Working Paper

Socio-Economic Assessment of the Russian Boreal Forests

A.I. Pisarenko and V.V. Strakhov

WP-96-58
July 1996

IIASA International Institute for Applied Systems Analysis • A-2361 Laxenburg • Austria
Telephone: +43 2236 807 • Telefax: +43 2236 71313 • E-Mail: info@iiasa.ac.at

Socio-Economic Assessment of the Russian Boreal Forests

A.I. Pisarenko and V.V. Strakhov

WP-96-58
July 1996

Dr. Pisarenko is with the Federal Service of Forest Management of Russia; Dr. Strakhov is with the All-Russian Research & Information Centre for Forest Resources (ARICFR).

International Institute for Applied Systems Analysis • A-2361 Laxenburg • Austria
Telephone: +43 2236 807 • Telefax: +43 2236 71313 • E-Mail: info@iiasa.ac.at

Contents

Foreword

Siberia's forest sector has recently gained considerable international interest. IIASA, the Russian Academy of Sciences, and the Russian Federal Forest Service, in agreement with the Russian Ministry of the Environment and Natural Resources, signed agreements in 1992 and 1994 to carry out a large-scale study on the Siberian forest sector. The overall objective of the study is to focus on policy options that would encourage sustainable development of the sector. The goals are to assess Siberia's forest resources, forest industries, and infrastructure; to examine the forests' economic, social, and biospheric functions; with these functions in mind, to identify possible pathways for their sustainable development; and to translate these pathways into policy options for Russian and international agencies.

The first phase of the study concentrated on the generation of extensive and consistent databases for the total forest sector of Siberia and Russia. The study is now moving into its second phase, which will encompass assessment studies of the greenhouse gas balances, forest resources and forest utilization, biodiversity and landscapes, non-wood products and functions, environmental status, transportation infrastructure, forest industry and markets, and socio-economic problems. This report, by Acad. A.I. Pisarenko of the Federal Forest Service of Moscow, Russia and Dr. V.V. Strakhov of the All-Russian Research and Information Centre for Forest Resources, Moscow, is a contribution to the analyses of the topic of socio-economics.

Socio-Economic Assessment of the Russian Boreal Forests

A.I. Pisarenko[1] and V.V. Strakhov[2]

1. General Description of the Russian Forest Land

On the whole, plains are typical for the Russian landscapes. There are mountainous areas in the European Ural part of Russia (EUPR) (e.g., Zhiguli Mountains near Volga). In the EUPR, the mountains (except for the Urals) are located along the boundaries. The vast West-Siberian Plain (between the Urals and the Yenisey river) represents an absolutely flat lowland slightly sloping to the north. The Central Siberian Plateau (between the Yenisey and the Lena rivers) is featured by a sharply elevated surface with some smooth hills. As a matter of fact, the whole territory located east of the Lena river and Lake Baikal to the Pacific Coast may be regarded as mountainous land where the peaks reach up to 3,000 m altitudes.

Based on isotherms, spatial distributions of tree species, and minimum temperatures required for forest growth the forest boundaries have been investigated. Some researchers consider the northern boundary of boreal forests to be along the July isotherm of +10.5 C, whereas others believe the northern boundary to coincide with the July isotherm of +14.5 C. Other approaches have highlighted the importance of the duration of the warm period of the year. These approaches suggest the northern boreal boundary to coincide with the isotherm of +10.5 C of average daily temperature lasting not less than 30 days (some authors considered it to be 40 days) within a vegetation period.

The tree species of the Russian boreal forests, such as pine, cedar (Siberian pine), spruce, Siberian spruce, Siberian fir, birch, and especially, larch (5 major species) are resistant to low temperatures in winter and can grow both on transition zones to the tundra and on high altitudes. However, shoots, flowers, young needles or leaves may perish even at +5.0 C during the vegetation period. This is why light frost occurring during the vegetation period considerably restrict the migration of tree species.

The distribution of the forests over the territory of Russia also depends strongly on the moisture conditions. Already in 1905 it was suggested to consider the climate aridity (calculated as the annual precipitation divided by the evaporation capacity) as an important criterion for analysis of the distribution of forests in Russia. Later on, this idea resulted in more complex empirical indices, such as the hydrothermic index, and the radiation aridity index. The distribution of both summer and winter precipitation among different reliefs strongly influences the moisture conditions and migration of tree species. In addition, the winter precipitation makes the soils warmer and prevents the soils from deep frost and by that

[1] Federal Service of Forest Management of Russia.
[2] All-Russian Research & Information Centre for Forest Resources (ARICFR).

securing the survival of the young growth. The summer precipitation contributes to a decrease of the temperatures of the soils and the air.

The continental climate of Russia, with severe winters and hot summers, is featured by certain paradoxes. For instance, even in the central part of Yakutia the watermelons can get ripe in the summer, which would hardly be possible at the same latitude in Europe. The continental climat manifests itself most distinctly in East Siberia. East Siberia is characterized by the coldest winter and the most extensive permafrost areas in Russia. Permafrost soils constitute more than half of the Russian soils. In the EUPR, the permafrost areas are found in the Kola Peninsula, in the Nenets National District, and in the extreme north of the Republic of Komi. In West Siberia, the permafrost areas are stretched much more to the south. East of the Yenisey river, to the Pacific Coast, all regions (except for south littoral subregion) are located within permafrost.

On the whole, climatic conditions are comparatively favorable for forest growth on 59% of the Russian land (70% in the EUPR). According to our estimates, 78% of the Russian territory can be referred to as boreal forest zone and about 87% of the Russian forested areas belongs to this category.

In the beginning of the twentieth century, the forests of Russia were owned to 47% by the State, to 33% by private estates, to 10% by peasants, to 4% by the Crown, and by others to 9%. In 1913, the harvesting volume amounted to some 300 million m^3 of wood, of which 66.5 million m^3 derived from industrial harvesting. The forests were cut, without any restrictions, during the period of Civil War (1917–1920).

During 1925–1928 Russia restored the industrial harvest level to be at a similar level as in 1913. However, demand for timber increased more and more (driven by the demand for hard currency). By this, the mechanization of the forest harvesting started.

During 1926 and 1937, an extensive industrialization of the country took place. At this time the principles of sustainable forest management were officially announced as dangerous capitalistic ideology. However, a discussion started on the major theoretical fundamentals of forest inventory and planning, which later on resulted in the principles of sustainable forest utilization and even harvest levels within the boundaries of the individual enterprises. By the 1960s, this put an end to the earlier unlimited and unplanned harvests.

By 1975, the forest harvest had reached the level of 397 million m^3. This was a period of strong economic development and the forest resources were severely damaged, especially in the northern (taiga) forests. The volumes harvested was directed by the "planned needs for timber". The actual logging sites were chosen mainly based on the availability of high quality timber and by the accessibility to major transportation roads without any respect to ensuring a sustainable forest utilization.

