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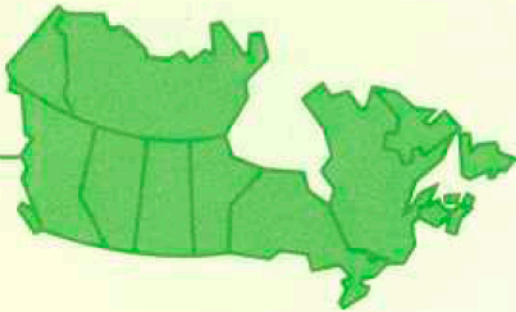
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# Forestry Report: Norway

R. Hirvonen

Information Report DPC-X-19

International Forestry Branch,  
Canadian Forestry Service Headquarters



## THE CANADIAN FORESTRY SERVICE ENVIRONMENT CANADA

The Canadian Forestry Service is the principal source of federal expertise in forestry. Its general objective is to promote the wise management and use of Canada's forest resources for the economic, social, and environmental benefit of Canadians.

The following are the main functions of the CFS:

1. Coordination of federal policies, for the promotion of better resource management and forest industry development.
2. Provision of scientific and technological leadership in forestry through research and development.
3. Provision and analysis of national and international statistics and information as a basis for policy formulation.
4. Development and certification of codes and standards for wood product performance.
5. Protection of Canada's forests from foreign pests.
6. Fostering the potential use of the forest resource for energy.
7. Contributing to the environmental objectives of the Department of the Environment.

A number of federal agencies are involved in forestry programs and a Federal Forestry Sector Strategy Committee has been established to coordinate federal forestry activities. The Canadian Forestry Service has been designated the lead agency role.

The Canadian Forestry Service is comprised of a Headquarters Unit, six Forest Research Centres and two National Institutes. The Forest Research Centres are responsive to regional priorities and maintain close liaison with the respective provincial government forestry departments and other clients. They also participate in, and frequently lead, national programs. The National Institutes provide the focus for programs of national scope.

**FORESTRY REPORT: NORWAY**

by R. Hirvonen

Information Report DPC-X-19

Information Report  
World Forestry Information Group

International Forestry Branch  
Canadian Forestry Service  
Environment Canada

1984

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ISSN 0705-324X  
ISBN 0-662-13199-1  
Cat. No. Fo 46-13/19-1984 E

Additional copies of this publication are available at no charge from

Environment Canada Distribution Centre  
151 Jean Proulx Street  
Hull, Que.  
K1A 1C7

Cette publication est aussi disponible en français sous le titre *La Foresterie en Norvège*.

## 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 Norway.

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

- (1) briefing Canadian officials traveling abroad or receiving foreign visitors,
- (2) studies of world wood supply and international trade in forest products,
- (3) planning and evaluating Canada's participation in international forestry cooperative projects,
- (4) background for policy decisions by Canadian federal and provincial governments, and
- (5) answering inquiries from the Canadian forestry community and the general public.

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## THE COUNTRY

### Size

The country's official name is the Kingdom of Norway. The area of Norway is 323 886 km<sup>2</sup> excluding her island possessions of Spitzbergen (62 050 km<sup>2</sup>) and Jan Mayen (372 km<sup>2</sup>) in the Arctic Ocean, and Bouvet Island (58 km<sup>2</sup>) and Peter I Island (249 km<sup>2</sup>) off the coast of Antarctica. In comparative terms, Norway is about one-half the size of the province of Manitoba. Also under Norwegian control is Queen Maud Land, which consists of the sector between 20°W and 45°E longitudes on continental Antarctica.

The population is 4.08 million, of which nearly 45 % live in urban centers. The largest city is the capital city of Oslo (population 450 000). The next largest is the port city of Bergen with a population of slightly more than 200 000.

Norway has the sixth largest land area in Europe but rates twenty-third in population.

### Location

Norway is located in northern Europe and occupies the western half of the Scandinavian Peninsula. The northernmost point is 70°11'08" N latitude and the southernmost point is 57°57'31" N latitude. The country extends to 31°10'04" E longitude in the east and to 4°30'13" E longitude in the west. Approximately one-quarter of the country is situated north of the Arctic Circle.



MAP 1

Norway is about 1 750 km long. It is 430 km at its widest point and only slightly more than 6 km at its narrowest. Land boundaries with Norway's neighbours are 1 619 km with Sweden, 716 km with Finland, and 196 km with the USSR, to give a total land boundary of more than 2 500 km. In addition, Norway has a coastline of about 2 650 km excluding fjords and other inlets. If the latter are included, the coastline length increases more than tenfold. The coastline touches the Arctic Ocean in the north, the Norwegian Sea and the North Sea in the west, and the Skagerrak in the south.

## Government

Norway is a constitutional monarchy. The king is the head of state and presides over the cabinet through which the king's executive power is exercised. Otherwise the monarchy has largely a symbolic and ceremonial role. The king is also the commander-in-chief of the armed forces but, again, this is in name only. The cabinet consists of the prime minister and at least seven councillors (ministers) who are also the heads of their respective government ministries. The cabinet members sit in the parliament but do not vote.

The legislative power rests with the parliament, or Storting, which is elected by universal suffrage to a 4-year term. There is no provision for the dissolution of the parliament and it, therefore, sits for the full 4 years until the next election. Likewise there are no by-elections, and vacancies are filled by deputies. Representatives are elected on a county basis and total 155. With certain reservations, each political party is allocated a number of seats in the parliament according to the percent of the popular vote it receives at the elections.

Parliament consists of a single legislative chamber but on legislative matters it is divided into two parts; one of 39 members, the other 116. Bills are first debated in the larger chamber and, if passed, are forwarded to the smaller. If the two chambers are in disagreement over the passage of a bill, a joint session is held in which a two-thirds majority is required before the bill becomes law. On nonlegislative issues the parliament sits in a joint session.

The country is subdivided into 19 counties, each governed by an elected assembly, the County Council. There are also some 450 municipalities, each of which is governed by elected representatives.

Norwegian courts are independent of government influence in the administration of justice. There are 100 lower courts, 5 courts of appeal, and the supreme court. In addition, there are about 450 Conciliation Boards that deal with civil cases before these are allowed to proceed before the courts. There are also special courts that deal with specific types of cases, such as labor relations courts and land apportionment courts.

## Physiography

Norway is a rugged, mountainous country with the highest peaks approaching (2 500 m). The average elevation for the country is 500 m a.s.l. and much of it is treeless tundra. The mountains are a continuation of the Caledonian Mountain System, which is prevalent on the British Isles. The mountains derive from the Paleozoic Era of 240-270 million years ago. Part of the Fennoscandian Shield also reaches into the eastern and southern areas of Norway; this formation consists primarily of granitic bedrock of Precambrian age.

Bedrock is close to the surface and exposed throughout much of Norway. Thick layers of clay, silt, and sand deposits also occupy considerable areas, particularly in coastal regions and in the lowlands around the Oslo and Trondheim valleys. Much of this deposition is of marine origin. The land was depressed by the massive weight of glaciers and, when they melted, the sea moved in. Gradual uplift has taken place since glacial times, and many of these areas are now hundreds of metres above present-day sea level. In addition to

marine deposits, many of the soils are morainic in origin. These soils were left by the melting glaciers some 9-10 thousand years ago.

The glaciers cut numerous valleys through the mountains. Generally the east- and south-sloping valleys have a gentle gradient but those descending westward are much steeper. The latter often continue as fjords into the sea.

There are still 1 700 glaciers in Norway; they cover a total area of nearly 3 400 km<sup>2</sup>. The largest of these is Jostedalbreen with an area of 815 km<sup>2</sup>.

The country is also characterized by numerous lakes, which fill the many depressions left by glaciers. Norway's lakes include Europe's deepest but are generally small; Norway's largest lake is only about 370 km<sup>2</sup> in area.

The coastline is rugged, irregular, and contains many indentations and deep fjords. There are some 50 000 islands along the coast but only about 2 000 of these are inhabited.

### Climate

Most of the country has a typical maritime climate with cool summers and mild winters. There is abundant precipitation, averaging 2 000 mm annually in some locations. East of the mountain range the climate is more continental. Because these areas are also in the rain shadow of the mountains, they receive as little as 300-400 mm of precipitation annually.

