practitioners, machine and equipment manufacturers and researchers work together.



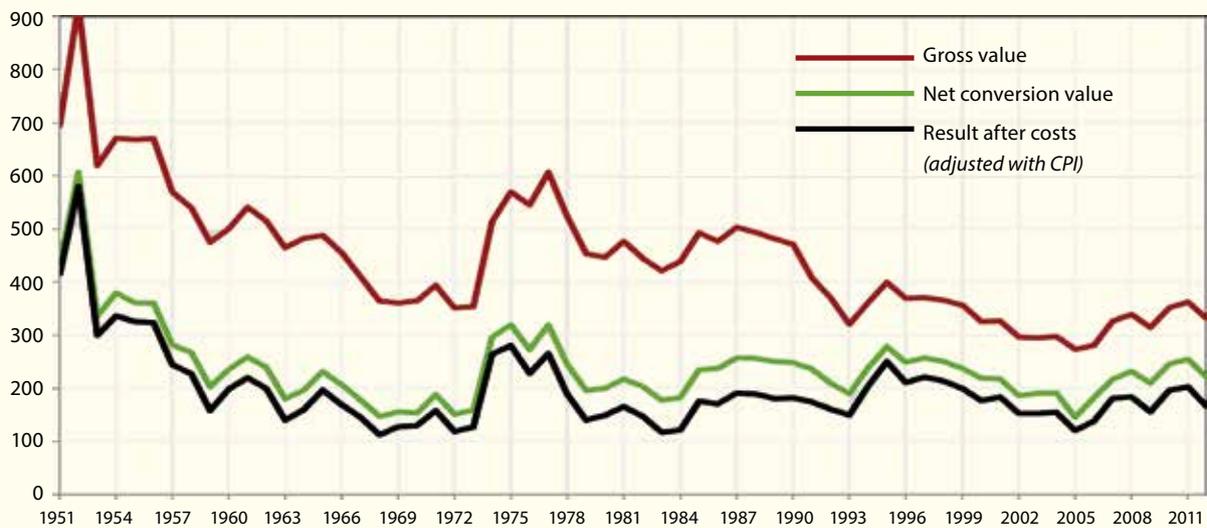
Rottne H21D single-grip harvester.
Photo: Courtesy of Rottne.



Komatsu 860.4 forwarder.
Photo: Courtesy of Komatsu.

Calculated gross and net conversion value and result after costs of annual felling at year 2012

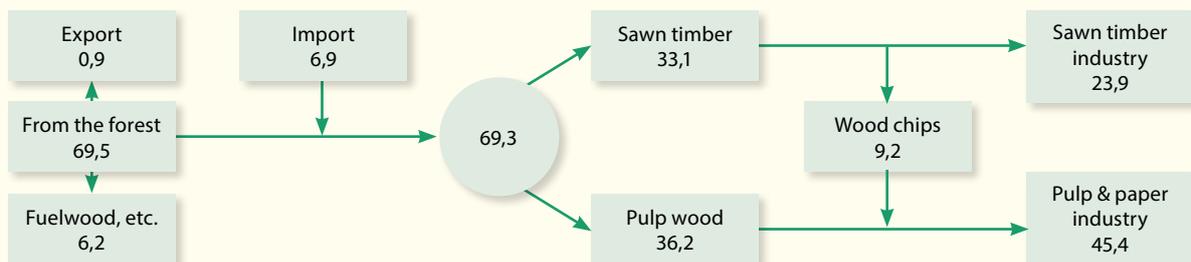
SEK/Cubic metre solid volume incl. bark



Source: Swedish Forest Agency, processing of multiple data sources.

The timber market 2013

Figures in boxes = million m³ (solid)



Source: Timber Measurement Council/SDC.

Conservation of Biodiversity in Forests

Conservation of biodiversity is a priority policy issue, and it is also a field where both scientific and operational knowledge is rapidly growing. Several forest measures may cause great losses of local biodiversity, especially if forests of high conservation value are cut. The Swedish model for protecting forest biodiversity is a combination of *general conservation considerations* in all day-to-day forest management and the designation of more *strictly protected forests areas*.