Today, the management, with respect to the utilization, restoration, protection and conservation of the national forests of the Russian Federation, is executed by a specially authorized governmental agency, the Federal Forest Service of Russia.

According to the latest Forest State Account (FSA of 1 January 1993), the area being managed by the Federal Forest Service of Russia amounts to 1.110.500.000 ha, or 94% of the national "Forest Fund" area (1.180.900.000 ha). About 4% of the "Forest Fund" are used for

agricultural purposes, 1% is under the management of the Ministry of Natural Resources and Environmental Protection, and 1% is managed by other governmental agencies.

1.1. European Russia

Ancient inhabitants of Russia settled along rivers in the areas located to the north, northeast and east of the Dnieper and Kiev (the former capital of Rus). Ancient reports witness a large amount of forests and woods around Kiev at the time for the settlement. However, already in the eleventh century the forests at the northern edge of the current steppe zone had disappeared. The area north of Kiev was populated by the tribes of Rusiches (called Drevlianes), and further north by the tribes of Dregovichis, Severianes, Rodimichis, and others. Those people resided in the forests and were occupied with forest trades. The ancient reports speak about a dense forest cover and high forest inventories in the extreme northeast of the European Rus and in the northern Urals.

Ancient inhabitants of Russia were compelled to transform some forest areas into agricultural lands. However, only parts of the land transformed turned out to be suitable for agricultural production. Instead, to get arable land the forests along rivers were cleared.

During the period between the fourteenth to the sixteenth century, a special route for the forest harvest was followed in Central Russia in order to protect the settlements (Tula abatis). The forests played a significant role in defending the country against the forays of Turk tribes, who called the forests "the great fortresses".

Some 200–300 years ago people's demand for timber could easily be satisfied, mainly from the nearby State or privately owned forests. Nevertheless, already in the seventeenth century (during the reign of Alexei Mikhailovich) certain forests were set aside (for instance, tsar's ancestral lands in Izmailovo) in which all felling was forbidden and if felling was carried out it was severely punished.

During the seventeenth century industrial plants and factories using wood started to be established. During the eighteenth and to the end of the nineteenth century, high-quality shipbuilding timber was consumed by the navy and the merchant fleets, and huge timber resources were demanded by artillery. During the nineteenth century, the railroad network was developed in European Russia and the railroads demanded sleepers, firewood, telegraph poles, as well as construction lumber. During this period old cities grew and new ones were established and the buildings were mainly built from wood. Numerous forest products (masts, shipbuilding timber, resin, etc.) were exported to European countries on a large scale at this time.

In comparison with other regions, the forests of the Central region of European Russia were ousted by the arable land much earlier. During the seventeenth century, disturbed age class structures were observed in these forests. Young stands and final cuts were located close to waterways and cities, whereas mature forests were growing in more remote areas. A steady increase of the population between the eighteenth and nineteenth centuries made it necessary to expand the arable land, but no reserves of land were available any longer in the EUPR.

The intensive logging which took place in the private forests during the nineteenth century was an effect of the economic development efforts and an introduction of the capitalist

economic system. The logging in private forests was carried out in an unregulated way within zones which did not have any surplus of forest land. The abundance of timber harvested within the private forests resulted in a reduced demand for timber from the State forests, and it resulted in a surplus of overmature stands within the State forests. Thus, State forests were destroyed in some provinces due to overmaturity caused by private landowners strive for a maximum profit. The transfer of forests to arable land worsened the climatic conditions and contributed to soil erosion.

At the end of the seventeenth and to the beginning of the eighteenth century, European Russia had about 8% of arable land, and 50% was covered with forests. As population continued to increase, an increase in the areas of arable land, hayfields and pastures, took place and the forest area was correspondingly reduced.

For a period of 219 years (1696–1914), there was a steady decrease in the percentage of forest land in European Russia: 52.68% in 1696, 51.16% in 1725, 42.27% in 1861, and, finally, 35.16% in 1914. However, the decrease took place unevenly in different regions and the well forested regions were affected least. The most drastic reduction in the forest land took place in the Central regions and in the forest steppe zones (see *Figure 1*).

The average rate of forest clearing in European Russia amounted to between 203,000 to 233,000 ha annually in the seventeenth century, and in the first half of the nineteenth century to 164,000 ha annually. Between 1862 and 1888 (i.e., after the abolition of serfdom and to the adoption of the "Regulations on forest conservation"), about 900,000 ha of forests were cleared every year. At the end of the nineteenth and at the beginning of the twentieth century, the rate of forest clearing was somewhat reduced. Nevertheless, it was more than twice the rate that had been observed during the seventeenth century. Thus, for a period of 200 years, about 67 million ha of forests were cleared in European Russia for arable land and settlements. During the same time period, only 1.26 million ha were reforested (corresponding to 2% of the original forest area) and only 0.6 million ha of forests were planted on new sites.

In the second half of the nineteenth century, an increased interest was shown for the forests of the European North, especially by foreign concessionaires.

The national forest resources of European Russia, which for a long time served as the main source for the timber harvest, today only allow a limited expansion of the harvest. Earlier the forest resources assigned to the logging enterprises were exploited in an unsustainable way; the best and high productive stands were felled and the coniferous forests were exploited intensively. At the same time, the less productive coniferous stands, as well as the deciduous species, were exploited insufficiently. This has led to a current increase in the exploitation of swamp forests of lower quality. These forests are less accessible with increased costs for exploitation and management. Therefore, there are strong links between the current decrease in the coniferous harvest and the earlier exploitation of the forests in European Russia.

The consumption of wood and forest products is mainly concentrated to European Russia (some 75% of the total consumption). At the same time, the major part of Russian forest resources (67.4% of the growing stock) is concentrated in the Asian part of the country. As a result, during the late 1980s roundwood was supplied from Siberia to European Russia and within the boundaries of the EUPR, from the well forested regions to the more sparsely wooded ones. To meet the demand of timber at the time of the late 1980s, about 6.9 million m^3 roundwood and 4.8 million m^3 of lumber were shipped from Siberia and the Far East to

European Russia annually. During a period of two decades (1970s and 1980s), the single average transportation distance for roundwood was about 1,700 km.

1.2. Asian Russia (Siberia)

The Asian part of Russia, subdivided into West Siberia (from the Urals to the Ob river inclusive), East Siberia (from the Yenisey river to the Lena river) and the Far East (from the Lena river to the Pacific Coast, also including Sakhalin and Kamchatka). The documented history of the development of the Asian part of Russia goes back to the epoch of Peter the Great and his associates, i.e., to the end of the seventeenth century. However, the first settlers from European Russia reached Siberia and the Far East as far back as in the sixteenth century. The vast areas in and the scarcely populated Asian Russia resulted in a pressure on the forest resources first in the second half of the nineteenth 19th century. An intensive settlement and exploitation of the forests of Siberia and the Far East started at that time.

