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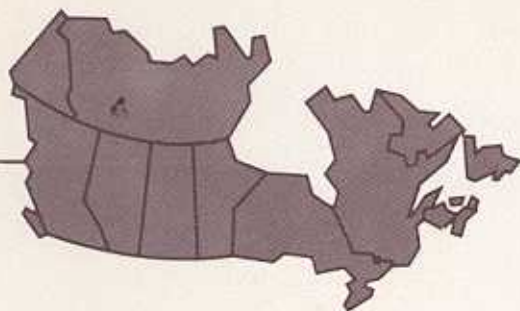
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Forestry Report: Finland

R. Hirvonen

Information Report DPC-X-16
International Forestry Branch,
Canadian Forestry Service Headquarters



FORESTRY REPORT: FINLAND

by R. Hirvonen

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International Forestry Branch
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COUNTRY FORESTRY REPORTS

The World Forestry Information Group, as part of the Canadian Forestry Service's International Forestry Branch, has collected, in the course of its work, a considerable volume of literature on forest resource data, forest development, and forest management in other countries.

It was decided to summarize into reports the forestry information on several countries where the forest resource plays a significant role in the national economy. This report summarizes forest resource and related information on Finland.

Primarily intended for the Canadian professional forestry community, the information contained in the report can be used for:

briefing Canadian officials traveling abroad or receiving foreign visitors,

studies of world wood supply and international trade in forest products,

planning and evaluating Canada's participation in international forestry cooperative projects,

background for policy decisions by Canadian federal and provincial governments, and

answering inquiries from the Canadian forestry community and the general public.

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THE COUNTRY

Location and size

The total area of Finland excluding sea, is 337 000 km² of which about 91% is land. Therefore, Finland is approximately one-half the size of the province of Alberta. Its total population is 4.8 million. The capital city is Helsinki with a population of nearly half a million.

Based on area, Finland is the fifth largest country in Europe, after the USSR, France, Spain, and Sweden, but ranks 22nd in terms of population. Approximately 60% of the population resides in urban centers.



MAP 1

Finland is situated in northern Europe, between the Soviet Union and Sweden. The southernmost part of the country is at about 60°N latitude, the same parallel as the southern boundary of Canada's Northwest Territories. The country extends northward nearly 1200 km to a latitude of 70°05'30" N, a level approximating the northern limits of mainland Canada and Alaska. About one-third of the country is north of the Arctic Circle. The easternmost longitude is 31°35'20" E and the farthest point to the west is at 19°07'03" E.

Land boundaries with Finland's neighbours are 586 km with Sweden, 716 km with Norway and 1 269 km with the USSR. In addition, there is a coastline of about 1 100 km, providing sea access via the Gulf of Bothnia in the west and the Gulf of Finland in the south.

Government

Finland is an independent republic formed in 1917.

The head of state is the president who is elected to a 6-year term by 300 electors. The electors are chosen by universal suffrage of the population. The president is the chief executive of the republic and has the right to depart even from a unanimous cabinet opinion. Laws passed by the parliament are subject to presidential approval. He is responsible for foreign relations but important treaties must be approved by parliament.

The cabinet is appointed by the president. It consists of the prime minister and the ministers responsible for the various government departments. The ministers are responsible for the administration of the government and are accountable to parliament and must enjoy the confidence of parliament.

The parliament consists of one chamber of 200 members, representing 15 electoral districts, elected to a term of 4 years by universal suffrage. The number of members of parliament a party will have is proportional to the votes received by that party. Legislative power is exercised by the parliament but the president has the right of veto on laws passed by the parliament.

The country is subdivided into 12 provinces each headed by a governor appointed by the president. On the local level, urban and rural communities are administered by locally elected councils of representatives.

Justice is administered by independent courts. The public courts of justice handle both civil and criminal cases. There are three basic levels of courts, the lower courts (at the local level), courts of appeal, and the supreme court. There is also a tribunal called the High Court of Impeachment that deals with the impeachment of high government officials.

Physiography

Most of the country is underlain by a massive bedrock shield of igneous rocks of Precambrian age; about 75% of these rocks are granite. Small amounts of sedimentary formations also occur, mostly in the west-central part of the country. Subjected to repeated glaciation during the last ice age, the bedrock is often close to the surface and characteristic glacier-rounded outcrops are frequent.

Similarly, the soil parent material is predominantly of glacial origin. Typically the soils are shallow and surface features are governed by the configurations of the underlying bedrock.

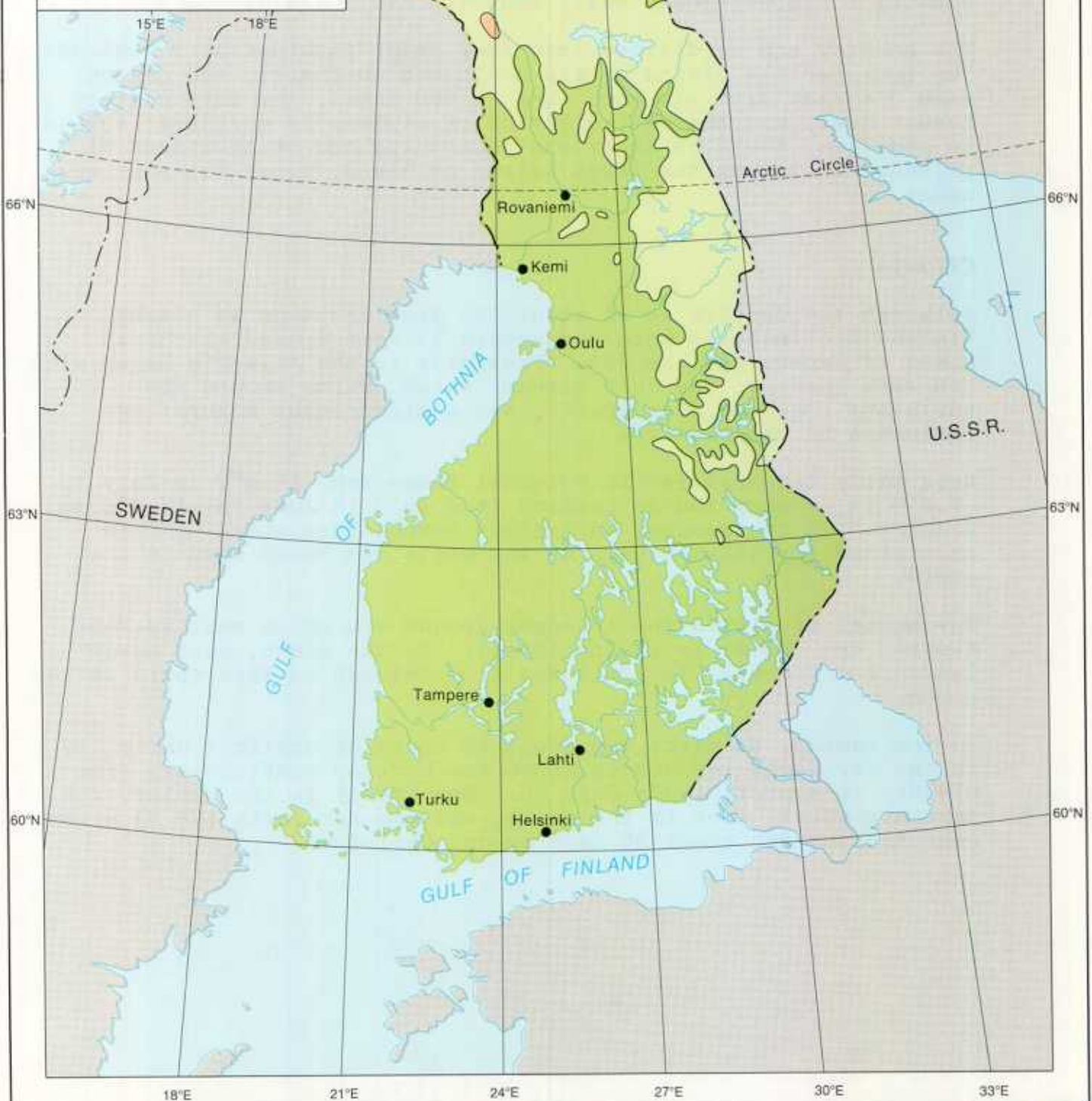
21°E 24°E 27°E 30°E 33°E 36°E 39°E

FINLAND PHYSIOGRAPHY

ELEVATION A.S.L.

- > 1000 m
- 500 - 1000 m
- 200 - 500 m
- < 200 m

KILOMETRES



Undifferentiated till is the characteristic soil parent material. The countryside bears constant reminders of glaciation in the form of drumlins, moraines, and eskers. Parts of southwestern Finland were submerged under the Baltic Sea during the final phases of glaciation and uplifted following glacial retreat. Soils with marine deposits occur in these areas.

In general terms, the land rises gradually from the south and west sea coasts towards the north and the east. It reaches highest elevations in the fell district of northeastern Finland with the country's highest peak, Halti Mountain, at 1 328 m.

The country can be divided into four major physiographic regions: The low, fertile plains of the south and southwest, the central lake district with its more than 55 000 lakes, the northeastern forest area, and the fell district of Lapland in northern Finland. In addition, there is an extensive archipelago of thousands of islands, including the large island of Åland, along the southwest coast.

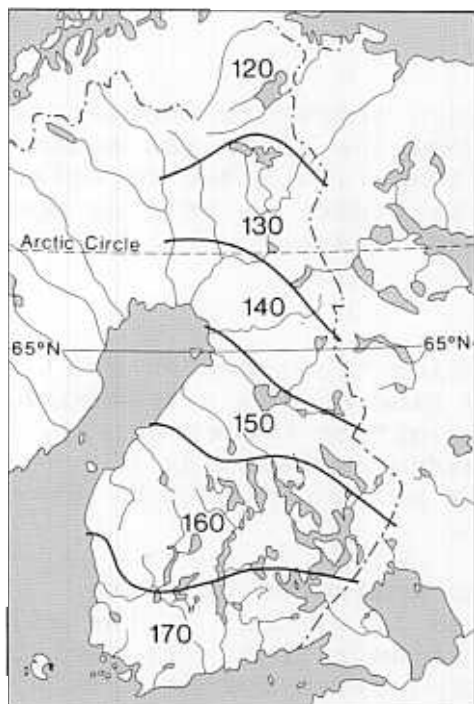
Climate

Although the country is at about the same latitude as Alaska, Finland's climate is more comparable to that around the Great Lakes of Canada and the USA. Proximity to the Atlantic Ocean with its warm current, the Gulf Stream, which skirts around the northwest coast of Scandinavia, has a significant moderating influence on the climate.