The major principles for conservation are to protect high conservation value forests and include sufficient levels of tree retention in all forest measures.

Protection of forests

Of Sweden's 28 million hectares of forest land about two million hectares are protected for conservation purposes, mostly in national parks and nature reserves. In these areas, timber extraction is not allowed unless it is to specifically improve the value of the land for nature and/or for the purposes of cultural conservation. In addition, unproductive forest land which accounts for some four million hectares are protected through the Forestry Act since the 1970s. On the remaining forest land there is active forest management with equal importance attached to biomass production and environmental goals.

Various measures for biodiversity



Illustration: Martin Holmer

Formally protected areas: National parks and nature reserves (A), and habitat protection areas and nature conservation agreements (B).

Forest land voluntary set aside for conservation purposes (C).

General consideration for high nature values and cultural heritage in forest operations (D).

The two forest certifications schemes, the Forest Stewardship Council system (FSC) and the Programme for the Endorsement of Forest Certification (PEFC), both require that five percent of the certified forest area where timber is extracted should be voluntarily set-aside land, a demand which has been the main driver for more than one million hectares of productive forest land being voluntarily set aside by various owners.

Retention in forest measures

In recent years, the Swedish Forest Agency together with a group of stakeholders representing a wide range of interests, have developed targets for retention, specifically for final felling. The targets cover not only biodiversity, but also water quality, cultural heritage, social values, etc.

Currently, the major companies which conduct forest operations are including the agreed objectives in their internal governing documents, an important step towards an improved level of retention in forest management. For biodiversity, the targets focus on delimiting and securing high conservation value areas, leaving enough trees near waterways and lakes to form functional buffer zones and leaving dead wood *in situ*.

Action programmes for individual species

For rare species with special habitat requirements there are special programmes designed to improve the habitats for the species in question. One such species is the white-backed woodpecker which demands large areas of old and decaying deciduous forests if it is to thrive.

Forest exempted from forestry, year 2011

Protection type	Million hectares	Percentage of total forest area
Formally protected	2.0	7.0 %
Forest land voluntarily set aside for conservation purposes	1.1*	3.9 %
Unproductive forest land, i.e. low productive forest land which is protected according to the Forestry Act	4.0	14.1 %
Total	7.1	25 %

*) The figure refers to productive forest land below the boundary of sub-montane forest. A recent study indicates that the figure is underestimated.

Source: Statistical Yearbook of Forestry. Swedish Forest Agency.

Social Aspects

The social aspects of what forests can provide to society have been particularly highlighted in recent years. These aspects are based on the various tenure regimes, such as right of public access or usufructuary rights (for example the right to herd reindeer). In addition to these aspects, the importance of the forest for human health, job opportunities and as a basis for new entrepreneurship has been stressed.

Outdoor activities

The right of public access

The ancient right of public access in the countryside in Sweden entitles people to pick berries, gather mushrooms, camp and pursue outdoor recreational activities regardless of forest ownership.

There are some restrictions, however; you must not cause damage to a landowner's property or to objects or sites of natural, historical or heritage value. Cutting down trees is, for example, prohibited.

The right of public access, which has few parallels in other countries, has benefitted generations of Swedes. People who can roam freely in the forests and countryside generally acquire not only knowledge of, and affection for, wildlife and the natural environment, but also some familiarity with forestry practice.

Hunting

With close to 300,000 registered hunters, hunting in Sweden, and moose (elk) hunting in particular, is an important source of recreation, as well as being a vital social and cultural activity. High numbers of moose and other ungulates, however, cause browsing damage, which leads to both reduced growth and inferior timber quality. To reduce conflicts between forest owners and hunters a new local and ecologically based moose management scheme has been introduced: representatives of hunters, landowners and regional authorities are formally brought together to manage wildlife at multiple levels. The scheme aims at reaching a moose population with high quality and reducing the browsing damages.