2. The Forest Resources of Russia

2.1. General information

According to forest legislation of Russia the forest resources include land, water, all communities of plants and animals associated with forests. The Russian forest resources are associated with the notion "Russian Forest Fund". The "Russian Forest Fund" includes lands on which forests are currently growing, or on which forests could grow, and they should be managed with a practicing forestry purpose, and it is divided into two land-use categories – "forest lands" and "nonforest lands".

The categories of the Russian forest account have been established in Russia during the last two centuries trying to describe the forest dynamics, the mosaic of plant life, waters, roads, land use, settlements, and so on, resulting from economic activities and natural processes.

The "nonforest lands" are important in their role for maintaining forest sustainability. This category describes the land on which forests do not grow due to natural, historical, or economic reasons. Nonforest lands comprise arable lands, hayfields, grazings, waters (lakes, streams, rivers, artificial water bodies), gardens (including vineyards, mulberry groves, small fruit plantations, etc.), roads, tracks, swamps, sands, glaciers, as well as other lands that do not belong to the above-mentioned types, but can be referred to as nonforest lands.

"Forest lands" include such categories of land on which (due to a number of natural, historical or economic reasons) forests are growing, or may appear in due course. With respect to the availability of forests, this category is subdivided into "forested" and "unforested" areas. "Unforested areas" comprise both temporarily deforested sites (unregenerated logged areas, dead stands and burnt areas) and sites being (more or less) permanently unwooded or sparsely wooded (grassy glades, wastelands, sparse forests).

"Forested areas" comprise natural and man-made (i.e., closed forest plantations) forests, as well as forest tree nurseries, seed plantations and open forest plantations.

The "Forest Fund" constitutes about 69% of Russia's territory (including inner water), and 78.5% of closed forests (forested areas) are located in the country's Asian part and 21.5% in European Russia. The closed forests account for 44.7% of the total Russian territory, and for 38% in European Russia.

In 1931, a special regulation concerning the exploitation and protection of the forests was established in Russia. According to the resolution of the USSR government in 1943 all State forests should be subdivided into three groups:

I. The first group includes State forest reserves, protected forests, green belts around industries and cities, etc. These forests are subject to special protection.
II. The second group includes forests located mainly in some of the regions of Central and Southern Russia. The harvesting volume is determined on the basis of the annual increment, and final felling can only be carried out in mature stands.
III. The third group includes industrial forests. The harvesting volume is mainly determined by the demand for timber.

According to the latest national State forest account (January 1993), the (forested) area of group I forests amounted to 122.0 million ha (17.3%), group II forests to 50.5 million ha (7.1%), and group III forests to 533.3 million ha (75.6%). Between 1988 and 1993, there has been an increase in the area of group I forests by 2.0 million ha (0.5%), and in the area of group II forests by 1.8 million ha (0.3%). At the same time, the area of group III forests decreased by 11.5 million ha (0.8%). The latter development may be regarded as a positive development supporting the environmental protection.

2.2. Forest land dynamics

The dynamics of the Russian forests managed by a forest authority during 1966 to 1993 is shown in *Tables 1* and *2*.

The forests being under the authority of State forest management bodies have decreased by 5.3 million ha between 1988 and 1993. The reasons are that forests have been transferred to other governmental departments and the establishment of 13 new nature reserves under the management of the Ministry of Natural Resources and Environmental Protection (on an area of 3.2 million ha).

The percentage of forested area (in percentage of the total land) in Russia was reduced from 45.2% to 44.7% between 1988 and 1993, or by 0.5%. According to the State forest account of January 1993, unforested areas constituted 115.5 million ha. In the European part of Russia, about 81% of unforested areas is constituted by earlier logged areas.

Coniferous are the dominant species in the Russian forests (see *Table 1*). For all of Russia, coniferous constitute some 72% of the exploitable forests. The share of coniferous of the total growing stock is somewhat more (74%), of which 61.5% are mature and overmature coniferous stands.

Up to 1988, there was a trend with an expansion of the areas covered by coniferous, but a reverse development occurred between 1988 and 1993. During this period there was a reduction. The decrease was most significant in the European part of Russia and for spruce.

More than 48% of the forested area belongs to (January 1993) mature and overmature forests (over 51%, with regard to coniferous stands). The area of mature and overmature forests decreased by 14.8% between 1966 and 1993. The average annual rate of reduction was 0.55% (during 1988 and 1993 the annual decrease was 0.68%). In European Russia, the area covered with mature and overmature forests decreased (between 1966 and 1993) by 11.8% (0.44% per year). Since 1966 there has been a tendency to increased young growth areas (for all major tree species) in all of Russia, the annual average rate of this increase has been +0.16%. But for coniferous species a negative trend has been identified for European Russia since 1983 with a decrease of the areas of young forests by 0.2% per year.

The decrease of forested area, and in the share of mature and overmature stands, as well as an increased share of young forests and middle-aged stands, is assumed to be a result of the intensive final fellings, which in some European regions have locally exceeded (in regions with predominantly mature stands) the allowable sustainable cut and by different disturbances, especially forest fire.

In order to describe the changing quality of the forest resources over a period of time, an index expressing the relation between the increase of the area of young coniferous forests (first age class) and the area of depleted mature and overmature coniferous forests can be used. If this index exceeds 1, there is an extended forest reproduction, and with an index less than 1 the forest conditions are getting worse. The dynamics of this index on a national scale is as follows: 1966–1973: 2.2, 1973–1978 : 1.3, 1979–1983: 0.17, 1983–1988: 0.03, and 1988–1993: 0.03

In other words, the increase in the area of young coniferous forests during the past ten years has been far from compensating the reduced area of mature and overmature stands. This is valid both for European Russia and the Asian part. Drastic reductions of the young coniferous forests were discovered in forested regions, such as the European North, the Urals, West Siberia, and the Far East. Within the boundaries of these territories, the most considerable decrease in the area of coniferous forests of the first age class (taking place between 1988 and 1993) are found in the Republics of Karelia, Komi, and Sakha (Yakutia), as well as in the Vologda, Perm and Kemerovo Regions. In addition, a stable trend can also be observed concerning increased areas with low value forests throughout Russia.

2.3. Dynamics of the growing stocks

The total growing stock of the major species amounts (within the forests being under the authority of State forest management and by taking long-term forest lease into account) to 73.03 billion m^3 (by January 1993). The development of the growing stock is presented in *Table 2*. During the last five-year period there was a substantial decrease in the total growing stock in Russia: between 1982 and 1987 a decrease by 0.78 billion m^3, and between 1988 and 1992 a decrease by 1.67 billion m^3. The coniferous growing stock decreased for the same time periods by 1.15, respectively 2.48 billion m^3. The total growing stock of soft deciduous had an opposite development and increased by 0.35 billion m^3 between 1982 and 1987, and by 0.78 billion m^3 between 1988 and 1992.