Mean daily temperatures in Helsinki range from 17.5°C in July to -7.4°C in January and in Lapland from 15°C in June to -17.4°C in January. In the summer, an average temperature above 10°C is maintained for 110-120 days in the south and 50-85 days in the north.

The annual precipitation averages around 700 mm in southwestern Finland and 400 mm in the northwest. In the south, snow cover lasts from December to April and from October to late April in the north.

In the summer, Helsinki has about 20 hours of daylight daily and in the far north the sun is above the horizon continuously from mid-May to approximately July 25. Conversely in the winter, the days are short, even in the south, and the far north (70°N) never sees the sun for about 50 days around Christmas.



MAP 3

The growing season varies from less than 115 days annually in the far north to more than 180 days in small areas in the southwest part of the country. (Growing season is defined as the number of days with the mean 24-hour temperature exceeding 5°C.) In the adjacent diagram, the figures represent the average number of growing days for each area between the isolines.

Land classification

The characteristic features of the Finnish landscape are the frequent lakes and the ever-present forests. Nearly 10% of the total area is occupied by freshwater bodies and nearly 70% by forests and woodlands. The main land use classes are summarized as follows:

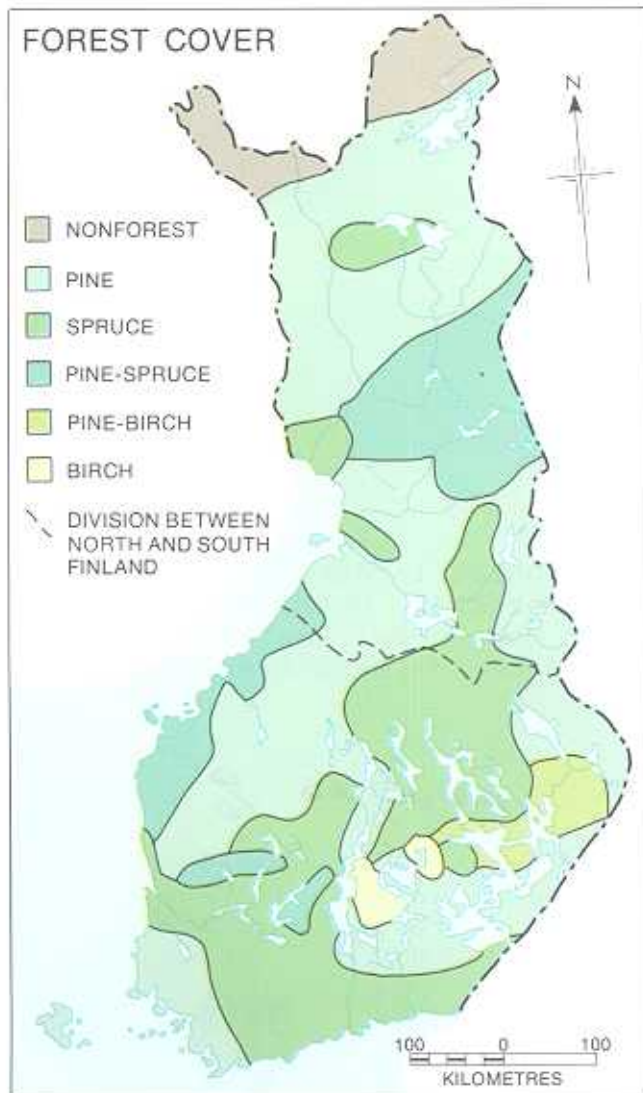
Land	1000000 ha	%
Productive forest land	19.7	58.4
Unproductive forest land	3.6	10.7
Agricultural land	3.1	9.2
Urban roads	0.7	2.1
Wasteland	3.4	10.1
Total land	30.5	90.5
Water	3.2	9.5
Total area of country	33.7	100.0

The unproductive forests and wastelands are concentrated toward the northern parts of the country where the severe climatic influences take their toll on productivity. Conversely agricultural activity is most prevalent in central, particularly west-central, and southern regions. Productive forests occur throughout except the very far northern extremities.

FOREST RESOURCE

Forest description

Almost all of Finland is within the northern temperate coniferous forest belt. A narrow band of forests along the south and southwest coast can be classified as northern temperate mixed forests. Also much of northern Finland above 69°N latitude, as well as most of Finland's northwest arm, are nonforested tundra.



MAP 4

The major tree species are Scots pine (*Pinus sylvestris*), Norway spruce (*Picea abies*), and birch (consisting of *Betula pubescens* and *B. verrucosa*).

The predominance of these species is evident in the adjacent illustration. It depicts the productive forest composition throughout the country with the species shown making up at least 75% of the stands within the delineated areas. In addition, small groves of poplars (*Populus tremula*) occur throughout the country. Other tree species that are occasionally encountered in the extreme south and southwest are oak (*Quercus*), elm (*Ulmus*), basswood (*Tilia*), and maple (*Acer*).

Scots pine is usually the prevailing species on dry and semi-arid sites, on rocky outcrops, and on poorly productive, swampy areas. Spruce is characteristic on the more fertile, mesic sites. Likewise the birches tend to occupy the better sites.

Of the total growing stock, about 45% is Scots pine, 37% Norway spruce, 15% birch, and 3% others (mostly poplar). On an area basis, pine is even more predominant, occupying nearly 60% of the forest land.

Tree species (% on forest land)

By area	Pine	Spruce	Hardwoods	Openings
North Finland ^a	71	19	6	4
South Finland ^a	49	38	9	4
Whole country	58	30	8	4

By volume

North Finland	57	26	17
South Finland	40	42	18
Whole country	45	37	18

^a Division according to forest cover type map on page 6.
- Nil or zero.

Forest distribution by age groups is fairly balanced in the young and maturing categories and no significant shortages are evident in these age groups. At present there is a preponderance of mature forest in southern Finland; overmature stands, on the other hand, occupy only a small part of the forest area. However, in the northern part of the country, a large number of trees are overmature.

Age distribution (% of forest area)

	Not regene- rated	Age in years							
		-20	21-40	41-60	61-80	81-100	101-120	121-140	140+
North Finland	4.5	10.8	10.2	12.5	11.3	9.3	9.4	8.2	23.8
South Finland	3.6	17.1	14.6	17.9	23.4	14.5	6.0	2.1	0.8
Whole country	4.0	14.4	12.7	15.6	18.2	12.3	7.5	4.7	10.6

Forest area

Forest and other wooded land cover 233 210 km² and represents more than 75% of the total land area of the country. About 197 380 km² are classified as forest and the remaining 35 830 km² as other wooded land. Forest is synonymous with productive forest and is defined as having a mean annual increment (MAI) of at least 1 m³/ha, with bark, over a 100-year rotation. Other wooded land is unproductive forest with MAI between 0.1 and 1.0 m³/ha. Areas with tree growth less than 0.1 m³/ha are categorized as nonforest.

Area distribution of forest and other wooded land

Region	Forest		Other wooded land	
	Area (1 000 ha)	% of region	Area (1 000 ha)	% of region
North Finland	8 426	58.3	2 673	18.5
South Finland	11 312	70.3	910	5.6
Whole country	19 738	64.6	3 583	11.7

Forest area (1 000 ha) by predominant species groups

Region	Pine	Spruce	Hardwoods	Openings	Total
North Finland	5 950	1 560	540	380	8 430
South Finland	5 540	4 370	990	410	11 310
Whole country	11 490	5 930	1 530	790	19 740

Wood volume

The total wood volume is estimated at 1 568 million m³ solid volume including bark. This figure does not include volume that may be available in open woodlands. More than 80% of the volume is softwoods, almost all of which is Scots pine and Norway spruce. The growing-stock volume of hardwoods is mostly birch with the next most common hardwood being poplar.

Summary of growing stock (millions of m³ solid volume including bark)

Species	South Finland		North Finland		Total	
		%		%		%
Pine	437	40.2	268	56.5	705	45.1
Spruce	461	42.3	124	26.0	585	37.4
Hardwoods	193	17.5	85	17.5	278	17.5
Total	1 091	100.0	477	100.0	1 568	100.0

Growing stock of forest land (m³/ha solid volume)

	South Finland	North Finland	Whole country
Pine	77	48	62
Spruce	121	83	111
Hardwoods	87	43	69
Average	92	52	75

Accessibility and wood transport

The road network is good throughout most of the country, being densest in the south and gradually becoming sparser towards the north. Similarly, the railway system is modern and efficient with extensive service in the southern half of the country but is practically nonexistent north of the Arctic circle. In addition, there is an extensive system of waterways, which are suitable as floatways for transportation of wood.

The total length of the road system is about 73 000 km giving a road density of 0.22 km/km² compared to Canada's 0.10 km/km². Considering that Canada has only 4-5 times the population but 30 times the area, Finland's investment in transportation infrastructure has been much less costly per capita. Some 30 000 km of the roads are paved or blacktop, the rest being all-weather gravel. The railway network extends for approximately 5 900 km giving a density of 0.02 km/km². Total length of floatways is some 40 000 km.

Road transportation of wood has increased steadily over the past 2 decades, whereas transportation by floating has decreased by half since 1960. Rail transport has maintained a fairly constant share. Indeed, the forest industry accounts for more than 40% of the total freight on the national railway system.

Percent of roundwood transportation by method (1979)

	<u>Truck</u>	<u>Railway</u>	<u>Water</u>	<u>Other</u>
North Finland	67	8	25	<1
South Finland	67	14	19	<1
Whole country	67	13	20	<1

To minimize floating losses resulting from sinkage and logs drifting away from rafts, more than 90% of the wood is floated in bundles.

Skidding and forwarding from the stump to the truck road is done by machine with only a small percentage still relying on horses. The average forwarding distance to a landing is about 350-400 m. Beyond the landing, mean transport distances to the mill are approximately 85 km by truck, 245 km by rail, and 235 km by water.