Although Norway's latitudes are similar to those of Alaska, the climate is much warmer because of the Gulf Stream off the coast and the prevailing warm air currents from the south. The coast is generally ice-free year round. The annual mean temperature along the west coast is about 7°C, some 12°C above average for that latitude.

#### Temperature and precipitation at selected locations

	Mean temperature (°C)			Mean annual precipitation (mm)
	Annual	January	July	
Southeast (Oslo)	5.9	-4.7	17.3	740
Southwest coast (Bergen)	7.8	1.5	15.0	1958
Central (Trondheim)	4.9	-3.4	14.4	810
North coast (Tromsø)	2.9	-3.5	12.4	994

Because of Norway's location at relatively high latitudes, there is great variation, from season to season, in the number of daylight hours. In the summer, in Oslo there are about 20 hours between sunrise and sunset. In Hammerfest, the country's northernmost city, the sun is above the horizon from mid-May to the end of July. Winter days are short even in the south. In Hammerfest the period of continuous darkness lasts from a month before, to a month after, the December solstice.

The growing season, defined as the number of days per year when the mean temperature is above 6°C, varies from nearly 200 in Bergen to less than 90 in the north.

1980, the value of forest products in the export market increased from slightly more than 4.5 billion Norwegian kroner (Nkr) in 1979 to nearly 5.2 billion Nkr in 1980.

Forest products are a net foreign currency earner in Norway's export trade. The trade surplus is generally of the order of US \$500 million annually. Most of the surplus is brought about on the strength of paper and paperboard exports, which, in 1980, showed a net income of some US \$470 million. Wood pulp is the other important income earner but most other categories of forest products show a deficit in external trade.

Norway's share in European and world export markets (1980)

	Europe		World	
	(%)	(Rank)	(%)	(Rank)
Wood pulp	7.4	3	2.5	8
Paper products	8.0	4	3.0	7
Coniferous sawnwood	1.9	8	0.7	12
Fiberboard	4.6	8	0.7	12
Particleboard	1.3	10	1.1	13

Note: Plywood is not significant in the export market.

Most of Norway's forest product exports are directed toward western Europe, with more than 60 % going to the EEC and some 13 % to EFTA countries. A more detailed breakdown of exports and imports of important forest products is given in Appendix 4.

### Labor

The forestry sector employs about 8 000 workers in forestry and some 25 000 in the manufacturing of forestry products. In addition, approximately 30 000 forest owners are involved in forestry work on their properties. Therefore, a total of 60 000 workers receive earnings from the forest and represent approximately 4 % of the total work force.

Increased mechanization in forest operations has resulted in a steady decline in the number of forestry workers. In the early 1970s the number averaged about 15 000 workers but has nearly halved since then. The shift to mechanization has been necessitated by constantly increasing labor costs. In the 1950s, labor was cheap and a low productivity in forest operations (about 0.9 person-days/m<sup>3</sup>) could be tolerated. By the early 1970s, productivity had been increased to about 0.3 person-days/m<sup>3</sup> and, in 1980, it was about 0.25 person-days/m<sup>3</sup>. Harvesting requires 0.15 person-days/m<sup>3</sup> and off-road transport 0.10 person-days/m<sup>3</sup>.

Trade unions are well established and have considerable influence. The government has also been committed to high employment. It often subsidizes industry, particularly the retraining of employees, to prevent massive layoffs during recessionary periods. As a result, unemployment has been markedly lower than in other industrialized nations (1.1 % in 1979), labor relations are generally amicable, the labor force is stable, and work disruptions and strikes are uncommon.

## FOREST RESOURCE

### Forest description

Most of Norway's forests are part of the northern temperate coniferous (boreal) forest belt. The Oslo Valley and a narrow coastal belt along the south coast can be classified into the northern temperate mixed forest zone. Large portions of the northern half of the country are nonforested tundra and much of the high plateaux, even in the south, support only treeless alpine vegetation. In all, approximately two-thirds of Norway's land area is either tundra or high plateau, which does not support tree growth. The tree line is at about 1 000 m in the south and at sea level in the northernmost areas.

The main tree species are

Norway spruce (*Picea abies*)  
 Scots pine (*Pinus sylvestris*)  
 Birch (*Betula odorata* and *B. verrucosa*)

Other native tree species include

Poplar (*Populus tremula*)  
 Oaks (*Quercus* spp.)  
 Ash (*Fraxinus excelsior*)  
 Elm (*Ulmus glabra*)  
 Beech (*Fagus sylvatica*)  
 Basswood (*Tilia cordata*)  
 Norway maple (*Acer platanoides*)

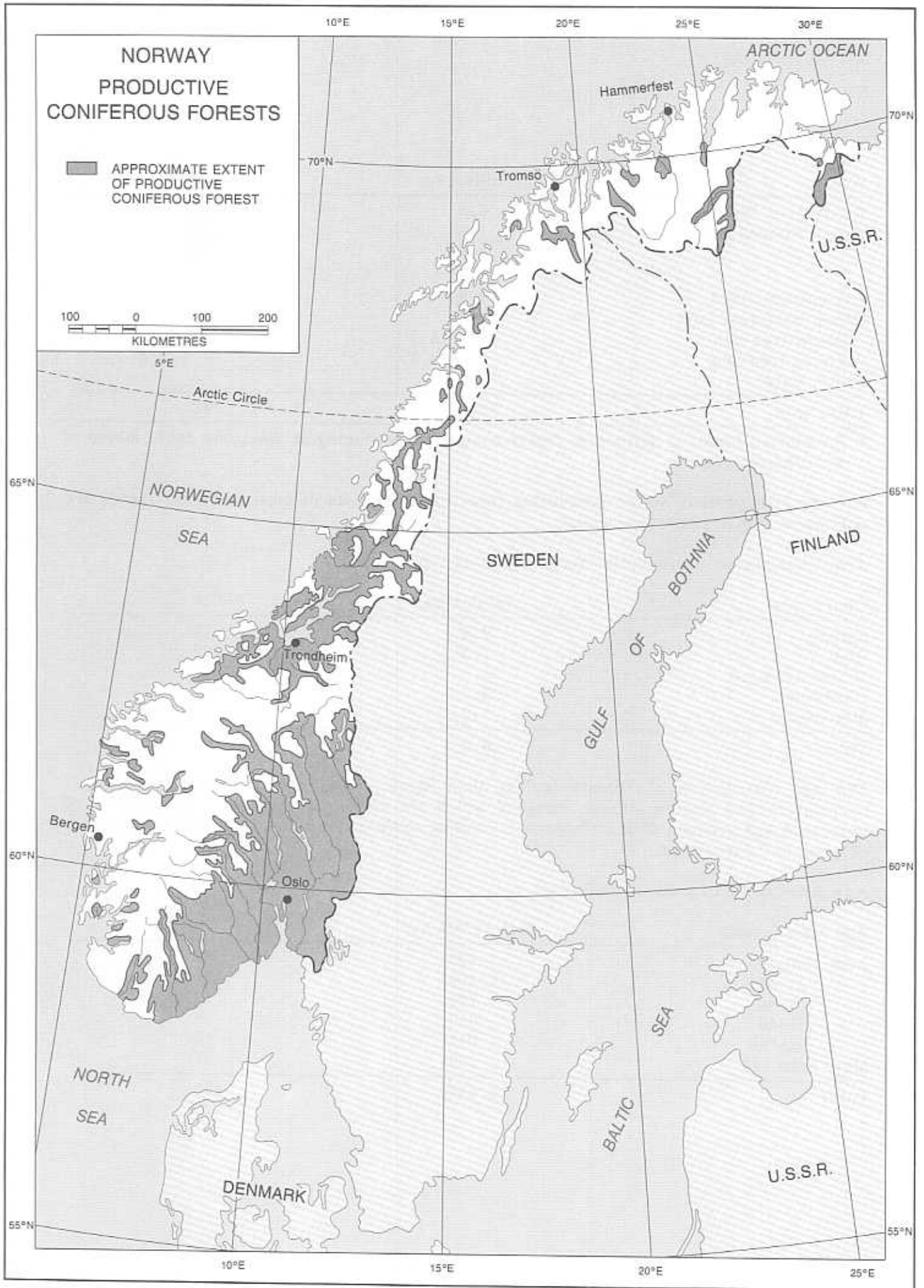
A few exotics with commercial potential have been introduced on a trial basis. The most notable of these are Sitka spruce (*Picea sitchensis*) and lodgepole pine (*Pinus contorta*).