The decrease of the growing stock has taken place in the Asian part of Russia (Tjumen Region, Krasnoyarsk and Khabarovsk Territories, Sakhalin Region, and Republic of Sakha-

Yakutia). In European Russia there has been an increase of the total growing stock since 1966. This increase can probably be explained by the increased increment rate due to a change of the age structure of the forests in this region. Between 1988 and 1993, the total growing stock increased in European Russia by 0.53 billion m^3 (of which 0.09 billion m^3 in coniferous forests). The most productive Russian forests are located within the boundaries of the Central and Volgo-Vyatsky economic regions of European Russia. During the last five years, the growing stock of mature forests in Russia has decreased by 4.2 billion m^3.

The average increment of major tree species decreased, between 1988 and 1993 by 14 million m^3, of which 6 million m^3 of the decline took place in European Russia. The average growing stock per hectare for all species is 105.7 m^3 at the national level, and 114.3 m^3 for the forests of the main forest forming species managed by the state forest authority.

2.4. Reforestation

The most intensively utilized forests are the forests in European Russia with more than 50% of all the Russian final fellings taking place there. In 1992 and 1993, there was, on average, 1.5–2.0 ha of final felled areas per 1,000 ha of forested area for total Russia. The corresponding figures for European Russia were 4.1 and 5.2 ha, and in the Asian part 0.9–1.2 ha.

Since 1988, there has been a reduction of the final felling areas in Russia: from 2.1 million ha in 1988 to 1.1 million ha in 1993. Between 1988 and 1993, clear felling was carried out on a total area of 8.8 million ha, whereas reforestation was performed on the area of 7.2 million ha (official statistics). Planting and sowing took place on 2.65 million ha. There are in total 17.3 million ha of forests replanted within the forests being managed by the State forest agencies (according to data from January 1993).

Between 1966 and 1989, the share of reforested areas (in relation to clearcut areas) in the taiga zone was 85.2%, of which 33.2% was carried out as artificial regeneration and 52% as a support of natural regeneration. The main reforestation method applied within the zone of mixed forests (as well as in the zone of forest steppe) is planting.

During the last five years (1988-1993), the increase in unforested areas requiring reforestation turned to almost 10 million ha. Those areas mainly have to be regenerated naturally.

In order to establish high productive forests, improvement of the qualitative structure of the stands and the forest health is necessary, as well as intensified thinnings. There has been a decrease in the commercial thinning volumes in Russia during the last years (from 2.2 million ha in 1990 to 1.8 million ha in 1993). The pre-commercial thinning has also decreased from 1.1 million ha in 1990 to 0.9 million ha in 1993. Such decrease in the thinning volume may result in a further decline of the quality timber resources in Russia.

The major disturbances to the Russian forests are: forest fires, logging, pests and insects, infrastructure and urban development, and air pollution.

2.5. Forest management

The State forest management, with respect to utilization, reproduction, and protection on the territory of the Russian Federation, is executed by the President of the Russian Federation, the Government of the Russian Federation, different organizations of the Federation, as well as by specially authorized governmental forestry management agencies.

The system of specially authorized governmental forestry management agencies of the Russian Federation includes the following:

- The Federal Forest Service of Russia, which is a governmental agency for State forest management;
- The subdivisions of the Federal Forest Service within the Federation are subjects or local bodies - "*leskhozes*" (forest management units), and "*lesnichestvo*" (the basic productive parts of *leskhoz*);
- National parks, training, and experimental forests carrying out forest management works are also included in the system of governmental forestry management agencies of the Russian Federation.

The Federal Forest Service is headed by a Director (Chairman) nominated by the President of the Russian Federation.

The Federal Forest Service of Russia manages an area of 1,110,600,000 ha, which corresponds to 94% of the Russian forest funds. The Federal Forest Service of Russia carries out the management according to special management plans.

The current management system follows a historically established hierarchical system of forest management. The lower layer of the management pyramid is the Forest Management Unit (FMU), or leskhozes, which currently number 1831. At the regional level of the pyramid there are 89 regional bodies for the forest management. The top of management pyramid is the Federal Forest Service of Russia.

The management planning is operated by State enterprises in the Russian State forests according to a system approved by the Federal Forest Service. The major planning operations are determination of the structure of forests, estimation of the health status, and estimation of the quality and quantity of the forest resources.

Russia has not yet established a specific country-wide (national) forest inventory system, but has developed the Forest State Account (FSA). The FSA is based on a periodic generalization of data obtained from the forest management inventory and planning. For forest which were not managed the account is based on data from airborne evaluations of the forests and by space imagery. The peculiarity of the FSA of Russia is the predominance of visual (and not instrumental) measurements of the forest characteristics, accompanied by a systematic error, especially for the estimation of the growing stock. An objective control mechanism is not built into this system.

The forest account data are usually revised, on average, every five years , throughout the different forest management levels. So far the data of the FSAs are available for 1 January 1956, 1961, 1966, 1973, 1978, 1983, 1988 and 1993.

The Forest Fund of several regions of Russia has been inventoried insufficiently. It can be explained by limitations of the practiced inventory methods and by a generalization of the forest land account categories. This is especially true for the growing stock increment and, consequently, for the productivity of the forest land (site classes).

The basic data collected is aggregated and summarized in categories describing general species distributions at the levels of Region (Oblasts, Krays, Autonomous Republics, etc.) and for total Russia. This description consists of: coniferous, hard deciduous, soft deciduous, unclosed planted forests, and plantation forests (closed).

The Russian Forest Fund subject to ground inventory comprises only 59% of the total area of the State Forest Fund. The remaining part (472,400,000 ha) has been investigated by different methods, including aerial visual observations (during 1950–1960s) and office deciphering of aerial photographs. Forest Fund investigated by these simplified methods are usually located far from any transportation infrastructure, and are not accessible for exploitation.

In the Northern Economic Region of European Russia, about 10% of the Forest Fund has been inventoried with these simplified methods, in West Siberia about 19%, in East Siberia 45%, and in the Far East 58%.

The Russian forest policy set should protect the national ecological (environmental), economic and social values of forests, provide multi-purpose, continuous and sustainable utilization of the forests. The policies set should take into account the required economic transition of the management, of an effective combination of sectorial and regional administration, and of business initiatives and the regional State control.

The forest policy is set mainly at the federal level, but the regional aspects are of high importance. Operational decisions in the field of forestry are made, at a large extent, by the regional and local administrations. The task of the State agencies of the forest management is to determine the rules for the decision-making concerning forest management planning and inventory, and to set the legal norms and standards.

The State forest agencies are not involved in the harvesting operation. Their main function is to protect and restore the forests. The forests may be granted to other organizations, legal or physical persons (including foreigners) for short-term or long-term use or lease. The compulsory condition for the leases is fulfillment of the silvicultural requirements and the rules set for forest management.