Transport of chips is mostly by truck. The distances involved have risen steadily with the average now approaching 100 km. Distances in south Finland are generally shorter and vary between 30 and 100 km but in the northern parts of the country chips are transported as far as 160 km. About 3.5 million m³ are truck transported annually. Rail transport of chips amounts to some 1.5 million m³. The distances are markedly longer when railway is used and average around 300 km. Water transport of chipped material is negligible.

Permanent forest road construction has increased steadily during the past 3 decades from about 300 km annually in the early 1950s to more than 4 000 km a year at present. Generally about 25-30% of the forest roads are built by the state, 15% by companies, and the remaining 55-60% by private forest owners and other organizations.

Forest ownership

Forest land in Finland is approximately one-quarter state owned and nearly three-quarters by private industry and individuals. Private ownership is particularly concentrated in the southern half of the country. Conversely, state ownership is predominant in the northern part; nearly a half of the productive forest in the north half is state owned.

Forest land ownership

Region	State		Company		Private		Other		Total
	1 000 ha	%	1 000 ha	%	1 000 ha	%	1 000 ha	%	1 000 ha
North Finland									
Productive forest	3 960	47	396	5	3 721	44	349	4	8 426
Other wooded	1 618	61	70	3	895	33	90	3	2 673
South Finland									
Productive forest	766	7	1 179	10	8 892	79	475	4	11 312
Other wooded	104	11	101	11	654	72	51	6	910
Whole Country									
Productive forest	4 726	24	1 575	8	12 613	64	824	4	19 738
Other wooded	1 722	48	171	5	1 549	43	141	4	3 583

Forest volume ownership (million m³ o.b.)

Region	State		Company		Private		Other		Total
		%		%		%		%	
North Finland	221	48	18	4	201	43	22	5	462
South Finland	57	6	87	8	871	82	43	4	1 058
Whole country	278	18	105	7	1 072	71	65	4	1 520

The forest is owned by numerous owners and the holdings tend to be small. There are over 50 000 holdings less than 5 ha in size. Forest holdings less than 50 ha in size number nearly 300 000 and account for 30% of the productive forest area. Indeed, the average size of forest holding for the entire country is slightly less than 50 ha. For most owners, therefore, forestry is not their main source of income. This is an important consideration for the forest industry when negotiating timber purchases because the forest owner often does not need to sell to survive.

Harvesting

Within the last 20 years the annual cut has varied from a low of 40 million m³ to a high of more than 60 million m³. In 1981 the total cut is estimated at approximately 53.5 million m³ o.b. solid volume.

The cut (1981) consisted of

	<u>million m³ o.b.</u>	<u>%</u>
Pine	23.0	
Spruce	21.0	
Hardwoods	9.5	
Total		

Approximately 4.5 million m³ of the harvest is lost as logging waste. Floating losses are minor and estimated at around 10 000 m³.

In addition to the cut, losses due to natural causes are estimated at approximately 1.2 million m³. Thus, the total drain for 1981 is nearly 55 million m³. The estimated allowable drain is about 62 million m³. The surplus is in spruce and the hardwoods, whereas pine, whose allowable drain is less than 21 million m³, is being overcut at 23 million m³.

Clear-cutting is the single predominant cutting method with more than 160 000 ha having been clear-cut in 1979.

Area cut by method (1979)

	<u>1 000 ha</u>	<u>%</u>
Clear-cut		
Seed tree/shelterwood		
Thinnings		
Other		
Total		

The four basic harvesting techniques used in Finland are shortwood, full tree, tree length, and log length. The shortwood method is predominant, largely because tree sizes are small, thinnings account for a substantial portion of the harvest, and the generally small size of forest properties creates substantial dispersion among cut locations. About 90% of the harvest is by the shortwood method.

The usual system in cutting operations employs a combination of felling with chainsaw and a processor operating at the work site; some 85% of the harvesting uses this type of system. Feller-bunchers and feller-skidders account for about 10% and harvesters the remaining 5% of the timber cut. In cutting operations in 1980 about 125 processors and 40 harvesters were in use.

Practically all skidding and forwarding is done by machines, whereas 20 years ago an estimated 60 000 horses were still used for these purposes.

Forwarding and skidding machinery (1980)

	No.	%
Tracked	350	16
Half-tracks	110	5
Wheeled	1 470	65
Converted farm tractors	320	14
Total	2 250	100

Machine ownership is about 95% in the hands of private contractors or woodlot owners.

Almost all debarking is done at the mill but since storage of unbarked timber in the forest increases insect infestation and consequently damage to the forest, it is expected that mobile debarking machinery will gain in importance in the future.

Natural losses

Natural losses (insect, disease, fire, etc.) are not a significant problem in Finland. Total such losses average about 2%, slightly more than 1 000 000 m³, of the total drain annually.

Natural losses by species (1980)

	1 000 m ³	%
Pine	620	52
Spruce	350	29
Hardwood	230	19
Total	1 200	100

Humid climate and good road network combine to reduce forest fire losses to near negligible levels. Generally the area burned averages less than 1 000 ha annually although the number of fires is relatively high. In 1980, 694 fires occurred but total area burned was only 774 ha, or a little over 1 ha per fire.

Growth

The total annual forest growth is estimated at over 63 million m³ solid volume with bark. This figure represents approximately 4% of the growing stock volume.

The mean annual increment averages about 3 m³/ha for the country as a whole. Some of the best regions in the south average more than 5 m³/ha, whereas two of the least productive districts in the far north average around 1 m³/ha; these figures represent district level averages, and individual locations can have better, or worse, growth.

Average annual growth by species groups

Region	Pine	Spruce	Hardwood	Total	
		million m ³	o.b.		m ³ /ha
North Finland	7.9	2.6	3.1	13.6	1.6
South Finland	18.4	20.2	10.9	49.5	4.4
Whole country	26.3	22.8	14.0	63.1	3.2
%	42	36	22	100	

Rotation ages vary from about 70 years on good sites in the south to more than 120 years in the northern parts of the country.

At the present rate of growth the forests can sustain an annual harvest of slightly more than 60 million m³. By the end of the century it is expected to sustain a 66 million m³ annual cut. The present rate allows for an amount equal to the total growing stock to be harvested every 28 years.

Reforestation and silviculture

Of the 160 000 ha annually clear-cut, approximately one-half are planted, 15 percent seeded, and the rest is allowed to regenerate naturally.

Area planted and seeded (1979)

Species	Planted		Seeded		Total	
	ha	%	ha	%	ha	%
Pine	64 057	81	24 278	99	88 335	85
Spruce	13 286	17	145	1	13 431	13
Other	1 634	2	-	-	1 634	2
Total	78 977		24 423		103 400	
%	76		24		100	

Nil or zero.

In addition, approximately 16 000 ha have been afforested annually over the last decade. Of this about 56% has been on arable land and the rest on previously unforested wildland, mostly reclaimed swamp.

Planting intensity generally varies between 1 500 and 3 000 seedlings per hectare depending on soil and site conditions. Planting is largely done by hand but increased labor costs and shortages of forest labor has spurred increased effort toward developing mechanized planting machinery. So far the stoniness of the country's forest soils had deterred mechanized planting, which has generally been restricted to peatlands and old fields.

Artificial regeneration is usually done on the mesic and moist sites whereas the arid areas are left to regenerate naturally, normally to pine.

Quantity of seedlings and seed used in reforestation in 1979

<u>Species</u>	<u>Number of seedlings</u>	<u>Amount of seed</u>
Pine	142.4 million	12 360 kg
Spruce	29.1 million	310 kg
Others	4.1 million	-
Total	175.6 million	12 670 kg

- Nil or zero.

In addition some 12 million seedlings were planted to supplement poorly stocked forest areas. Bare-root stock is preferred to containers as illustrated by the following table.

<u>Species</u>	<u>Bare-root %</u>	<u>Container %</u>
Pine	66	34
Spruce	94	6
Birch	95	5
All	71	29

Thinnings are an important aspect of Finnish forestry. Often as many as 4 thinnings (particularly in the south, whereas, one or two are the norm in north Finland) about 20 years apart, are done during one rotation. The first thinning is purely silvicultural; the second is still important silviculturally in determining species composition and influencing stand quality but it also provides commercial volume; the others are principally commercial. In round figures, after the first commercial thinning the stand density will be down to about 1 000 stems and the later thinnings will reduce it to an eventual 500-600 stems. With increased costs and increased use of machines, thinnings in the future will be fewer in number and heavier in the amount removed. Most thinnings are done by chainsaw,

cut into shortwood at the stump, and then removed. Mechanized thinning and skidding tree lengths tends to damage the residual stand and, therefore, has not been popular in the past. Low production rates and increased labor costs have spurred considerable activity in designing lightweight and agile machinery capable of operating in small timber. It is expected that mechanized thinning will increase substantially in the near future.

Thinnings are done on some 130 000 ha each year and nearly one-third of the annual harvest of wood volume comes from them

Site preparation is an important facet of forest renewal in Finland. Slash clearing and cleaning of cutovers is done in most instances. In addition, about half of the cutovers are scarified or tilled. Some prescribed burning is also done but only in very minor amounts.

Area by type of site preparation

	<u>1975-79 average</u>	<u>1979</u>
	ha	ha
Clearing of cutover	150 000	135 700
Scarification	92 500	99 800
Prescribed burning	600	

- Nil or zero.

The areas in the above table are not mutually exclusive but show that on many areas more than one kind of site preparation work is done prior to planting, seeding, or natural regeneration.

Drainage of poorly productive and nonforested peatlands has been carried out for more than 60 years. In that time some 1.2 million km of ditching and more than 5 million ha have been drained for forestry purposes. Most of the peatlands are fertile and can support good forest growth once the water table is lowered sufficiently but some areas require subsequent fertilization. Standard practice is to space drainage ditches about 40 m apart (200-300 m of ditch/ha). The ditches are generally 1 m or more wide and about 1 m deep with a gradient of 1/500. The aim is to lower the water table to approximately 50 cm below the surface.