Climatic improvement caused by the Atlantic Drift has allowed forest growth to reach far northern latitudes along the Norwegian coast. The world's most northern pine forests (71°N) and beech stands (59°30'N) are present in Norway.

Map 2 shows the approximate distribution of coniferous forest areas in Norway.

### Forest area

Productive forest and other wooded land cover a total area of approximately 8.3 million ha and represent slightly more than one-quarter of Norway's area (excluding its Arctic and Antarctic island possessions, none of which have any forest). More than three-quarters (6.5 million ha) of this wooded land is considered productive forest.



Area	million ha	%	
Productive forest*	6.5	20	
Other wooded land	1.8	6	
	8.3	26	
Agricultural land	0.9	3	
Other nonforest land	21.6	66	
Below tree line	6.3	19	
Above tree line	15.3	47	
Fresh water	1.6	5	
Total area	32.4	100	

\* Productive forest is defined as forest capable of producing at least one cubic metre of wood/ha per year.

Seventy-five percent of the productive forest area consists of pure softwood stands and only about 3 % are pure hardwoods.

#### Area distribution of productive forest by cover type

Cover type	million ha	%
Spruce	2.6	40
Pine	1.3	20
Mixed softwood	1.1	17
Hardwood	0.2	3
Mixedwood	1.3	20
Total	6.5	100

The age distribution of forests is less than ideal. The forests have an excess of overmature and mature stands, many of which are also understocked, and a deficit of immature age groups. This imbalance is causing some concern about potential shortages of wood in future years.

#### Age distribution of productive forest

Age class (years)	Area (1 000 ha)	%
Less than 20	1 420	22
21-40	1 350	21
41-60	720	11
61-80	610	9
81-100	1 010	16
More than 100	1 370	21
Total	6 480	100

### Wood volume

The merchantable wood volume is estimated at 480 million m<sup>3</sup> solid volume under bark. More than 50 % of the volume is Norway spruce and nearly 33 % is Scots pine. Volume increment is estimated at 14.3 million m<sup>3</sup> annually of which nearly 60 % is spruce and 25 % is pine.

### Productive forest growing stock volume distributed by species

Species	By total volume		By volume increment	
	(million m <sup>3</sup> )	(%)	(million m <sup>3</sup> /a)	(%)
Spruce	250	52	8.3	58
Pine	150	31	3.7	26
Birch	60	13	1.7	12
Other	20	4	0.6	4
Total	480	100	14.3	100

The national average volume on productive forest land is approximately 74 m<sup>3</sup>/ha and the average annual volume increment is about 2.2 m<sup>3</sup>/ha.

### Forest ownership

More than 80 % of Norway's forests are privately owned, mostly (90 %) by farmers. Industry controls some 7 % and the state approximately 10 % of the country's productive forest area.

### Ownership of productive forest and total forested area

Ownership	Forest and other wooded area		Productive forest	
	(million ha)	(%)	(million ha)	(%)
Public	1.4	17	1.0	16
State	1.2	15	0.6	10
Other	0.2	2	0.4	6
Private	6.9	83	5.5	84
Industry	0.5	6	0.5	7
Individual	5.7	69	4.9	75
Other	0.7	8	0.1	2
Total	8.3	100	6.5	100

Most of the state forest land is concentrated in northern parts of the country. A considerable proportion is not easily accessible and occupies areas with below-average growth and site conditions. Industrial forest lands, on the other hand, tend to occupy better locations and are more viable commercially.

Privately owned forest is held in thousands of separate parcels and, consequently, many of the individual properties are very small. Forest properties under private ownership number nearly 160 000 and have an average size of about 45 ha. Only some 1 000 of these holdings are larger than 500 ha, whereas those less than 2.5 ha total about 120 000.



### Accessibility and wood transport

Norway has an extensive road network that covers the country from the south to the Arctic coast. Similarly, a modern railway system extends beyond the Arctic Circle. In addition, coastal shipping and ferry service provide an integral extension and connecting service to the road and railroad network and extend all along the coast into the far north. Many of the inland waterways, as well as the coast, are used for floating logs.

The total length of public roads is nearly 82 000 km of which more than one-half is paved. The road density is 0.25 km/km<sup>2</sup> compared with Canada's 0.10 km/km<sup>2</sup>. In addition to these public roads there is an extensive network of private access roads maintained by the various resource industries, primarily the forest industry. Approximately 700-900 km of forestry roads are constructed annually. The railways have about 4 250 km of track, giving an average density of 0.01 km/km<sup>2</sup>. Nearly 60 % of the railways are electric.

Transport of wood from the forest to the mill has undergone considerable change during the previous two decades. Truck transportation has increased steadily, whereas floating and the traditional river drive, once the mainstays of wood transport, have become less important. In the 1950s, floating transported more than 3.5 million m<sup>3</sup> annually but now accounts for only about 0.5 million m<sup>3</sup>. Railways have not been an important means of carrying roundwood to manufacturing plants.

Percent of roundwood transportation by method (1980)

Truck	87 %
Railway	7 %
Water	4 %
Other	2 %

Off-road transport (skidding and forwarding) to the truck road is practically all done (98 %) by machine. In 1980, about 5 % of the harvested wood was moved from stump to road using some form of winch or cable logging. However, it is estimated that up to 25 % of the standing forest occupies terrain that will have to be logged in this manner. Until now these areas have been avoided by operators. Predicted raw material shortages will eventually force increased utilization of these rugged, poorly accessible hillsides. About 50 % of the forest land is in gentle terrain where standard machinery can operate. The remaining 25 % poses moderate difficulty but is still accessible to good, heavy-duty, off-road, logging machinery.

### Harvesting

Net removals of roundwood for sale and industrial consumption reached a peak (the only time the cut has exceeded 10 million m<sup>3</sup>) in the 1951-52 season when 10.3 million m<sup>3</sup> were harvested. Generally the amount varies between 7 and 9 million m<sup>3</sup> annually. In addition, private consumption, mainly on farms, now accounts for an additional 700 000-800 000 m<sup>3</sup> but has been declining steadily over the past several decades. In the 1930s and 1940s, farm consumption averaged well above 2 million m<sup>3</sup> annually.

## Net removals (1980) for sale and industrial production

Species	million m <sup>3</sup> u.b.	%
Spruce	6.6	79
Pine	1.2	14
Unspecified softwoods	0.1	1
Hardwoods	0.5	6
Total	8.4	100

Logging waste is estimated at about 0.8 million m<sup>3</sup>. Farm and other noncommercial consumption is approximately 0.7 million m<sup>3</sup>, making the total cut almost 10 million m<sup>3</sup>.

Clear-cutting is carried out on some 70 000 ha each year. It is the predominant cutting method accounting for about 97 % of annual removals. The other 3 % comes from thinnings.

Two harvesting systems account for practically all the commercial cutting. The shortwood system, where logs are cut into the required lengths prior to removal from the logging area, is used for approximately 57 % of the cut. Tree length systems make up the remaining 43 %. By comparison, other methods, such as full-tree and on-site chipping are of negligible significance in commercial operations in Norway.

The chainsaw is the common felling instrument; machine felling accounts for only about 10 % of the total. In commercial thinnings only 3 % is carried out by machines.

## Numbers of harvesting machines, by type, in use (1980)

Harvesters	20
Feller-bunchers/skidlers	10
Processors	65
Forwarders	350
Skidders	400
Winch/cable systems	250

More than 50 % of woods-working machinery is owned by private contractors. The approximate machinery ownership distribution is as follows:

Public enterprise	5 %
Forest industry	10 %
Machine operators/contractors	55 %
Individual forest owners	30 %

## Natural losses

Natural damaging agents such as insects, diseases, and fire, cause some losses to the growing forests but generally are not a significant problem in Norway.