Picking mushrooms is a popular pursuit in Sweden. Photo: Björn Svensson, SkogenBild.

The right to herd reindeer

Reindeer husbandry is an extensive and unique form of land use carried out by the indigenous Sami people across Sapmi, an area covering much of northern Finland, Norway, Sweden and north-western Russia. Reindeer husbandry has great cultural and economic significance for the Sami community, and has been declared a matter of Swedish national interest, emphasizing the possibility of preserving reindeer grazing rights according to law. In Sweden, the reindeer herding area covers 22.6 million hectares, equal to 55 percent of the Swedish land base and including more than 50 percent of the productive forest land. The right to herd reindeer is based on usufructuary rights and is carried out in conjunction with other land users. Forestry and reindeer husbandry thus use the same land but for different purposes; the potential for each of these interest groups to adversely affect one another is clear. Thus to reduce the risk of conflicts escalating the government has established a consultation process (which has been further developed through the certification systems

mentioned above) where the various parties can meet and discuss their respective needs before reaching agreement on the way forward.

Employment

The forest products industry involves cooperation with suppliers in the machine and chemical industries, the transport sector, IT, construction and many more spheres of economic activity. Research and education are also important elements in this economic cluster. Through this cooperation, employment is generated along with the development and deployment of knowledge and competence. The forest products industry provides direct employment for almost 60,000 people in Sweden. Together with its sub-contractors and the forest operations, including transportation, the sector is the source of some 200,000 jobs. In several counties the forest products industry accounts for 20 percent or more of industrial employment.



There are about 250,000 reindeer and 4,600 reindeer owners in Sweden. Photo: Tara Teel.

Forestry and Climate Change Mitigation

Government commitments to reduce greenhouse gas emissions over the coming decades can be achieved through reductions in emissions and increases in carbon sinks, relative to a baseline. The path to low fossil carbon economies, or bio-economies, will require substantial restructuring of the global dependence on fossil resources, and a strong increase in the use of renewable resources such as wood.

Active forest management and the use of forest biomass to replace fossil energy and energy-intensive materials can create a significant climate benefit in the longer term. Contemporary Swedish forestry practices and the use of forest products have already resulted in much lower emissions than would otherwise have been the case.

With a forest management strategy aimed at increasing forest growth and yield, and a strategy for

forest product use that substitutes fossil energy and energy-intensive materials, this climate benefit can increase further. Conservation of forests and reduction of harvest rates can also result in climate benefit in the form of an increase in forest ecosystem carbon stocks, but it also results in reduction of carbon stocks in harvested wood products and a reduction in benefits from the use of wood products as substitute.

Over time, substitution benefits can more than compensate for the gains in forest ecosystem carbon stocks. Moreover, depending on the risks to forests from natural disturbances and climate change impacts, conservation activities carry a high risk of reversal due to natural disturbances or climate-change induced tree mortality. Thus, mitigation portfolios need to be designed with consideration of future climate regimes in mind.

Carbon dioxide balance in the production of a four-storey building

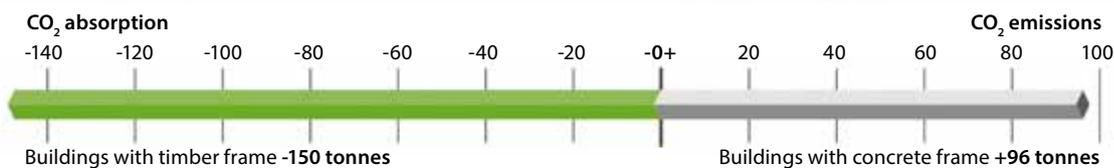
The carbon dioxide balances for two otherwise identical houses—one with a timber frame and the other with a concrete frame—have been compared over a 100-year period. The study has been carried out by researchers from Mid Sweden University in collaboration with, among others, Finnish researchers. The figure shows net emissions of

around 96 tonnes of carbon dioxide from the building with the concrete frame, while the building with the timber frame produces no emissions; instead it had a net uptake of 150 tonnes of carbon dioxide (a positive value means net emissions, a negative value means net uptake).