Drainage operations

	<u>1975-79 average</u>	<u>1979</u>
Length of ditching	45 400 km	33 500 km
Area affected	161 000 ha	117 100 ha

Large-scale forest fertilization did not become common practice in Finland until the 1960s. In the late 1960s the government began a program of loans and grants for forest fertilization with the result that the area fertilized annually increased rapidly. The average annual forest area fertilized was about 150 000 ha from 1975 to 1979. However, there has been a steady decline since the early 1970s when the average was well over 200 000 ha per year. The figures for 1979 are:

Area fertilized:	ha	%
Peat land	50 449	61
Mineral soil	32 456	39
Total		

On mineral soils often the only fertilizer needed is nitrogen, commonly applied in the form of ammonium nitrate-limestone or urea. On drained peatlands, potassium and phosphorus are usually required, sometimes also with the addition of nitrogen. Fertilization effects last for up to 15 years in the case of potassium and phosphorus but nitrogen remains effective for only about half that time. The increase in growth is site-influenced and can vary from a few m³/ha to several tens of m³/ha over the effective period of the fertilizer. Projections suggest that by the year 2000 the annual forest increment will be more than 10 million m³ higher than it would be if no fertilization were done.

Pruning as a silvicultural practice has gained popularity in Finland in recent years. It is felt that quality of timber and not just quantity is an important end product worth striving for. Branchiness is the major deterrent to quality timber, hence pruning. Finnish studies indicate that growth is not adversely reduced if as little as one-third of the tree height is left as live crown. Pruning is primarily confined to pine because it is the species used to produce quality sawn wood. Pine is also very resistant to disease after pruning. A large pruning program was started on state-owned forests in the late 1970s and it is expected that the companies and individual forest owners will follow suit on their lands.

FOREST INDUSTRY

Raw material supply and consumption

In recent years the total drain on Finland's forests has averaged between 55 and 60 million m³ o.b. solid volume of which pine accounts for more than 40%, spruce slightly under 40%, and hardwoods about 20%.

Total annual growth of the forest averages slightly more than 63 million m³ o.b. solid volume. Of this some 42% is pine, 36% spruce, and 22% hardwoods.

The allowable cut has been gradually increasing from about 55 million m³ in the early 1960s to about 62 million m³ in 1981. In the last decade the allowable cut has been consistently higher than the total drain and the growing stock has steadily increased. Between 1971 and 1980 the surplus totaled nearly 90 million m³ of which 13% was pine, 50% spruce, and 37% hardwoods. It is expected that the wood supply will continue to increase and no serious shortages are expected in the foreseeable future. However, the very fractured forest ownership pattern may create local wood shortages. Most owners do not rely on their forest holdings for a livelihood. They can afford to hold out for higher prices, sell only when they need the income and not necessarily when the industry needs the wood.

Summary of wood supply and drain (1975-80 average)

	Allowable drain	Total drain (million m ³ o.b./year)	Balance
Pine	20.4	19.1	+1.3
Spruce	23.7	18.5	+5.2
Hardwood	15.4	10.4	+5.0
Total			

Although pine shows an average annual surplus of 1.3 million m³ in the 6 years preceding 1980, it was overcut in 1979 and 1980 by 2.7 and 4.8 million m³ respectively. All other species show an increase for every year during the 1975-80 period. Indeed, the last time spruce was overcut was in 1964.

Industrial use amounts to more than three-quarters of the total drain or nearly 40 million m³ annually. In addition, industry imports between 3.5 and 4.5 million m³ each year, mostly from the Soviet Union. Exports of roundwood average only about one-third as much as the imports.

Consumption of Finland's domestic roundwood 1975-80 average)

	million m ³	%
Industrial raw material	36.0	77
Export	1.1	2
Other, incl. firewood	5.9	13
Premanufacturing losses	3.8	8
Total cut	46.8	100

By-products and recycling provide an additional 8 million m³ or so of raw material for the forest industries each year.

Summary of raw material supply and consumption 1980)

Productive forest area	19 740 000 ha
Growing stock	1 568 million m ³
Total annual allowable drain	61 million m ³
Annual harvest	58 million m ³
Annual imports	4 million m ³
Annual recycling (est. wood equivalent)	2 million m ³
Total annual raw material supply	64 million m ³
Annual industrial roundwood consumption	50 million m ³
Estimated annual industrial consump. capacity	65 million m ³
Annual exports	2 million m ³
Other annual wood consumption	5 million m ³
Total annual wood consumption	57 million m ³
Annual losses and waste	5 million m ³

The sawmill industry

Finland's production of sawnwood was approximately 10.3 million m³ in 1980. This figure represents 2.5% of the world production. It is expected that production for 1981 and 1982 will be considerably reduced; preliminary figures suggest the amounts will be 8.0 and 7.2 million m³ for 1981 and 1982 respectively. Exports in 1980 were nearly 7 million m³, which is close to 9% of world exports. Exports are also expected to be reduced to about 5 million m³ in 1981 and 1982. To achieve this production the industry utilized about 22 million m³ (38%) of the total 1980 harvest.

Annual exports usually take between 65 and 70% of the production. Export and production trends of the Finnish sawmilling industry are illustrated by the following figures:

	1960	1970	1975	1978	1979	1980	1981*	1982*
Production (million m ³)	7.7	7.3	4.9	7.6	9.6	10.3	8.0	7.2
Exports (million m ³)	5.3	4.7	2.9	5.5	6.6	6.9	5.4	5.0
% exported	69	64	59	72	69	67	68	69

* 1981 and 1982 figures are estimates.

The industry is highly integrated and, at the mill, production is often carried beyond the basic sawing process. Planing, jointing, kiln drying, and pressure treating are common processes done right at the sawmill.

Large industrial sawmills are highly mechanized and are also rapidly becoming highly computerized. Chipper-canter in combination with a band and/or frame saw is standard in newer mills; line speeds of over 70 m per minute can be achieved with this setup. Computerized edging is at its initial stages and holds considerable promise as an operationally feasible application. Loading and sorting are highly automated in the larger mills. There are two basic types of kiln drying with many of the high-volume mills opting for the continuous-operation type, whereas many smaller mills have stayed with the compartment kilns.

In the sawmilling industry yields from logs are about 50%. Nearly one-third is lost as slabs and edgings, which are chipped and processed into other products. About 15% is lost as sawdust, which is also used by other forest industries, and about 5% loss can be attributed to drying.

The industry is constantly becoming more concentrated into larger mills and small local operations are rapidly reducing in numbers. In the early 1970s the total number of all sizes and kinds of sawmills was estimated at around 12 000. In 1980, this figure was about 8 500, a reduction of nearly 30%, but total production has increased from 7-8 million m³ in the early 1970s to more than 10 million m³ in 1980. Notably the reduction has almost entirely taken place in south Finland, whereas the total number of sawmills in north Finland has remained practically unchanged during this period. In terms of sawmill size, those with an annual production of more than 500 m³ numbered only between 850 and 900 in 1980, approximately the same number as in 1970. Thus, the reduction in total sawmill numbers has happened entirely at the expense of the small, local, and seasonally operated mills. However, there still remains much room for consolidation since some 90% of the annual production comes from less than 1000 mills.

The pulp industry

The Finnish pulp industry accounts for about 6% of the world's wood pulp output. It ranks sixth in the world after USA, Canada, USSR, Japan, and Sweden.

Its share in the world's wood pulp export trade is nearly 10%, which makes Finland one of the top four exporters. More than 60% of the export pulp goes to EEC countries with West Germany and the U.K. taking about one-third of Finland's total pulp exports. France, Italy, and USSR are also large importers and together account for more than one-quarter of the Finnish export market.

Approximately 25% of the annual production is exported, as illustrated by the following figures:

	1960	1970	1975	1978	1979	1980
Production (1 000 t)	3516	6222	5182	6020	7236	7440
Exports (1 000 t)	1595	2057	944	1531	1865	1899
% exported	45	33	18	25	26	26

Wood-pulp production according to process (1980)

Sulphate	<hr/>	
Sulphite		
Dissolving		
Semichemical		
Mechanical		
Total	7 440	100

The pulp industry consumes more than 22 million m³, or nearly 40% of the annual harvest of wood. Wood by-products, particularly from sawmilling, add another 6-7 million m³ yearly and imported wood some 3 million m³.

There are 10 mills producing sulphite pulp with a total capacity of about 1 million t annually, 19 sulphate pulp mills with annual capacity of about 4 million t, and 4 semichemical pulp mills with capacity approaching 300 000 t/a. There are 21 mechanical pulp mills of which all but one are integrated with paper mills; total capacity is approximately 2.5 million t/a. Some companies have built thermomechanical pulp plants and several others are planning to do so in connection with their mechanical pulp mills. This process allows greater variety in raw material and is more efficient than straight mechanical pulping.

Pulp capacity has roughly doubled since 1960. The increase has been practically all in sulphate pulp and it is expected that further conversion from sulphite to sulphate will be the trend in the near future. Sulphate process is somewhat less expensive, more diversified raw materials can be used, and more export markets are available to it. Environmentally, the sulphate process is also less harmful than the sulphite process.

The paper industry

Finland's paper and paperboard production is more than 3% of total world output. Its share of the world export market in these products is approximately 14% making Finland the second largest exporter after Canada. The biggest customer is the U.K., which buys more than one-fifth of Finland's paper and paperboard exports. Other large purchasers are West Germany, USSR, and France. As a bloc, EEC countries form the biggest market area and account for 50-55% of the paper industry's exports.

Total production in 1980 was slightly more than 5.9 million t. Of this, nearly 4.9 million t (83%) were exported.

Production and export trends 1960-1980)

	<u>1960</u>	<u>1970</u>	<u>1975</u>	<u>1978</u>	<u>1979</u>	<u>1980</u>
Production (million t)	2.0	4.3	4.0	5.1	5.7	5.9
Exports (million t)	1.7	3.6	3.1	4.3	4.7	4.9
% exported	85	84	78	84	82	83

Finland has 29 paper mills with a total annual production capacity of 4.7 million t and 17 mills producing paperboard with a capacity of 1.6 million t. The total paper and paperboard production capacity of the country is approximately 6.3 million t. The production level in 1980 was somewhat less than 95% of capacity.

Vertical integration between the pulp and the paper industries has increased considerably since the 1950s in that a much higher proportion of the pulp is processed into paper products domestically. Twenty-five years ago, 40-50% of the pulp was exported, whereas now only about 25% is exported and 75% processed further within the country. Production of paper products has nearly tripled in the last 2 decades.