The two most important insect pests are pine weevils, which affect young pine plantations, and bark beetles, which attack overmature and weakened (e.g., by drought)

stands. Fungi and diseases are of very little importance nationally. Recently, concern over acid rain has gained prominence because Norway is in the path of airborne industrial pollutants from heavy industry elsewhere in Europe. However, no quantitative correlation of its effects on Norway's forests has yet been established.

Forest fires are not a significant hazard to Norwegian forestry. The climate is wet and the most important forest regions are well monitored (mostly from towers and aircraft). Access is good and fires that do start can usually be suppressed quickly. Local authorities have the power to recruit local residents for fire suppression duties if the situation warrants it.

The year 1976 was considered a bad fire season because nearly 17 km<sup>2</sup> of productive forest burned; whereas, in 1979, less than one-third of a square kilometre was destroyed. Commonly the annual damage is confined to 2-3 km<sup>2</sup> or less.

Total losses from insects, diseases, and fires is approximately 800 000 m<sup>3</sup> annually. Of this, approximately three-quarters is coniferous volume.

### Growth

Total annual productive forest growth is estimated at 14.3 million m<sup>3</sup> solid volume under bark, which represents somewhat less than 3 % of the growing stock volume. The mean annual increment averages about 2 m<sup>3</sup>/ha per year, as a result of the many low productivity lands at or near the climatic limits of tree growth. Nearly 50 % of the forest lands have a maximum potential annual production of less than 4 m<sup>3</sup>/ha. Actual production seldom achieves this.

Potential growth of productive forest lands (solid volume u.b.)

Forest land area (million ha)(%)	Site	Potential annual growth (m <sup>3</sup> /ha)	Rotation (years)	Actual annual growth (m <sup>3</sup> /ha)	
0.30	5	1	9.2+	65	6.3
0.85	13	2	6.5-9.1	75	4.3
2.20	34	3	4.1-6.4	90	2.4
1.95	30	4	2.5-4.0	100 +	1.3
<u>1.20</u>	<u>18</u>	5	< 2.4	110 +	0.8
6.50	100				

Of the total annual increment of 14.3 million m<sup>3</sup>, about 85 % is of coniferous species.

#### Growth by species

Species	Annual growth	
	(million m <sup>3</sup> )	(%)
Spruce	8.3	58
Pine	3.7	26
Birch	1.7	12
Other	0.6	4
	14.3	100

At the current rate of growth the forest can sustain a considerably higher annual harvest than the 8-10 million m<sup>3</sup> that has been cut in past years. The growing stock volume has, therefore, increased steadily. It is expected that the harvest will be gradually increased by 1990 to an annual level of 10-11 million m<sup>3</sup>, an amount approximately equal to present domestic industrial consumption, but still less than the annual growth. Growing stock volume of Norway's forests, therefore, is likely to increase in the foreseeable future. In terms of allowable cut, slightly more than 80 % is being harvested nationally. The harvest, however, is not uniformly distributed throughout the country and, in a few counties, the actual cut tends to exceed that allowable. In other counties, the cut reaches barely 50 % of allowable levels.

#### Reforestation and silviculture

The total area reforested annually averages about 42 000 ha. About two-thirds of this reforestation is done by planting and seeding and the remaining one-third is left to regenerate naturally. Planting accounts for almost all of the artificial stand renewal and averages some 28 000 ha/a. Seeding usually does not exceed 200-300 ha/a. Planting is concentrated on reforesting spruce cutovers, almost all of which are planted. Pine cutovers are more often left to regenerate naturally, usually with the aid of residual seed trees. Planting intensity generally averages about 2 000 seedlings/ha with a planned spacing of 2.2 m x 2.2 m.

Planting is done manually because of difficult terrain. Machine planting has not gained any significant foothold in Norwegian forestry. Containerized seedlings have become popular and, in recent years, more than 60 % of the planting stock is of this type. The rest is bare root, either 2/1 or 2/2 transplanted stock.

In addition to reforestation, some 37 000 ha are afforested annually. Most of this afforestation is done in the western and northern coastal areas where the purpose is to convert large areas of scrub birch and other undesirable species into merchantable quality softwoods. A program was established in 1950 by which 500 000 ha of these coastal areas would be afforested by the year 2010. This program has since been upgraded; it is expected that some 550 000 ha will be afforested by 1990.

There are some 50 tree nurseries, which supply the approximately 65 to 70 million seedlings needed each year for reforestation and afforestation. Most of the nurseries are operated by local forestry societies; the state has only four nurseries but these produce

approximately 25 % of the planting stock. Most of the seedlings are Norway spruce (approx 85 %), about 7 % are Scots pine. The remaining 8 % consists of various species, one of the more prominent of which is Sitka spruce.

Thinnings have not reached the importance in Norway that they have in neighboring Sweden and Finland. Only about 3 % of the merchantable harvest comes from thinnings (as much as 33 % of the harvest is from thinning in the other two countries). Commercial thinnings yield, on the average, approximately 50 m<sup>3</sup>/ha, and are done when the stands are 40-60 years of age. At this stage the trees have generally reached a size of about 10-20 cm. Commercial thinnings are done on some 5 000 ha annually. Purely silvicultural thinnings are carried out to an even lesser extent, with only about 1 000 ha being so treated each year.

Site preparation is an important part of reestablishing the forest after cutting. Slash clearing, brush control, scarification, and prescribed burning are carried out on some 60 000 ha annually.

#### Area by type of site preparation

	<u>1975-79 average</u>	<u>1979</u>
Clearing and brush control	61 000 ha	56 250 ha
Scarification and burning	<u>1 150 ha</u>	<u>1 100 ha</u>
Total	62 150 ha	57 350 ha

Drainage of poorly productive and nonforested swamp lands averages about 1 500 ha annually. In the mid-1970s the area drained each year was much larger, 2 500-3 000 ha, but has decreased steadily to the present level. About 1 100 km of new ditches are established each year in connection with the afforestation of swamps. Ditching and drainage is also done to aid reforestation of cutovers. In this context, about 200-250 km of ditching are done annually.

Fertilization of forest stands has been practiced for more than two decades but always on a moderate scale, particularly in relation to Sweden and Finland. In the 1960s, as much as 9 000 ha were fertilized yearly. However, only 4 000 ha have been fertilized on average yearly since 1975. Fertilization is done on both productive forest land and in afforestation of swamp lands, with the latter accounting for approximately one-third of the total area treated.

## FOREST INDUSTRY

### Raw material supply and consumption

In recent years the total depletion on Norway's forests has averaged between 7 and 10 million m<sup>3</sup> of solid volume inside bark, of which spruce accounts for nearly 80 %, pine 15 %, and hardwoods the remainder.

Total annual growth is slightly more than 14 million m<sup>3</sup>. Of this, nearly 60 % is spruce, about 25 % is pine, 12 % birch, and 4 % others.

The annual depletion has consistently been lower than the growth (slightly more than 80 % of the allowable cut since the mid-1970s) and, consequently, the growing stock has been increasing steadily. The harvest (averaging about 8 million m<sup>3</sup>) has not been able to satisfy the domestic demand (about 10-11 million m<sup>3</sup>) of wood-using industries. The deficit has had to be supplemented with imports, most of which have come from Sweden. Based on the growth capacity of the forests, Norway has the potential to produce enough roundwood raw material domestically to keep its wood-using industries supplied. The main problem looming in the near future is caused by poor age distribution of the forests. At present there is a marked paucity of imminently maturing (40 to 80-year age class) timber, which may cause shortages in the near future. Furthermore, in the past, much of the harvesting concentrated on the more easily accessible terrain; the most difficult, steep mountainsides have been avoided. The lower productivity in these areas, along with more expensive access, could escalate Norway's roundwood costs. This comes at a time when competition from other wood products exporting countries is becoming more and more acute.

Of the total 9.9 million m<sup>3</sup> of roundwood cut in 1979-80, some 7.4 million m<sup>3</sup> went for industrial use. In addition, the forest industry imported about 1.5 million m<sup>3</sup> for a total consumption of 8.9 million m<sup>3</sup>.