Building with timber frame



Reference building with concrete frame



The analyses take into account energy consumption in the production and distribution of the building materials used, as well as the construction of the building. In the case of the wooden building it is assumed that the by-products from harvesting of the forest and production of the sawn timber are used as biofuel and thus replacing fossil fuels. In the case of the concrete building, the uptake of carbon dioxide by the cement through the carbonisation process has been taken into account. It has also been assumed that the harvested trees are replaced by new saplings that bind carbon dioxide through photosynthesis. The carbon from the harvested trees is stored in the wood as long as the material still exists. It is assumed that once the buildings have been demolished the wood will be used to replace fossil fuels.

Source: Mid Sweden University.

Damage and Threats to Forests

Fungi

The single most severe biotic cause of damage to forest trees is root rot, mainly on spruce, caused by *Heterobasidium annosum*. Other fungi that seriously affect conifers are *Gremmeniella abietina*, *Cronartium flaccidum* and *Lophodermium seditiosum*. Broadleaved trees are also susceptible: the problems from Dutch elm disease, caused by *Scolytus sp.*, are well known, but ash is being increasingly attacked by *Chalara fraxinea*.

Insects

The pine weevil *Hylobius abietis* is a serious pest, killing many newly planted seedlings. On mature spruce trees, the bark beetle *Ips typographus* is the most serious insect pest, especially in years following major storms when dead and weakened trees provide feeding and nesting opportunities.

Mammals

By far the most serious mammal damage to forest trees is caused by moose, which damage young trees and thereby reduce the quality and production of future sawn timber. This forces many forest owners to plant spruce (which moose normally do not consume) on sites where pine would have been better adapted. Also, the regeneration of deciduous species such as rowan and aspen is suppressed in many areas of Sweden due to moose browsing.

Weather

When selecting tree species for forest regeneration, it is important to consider the length of the growing season to prevent damage from frost and minimize the potential adverse effects of extreme weather events. The single most severe abiotic threat is storms, which cause substantial damage at irregular intervals.

Forest fires are usually a minor problem in Sweden; however, they do occasionally cause substantial damage and in the past forest fires were frequent occurrences in Swedish forests.

Climate change

Although there is still much uncertainty, it is believed that climate change will increase the range of threats to Swedish forests. Outbreaks of new types of pests are likely, and it is forecast that the frequency of storms and droughts will increase.



The number of moose is high compared with other countries. On average, just over 90,000 moose are shot each year. Photo: Stefan Örtenblad, SKOGENBild.



The aftermath of Hurricane Gudrun in January 2005. Roughly 75 million m³ of trees were blown down in southern Sweden. Storms are the single most abiotic threat to Swedish forests. Photo: Areca.

National Networking

The combination of private and public ownership of Swedish forests, a forest policy that includes wide-ranging discretion for forest owners to manage their forests according to the principle of freedom with responsibility and soft governance tools has created a need to establish strong partnerships and networks between different forest-related actors. All of these actors are currently involved in the National Forest Programme.

Non-governmental organizations

The many popular voluntary movements that blossomed at the end of the 19th century were effective advocates of new ideas and thinking. Trade unions, the Free Church and the temperance movements have been important in shaping modern Sweden, in parallel with political parties and industry.

The involvement of people in voluntary movements relevant to forestry lives on today. The majority of family forest owners are members of the Swedish Federation of Family Forest Owners either through membership of a Family Forest Association and/or the Swedish Federation of Farmers. There are environmental organizations such as the Swedish Society for Nature Conservation and the WWF. Twenty-one outdoor-recreation societies, among them the Swedish Orienteering Federation, the Swedish Association for

Hunting and the Swedish Kennel Club, have formed an umbrella organization *Svenskt Friluftsliv* (Swedish Outdoor Life) to strengthen the recreational voice in the ongoing public discourse on forestry.