In addition to the country's 29 paper and 17 paperboard mills there are 20 paper-converting plants that process the paper and cardboard into a multitude of refined paper products. About a third of a million tonnes of these refined products are exported annually.

The Finnish pulp and paper industry also has mills in other countries, notably in Canada, USA, U.K., West Germany, France, and Spain. This distribution assures them better access to local markets and, in some instances, increases their raw material base.

The plywood industry

The industry comprises plywood, blockboard, and other laminated board products. Mills number 29 and their total production capacity is more than 800 000 m³ annually, with the largest mills having a capacity of more than 100 000 m³ each. Production peaked at more than 700 000 m³ in the early 1970s, then declined to about 400 000 m³ in 1975 but has gradually increased to nearly 650 000 m³ (approx. 80% capacity) in 1980. Production is expected to slow down to about 600 000 m³ or less in 1981 and 1982.

Around 85% of production is exported (531 000 m³ in 1980). This figure represents about 8% of world exports and makes Finland the leading plywood exporter in Europe and fifth in the world. The biggest purchasers are West Germany, the U.K., and Sweden. As with production, exports in 1981 and 1982 are also expected to decline to 500 000-510 000 m³.

Production and export trends (1960-1980)

	1960	1970	1975	1978	1979	1980	1981*	1982*
Production (1 000 m ³)	413	706	415	549	639	639	585	600
Exports (1 000 m ³)	358	605	346	503	549	531	510	510
% exported	87	86	83	92	86	83	87	85

* Figures for 1981 and 1982 are estimated.

Until the 1970s almost all Finnish plywood was birch but, as the demand for birch logs began to approach the limit of supply, the use of spruce became more prominent. By 1980 nearly 60% of exports consisted of combination spruce-birch plywood and pure birch plywood's share had declined to about 25%.

Particleboard industry

A relatively young industry in Finland (began in 1956) it today consists of 15 mills with an annual production capacity of 1.2 million m³.

About 40-45% of the production is exported with the single biggest customer being the U.K., which takes about 70% of Finland's exports of particleboard.

Production and export trends (1960-1980)

	1960	1970	1975	1978	1979	1980	1981*	1982*
Production (1 000 m ³)	87	371	667	673	800	809	750	780
Exports (1 000 m ³)	40	168	276	290	318	374	340	350
% exported	46	45	41	43	40	46	45	45

* Figures for 1981 and 1982 are estimated.

Finland's particleboard exports account for about 7% of world exports and puts Finland at par with France as the fifth and sixth largest exporters of this product.

Fiberboard industry

There are five fiberboard mills with an annual capacity of about 280 000 t. Production covers the full range from surface-treated hardboards suitable for furniture manufacture to softboard for such uses as insulation.

About 50% of the production is exported, most of which (roughly 90%) is hardboard. The biggest customer is the U.K., which takes more than 60% of Finland's fiberboard exports.

Production and export trends 1960-1980

	1960	1970	1975	1978	1979	1980
Production (1 000 t)	191	241	148	136	160	175
Exports (1 000 t)	128	152	79	66	78	89
% exported	67	63	53	48	49	51

Finland's fiberboard exports amount to 5-6% of world export market. This places Finland among the top six fiberboard exporting countries in the world.

Prefabricated wooden house industry

This important industry in Finland consists of 20 factories with an annual capacity of about 12 000 housing units. Most of these are still destined for the domestic market but the industry is beginning to make notable inroads in exports. In 1979 some U.S.\$40 million worth were exported, mostly to Sweden and central Europe but also as far afield as the Middle East, Africa, and Japan.

Trade

Finland has an economy that is highly dependent on foreign trade. The lack of key raw materials and fuels such as oil and coal necessitate their importation. Similarly, much specialized machinery must be imported. To pay for these imports, Finland must be able to export comparable amounts of goods. Accordingly, exports account for over one-quarter of her Gross Domestic Product (GDP). Finland, therefore, is much involved in trade agreements with various international organizations and trading blocs. She is a signatory to GATT and a member of OECD. She has trade agreements with the three major trading communities in Europe by being an associate member of EFTA, by having a free trade agreement on industrial products with EEC, and by having negotiated free trade agreements with several eastern bloc (CMEA) countries, including the USSR.

The forestry sector share of Finland's exports has diminished somewhat in recent years but in 1980 it still accounted for more than 42% and currently averages around 35-40%. It is the country's biggest net foreign currency earner. The net revenue of the forest industry in foreign trade is around 80% of the total net revenue.

Through her involvement in EFTA, Finland not only has privileged access to member countries but also has advantages (over Canada) with regard to certain markets in the EEC. In forest products, for example, agreements between EFTA and EEC have allowed gradual increases to tariff-free exports and in 1984 Finland will gain full free trade privileges with EEC.

Finland's share of European and world export markets (1980)

	Europe		World	
	%	Rank	%	Rank
Wood pulp	26.6	2	9.0	4
Paper	26.9	1	13.9	2
Coniferous sawnwood	30.9	1	10.6	2
Fiberboard	9.1	3	5.6	6
Particleboard	7.8	4	6.8	5
Plywood	36.1	1	7.7	5

Detailed breakdown of exports and imports of forest products are given in Appendix 4.

Most of Finland's forest products export trade is directed toward Western Europe with the European Economic Community (EEC) taking about 55% of all forestry sector exports and EFTA countries buying another 9%. The eastern bloc imports 15% of Finland's export output and the remaining 21% are distributed throughout the rest of the globe; Finland ships forest products to a total of some 140 countries. The three biggest buyers of Finnish forest products are the U.K. (18%), West Germany and the U.S.S.R. (about 14% each).

Total value of forest industry exports in 1980 was approximately U.S.\$6 billion. This figure represented more than 42% of Finland's total exports as illustrated by the following table.

Dollar value of Finland's exports 1980

	million U.S.\$	%
Sawnwood	1,330	9.4
Panelling	440	3.1
Other wood products	140	1.0
Pulp industry	930	6.6
Paper industry	3,160	22.3
Total forest industry	6,000	42.4
Other industries	8,150	57.6
Total exports	14,150	100.0

Labor

The forestry sector employs about ~~60 000~~ workers in forestry and 100 000 in the manufacturing of forest products for a total of 160 000, which represents approximately 7% of the total labor force. It is estimated that another quarter million jobs are created as a direct result of the forestry sector activity. Thus, the forest provides employment to approximately one in five people in the total work force.

Until the 1950s, woods operations were very seasonal and fragmented among the some 300 000 small holdings that characterize Finland's forest ownership pattern. Accordingly forest workers generally were not part of any centralized labor organization. Since that time, increased mechanization and adoption of year-round harvesting has evolved into a permanent, professional work force. With it came organized labor and most forest workers now belong to a union. Workers in forest industry, on the other hand, have a long tradition of unionization (since 1906). There are two main unions, one of which encompasses the pulp and paper industry and another the mechanical forest industries.

Labor contracts are usually negotiated on an annual basis between the Central Organization of Finnish Trade Unions and the Finnish Employers' Confederation. The centralized bargaining system tends to create nationwide labor stability throughout the term of the agreement. Similarly, a serious snag during negotiations can result in nationwide labor disruptions. Disputes can be arbitrated by a Labor Court, which consists of noninvolved members, as well as union and employer representatives.

Costs

Finland's economic well-being relies heavily on exports and of these the forestry sector is the most important net income earner. It is therefore very important that costs within the forestry sector remain in line with those of her competitors.

Labor costs in the forestry sector have quadrupled between 1970 and 1982. This rise, however, has not had a significant impact on the competitiveness of Finnish wood products because these kinds of increases are comparable to cost trends in other exporting countries.

Similarly, raw material costs have more than tripled between 1970 and 1980. They are fractionally higher than in neighbouring Sweden and Norway but still well in keeping with the general cost trends of both countries.

Stumpage price index (1969-70 = 100)

	<u>1972-73</u>	<u>1975-76</u>	<u>1978-79</u>	<u>1979-80</u>
Coniferous sawlogs	133	256	292	337
Spruce pulpwood	138	303	254	303
Pine pulpwood	148	347	303	358
Birch pulpwood	157	514	370	483

As pulping processes are using more and more hardwoods, the demand for birch pulpwood has increased and pushed up the price relatively more than that of the more traditional pulp species. However, the absolute price of birch pulpwood is still some 25% less than spruce or pine.

Approximate range of stumpage prices 1980 (U.S.\$/m³ with bark)

	Sawlogs		Pulpwood	
	<u>Range</u>	<u>Mean</u>	<u>Range</u>	<u>Mean</u>
Pine	26-35	32	10-14	13
Spruce	20-33	28	11-15	14
Hardwood	22-31	30	7-12	10

In general the stumpage prices have climbed steadily since the mid-60s but, fortunately for the industry, improved efficiency in harvesting and transportation have caused almost corresponding savings in the cost of getting the wood from the standing forest to the mill. Total wood costs have thus remained within acceptable limits. In comparison with Canada, the stumpage prices in Finland average some ten times higher. This difference is a reflection of the predominance of small private ownerships in Finland, as well as the generally higher investment they are required to make toward intensive forest management.

Harvesting costs, including forwarding to roadside, averaged (1980) roughly 10 U.S.\$/m³ but there is considerable variation because of location, harvesting method, and terrain conditions.

Average 1980 wood prices at the mill (U.S.\$/m³ with bark)

	<u>Stumpage</u>	<u>Sawlogs delivery</u>	<u>Total</u>	<u>Stumpage</u>	<u>Pulpwood delivery</u>	<u>Total</u>
Pine	32	38	70	13	24	37
Spruce	28	36	64	14	25	39
Hardwood	30	36	66	10	20	30

Direct cost of transporting roundwood amounts to about 15% of the mill price. Generally truck transport is 2-3 times as expensive per m³ as rail and 5-10 times that of water transport. The 1979 direct transportation costs were:

	<u>U.S.\$/m³/km</u>
Truck	0.06 - 0.07
Railway	0.02 - 0.03
Water	0.01 - 0.02

Silvicultural treatments and operations receive an annual input of approximately U.S.\$100 million. with mean costs per hectare as follows:

Silvicultural costs per ha (1979)

	<u>U.S.\$</u>
Clearing of cutovers	58
Scarification	93
Seeding	100
Planting	320
Stand improvement	102
Fertilization	104

Approximately U.S.\$15 million are spent on forest drainage annually. The average ditching cost is about U.S.\$70 per hectare. When overhead, ditch maintenance, and supplementary ditching costs are added, the cost per drained hectare is usually well over U.S.\$100.