### Consumption of Norway's domestic roundwood 1979-80 (million m<sup>3</sup> u.b.)

Industrial raw material	7.2
Industrial fuelwood	0.2
Export	1.0
Farm/other noncommercial	0.7
Felling losses	<u>0.8</u>
Total cut	9.9

### Summary of raw material supply

Productive forest area	6.5 million ha
Growing stock	480.0 million m <sup>3</sup> u.b.
Annual growth	14.3 million m <sup>3</sup> u.b.
Total cut	9.9 million m <sup>3</sup> u.b.
Imported roundwood	1.5 million m <sup>3</sup> u.b.
Recycled paper, etc.	100 000 t

### The sawmill industry

Norway's production of sawnwood was approximately 2.5 million m<sup>3</sup> in 1980, which represented only about 0.5 % in terms of world production. Exports in 1980 were 430 thousand m<sup>3</sup>, which also amounted to approximately 0.5 % of the world export trade in sawn goods. Annual exports have increased gradually during the past decade and, likewise, the proportion of production that is exported has increased substantially during the same period.

#### Sawnwood production and export trends (1970-1981)

	1970	1975	1978	1979	1980	1981
Production (million m <sup>3</sup> )	2.0	2.1	2.1	2.4	2.5	2.2
Exports (million m <sup>3</sup> )	0.1	0.2	0.3	0.5	0.4	0.2
% exported	5	11	14	19	17	11

The single largest export market is the United Kingdom, which takes nearly 40 % of Norwegian lumber exports. West Germany and Denmark are other important markets, which take approximately 20 % and 15 % respectively. Almost all lumber exported by Norway goes to Europe; only 1 % or less goes elsewhere in the world.

The sawmill industry includes more than 700 sawmills. About 300 sawmills account for more than 95 % of the 2.5 million m<sup>3</sup> annual production. About 60 of the mills produce 75 % of the total output.

Sawmilling utilizes about 50 %, or approximately 5 million m<sup>3</sup>, of the domestic roundwood production.

#### Roundwood consumption by the sawmill industry (1979-80)

	million m <sup>3</sup>	%
Spruce	3.9	80
Pine	0.7	14
Hardwoods	0.1	2
Imported conifers	0.2	4
Imported hardwoods	0.1	--
	5.0	100

-- Amount too small to be expressed.

The industry achieves sawnwood yields of about 50 % of the roundwood entering the mills. About 33 % goes into slabs and edgings and 15 % into sawdust. Most of these byproducts are used in the pulp, particleboard, or fiberboard industries. Shrinkage of the sawn lumber accounts for the loss of most of the remainder.

### The pulp industry

Wood pulp production in Norway has varied from 1.4 to 2.2 million metric tons during the past decade. In general, Norway's production accounts for about 1.5 % of world production annually. Exports of wood pulp were about 900 000 metric tons in the late 1960s and early 1970s, and accounted for nearly 5 % of world exports. Since 1974, exports have declined dramatically and have not recovered. In 1980, slightly more than 500 000 metric tons were exported, representing only 2.5 % of world export trade in wood pulp.

#### Production and export trends in wood pulp

	1970	1975	1978	1979	1980
Production (1 000 t)	2 182	1 731	1 374	1 529	1 602
Exports (1 000 t)	981	597	612	573	529
Exports (% of production)	45	34	44	37	33

The most prominent importers are West Germany and the U.K., each of which takes about 20 % of Norway's pulp exports. The rest of Europe takes more than 50 %, thus making Europe the recipient of more than 90 % of Norway's export pulp.

#### Wood pulp production by process (1980)

	(1 000 t)	(%)
Sulphate	207	13
Sulphite	303	19
Dissolving	118	7
Semichemical	73	5
Mechanical	901	56
Total	1 602	100

#### Total capacity (1981)

(1 000 t/a)
455
385
135
95
1 350
2 420

The pulp industry consumes more than 3 million m<sup>3</sup> of roundwood and at least 2 million m<sup>3</sup> of mill residue (slabs, chips, sawdust, etc.) from other wood industries, principally sawmilling. The industry also uses about 100 000 t of recycled paper each year.

#### Roundwood consumption in the pulp industry (1979-80)

	(1 000 m <sup>3</sup> )	(%)
Spruce	2 443	74
Pine	287	9
Hardwoods	138	4
Imported conifers	409	12
Imported hardwoods	18	1
Total	3 295	100

Since the mid-1970s, the pulp industry has been operating at only about two-thirds capacity. This low ratio results from a general slowdown in the market for pulp; Norway,



unlike her neighboring competitors Sweden and Finland, cut back production rather than stockpile.

There are a total of 40 pulp mills. Of these, 75 % are mechanical pulp mills, which account for 56 % of the total pulp production. Compared to Sweden, Finland, and Canada, the mills are relatively small and generally integrated to a lesser degree. However, a gradual consolidation is leading to fewer and larger mills. For example, construction of a 250 000 t sulphate mill was approved in 1977 on the premise that 5-6 existing mills (2-3 sulphite and 3 sulphate) will close.

### The paper industry

Norway's paper and paperboard production is less than 1 % of world output but it accounts for about 3 % of the world's export trade in these products. Norway ranks sixth and France seventh among the world's paper products exporters. The two biggest customers are the U.K. and West Germany, each of which purchase about 20 % of Norway's export paper products.

Of the total production of paper and paperboard, generally about 75 % is exported. In 1980, production was nearly 1.4 million t, of which more than 1 million t (76 %) were exported.

Production and export trends for all paper and paperboard (1970-1980)

	1970	1975	1978	1979	1980
Capacity (1 000 t)	..	1 650	1 750	1 795	1 845
Production (1 000 t)	1 417	1 147	1 241	1 390	1 373
Exports (1 000 t)	1 018	774	897	1 017	1 048
Exports (% of production)	72	67	72	73	76

.. Figures not available

There are a total of 39 mills producing paper products. Four of these are newsprint mills, which in 1980, produced more than 550 000 t of newsprint.

### Newsprint production and export

	1970	1975	1978	1979	1980
Capacity (1 000 t)	..	600	650	675	700
Production (1 000 t)	554	435	482	568	557
Exports (1 000 t)	476	381	369	462	523
Exports (% of production)	86	88	77	81	94

.. Figures not available

Norway's newsprint production is about 2 % of world production and puts Norway among the top 10 producers. As seen from the preceding table, a very high proportion of the production is exported. Norway accounts for about 4 % of the world newsprint exports and is the fourth largest exporter after Canada, Finland, and Sweden. West Germany and the U.K. are the biggest customers and, together, take about 40 % of the exports.

### The plywood industry

The industry produces plywood, blockboard, and other laminated-board products. In Norway this industry is small, producing less than 10 000 m<sup>3</sup> annually from 2 mills. Exports are insignificant in the world market; Norway is a net importer of plywood products. Imports average from 60 000 to 70 000 m<sup>3</sup> annually.

### The particleboard industry

This is a relatively small industry on a world scale, producing about 350 000 m<sup>3</sup> annually. Generally, between 15 and 20 % of production is exported. Norway also imports considerable quantities of particleboard and, since the mid-1970s, has been a net importer of these products.

	1970	1975	1978	1979	1980	1981
Production (1 000 m <sup>3</sup> )	211	291	360	348	354	315
Exports (1 000 m <sup>3</sup> )	48	66	45	50	62	51
Imports (1 000 m <sup>3</sup> )	27	60	83	81	79	86

There were eight particleboard mills in operation in 1981.

### The fiberboard industry

Fiberboard is also a small industry with only four operating mills in 1981 having an annual production of about 300 000 m<sup>3</sup>. Production is on a par with that of Finland and is one-half of Sweden's production. About 76 000 m<sup>3</sup> (28 %) were exported in 1981. In the late 1960s and early 1970s, exports were much higher but have been diminishing constantly since then. However, they still represent nearly 3 % of world exports and place Norway among the top 12 or so exporting countries.

	1970	1975	1978	1979	1980	1981
Production (1 000 m <sup>3</sup> )	281	275	194	215	281	275
Exports (1 000 m <sup>3</sup> )	110	115	72	65	60	76
Exports (% of production)	39	42	37	30	21	28

### Trade in forest products

Norway is a member of the European Free Trade Association (EFTA), which has duty-free trade (except in agricultural products) among its members. With respect to manufactured products, EFTA has a free trade agreement with the European Economic Community (EEC). This latter arrangement is important to Norway because some EEC countries, West Germany and the U.K. in particular, are important customers for Norwegian forest products.