Transfer of forest areas for leasing is following a joint decision by local (District) administration and other owners of the forest land and is formalized by a license. Leases are granted based on direct negotiations, timber auctions, or biddings. Timber auctions and biddings are organized and conducted by the district (municipal) administration and with participation of local subdivisions of the governmental forestry agencies of the Russian Federation.

The payment for the utilization of the forest land include costs for regeneration, and protection of the forests, forest taxes and a leasing fee.

Forest taxes and the leasing fee are paid to the local authorities. Part of the payments (20% of the timber value) is collected to the National Fund established for targeted investments in regeneration and protection of the forests, forest research and forestry infrastructure.

The latest "Principles of Forest Legislation of the Russian Federation," which was adopted in 1993, has created the legal foundation for the transition of forestry into sustainable development.

3. Non-Wood Resources and Their Utilization

According to the forest legislation of the Russian Federation, the following kinds of forest exploitation, besides timber harvesting, are admitted in the forests:

1. Gum or resin harvesting.
2. Harvest of so-called minor products (stumps, bast, branches, birch bark, twigs of fir, spruce and pine).
3. Collateral forest exploitation (hay harvesting, grazing, setting out beehives and apiaries, collect tree saps, harvest and collect wild fruits, mushrooms, berries, nuts, medical plants, moss, litterfall, rush, etc.).

3.1. Gum or resin tapping

The resources for tapping of gum or resin are mature and overmature stands of pine, spruce, Siberian pine, and larch assigned for final or regeneration felling forests. As a rule, immature stands are not suitable for tapping. The tapping should be performed two years before the felling of trees.

The dominating part of the tapping takes place in pine stands. Therefore the following discussion will concentrate on this kind of tapping. Gum or resin obtained from tapping coniferous trees (mainly pine) is used in many different products. Resin is used for production of: paper, lacquers, dyestuffs, soap, and in chemical, petrochemical, metallurgical, light and food products.

Before 1917, the tapping was marginal in Russia and the industrial production started only after 1920. Data on gum or resin harvest in Russia is presented in *Table 3*.

Based on existing data on the gum yield per ha and the suitable areas for tapping and resin tapping, *Table 3* is compiled in order to estimate the likely volumes of annual harvest of gum or resin. The tapping is mainly concentrated in the Northern region of European Russia, in the Urals, and in West and East Siberia.

The gum or resin production is dependent on the site class and the length of the growing season. Thus, from one hectare of pine, 125 kg of gum can be harvested during one season in Central Russia, 100 kg in the Urals, 90 kg in West Siberia, and 50 to 60 kg in the northern part of Russia and in East Siberia. The average national yield levels per hectare are presented in *Table 4*.

According to data from the latest State forest account (January 1993), a total area of 1,712,200 ha of pine stands (of which 766,500 ha are located in European Russia, and 945,700 ha in the Asian part) are suitable and allowed for tapping.

Gum or resin tapping is a way to exploit the growing pine stands by obtaining a valuable chemical wood product. The tapping is carried out as scraping (third-rate gum), and from tarred stem wood (lightwood).

Resin tapping is regarded as a reasonable way for exploiting low-grade pine stands. Resin tapping has existed almost for 200 years under the name of "Velsk tapping" (after the name of the location where the tapping was originally started – the Velsk District of Arkhangelsk Region).

The scrape yield can be estimated based on the number of suitable trees for tapping per ha (normally 300) and the average scrape yield per tree (250g during each of the first three years, and 125 g during the last year of the tapping). The lightwood yield averages 30 m^3 per ha.

Tapping is carried out mainly by the enterprises of Roslesprom (the ex-Ministry of the Forest Industry of the Russian Federation) and Federal Forest Service of Russia. The latter is in charge of some 10% of the total forest area being suitable for tapping. According to the forest regulation, the tapping is compulsory of the low-grade stands before harvesting but due to the economic conditions today, harvest is permitted without tapping.

3.2. Tree saps

Among all possible tree saps the most popular in Russia is the sap of birch. Maple sap is also very important. In some regions, there are traditions of collecting and handling other kinds of sap (e.g., cherry sap) for domestic use, but the volume is minor in comparison to the birch sap. The main source of the birch sap is mature birch stands of high quality. The trees tapped have to be more than 20 cm in diameter. Such forests can yield 20–30 tons sap/ha during one season. The tapping is carried out during 5–10 years before the harvest. The distribution of high quality mature stands of birch (Betula pubescens and B. pendula) is shown in *Table 5*.

Less than one third of birch stands suitable for sap tapping is used in reality. The major birch sap supply in the country stems from the Central economic region of European Russia with more than 40% of the total production. West Siberia has 18% of the total production and Volzhski 16%. The average annual harvested volume during 1970–1978 was 4300 tons, and during 1978–1983 it increased to 11,000 tons per year (of which 8600 tons where collected in European Russia). Today, due to lack of markets, the birch sap harvest has almost vanished.

3.3. Medical raw material

Over 2,000 species of higher plants with medical properties are growing in the forests of Russia. Some 600 of them could currently be used by the pharmaceutical industry. Lately, the medical industry has started to pay more attention to plants. Among the about 200 species used by the medical industry in 1987, more than 150 are purely forest species. Up to 70% of the medical raw material purchased in Russia stems from forest plants. The resources of medical plants are far from being explored, there are only complete data for a number of species in a number of regions. In this paper, attention is paid to the most common and most widespread plants for medical use.

Nearly all parts of pine are curative. Flour and decoction made from needles contain a lot of vitamins, especially vitamin C. Pine forests exhale phytoncides, which are (especially growing on sandy soils) regarded to cure pulmonary diseases.

Oil extracted from the needles of fir species is used for the manufacturing of medical camphor. The resin of the oil is regarded as a cure to heal bad burns. Bark decoction of oak is used as an astringent when treating intestinal diseases, as well as for the treatment of burns.

The bast of Phellodendron amurense is used for the production of preparations for the treatment of dysentery, other intestinal and gastric diseases (including ulcer), and tuberculosis. The fruits of this species are used as a vermifuge. But due to the restricted availability of this endemic species no trade takes place of the species; it is only collected by local dwellers.

People purchase to a large extent, for medical purposes, different parts of plants, such as raspberry, red and black currants, dog rose, rowan, bilberry, lime, sea buckthorn, Schisandra chinensis, plantain, etc. The above-mentioned species are also cultivated in private gardens.

Purchasing and processing of medical raw material is very profitable for forestry. In 1986, there were nearly 80 specialized forest reserves in areas providing voluminous trade of medical raw materials. These reserves are not sufficient for the Russian demand. In many regions, as a result of an unplanned and non-regulated exploitation, a sharp decline has taken place in the biological trade of sea buckthorn, dog rose, Schisandra chinensis, ginseng, snowdon rose, sand immortelle, etc.

The medical raw material (as many other non-wood products) is purchased by various organizations. The most important organizations are former "Centrosoyuz" (Central Direction of Purchasing Co-operatives), the Pharmaceutical Directorate, and enterprises of the Federal Forest Service of Russia.