Twenty-five million or so U.S. dollars are spent annually on construction of new forest roads.

Cost of permanent forest road construction (1979)

	<u>Range of costs</u> U.S.\$/km	<u>Mean cost</u> U.S.\$/km
Trunk roads	1 300-19 000	8 500
Secondary access roads	1 300- 9 500	5 000

In addition, some U.S.\$10 million are allocated yearly for maintenance and upkeep of existing forestry roads.

Investment and finance

Modernization and construction of new facilities is expected to be the main thrust of industrial investment during the 1980s. It is estimated that about one-third of industrial buildings and facilities and one-half of the machinery and equipment that will be in use by the year 1990 was not yet in existence in 1980. The exception to this is the pulp industry, which is predominantly very modern; about one-half of Finland's market pulp capacity has been built or thoroughly modernized since 1974.

Forest industry's share of the total annual industrial investment has remained fairly stable at about 25% since the mid-60s. In 1980, the investment by the forest industry totaled 2 932 million Fmk (Finnish Markka) (approx. U.S.\$735 million), which makes the forestry sector the second largest contributor to industrial capital investment in Finland.

Concern over the potential supply of raw material has had a dampening effect on financial support for expansionary industrial projects. Since 1969, for example, the Bank of Finland has not given financial backing to capacity-increasing projects of the forest industry unless it has been very clear that a sustained raw material supply is available. Investment in new capacity was practically nonexistent from 1975 to 1978 but has picked up since, particularly in the sawmill and paper sectors. In sawmilling, however, the investment is directed less toward increased capacity and more into integration, automation, and marketing coordination. In the paper sector, the investment emphasis has been toward producing printing paper from mechanical pulp.

In the past couple of decades, pollution abatement has been the center of much attention and accordingly a considerable portion of investment funds have been directed to that end. During the 1970s, Finnish industry spent an estimated U.S.\$0.4 billion on water pollution control alone, most of this by the forest industries. In addition to water pollution control, some U.S.\$80 million worth of air pollution control equipment is presently in place in forest industry manufacturing plants. The costs of pollution controls amount to as much as 4% of the final product price and up to 10% of the capital investments of the manufacturing plants.

As most of the forest land is in private woodlots, it was recognized early that to ensure adequate investment in silvicultural practices financial support would have to be provided by the state. Accordingly, forest improvement work on private woodlots are subsidized by the government whereby nearly 30% of the costs are paid for by grants. In addition, government loans pay for about one-quarter of the costs. In 1979, government grants totaled nearly 115 million Fmk (approx. U.S.\$30 million) and government loans 95 million Fmk (U.S.\$24 million).

In addition to the government, a number of other principal sources of investment financing are available to the forest industry. One is the Finnish Export Credit Limited whose shareholders consist of the government of Finland, Finnish banks, and some large companies. It finances and gives export credits to Finnish companies to promote exports. In 1979, the value of such financing was some U.S.\$850 million. Another is the Nordic Investment Bank established in 1976. It provides investment funds for industries in Finland, as well as in the other Nordic countries. Finnfund, established in 1979, is another finance corporation set up to facilitate industrial investment but its main thrust is in helping Finnish companies establish abroad.

FORESTRY ORGANIZATIONS

Government

The government department responsible for forestry matters in Finland is the Ministry of Agriculture and Forestry. The responsible agency within this department is the National Board of Forestry. This agency oversees forestry on both state and private lands and has a separate branch for each. The State Forestry Administration branch is organized into four regional offices with a total of 82 district offices. The branch looking after forestry on private lands is split into two Central Forestry Boards. One of these consists of two District Forestry Boards (Swedish-speaking) and the other 17 District Forestry Boards (Finnish-speaking). In addition, there are some 450 Municipal Forestry Boards. The Central, District, and Municipal forestry boards are self-governing bodies and the National Board of Forestry acts in an overseeing capacity.

The State Forestry Administration looks after all aspects of forestry on government lands and reports to the National Board of Forestry. On private lands, the National Board of Forestry promotes silviculture, provides training to private owners, and ensures that forestry regulations are followed. It does this through its two Central Forestry Boards and their various district and municipal boards.

Also under the Ministry of Agriculture and Forestry is the Finnish Forest Research Institute, which was established in 1917. The Institute consists of nine departments, each covering one of the following broad subject matters: soil science, peatland forestry, forest genetics, inventory, economics, mathematics, forest protection, forest technology, and silviculture. The Institute also has several experimental forests, and research and experiment stations at its disposal throughout the country.

Under the Ministry of Commerce and Industry is the Technical Research Centre of Finland. It conducts research on various disciplines and also has laboratories doing studies on three lines of wood products, wood panels, wood preservation, and timber products.

The National Research Council for Agriculture and Forestry is one of six research branches within the Academy of Finland (a central organization of scientific research under the auspices of the Ministry of Education). The Council promotes and coordinates research among the various research institutions in the country. It also provides expertise to government, distributes grants, and contracts long-term research projects. The Council does not have research facilities of its own but the staff partake in research projects conducted at other establishments.

Nongovernment research establishments

The Society of Forestry in Finland is involved in promoting and supporting forest research as well as disseminating forestry information. The Society publishes the bulk of forest research findings conducted outside the government organizations.

Another nongovernment research organization is Metsäteho. It is supported by the forest industry and its main field of activity is logging and related studies.

The Work Efficiency Association is a private organization whose study activities relate primarily to small-scale forestry and thinning operations.

Studies on tree genetics and breeding are carried out by the Foundation for Forest Tree Breeding. It has its own nursery and runs two research stations.

The pulp and paper industry is the prime supporter of the Finnish Pulp and Paper Research Institute. The institute also does contract research and obtains some 20% of its funding in this manner. It owns a fully equipped pilot plant for pulp, paper, and board production. It also has the capacity to test and do research on pollution abatement.

Industrial forestry organizations

The national representative of Finland's forest industries is the Central Association of Finnish Forest Industries. It includes some 60 forest companies in its membership. Its principal purpose is to promote the interests and well-being of all branches of the forest industry.

For the wood panel producers there are a number of additional organizations. Their central organ is the Federation of Finnish Wood Panel Industries, which encompasses three other groups:

The Finnish Particle Board Association, which had 10 members in 1979 and included all particleboard producers in the country;

The Wallboard Association of Finland with four member firms totaling an annual production capacity of some 230 000 t; and

The Association of Finnish Plywood Industry with 14 member companies (1979) that control 23 mills.

The panel industry does not have a centralized sales organization, instead the individual companies handle their own selling.

All the major producers of prefabricated houses belong to the Prefabricated Wooden House Factories Association. This organization is primarily promotional and is not involved in sales, which are done by the companies themselves.

The Finnish Sawmill Owners' Association represents 44 companies (1979) which account for more than 80% of Finland's sawn-goods exports. Some 170 smaller sawmills belong to another central association called the Finnish Sawmills. Neither of the two sawmill associations are sales oriented. Instead, marketing of lumber is handled by several sales agents, most of which belong to a central organization called the Association of Finnish Timber Agents.

Industry in Finland has a central promotional organization, the Finnish Foreign Trade Association, which is funded jointly by government and industry. Its main function is to promote international trade and publicize Finnish industry. It is a central organ for all industries and not specifically only for the forest industries.

Sales associations for the forest industry consist of:

- Converta, which represents the converted paper and paper-board industries;

- Finnboard, which handles the sales of the paperboard producers;

- Finncell, which is the sales organ for the pulp industry;
 - and

- Finnpap, which represents the paper manufacturers

These associations sell in both the domestic and international markets and protect the interests of their respective industries in this respect.

Private forest owners' organizations

The thousands of small, private forest owners are organized at three levels. The Central Union of Agricultural Producers, through its Forestry Council, represents the owners at the national level. It is instrumental in negotiating stumpage and other roundwood prices on behalf of the owners. It also looks after the owners' interests on other national forestry matters, e.g. forest regulations, taxation, forest policy, etc. On the provincial level, representation is by a Union of Forest Management Associations. The Forest Management Associations total 377 (1980) and they are, on the local level, the representatives of more than 300 000 private forest owners. Besides liaising between the owners and the Provincial and Central Unions, they are instrumental in aiding forest owners at all stages of forest management, from planning to harvesting.

A commercial arm for private forest owners was established in 1934. It now has two branches, the Cooperative Society Metsäliitto, which concentrates on roundwood marketing, and Metsäliiton Teollisuus Ltd which owns and operates a number of forest industrial plants. The Cooperative now has about 125 000 forest owners as members, some of which are also shareholders in the Cooperatives' industrial enterprises.

Education

Forestry education at the post-secondary level has been available in Finland since 1862. It became part of the University of Helsinki in 1907. Today there are two main lines that students can follow at the University, general forestry, which covers a variety of topics on silviculture and forest management related subjects. or a commercial course where the subject matter emphasizes marketing. On the average about 80 students are admitted annually, three-quarters of whom take the general course.

Within the Helsinki University of Technology is the Department of Forest Products, which provides higher education in the fields of wood technology and chemistry, pulping, paper making, and printing technology.

In addition to the university level, there are numerous schools and colleges that give forestry-related courses:

Forestry Colleges have secondary school completion as a prerequisite. Graduates usually end up as supervisors in forest management related positions after completing the 4-year course. About 120 students graduate each year.

Colleges of Forestry and Forest Industry concentrate on the industry and production sides of forestry. The entrance requirements and course duration are similar to the Forestry Colleges. About 100 graduates complete the course annually.

Forest Foreman Schools are designed to train field supervisors. For entrance, a completion of a lower level forestry course is usually needed. The course length is 3 years. Generally more than 200 people graduate annually from these schools.

Forest Workers' Schools provide a 2-year program that covers all aspects of field work from planting to logging. Between 300 and 400 trainees go through this course annually.

Forest Machine Schools train both operators and mechanics for machinery used on forest operations. Some 175 drivers and 30 mechanics get certified annually after the 2-year driver and 3-year mechanics courses.