Traditionally, forest products have been an important part of Norway's foreign trade but their relative importance has diminished considerably since North Sea oil production became a significant factor in the 1970s. In the 1950s, forest products accounted for about 20 % of Norway's total export value. In 1979, the figure was down to about 6.5 % and in 1980 to 5.6 %; whereas, natural gas and petroleum products jumped from a negligible level to 36 % and to 48 % respectively. Despite the lower percentage share in

1980, the value of forest products in the export market increased from slightly more than 4.5 billion Norwegian kroner (Nkr) in 1979 to nearly 5.2 billion Nkr in 1980.

Forest products are a net foreign currency earner in Norway's export trade. The trade surplus is generally of the order of US \$500 million annually. Most of the surplus is brought about on the strength of paper and paperboard exports, which, in 1980, showed a net income of some US \$470 million. Wood pulp is the other important income earner but most other categories of forest products show a deficit in external trade.

Norway's share in European and world export markets (1980)

	Europe		World	
	(%)	(Rank)	(%)	(Rank)
Wood pulp	7.4	3	2.5	8
Paper products	8.0	4	3.0	7
Coniferous sawnwood	1.9	8	0.7	12
Fiberboard	4.6	8	0.7	12
Particleboard	1.3	10	1.1	13

Note: Plywood is not significant in the export market.

Most of Norway's forest product exports are directed toward western Europe, with more than 60 % going to the EEC and some 13 % to EFTA countries. A more detailed breakdown of exports and imports of important forest products is given in Appendix 4.

### Labor

The forestry sector employs about 8 000 workers in forestry and some 25 000 in the manufacturing of forestry products. In addition, approximately 30 000 forest owners are involved in forestry work on their properties. Therefore, a total of 60 000 workers receive earnings from the forest and represent approximately 4 % of the total work force.

Increased mechanization in forest operations has resulted in a steady decline in the number of forestry workers. In the early 1970s the number averaged about 15 000 workers but has nearly halved since then. The shift to mechanization has been necessitated by constantly increasing labor costs. In the 1950s, labor was cheap and a low productivity in forest operations (about 0.9 person-days/m<sup>3</sup>) could be tolerated. By the early 1970s, productivity had been increased to about 0.3 person-days/m<sup>3</sup> and, in 1980, it was about 0.25 person-days/m<sup>3</sup>. Harvesting requires 0.15 person-days/m<sup>3</sup> and off-road transport 0.10 person-days/m<sup>3</sup>.

Trade unions are well established and have considerable influence. The government has also been committed to high employment. It often subsidizes industry, particularly the retraining of employees, to prevent massive layoffs during recessionary periods. As a result, unemployment has been markedly lower than in other industrialized nations (1.1 % in 1979), labor relations are generally amicable, the labor force is stable, and work disruptions and strikes are uncommon.

### Costs

In 1978 the government imposed a wage-and-price freeze for 15 months, a move considered successful because increases were kept to 4-5 % for the period. A wage-regulation law was brought into existence following the freeze. This law stipulates that wage settlements conform to limits set through negotiations between the Confederation of Trade Unions and the Employers' Federation. It is expected that wage and price growth will remain moderate in the near future. Since 1979, consumer prices have been in line with those of other industrialized countries.

#### Average costs/m<sup>3</sup> (1979-80) in US \$

Harvesting	7
Hauling	7
Administration and overhead	8
Depreciation	3
Silviculture	4
Total cost of wood	29
Average mill price for wood	35

#### Mean roadside prices/m<sup>3</sup> (US \$)

	1975-76	1979-80
Veneer logs	40	66
Spruce sawlogs	32	44
Pine sawlogs	32	47
Spruce pulpwood	27	29
Pine pulpwood	25	28
Birch pulpwood	17	24

Prices of veneer and sawlogs have increased as much as 65 % over the 4-year period preceding 1980, while pulpwood prices have remained stable. As seen in the following table, export prices for forest products have remained weak. It is important, therefore, that Norway be able to maintain raw material costs at a competitive level in the pulp and paper industry - her most important export revenue source in the forestry sector.

#### Average export prices in US \$

		1975	1979
Veneer logs, sawlogs	m <sup>3</sup>	44	51
Pine sawnwood	m <sup>3</sup>	133	145
Spruce pulpwood	m <sup>3</sup>	21	29
Pine pulpwood	m <sup>3</sup>	28	31
Mechanical wood pulp	t	223	228
Bleached sulphite pulp	t	406	454
Newsprint	t	320	440
Kraft paper	t	450	595

In terms of Norwegian currency, price increases are much less significant; prices actually decreased for pine sawnwood and all wood pulps. The price increase in terms of US \$ resulted from the relative increase of about 12 % in value of the Norwegian krone during the 1975-79 period.

### **Expenditure and finance in forest management**

Because of Norway's rugged terrain, accessibility has always been an important concern in Norwegian forestry. Accordingly, millions of kroner are spent annually in the construction and maintenance of forest roads. On the average, between 700 and 900 km of new all-weather forestry roads are built, and another 200-300 km of old roads are reconstructed each year. In addition, more than 1 000 km of winter haul roads are constructed yearly. The total yearly expenditure is equivalent to about US \$20 million for all-weather roads and some US \$6-7 million for winter roads. Approximately one-third of each of these amounts comes from government subsidies; most of the remainder is paid for by the forest owners; various nongovernment grants and subsidies account for only 1 or 2 %.

More than 1 000 km of ditching is done annually to drain some 2 000 ha of swamp lands for forestry use. Expenditures for this work average about the equivalent of US \$1 million, of which approximately one-half is provided by government subsidies.

On the average, about 4 000 ha of forest land are fertilized annually at a total equivalent expenditure of US \$400 000-500 000. Generally about 20 % of this expenditure is provided by government subsidies, but in 1979, subsidies for forest fertilization amounted to nearly 40 %.

Regenerating cutovers and afforestation of many nonforest areas are important aspects of Norwegian forestry, and consequently, considerable funds are expended to these ends. The equivalent of some US \$20-25 million goes toward regeneration each year and an additional US \$4 million goes for afforestation. Government subsidies pay for more than one third (US \$9-10 million) of this work. Investments in afforestation by landowners are tax deductible.

## Summary of forestry expenditures (1979) in millions of US \$

	Total	Subsidy	% subsidized
Regeneration	22.9	9.4	36
Afforestation	3.5	..	..
Fertilization	0.4	0.2	50
Drainage	0.9	0.4	44
Forest roads	23.6	8.2	35
All-weather roads	18.3	6.2	34
Winter roads	5.3	2.0	38

.. Figures not available.

To ensure reinvestment in forestry on private lands, a forest levy, imposed by the Forestry Act, of about 10 % of the gross timber sales is held back from the owner. These moneys belong to the forest owner but are made available to him only for forest improvement work approved by the County Forestry Board. Income from timber sales used in this manner is tax free. In many instances, more than one-half of investment in silvicultural activities is financed from these funds. However, after the County Forestry Board inspects the owner's property and concludes that no forestry improvement work is necessary, the owner can have the funds released for his own use.

Because of Norway's rugged terrain, some form of cable logging is often essential for access to harvestable timber. The government, therefore, gives considerable financial assistance for the installation of forest cableways. The amount of total expenditure can vary greatly from year to year; the amount of subsidy paid by the state varies accordingly. In recent years, total expenditures have ranged from a high of nearly the equivalent of US \$250 000 to a low of about the equivalent of US \$6 000. Subsidies generally cover between 30 and 50 % of the cost.

Investment (1979) in fixed assets by the mechanical wood products industry totaled about the equivalent of US \$97 million and for the paper and paper products industry, US \$165 million.

## Investment in fixed assets (million US \$) (1979)

Type of industry	Building	Machinery	Transport equipment	Other	Total
Mechanical wood products	33	51	9	4	97
Paper products	57	101	3	4	165
Total manufacturing	493	764	120	82	1459

Of the total investment, the mechanical wood products industry accounted for some 6.5 % and the paper industry for more than 11 % of the total manufacturing industry outlay of capital in 1979. In this respect, the paper industry is exceeded only by the metal products, and food manufacturing industries.