Last year's annual purchase of several forest goods by enterprises of the former Ministry of Forestry were as follows: "chaga" – 25–27 tons; birch buds – 10–12 tons; oak bark – 7–9 tons; hawthorn – 7.5 tons; buckthorn – 4.5 tons; dog rose – 2,000 tons; Leuzea carthamoides – 2 tons; Eleutherococcus – 23 tons; Kalopanax – 3 tons; Saint-John's-wort (dried) – 2 tons; immortelle – 2.5 tons; bearberry 3 tons; and sea buckthorn – 400–450 tons.

Statistics from the Federal Forest Service of Russia reports the total volume of purchases of medical raw material (*Table 6*).

3.4. Honey production

The harvest of honey differs in the same way as other forest food production in Russia. To collect the honey, apiaries are established in the forests, and they are managed by beemasters who look after the beehives and deal with a timely harvest of the honey. Russian forests are rich in honey supplying plant species.

According to the State Forest Account of 1 January 1993, the area of forest stands where lime dominates exceeds 3 million ha, and 73% of this area (2.2 million ha) is located in the European-Ural part of the country, mainly in the Ural (48.7%) and Volga-Vyatka (6.7%) economic regions. During one season one hectare of a Lime stand can yield up to 50 kg of

honey. Other "honey trees" are locust (has 60% of the honey-bearing capacity of lime) and willows (30%). Many forest enterprises are familiar with bee-keeping; apiaries of forest management units (leskhozes) are only a little bit smaller than those in collective farms. The honey from Bashkortostan, North Caucasus and Primorye are in most demand both on the domestic and the foreign markets. The honey yield (as well as the harvest of other non-wood forest products) depends directly upon weather conditions in general, and during the period of the blossom of "honey-bearing" plants, in particular.

The honey procurement is done by many organizations, but the major one was the former Central Union of Co-operatives ("Centrosoyuz") having 90% of the honey supply. The share of the supply of the former Ministry of Forestry was only about 3%. The honey is supplied not only from forest lands, but also from collective farm fields. In this report we are only able to deal with the production supplied by forest enterprises. During 1970–1977, the average annual volume of honey supplied by the Federal Forest Service of Russia was 762.6 tons in Russia as a whole. The last years supply by enterprises of the Federal Forest Service of Russia (former Ministry of Forestry) is shown in *Table 7*. The decline in the production may be explained by weather conditions and by negative development of the national economy.

3.5. Fruit and berries

Plant-derived food, together with forest animals, are integrated parts of the forest ecosystems. They form a favorable environment for the growth and development of the forests. At the same time, they have an essential additional function to help to meet the food needs of the local people. Wild fruits, berries, nuts and mushrooms are the most important ones. Nearly 200 species of fruit trees, shrubs, and dwarf shrubs having edible fruits grow in the Russian forests. Their areas and yields are enormous. The "Instruction for forest inventory and planning ... ," now in force (part I, Moscow, 1986), requires a compulsory account of food products and medical plant raw material at the inventory of the forest resources. Major wild fruit trees and shrubs – playing an essential role in the forest stand and being of high economic value – have to be specially recorded at the forest monitoring and planning as forest forming species. These species are objects of a special plan of care and use within the forest management unit.

An aggregated survey of wild fruit and berry resources of the Russian forests was compiled by the ARICFR experts in 1995, based on information from the State Forest Account of 1993, reports of inventory and planning enterprises, public publications, and data obtained by regional forest experimental stations (*Table 8*).

Birds and mammals usually consume 20% to 70% of the biological crop (depending on the year's yield and the animal population density in a given region). In these calculations we assumed that 50% of the biological crop was consumed by animals in all the western economic regions, and 70% in the eastern economic regions. The remaining part of the biological stock was assumed to be available resources. The accessibility of the available stocks was estimated by experts in each region and this estimate is classified as the commercial resources. The losses at the collection are some 40%. Thus, only 40–60% of the available resources, or 10–30% of the biological crop can be used by the local people for consumption or trade.

The annual biological crop of major berry species is estimated to be: cowberry – 3,250,000 tons; bilberry – 1,800,000 tons; blueberry – 640,000 tons; and cranberry – 1,100,000 tons.

Different varieties of apple trees are spread almost all over the forests of the European-Ural part of the country. Apple trees occupy 2,600 ha as the dominating species. As understory the area of apple trees is much larger.

Pear trees are located in the forests of the central regions of the European-Ural part. As a dominating species in the stands it occupies 16,300 ha of stocked forest lands. Rowan is spread everywhere, mainly as undergrowth.

Apricot is spread in the forests of the southern regions of the European-Ural part, while one species exists in the Primorye Territory in the Far East. As a dominating species in the stands it occupies 1,200 ha of forested areas.

Plum trees are spread in the forests of the southern regions of the European-Ural part of Russia. As the dominating species, it occupies only 500 ha, but in the understory it is much more widespread.

The cherry trees are also spread in the forests of the southern regions of the European-Ural part of Russia, in the Southern Urals and in the southern part of the West Siberia.

Other fruits are collected from shrubs and dwarf shrubs growing in the forests. In some cases these species form stands in Russia: hawthorn, 1,400 ha; sea buckthorn, 5,700 ha; currant, 2,400 ha; and dog rose, 100 ha. Except for the sea buckthorn these species are spread over huge areas of the Russian forests.

All of the above mentioned pip and stone fruits are used fresh, dried and as jams and beverages. Due to their healthful properties and possibilities for long-term storage, cowberry and cranberry are in great demand by the Russian people.

Bilberry, raspberry, Schisandra chinensis, and sea buckthorn are not only tasteful, they are also curative and purchased for pharmaceutical uses.

3.6. Nuts

Forest tree and brush species producing nuts are a valuable resource in Russia. Pine nuts are produced by Pinus sibirica, P. koraiensis, P. pumila. Forests of P.sibirica and P. koraiensis are spread over 39.8 million ha, and with stands in fruiting age on 27.2 million ha. In addition to these areas, special commercial nut zones are set aside of the forest lands with a total area of 10.9 million ha on which various pine stands occupy 6.8 million ha.

The total area of P. pumila in the mountainous regions of East Siberia and the Far East (including Kamchatka, Sakhalin and the Kuril Islands) is 37.6 million ha, and with stands in fruiting age is 35.9 million ha.

The fruiting age of Siberian pine starts at an age of 80 or 90 years, but the major fruitage starts first after 100 years and starts to decrease at an age of 170–250 years. A high nut crop occurs every fourth or fifth year. The average yield of one hectare depends on age and stand density

in general, and pine density of the stand. Pure pine stands yield as a maximum 110 kg/ha and this yield is obtained in stands with a stand density of 0.5–0.8.

The fruiting age of Dwarf siberian pine starts at the age of 30 years, and the massive fruit production starts at the age of 90 years. The fruiting occurs every third or fourth year. One hectare (depending on the stand density) yields – as an average 10 kg – but in some years the production could reach 100 kg.