There are also forestry courses designed to provide training to private forest owners in various aspects of forestry from silviculture to harvesting. The basic curriculum consists of several short courses, which can be taken individually. Some 6000 participate in these courses annually.

Besides formal schooling, short training courses in specific subjects or functions are being provided continually in a number of the training institutions. Generally several thousand people partake in these each year. These short courses are generally intended to either orient a person to a new facet in his job or as a refresher course.

Research institutions

Name of institution:	Address:
The Finnish Forest Research Institute	Unioninkatu 40A, SF-00170, Helsinki 17
Technical Research Centre of Finland	SF-02150 Espoo 15
The National Research Council for Agriculture and Forestry	The Academy of Finland, Lauttasaarentie 1, SF-00200 Helsinki 20
The Society of Forestry	Unioninkatu 40B, SF-00170 Helsinki 17
Metsäteho (Forest study section of the Central Assoc. of Finnish Forest Industries)	Opastinsilta 8B, SF-00520 Helsinki 52
The Work Efficiency Association	Melkonkatu 16A, SF-00210 Helsinki 21
The Finnish Pulp and Paper Research Institute	P.O. Box 10136, SF-00101 Helsinki 10
The Foundation for Forest Tree Breeding	Alkutie 69, SF-00660 Helsinki 66
Faculty of Agriculture and Forestry of the University of Helsinki	Viikki, A-talo, SF-00710 Helsinki 71
Helsinki University of Technology, Forest Products Department	SF-02150 Espoo 15

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APPENDIX 1**General data**

<u>Official name:</u>	Republic of Finland
<u>Capital:</u>	Helsinki (population 484 000)
<u>Location:</u>	
World region	Northern Europe
Latitudinal limits	59°30'10"N and 70°05'30"N
Longitudinal limits	19°07'03"E and 31°35'20"E
<u>Neighbouring countries:</u>	Norway to the north with land boundary 716 km; USSR to the east with land boundary 1270 km; south across the Gulf of Finland; and Sweden to the west with land boundary of 586 km.
<u>Form of government:</u>	Republic. Head of state is the president chosen by a popularly elected Electoral College of 300 members. The president's term of office is 6 years. Head of government is the prime minister who, along with the cabinet, is appointed by the president from among the 200-member parliament. The parliament consists of one chamber with members elected to 4-year terms by direct universal suffrage.
<u>Economy:</u>	Developed; market economy based on private ownership.
<u>International organizations:</u>	Member of: UN, OECD, EFTA, GATT, IBRD, IDA, IFC, AsDB, AfDF, and IADB. Has a free-trade agreement with EEC and a cooperation agreement with CMEA.
<u>Languages:</u>	Finnish and Swedish are official. Approximate proportions of 94% and 6% of the population have Finnish and Swedish respectively as their first language.
<u>Population:</u>	4 788 000 (1980)

APPENDIX 1 (cont'd)

<u>Area:</u>	337 000 km ²	100%
Land	305 500	91
Forest and other wooded land	233 200	69
Closed forest	197 400	58
Other wooded	35 800	11
Nonforest	72 300	22
Agriculture	26 200	8
Other	46 100	14
Water (inland)	31 500	9

APPENDIX 2**Economic indicators**

<u>Monetary unit:</u>	Markka, symbol Fmk
<u>Currency exchange rate:</u>	5.70 Fmk = U.S.\$1.00 (Nov. 1982)
<u>International reserves:</u> (minus gold)	U.S.\$1.5 billion (April 1982)
<u>International gold reserves:</u>	1.27 million fine Troy ounces (April 1982)
<u>Exports:</u>	U.S.\$13.7 billion (1981)
<u>Imports:</u>	U.S.\$13.9 billion (1981)
<u>Gross domestic product:</u>	U.S.\$48.4 billion (1981)
<u>Gross national product:</u>	U.S.\$47.5 billion (1981)
<u>Labor employment:</u>	2.2 million (1980)
<u>Labor unemployment:</u>	4.3% of total labor force 1980 average)
<u>Consumer price index:</u>	201, April 1982 (1975=100)
<u>Discount rate:</u>	9.25% (March 1982)

APPENDIX 3

Forest resource data

1. Forest classification (1980)

Forest type	Area (km ²)	Volume (million m ³ o.b.)
Natural	..	..
Man-made	..	..
Total closed forest	197 380	1 568
Other woodland	35 830	..
Total forest land	233 210	1 568

.. Figures not available.

2. Ownership of closed forest

Ownership	Natural (km ²)	Man-made (km ²)	Total (km ²)
Public	55 160
State	47 260
Other	7 900
Private	142 220
Industry	15 750
Individual	126 130
Other	340
Total closed forest	197 380

.. Figures not available.

APPENDIX 3 (cont'd)

3. Exploitability of closed forest land (1980)

Exploitability	Area (km ²)	Volume (million m ³ o.b.)
Exploitable		
Stocked	186 200*	1 540*
Nonstocked	7 800*	-
Total	194 000*	1 540*
Unexploitable		
Stocked	3 280*	30*
Nonstocked	100*	-
Total	3 380*	30*
Total stocked	189 480	1 570
Total nonstocked	7 900	-
Total forest land	197 380	1 570

* Estimated figures.

4. Forest cover

Cover type	Area (km ²)	Volume (million m ³ o.b.)
Coniferous	..	..
Mixedwood	..	..
Nonconiferous	..	..
Total	197 380	1 570

.. Figures not available.

5. Species composition (1980 estimates)

Species	Volume (million m ³ o.b.)	%
Coniferous		
Pine	708	45.1
Spruce	586	37.4
Total	1 294	82.5
Nonconiferous		
Birch	235	15.0
Other	39	3.5
Total	274	17.5
Grand total	1 568	100.0

APPENIDX 3 (cont'd)

6. Forest age structure (1980 estimates)

Age class	Area		Volume (million m ³ o.b.)	%
	(km ²)	(%)		
Nonstocked	7 900	4.0	-	-
Regeneration	53 490	27.1	93	5.9
Immature	66 710	33.8	717	45.8
Mature	39 080	19.8	552	35.2
Overmature	30 200	15.3	206	13.1
Uneven aged	-	-	-	-
Total	197 380	100.0	1 568	100.0

- Nil or zero.

7. Changes in land areas (1951 - 1980)

	Area (1 000 ha)			% change
	1951	1980	Change	
Closed forest	17 352	19 738	+2 386	+13.8
Other wooded land	4 522	3 583	- 939	-20.8
Total forest & wooded land	21 874	23 321	+1 447	+ 6.6
Wasteland	4 441	3 371	-1 070	-24.1
Other land	4 225	3 855	- 370	- 8.8
Total land	30 540	30 547	+ 7	+ --

-- Amount too small to be expressed.

APPENDIX 3 (cont'd)

8. Forest growth and depletion (1980)

		<u>Conifer</u>	<u>Non- conifer</u>	<u>Total</u>
Growing stock	(million m ³ o.b.)	1 290	278	1 568
Growing stock/ha	(m ³ o.b.)	..	..	77
Growth				
Gross annual increment (GAI)	(1 000 m ³ o.b.)	49 070	14 030	63 100
Net annual increment (NAI)	(1 000 m ³ o.b.)	48 100	13 800	61 900
Depletion				
Natural losses	(1 000 m ³ o.b.)	970	230	1 200
Gross fellings	(1 000 m ³ o.b.)	47 220	10 410	57 630
Total depletions	(1 000 m ³ o.b.)	48 190	10 640	58 830
Harvesting losses	(1 000 m ³ o.b.)	2 880	1 790	4 670
Removals	(1 000 m ³ o.b.)	44 340	8 620	52 960
Annual allowable depletion	(1 000 m ³ o.b.)	44 800	15 900	60 700
Depletion/growth ratios				
Harvesting intensity (gross fellings/NAI)		0.98	0.75	0.93
Depletion intensity (total depletion/NAI)		1.00	0.77	0.95
Depletion/growing stock		3.7%	3.8%	3.8%
Forest balance (Allowable depletion less total depletions, million m ³ o.b.)		-3.4	+5.3	+1.9

.. Figures not available.

APPENDIX 4

Forest products data (1980)

1. Production of forest products by commodity aggregate and quantity

<u>Commodity aggregate^a</u>	<u>Quantity</u>
Roundwood	
Fuelwood and charcoal (1 000 m ³)	3 972*
Industrial roundwood (1 000 m ³)	
Sawlogs, veneer logs, and logs for sleepers	23 684
Pitprops	5*
Pulpwood, chips, particles and wood residues	19 030
Other industrial roundwood	1 270*
Total industrial roundwood	43 989
Coniferous	39 499
Nonconiferous	4 490
Total roundwood (1 000 m ³)	47 961
Coniferous	40 452
Nonconiferous	7 509
Sawnwood and sleepers (1 000 m ³)	10 275
Wood-based panels (1 000 m ³)	1 760
Wood pulp (1 000 t)	7 440
Paper and paperboard (1 000 t)	5 923

^a Roundwood, chipped material, and products of mechanical wood conversion are expressed in terms of solid volume. All pulp and paper products are expressed in terms of air-dried tonnes.

* Estimated figures.

APPENDIX 4 (cont'd)

2. Import and export volume (1980)

Commodity aggregate ^a	Imports	Exports
	U.S.\$000	
Roundwood		
Fuelwood and charcoal (1 000 m ³)	100	-
Industrial roundwood (1 000 m ³)		
Sawlogs, veneer logs and logs for sleepers	658	695
Pitprops	-	5*
Pulpwood, chips, particles, and wood residues	3 338	1 083
Other industrial roundwood	2	280
Total industrial roundwood	3 998	2 063
Total roundwood (1 000 m ³)	4 098	2 063
Sawnwood and sleepers (1 000 m ³)	32	6 939
Wood-based panels (1 000 m ³)	20	1 040
Wood pulp (1 000 t)	36	1 899
Paper and paperboard (1 000 t)	53	4 868

^a Roundwood, chipped material, and products of mechanical wood conversion are expressed in terms of solid volume. All pulp and paper products are expressed in terms of air-dried tonnes.

* Estimated figures.