Norway has a favorable attitude toward foreign investment, particularly involving development in the less industrialized northern parts of the country. High technology industries are also much favored. The general principle in attracting foreign investment is to create a more diversified industrial base rather than to rely heavily on the country's resource base, i.e., oil, forest products, and fisheries.

## FORESTRY ORGANIZATIONS

### Government

Public forest lands are administered by the State Forest Service, a semiautonomous directorate within the Ministry of Agriculture. The Service has headquarters in Oslo and 30 district offices throughout the country.

The State Forest Service manages a total of about 600 000 ha of forest land (nearly 10 % of Norway's total forests). These areas include all the national parks, military reserves, church forests, community common lands, and state common lands, as well as other Crown-owned lands. The Service also owns and operates 5 sawmills with a total annual output of some 100 000 m<sup>3</sup>. The annual cut under the auspices of the Service is approximately one-half million m<sup>3</sup> or about 7 % of the national total.

The principal agency for administering private forestry is the Civil Forest Administration, a branch of the Ministry of Agriculture. It consists of 17 County Forestry Boards and 200 District Forestry Boards. The main responsibilities of the Civil Forest Administration are 1) to ensure that forestry on private lands is practised according to the Forestry Act; 2) to administer government grants and subsidies; 3) to administer the Forest Levy, a percentage of the sale price of timber, which is held back for the owner for reinvesting in his forest; and 4) to provide assistance and advice to the owners on forestry matters.

### Private forest owners' organizations

The Norwegian Forest Owners' Federation is a cooperative organization of some 56 000 members (1981) who control more than one-half of the country's productive forest land and provide more than two-thirds of its harvest. The Federation is made up of 19 district and 463 local associations. The Federation negotiates price agreements for its members and provides a professional and technological service for the benefit of individual forest owners. It also strives to establish and maintain a wood-using industry, which is controlled by the forest owners. Another of its functions is to initiate and influence forest policy that will be in the best interests of the private forest owners.

The Forest Owners' Federation is also active in the development of forest industries and founded the Norwegian Forest Industries Ltd. in 1962. The latter is now the largest forest-industry enterprise in the country, and employed some 3 000 people in 15 wood-using plants in 1981. It consumes nearly 2 million m<sup>3</sup> of roundwood annually and has the capacity to produce nearly 400 000 t of newsprint, 60 000 t of kraft paper, 230 000 m<sup>3</sup> of particleboard, and 550 000 m<sup>3</sup> of sawnwood.

The Forest Owners' Association established in 1950, in contrast to the Federation, which includes primarily farm and other small forest owners, consists of some 120 of the largest private forest concerns. This group accounts for about one-fifth of the roundwood production. The Association's functions and aims are very similar to those of the Federation.

The Forest Owners' Federation and Forest Owners' Association of 1950 together account for about 90 % of the wood harvested in Norway. They have, therefore, a strong influence on national forest policy and price trends. Prices are negotiated between these two cooperatives and the appropriate industry representatives, then fixed for an agreed

period. Should the owners' representatives and industry not reach an agreement, the government may impose an arbitrated price.

#### **Forest research organizations**

In Norway, forest research is a responsibility left primarily to the government. The two organizations, which carry out most of the research, are the Norwegian Forest Research Institute and the Agricultural University of Norway.

The Norwegian Forest Research Institute comes under the jurisdiction of the Ministry of Agriculture. The Institute's work encompasses all aspects of forest management and silviculture. For this purpose it is subdivided into eight branches, one for each of the general subjects: forest ecology, regeneration, protection, yield, tree breeding, wood technology, harvesting, and inventory. The inventory branch not only does research but also conducts the national forest inventory and other inventory work.

The Agricultural University of Norway is engaged in research, as well as in education. The work is organized in five separate departments covering the disciplines of forest mensuration, silviculture, forest economics, logging engineering, and wood technology.

Scientific publications on forestry and forest research are published by both organizations.

#### **Forestry education**

The Agricultural University of Norway provides degree courses in forestry. Specialization can be obtained in one or more of the following disciplines: silviculture, forest mensuration, forest economics, wood technology, or logging. On average, 25 graduates complete the 5-year course each year.

Forestry at the technician level is taught at three forest ranger schools. The course lasts 4 years and prepares the students for all aspects of forestry operations and extension work.

Forest worker training is provided by vocational schools through courses of various duration and subject matter. Two-year courses, which qualify as prerequisites for more formal education, as well as short training courses covering a diversity of topics, are given in these institutions.

Another educational organization is the Forestry Course Institute, which offers short courses, usually only a few days in duration. These courses are aimed at keeping the forest owner, technician, or professional abreast of current developments in forestry.



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## APPENDIX 1

## General data

<u>Official name:</u>	Kingdom of Norway	
<u>Capital:</u>	Oslo (population 462 000)	
<u>Location:</u>		
World region	Northern Europe	
Latitudinal limits	55°57'31"N and 71°11'08"N	
Longitudinal limits	4°31'13"E and 31°10'04"E	
<u>Neighbouring countries:</u>	Sweden, Finland, and USSR in the east; the Skagerrak in the south; the North Sea and the Norwegian Sea in the west; and the Arctic Ocean in the north.	
<u>Form of government:</u>	A constitutional monarchy with a parliamentary form of government.	
<u>Economy:</u>	Developed; market economy based on private ownership.	
<u>International organizations:</u>	Member of: UN, ECE, FAO, GATT, IBRD, IDA, IFAD, IFC, ILO, IMF, ADB, ADF, BIS, CCC, EFTA, NIB, OECD.	
<u>Languages:</u>	Norwegian	
<u>Population:</u>	4 093 000 (1981)	
<u>Area (excluding island territories):</u>	323 886 km <sup>2</sup>	100 %
Land	304 538	95
Forest and other wooded land	83 299	26
Agricultural	9 358	3
Other nonforest	214 881	66
Water (inland)	16 348	5

## APPENDIX 2

## Economic indicators

<u>Monetary unit:</u>	Norwegian krone (market rate, Dec. 1983, 7.67 Kr = US \$1)
<u>International reserves minus gold:</u>	US \$6 870.4 million (Sept. 1982)
<u>International gold reserves:</u>	1.184 million fine Troy ounces
<u>Exports:</u>	US \$17.7 billion (1981)
<u>Imports:</u>	US \$15.4 billion (1981)
<u>Gross domestic product:</u>	US \$56.5 billion (1981)
<u>Gross national product:</u>	US \$54.8 billion (1981)
<u>Labor employment:</u>	1.9 million (1980)
<u>Labor unemployment:</u>	1.7 % (1980 average)
<u>Consumer price index:</u>	192.8, Sept. 1982 (1975=100)
<u>Discount rate:</u>	9.0 % (August 1982)

## APPENDIX 3

## Forest resource data

## 1. Forest classification

Forest type	Area (1 000 ha)	Volume (million m <sup>3</sup> u.b.)
Closed forest	6 480	480
Softwood	5 000	..
Mixedwood	1 260	..
Hardwood	220	..
Other wooded land	1 850	..
Total forest and woodland	8 330	480

.. Figures not available

## 2. Ownership of closed forest

Ownership	Area (1 000 ha)	(million m <sup>3</sup> u.b.)
Public	1 030	16
State	640	10
Other	390	6
Private	5 450	84
Industry	440	7
Individual	4 880	75
Other	130	2
Total closed forest	6 480	100

## 3. Species composition

Species	Volume (u.b.)		Volume increment (u.b.)	
	(million m <sup>3</sup> )	(%)	(million m <sup>3</sup> /a)	(%)
Coniferous	400	83	12.0	84
Pine	150	31	3.7	26
Spruce	250	52	8.3	58
Nonconiferous	80	17	2.3	16
Birch	60	13	1.7	12
Other	20	4	0.6	4
Grand total	480	100	14.3	100

## APPENDIX 3 (cont'd)

## 4. Forest age structure

Age class (years)	Area	
	(1 000 ha)	(%)
Less than 20	1 420	22
21-40	1 350	21
41-60	720	11
61-80	610	9
81-100	1 010	16
Over 100	1 370	21
Total	6 480	100