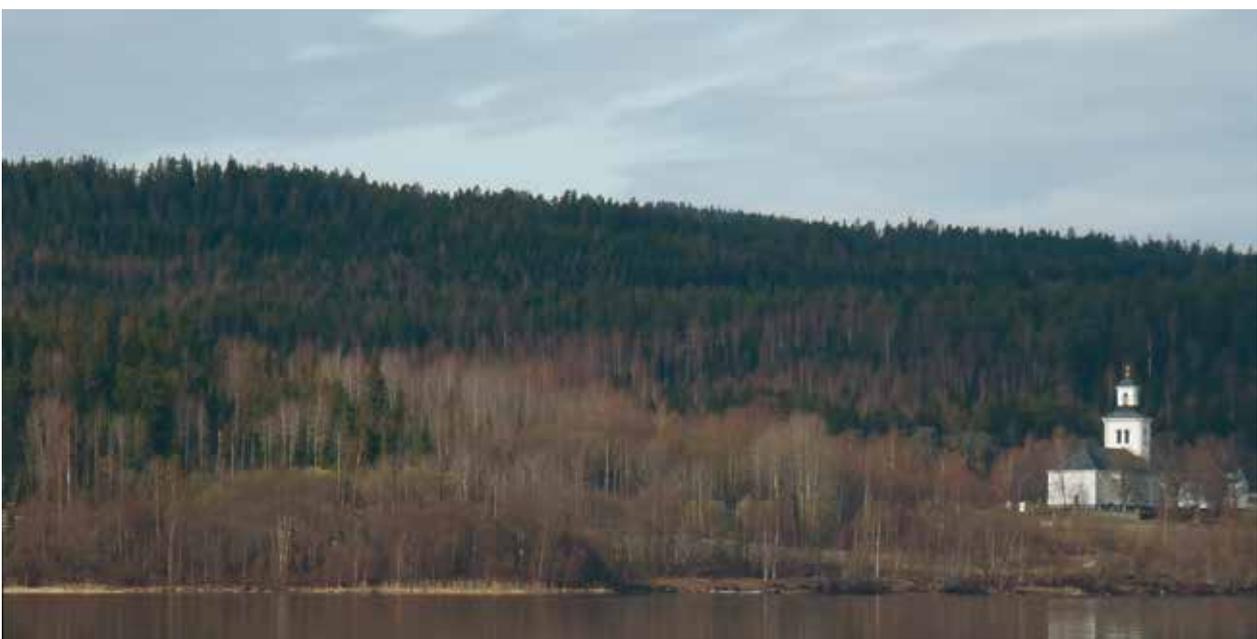
The forestry business organizations

Almost all Swedish sawmills and pulp and paper mills are members of the Swedish Forest Industries Federation, which speaks on their behalf in policy discussions.

... and others

The Swedish Church, the Royal Swedish Academy of Agriculture and Forestry, the Swedish Forestry Association, the Samian Federation and trade unions are also important stakeholders in discussions about forestry development.

Gradually, networks have evolved that enable different parties to negotiate and cooperate. The safety regulations that govern forestry, for instance, grew out of such a collaborative approach, as did nature conservation measures relevant to forestry. Discussions also take place about recreation-friendly forestry, especially close to towns. The emergence of an important forestry network has also followed the development of the FSC and PEFC certification systems, see page 9.



International Cooperation

Although there are very different socio-economic and ecological conditions across the world's forests, there is a need to cooperate globally on forestry issues. It is vital that international agreements between governments are reached as these, together with economic viability, are of crucial importance when developing sustainable forest management.

Pressing global challenges such as climate change, poverty eradication, deforestation, biodiversity loss and desertification need discussions in international forums and resolute actions if they are to be effectively addressed.

The Swedish government and the forest sector are active in a number of international fora and processes. The Swedish contribution includes collaboration in the fields of development projects and research, and a strong presence in civil society groups and at intergovernmental negotiations.

The Swedish governance model for forestry continues to evolve, and is characterized by the active participation of different stakeholders. Swedish experiences may be shared internationally to promote the development of equitable and legitimate arenas for participatory processes that set appropriate frames for forest governance models.





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