APPENDIX 4 (cont'd)

3. Imports and exports: value (1980)

Commodity aggregate	Imports	Exports
	U.S.\$1 000	
Roundwood		
Fuelwood and charcoal	1 159	-
Industrial roundwood		
Sawlogs, veneer logs, and logs for sleepers	25 682	51 941
Pitprops	-	275*
Pulpwood, chips, particles, and wood residues	88 002	44 105
Other industrial roundwood	71	49 371
Total industrial roundwood	113 755	145 692
Total roundwood	114 914	145 692
Sawnwood and sleepers	16 278	1 162 520
Wood-based panels	16 877	436 483
Wood pulp	20 015	922 855
Paper and paperboard	73 890	2 802 760
Total forest products	241 974	5 470 310

- Nil or zero.

* Estimated figures.

APPENDIX 4 (cont'd)

4. Imports of forest products by commodity aggregate, major exporters, and quantity (1980)

Commodity aggregate: Sawlogs and veneer logs (coniferous)

<u>Major exporters</u>	<u>Quantity (1 000 m³)</u>
USSR	654
Total	<u>654</u>

Commodity aggregate: Pulpwood

<u>Major exporters</u>	<u>Quantity (1 000 m³)</u>
USSR	3 002
Poland	31
Sweden	42
USA	1
Total	<u>3 076</u>

5. Exports, major importers (1980)

Commodity aggregate: Pulpwood

<u>Major importers</u>	<u>Quantity (1 000 m³)</u>
Sweden	731
G.F.R.	2
Hungary	48
Others	1
Total	<u>782</u>

APPENDIX 4 (cont'd)

5. Exports of forest products (cont'd)

Commodity aggregate: Sawnwood (coniferous)

<u>Major importers</u>	<u>Quantity (1 000 m³)</u>
U.K.	1 285
G.F.R.	944
Italy	224
Netherlands	939
France	773
Denmark	485
Belgium - Lux.	249
Hungary	70
Spain	124
Australia	7
Saudi Arabia	23
Egypt	283
Latin America	10
Others	<u>1 482</u>
Total	6 898

Commodity aggregate: Particleboard

<u>Major importers</u>	<u>Quantity (1 000 m³)</u>
U.K.	221
G.F.R.	8
Netherlands	2
France	1
Poland	16
G.D.R.	26
Denmark	11
Norway	6
Ireland	10
Czechoslovakia	1
Others	<u>72</u>
Total	374

APPENDIX 4 (cont'd)

5. Exports of forest products (cont'd)

Commodity aggregate: Fiberboard

<u>Major importers</u>	<u>Quantity (1 000 m³)</u>
U.K.	50
G.F.R.	6
USA	1
Netherlands	12
G.D.R.	9
Belgium - Lux.	3
Denmark	2
France	3
Nigeria	11
Others	<u>22</u>
Total	119

Commodity aggregate: Wood pulp

<u>Major importers</u>	<u>Quantity (1 000 t)</u>
USA	20
G.F.R.	358
U.K.	292
Italy	200
Japan	50
France	179
Netherlands	81
Belgium	39
Norway	81
Spain	23
Australia	15
Switzerland	41
Poland	5
USSR	184
G.D.R.	24
Korea Rep.	5
Latin America	6
Africa	38
Others	<u>258</u>
Total	1 899

APPENDIX 4 (cont'd)

5. Exports of forest products (cont'd)

Commodity aggregate: Newsprint

<u>Major importers</u>	<u>Quantity (1 000 t)</u>
USA	13
U.K.	356
G.F.R.	198
France	172
Netherlands	80
Australia	89
Denmark	63
Belgium-Lux.	32
India	30
Brazil	31
Argentina	30
Venezuela	6
Mexico	22
Others	310
Total	<u>1 432</u>

Commodity aggregate: Paper and paperboard

<u>Major importers</u>	<u>Quantity (1 000 t)</u>
G.F.R.	470
U.K.	641
France	194
USA	140
Netherlands	124
Belgium - Lux.	56
Italy	32
USSR	588
Denmark	112
Japan	60
Australia	87
Switzerland	50
Canada	4
G.D.R.	4
Hungary	19
South Africa	59
Latin America	154
Africa (excl. S. Africa)	122
Hong Kong	3
Malaysia	6
Singapore	5
Others	505
Total	<u>3 435</u>

APPENDIX 5**Abbreviations, symbols, and conversion factors**

Abbreviations

AfDF	African Development Fund
AsDB	Asian Development Bank
a.s.l.	above sea level
CE	Council of Europe
c.i.f.	cost, insurance, and freight
CMEA	Council for Mutual Economic Assistance
DBH	diameter at breast height
ECE	Economic Commission for Europe
EDF	estimated derived fellings
EEC	European Economic Community
EFTA	European Free Trade Association
FAO	Food and Agriculture Organization of the United Nations
f.o.b.	free-on-board
GAI	Gross Annual Increment
GATT	General Agreement on Tariffs and Trade
G.D.R.	German Democratic Republic (East Germany)
G.F.R.	Federal Republic of Germany (West Germany)
GDP	gross domestic product
GNP	gross national product
GS	growing stock
IADB	Inter-American Development Bank
IBRD	International Bank for Reconstruction and Development
IDA	International Development Agency
IFC	International Finance Corporation
IMF	International Monetary Fund
MAI	mean annual increment
NAI	net annual increment
o.b.	over bark
OECD	Organization for Economic Co-operation and Development
SI	The International System of Units (le système international d'unités)
u.b.	under bark (solid wood)
U.K.	United Kingdom of Great Britain and Northern Ireland
UN	United Nations
UNESCO	United Nations Educational Scientific and Cultural Organization
USA	United States of America
USSR	Union of Soviet Socialist Republics

APPENDIX 5 (cont'd)**Symbols**

a	annum
ha	hectare(s)
km	kilometre(s)
km ²	square kilometre(s)
m	metre(s)
m ²	square metre(s)
m ³	cubic metre(s)
t	tonne(s) or metric ton(s)
°C	degree(s) Celsius
/	per

Conversion Factors (SI to English units)

1 ha	= 2.471 05 acres
1 km	= 0.621 371 mile
1 km ²	= 0.386 102 square mile
1 m	= 3.280 84 feet
1 m ²	= 10.763 9 square feet
1 m ³	= 35.314 7 cubic feet
	= 0.353 147 cunit (of 100 cubic feet of solid wood)
1 m ³ /ha	= 14.291 3 cubic feet per acre
1 mm	= 0.039 370 inch
1 t	= 1.102 31 tons (of 2 000 pounds)

Conversion Factors (Over-bark volume to under-bark or solid-wood volume)

Coniferous	0.85
Nonconiferous	0.88

APPENDIX 6

Definitions of terms

These definitions are, for the most part, the same or similar to those used in Reidar Persson's *World forest resources: review of the world's forest resources in the early 1970's*, published in 1974 as Research Note No. 17, Department of Forest Survey, Royal College of Forestry, Stockholm, Sweden. Several others included here are used by the FAO and ECE.

Closed Forest

Land with a "forest cover," i.e., with trees whose crowns cover more than 20% of the area, and used primarily for forestry purposes.

Also includes

- (a) Forests in which trees have been temporarily removed by cutting or burning so that not more than 20% of the area is covered by tree crowns, as well as young natural stands and all plantations, including one-rotation plantations, established for forestry purposes, which have not yet reached a crown density of more than 20%;
- (b) Areas of windbreak and shelterbelt trees sufficiently large to be managed as forest;
- (c) Land under shifting cultivation that is expected to return to forest in the foreseeable future, except those areas that are at present being prepared or used for agricultural crops;
- (d) Areas satisfying the conditions of the definition, even if not under forest administration, e.g. all forest on private land;
- (e) Areas satisfying the conditions of the definition but planned to be converted into other land use categories.

Excludes:

- (a) Isolated tree groups on less than 0.5 ha;
- (b) Land under shifting cultivation that is at present being prepared or used for agricultural crops or that is unlikely to return to forest in the foreseeable future.

NOTE: In running text, "forest" may be used instead of "closed forest."

Commercial (merchantable): That which can be economically removed under given conditions.

APPENDIX 6 (cont'd)

Exploitable forest: Forest in which industrial cuttings have occurred or could occur periodically, which implies at least one industrial cutting during a rotation period.

Forest and other wooded land: Land covered with trees and/or shrubs and not used primarily for agriculture or other nonforestry purposes.

Includes:

- (a) Public and private forest and other wooded land;
- (b) All plantations, including one-rotation plantations primarily used for forestry purposes and including wattle plantations;
- (c) Forest roads and streams and other small open areas, as well as forest nurseries, that cannot readily be excluded by the survey system used;
- (d) National parks.

Excludes:

- (a) City parks and gardens;

Areas occupied by orchards of fruit or nut trees, and plantations for nonforestry crops such as rubber and cinchona;

Wooded pastures and rangelands;

Areas not meeting the conditions of forest and other wooded land as described above, even if administered by forestry authorities.

Gross annual increment: Average volume of annual increment of all trees.

Growing stock: Volume of standing trees, all species, all diameters, measurable at breast height, and including bark. Species that do not reach upright trunk forms (brush, etc.) are not considered as trees.

APPENDIX 6 (cont'd)Man-made forests:

Afforestation: Forests established artificially on land that previously did not carry forest within 50 years (when records exist) or within living memory (when no records exist).

Reforestation: Forests established artificially on land that carried forest within the previous 50 years or within living memory.

Mean annual increment: The total increment up to a given age divided by that age.

Net annual increment: Average annual net increment equals gross increment minus natural losses.

Nonstocked forest: Forest in which temporarily less than 20% of the land area is actually covered by tree crowns.

Open woodland: Land, other than forests, with trees whose crowns cover 5-20% of the area, which is not primarily used for agricultural or other nonforestry purposes (such as grazing of domestic animals). In Europe and other temperate regions open woodland, scrub and brushland, forest nurseries, seed orchards, and areas occupied by trees in lines, and shelterbelts are included in this category.

Protection reserves: Reserved land, the management of which is principally aimed at the protection of natural resources not directly related to the production of wood (e.g. parks, watershed, soil conservation, etc.).

Removals: Fellings (or cut) less harvesting losses.

Scrub and brushland: A residual category because the areas concerned may have some forestry characteristics in their vegetation or administrative status.

Stocked forests: Forest in which 20% or more of the land area is actually covered by tree crowns.