## 5. Forest growth and depletion

		Conifer	Non-conifer	Total
Growing stock	(million m <sup>3</sup> )	400	80	480
GS/ha	(m <sup>3</sup> )	..	..	74
Growth				
Gross annual increment (GAI)	(1 000 m <sup>3</sup> )	12 000	2 300	14 300
Net annual increment (NAI)	(1 000 m <sup>3</sup> )	11 400	2 100	13 500
Depletion (1 000 m <sup>3</sup> )				
Natural losses		600	200	800
Harvesting (incl. waste)		9 000	900	9 900
Total depletion		9 600	1100	10 700
Annual allowable depletion		10 400*	2 000*	12 400*
Depletion/growth ratios				
Harvesting intensity (Fellings/NAI)		0.79	0.43	0.73
Depletion intensity (Total depletion/NAI)		0.84	0.52	0.79
Depletion/growing stock		2.4 %	1.4 %	2.2 %
Forest balance (allowable depletion less total depletion)	(1 000 m <sup>3</sup> )	+ 800*	+ 900*	+ 1 700*

.. Figures not available

\* Estimated figures

## APPENDIX 4

## Forest products data

1. Production<sup>a</sup> of forest products by commodity aggregate (1981)

Commodity aggregate	Quantity
Roundwood (1 000 m <sup>3</sup> )	8 720
Fuelwood	595*
Industrial roundwood	8 125
Sawlogs and veneer logs	5 015
Pitprops	-
Pulpwood, chips, and particles	3 030
Other industrial roundwood	80*
Sawnwood and sleepers (1 000 m <sup>3</sup> )	2 462
Wood-based panels	603
Wood pulp (1 000 t)	1 614
Paper and paperboard	1 373
Roundwood (1 000 m <sup>3</sup> )	8 720
Coniferous	7 996
Nonconiferous	724
Industrial roundwood (1 000 m <sup>3</sup> )	8 125
Coniferous	7 810
Nonconiferous	315

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.

- Nil or zero

## 2. Imports and exports of forest products (1981)

Commodity aggregate	Imports	Exports
Roundwood (1 000 m <sup>3</sup> )	1 579	957
Fuelwood	2	-
Industrial roundwood	1 511	955
Sawlogs and veneer logs	190	192
Pitprops	-	-
Pulpwood, chips, and particles	1 291	753
Other industrial roundwood	10	11*
Sawnwood and sleepers (1 000 m <sup>3</sup> )	1	247
Wood-based panels (1 000 m <sup>3</sup> )	170	122
Wood pulp (1 000 t)	281	560
Paper and paperboard (1 000 t)	180	1 019

## APPENDIX 4 (cont'd)

## 3. Imports and exports (1981) of forest products in US \$1,000

Commodity aggregate	Imports	Exports
Roundwood	70,506	37,527
Fuelwood and charcoal	2,815	136
Industrial roundwood	67,691	37,391
Sawlogs and veneer logs	9,272	9,861
Pitprops	-	-
Pulpwood, chips, and particles	55,760	25,775
Other industrial roundwood	1,659	1,755
Sawnwood and sleepers	111,511	42,872
Wood-based panels	66,559	18,573
Wood pulp	95,720	236,928
Paper and paperboard	136,353	524,246
Total forest products	480,649	860,146
Forest products trade surplus		379,497

- Nil or zero

\* Estimated figures.

## 4. Major exporters of forest product imports (1980)

Commodity aggregate	Exporters	Quantity
Pulpwood, chips, and particles (1 000 m <sup>3</sup> )	Sweden	1 255
	USA	125
	Poland	22
	USSR	2
Plywood (1 000 m <sup>3</sup> )	Finland	25
	Korea Rep.	3
	Singapore	3
Particleboard (1 000 m <sup>3</sup> )	Sweden	53
	Finland	6
Wood pulp (1 000 t)	Brazil	182
	Sweden	76
	Finland	27
	South Africa	2
	Portugal	1

## APPENDIX 4 (cont'd)

## 5. Major importers of main forest product exports (1981)

Commodity aggregate	Importers	Quantity
Sawlogs and veneer logs (1 000 m <sup>3</sup> )	Sweden	174
	Finland	11
	G.F.R.	4
	Others	2
Pulpwood, chips, and particles (1 000 m <sup>3</sup> ) Fiberboard (1 000 m <sup>3</sup> )	Sweden	630
	U.K.	27
	Denmark	14
	Switzerland	1
	Others	6
Wood pulp (1 000 t)	G.F.R.	145
	U.K.	93
	Netherlands	47
	USSR	43
	France	41
	Italy	37
	Belgium-Lux.	31
	Switzerland	20
	Poland	17
	G.D.R.	12
	Spain	8
	USA	3
	Yugoslavia	3
	Latin America	25
Others	35	
Newsprint (1 000 t)	G.F.R.	119
	USA	98
	Netherlands	62
	France	54
	Denmark	31
	Belgium-Lux.	25
	India	14
	USA	13
	China	5
	Brazil	2
	Argentina	2
	Australia	1
	Others	147



## APPENDIX 4 (cont'd)

Commodity aggregate	Importers	Quantity
Paper and paperboard, less newsprint (1 000 t)	G.F.R.	50
	USSR	49
	Denmark	22
	France	14
	U.K.	13
	Netherlands	13
	Belgium-Lux.	10
	Switzerland	8
	Iran	7
	USA	6
	Australia	5
	Spain	4
	Italy	3
	Japan	2
Africa	1	
Latin America	10	
Others	229	

## APPENDIX 5

## Abbreviations, symbols, and conversion factors

## Abbreviations

ADB	Asian Development Bank
ADF	African Development Fund
a.s.l.	above sea level
BIS	Bank of International Settlements
CCC	Customs Cooperation Council
CMEA	Council for Mutual Economic Assistance
DBH	diameter at breast height
ECE	Economic Commission for Europe
EEC	European Economic Community
EFTA	European Free Trade Association
FAO	Food and Agriculture Organization of the United Nations
GAI	gross annual increment
GATT	General Agreement on Tariffs and Trade
G.D.P.	gross domestic product
G.D.R.	German Democratic Republic (East Germany)
G.F.R.	Federal Republic of Germany (West Germany)
GS	growing stock
IADB	Inter-American Development Bank
IBRD	International Bank for Reconstruction and Development
IDA	International Development Association
IFAD	International Fund for Agricultural Development
IFC	International Finance Corporation
ILO	International Labour Organization
IMF	International Monetary Fund
MAI	mean annual increment
NAI	net annual increment
NIB	Nordic Investment Bank
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
USA	United States of America
USSR	Union of Soviet Socialist Republics

**Symbols**

a	annum
ha	hectare(s)
km	kilometre(s)
km <sup>2</sup>	square kilometre(s)
m	metre(s)
m <sup>2</sup>	square metre(s)
m <sup>3</sup>	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 <sup>2</sup>	= 0.386 102 square mile
1 m	= 3.280 84 feet
1 m <sup>2</sup>	= 10.763 9 square feet
1 m <sup>3</sup>	= 35.314 7 cubic feet
	= 0.353 147 cunit (of 100 cubic feet of solid wood)
1 m <sup>3</sup> /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 solid volume to under-bark solid volume)**

Spruce	0.89
Pine	0.92
Birch/aspens	0.87
Alder	0.90

## 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 those 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) Areas satisfying the conditions of the definition, even if not under forest administration, e.g., all forest on private land;
- (d) Areas satisfying the conditions of the definition but planned to be converted into other land utilization categories.

Excludes:

- (a) Isolated tree groups smaller than 0.5 ha;

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

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

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;

**APPENDIX 6 (cont'd)**

- (c) Forest roads and streams and other small open areas that cannot readily be excluded by the survey system used;
- (d) National parks.

**Excludes:**

- (a) City parks and gardens;
- (b) Areas occupied by orchards and plantations for nonforestry crops;
- (c) Wooded pastures and rangelands;
- (d) 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. Species that do not reach upright trunk forms (brush, etc.) are not considered as trees.

**Man-made forests:**

- (a) **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).
- (b) **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, 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, of fauna and flora or at other purposes 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.