The pine nut is food of very high value. Its core contains – as an average – 60% of vegetable fats, up to 16% of proteins and up to 12% of carbohydrates. Its oil content exceeds almost all oil plants, including sunflower. Besides oil, pine nuts could be made into "pine cream" which has more calories than meat and eggs and is recommended as food for children. The shell of the pine nut can be used at the manufacturing of acetone, acetic acid, and furfurole. The commercial collection of tree nuts is presented in *Table 9*.

The value of pine nuts collected during a rotation period exceeds the value of timber harvested from a nut collecting area.

The hazel bush is common on large areas in the forests of Russia, mainly as undergrowth. According to the State Forest Account of 1 January 1993, the area of closed fruiting hazel stands is 10,200 ha, and the area of hazel as undergrowth is nearly 1.8 million ha.

The core of the hazelnut can contain up to 22% of proteins, 77% of fats, 13% of sugar and many vitamins. It is also rich in cobalt that stimulate producing blood corpuscles and hemoglobin. Currently the hazel resources are not managed and by that to some extent depleted. Therefore it yields only 20–30 kg/ha in stands as forest undergrowth.

Natural stands of the European walnut (Juglans regia) are most common in the North Caucasian region. The European walnut is a valuable food stuff, its core contains up to 65% of fats, up to 17% of proteins, up to 16% of carbohydrates and many vitamins. Oil produced from the walnut is of the same quality as olive oil. Walnut oil cake is a very nutritive food.

According to the latest State Forest Account, the area of closed European walnut stands is 9,600 ha, and of those 4,900 ha are in the fruiting age. The average yield varies from 120 to 300 kg/ha. Assuming an average yield of 200 kg/ha, the average total biological production is estimated to 720 tons per year, of which 320 tons are commercial.

Manchurian walnut (Juglans mandschurica) occurs only in the Primorye and Khabarovsk Territories in the Far East. Its area is estimated to be 6,600 ha. It grows mainly in mixed stands. Therefore the pure area of Manchurian walnut is estimated to be 3,300 ha. It fruits every year, but major crops occur only every second or third year and the average annual crop is estimated to be 500 kg/ha. Thus, the total biological crop averages 1,650 tons per year, and the commercial crop is 800 tons per year. The Manchurian walnut is mainly collected by the local people.

The European chestnut occurs predominantly in the forests of the southern regions of Russia. Its fruits are used fresh, fried, roasted, and boiled.

Pure stands of chestnut are rare, usually the chestnut grows in mixed stands of oak, beech, hornbeam and other species. Chestnut stands yield regularly with a beginning at the age of 10–15 years. The total area of chestnuts in Russia is 48,900 ha, and with a productive area of

34,300 ha. The average yield is 200–250 kg/ha, and the total biological crop may be 4,300 tons per year. Only 25–30% of this crop is utilized.

3.7. Edible mushrooms

Mushrooms [Pileus (cap)] occur throughout all Russia, from the Polar Ocean islands to the steppe zone, and in all forest types, but they are most abundant in the boreal forests. Of all the mushroom species only 5–7% are known to be edible. In Russia it is said that 1 ton of dried mushrooms correspond to 91 tons of wheat.

The yield of the major species of edible mushrooms is different in different types of forest lands but the total average yield is estimated to be nearly 70 kg per year (fresh weight). The extent of damage by insects can be some 30% depending on the weather conditions and the specific mushroom crop. The total net biological mushroom crop of the country in 1993 is estimated to be 3,187,000 tons per year, of which 658,000 tons are produced in the European-Ural part and 2,529,000 tons in the Asian part. The possible commercial resources of mushrooms are about 505,000 tons in Russia (*Table 10*). The average annual harvest of mushrooms by commercial organizations was 18,500 tons during the period 1970–77, which declined to 7,200 tons during the period 1985–1992.

3.8. Grazing and hay harvesting on forest fund areas

Hayfields and pastures on forest fund areas provide the needs for both forestry and agriculture. More than 30% of hayfields is used for agricultural purposes annually, and more than 50% of pastures is used for domesticated reindeers.

At present, the share of hayfields in the Forest Fund amounts to about 2 million ha, of which 1.04 million ha (52.4%) are located in the European part of Russia. There are both regular and provisional hayfields. According to the latest data (1989), the share of regular hayfields amounted to 81.5%, of which only 24.6% was used by forestry.

Yielding ability of hayfields in Russia varies within a very broad range, both between different regions and depending on weather conditions within each of them. The yield averages 750 kg/ha.

One distinguishes between hayfields of high, medium and low quality. The first group constitutes only about 15%. The prevalence of medium and low quality hayfields featured by comparatively low yielding ability (not more than 300–500 kg/ha). The areas of forest hayfields is getting more and more reduced. Since 1956 the area of hayfields has been reduced from 8 to 2.3 million ha (i.e., by 71.4%), and the major reduction has taken place in the Asian part of Russia (where the hayfield area was reduced by more than 75%).

According to data of the latest Forest State Account, forest pastures occupy 17.5 million ha, of which 10.3 million ha (59%) are under long-term lease.

The area of pastures increased, between 1956 and 1993, by 15 million ha, mainly in the form of reindeer pastures. Only 2.3% of the pastures are located in European Russia, the rest are in

the Asian part, mainly in the Kamchatka Region (52.3%), Yakutia (28.9%), Krasnoyarsk Territory (4.4%), Tyumen Region (4.3%), and Tuva (3.1%). Thus, those five regions have 93% of the national pastures. Grazing is carried out both on special meadows and in some open forests and grassy glades.

According to data of 1989, special pastures and meadows amounted to 69% of the total area used as pastures, of which 81% are under long-term lease (mainly for reindeer grazing), and forestry is only using some 1% of the pastures. About 75% of the hayfields are under long-term lease, mainly for agricultural purposes. The rest of hayfield area is used by forestry management units (FMU) for hay production. The dynamics of FMU hay procurement over time is shown in *Figure 2*.

About 75% of the total volume of harvested hay falls to the share of FMUs of the European-Ural part of Russia which accounts for higher population density and better accessibility to the forest areas.

3.9. Hunting and recreation

Russian boreal forests are main habitats of many valuable game animal species. The boreal forest of Russia is also home to many professional hunters and trappers. The forest legislation of Russia determines the forest utilization with respect to hunting and game management. "Forest utilization and forestry activities shall be carried out under conditions of conserving favorable environment for wild animals." Moreover, timber harvests are forbidden, without special permits by the State body for natural environment protection, in forests serving as habitats for valuable animals.

Special game management units are established and, as a rule, these management units are not the major user of the land. The game management is carried out in close cooperation with the major land users, the game habitats are divided into three major groups concerning allocation:

(a) State agencies, cooperatives, public associations;
(b) Natural reserves (*zapovednik*), partial natural reserves (*zakaznik*), national parks, and green belts in which hunting is completely forbidden;
(c) Lands for common use, where hunting is permitted for all citizens.

More than 16% of the existing game habitats are not allocated to any user. It means that for these areas there is no game management. In the Asian part these lands constitute nearly 20%.

An estimate of the population of game animals of different species in 1993 inhabiting the Russian forests is shown in *Table 11*.

Sudden yearly fluctuations of stocks are typical for several game species (such as squirrel, all kinds of hares, and muskrats). Among carnivores the greatest fluctuations are reported for Arctic fox. This fox population depends directly upon the state of the food supply. Due to overpopulation, mass diseases happen in the hare population, also leading to sharp decrease of the fox stocks.

If we compare the population estimates for 1993 of some game species with data for the period 1971–1978, it can be concluded that the stocks of marten, hare, roe deer and wild boar have increased. On the contrary, the muskrat population has been reduced to half.

The game management units belong to many different agencies and organizations, and they harvest game meat and furs. *Table 12* illustrates the harvest by these organizations in 1993.

4. Environmental Concerns

Degradation of forest ecosystems is accompanied by soil erosion. Soil erosion destroys the upper most fertile layers of the soil and the underlying rocks by snow melting, rain waters and wind.

Protection of the soil from erosion is realized with help of agroforestry reclamation which is the whole complex of forestry measures leading to the improvement of the site, like afforestation of gullies, steep slopes and sands. For the purpose of soil protection a special category of protected forests is established (erosion-control forests). To this group belongs forests growing on grounds with mountainous and broken land forms, gullies, as well as forest belts, band piny woods, forests on eolian sands, and also agricultural lands including neighboring forests.

Water protection is important in areas with permanent forest harvest and in areas with deforestation of watersheds. As a result of the destruction of the tree cover, the water flow is disturbed, erosion is intensified and the quality of water declines. Increase of the water flows leads to the washing out and accumulation of minerals and organic additions, which in turn leads to decreasing quality of drinking water, and habitats for flora and fauna.

Special protective forests are being set aside for water protection in order to regulate the water flow, preserve the water quality, protect the banks of rivers, lakes and reservoirs from erosion and destruction, and protect spawning areas in rivers and basins.

The reduction of forest areas in the forest-steppe zone of the European part of Russia and agricultural cultivation of river floodplains decreased the water table, which in turn caused serious problems for the restoration of forest vegetation on areas covered with forests not long ago.

Boreal forests of Russia are subject to considerable changes concerning concentrated clear cuttings. The influence of such concentrated cuttings has become evident during the second half of this century in the Russian European North, and in recent years in the Asian boreal forests. According to expert estimates, the area of Russian boreal forests decreases currently by 0.04 million km^2 per annum, of which 0.02 million km^2 is a result of planned industrial harvesting carried out mainly (over 90%) as clear cutting with heavy equipment. The soil erosion which takes place after such cuttings reduces the natural regeneration and the productivity of the land.

Not less than 20,000 km^2 of the boreal forest zone is damaged annually as a result of forest fires. Earlier forest fires were a natural component in the dynamics of the boreal forests, but now they have turned into a factor of anthropogenic degradation. The fire-danger increases in the forest utilization regions. A considerable part of the boreal forest zone in the Asian part of

Russia is not embraced by any aircraft forest fire protection, and many forest fires are not even taken into account or fought by the forest fire service. The fires severely damage the reindeer pastures. During the last 20 years about 15 million ha of this pasture have been devastated by fires in European Russia. The area of reindeer pastures has been reduced by 700,000 ha in the Taimyr Peninsula as a result of fires and in Evenkia by 3 million ha.

The pre-tundra larch forests are highly predisposed to natural fire danger. This can be explained by the large amounts of combustible matters on the ground. Only in the North of West Siberia (in the regions of oil- and gas exploitation) about 1.3 million ha of forest lands and 0.9 million ha of reindeer pastures were affected by fires between 1988 and 1990.

According to expert estimates, not less than 0.01 million km^2 of boreal forests are damaged every year by anthropogenic and technogenic factors. The main feature of this degradation in the boreal zone of Russia consists in an arising number of damaged nidi. Their dimensions vary rather substantially, from some hectares to thousands and millions of hectares.

Over 75% of the Russian forests grows on soils formed on permafrost rocks or in zones of insular or lensing permafrost. Timber harvesting and gas and oil exploitation in these forests cause dramatic changes of the plant and animal habitats. In excessively wet regions (essential part of northern and middle plain taiga), exploited areas with destroyed vegetation cover are intensively swamped. Consequently, there are major changes in radiation, heat and water balances on vast territories. Changes also occur in the albedo of the surface, in dynamics and intensity of surface and belowground runoff, and in evaporating capacity. The temperature of soils rises in summer time (and as a result often also the mean annual temperature). The exploitation increases the thickness of the layer of seasonal permafrost, and the melting of the built-up belowground ice leads to thermocarsts.

When the protection of slopes by tree roots is lost, intensive processes of thermoerosion begin (solifluction, linear erosion, etc.) with landslides as a result. All of these processes change the landscapes irreversibly, and soil and plant cover may be completely lost. The consequences of such alterations may be detrimental not only for the local climate, but also change the habitat conditions of forest-forming species and, as a result, irreversible disturbances of the processes of natural forest regeneration.

5. Near Term Development of the Forest Resources of Russia

5.1. Wood resources

The main forest forming species occupy more than 90% of the forested area. At present, they comprise (without the forests transferred to long-term lease) more than 79% (476.8 million ha) of coniferous stands, 2.6% (15.4 million ha) of hard deciduous and 18.3% (110.6 million ha) of soft deciduous stands.

Estimates show that it is most likely that the stocked forest area of the main forest forming species will increase by 5.1 million ha during the period 1993 and 2000 (mainly due to ingrowth by young stands). The increase will be distributed on 3.7 million ha of coniferous and 1.8 million ha of soft deciduous species. This trend is believed to take place both in

European Russia and in Asian Russia. The share of coniferous within the forested area of main forest forming species over the whole country is expected to become rather stable.

With respect to hard deciduous species, the most probable development would be a slight decrease in the share of the forested area in the Asian part of Russia. In European Russia, a slight increase is expected. There will be a tendency toward an increase of soft deciduous stands, especially within well forested regions (such as the Northern region and the Urals).

The age structure of the Russian forests (with respect to the main forest forming species) is featured by the prevalence of mature and overmature stands (47%). By the year 2000, the age structure of all species groups is expected to be featured of a forested area covered by 45.3% of mature and overmature stands.

Since 1966, the share of forest area covered with young stands has had a steady growth all over the country. This positive trend is expected to continue for the period 1995 to 2005. In individual regions, such as the Karelian Republic, North-West, Central (including Kostroma and Yaroslavl regions), and Kirov regions, a decrease is expected in the area of coniferous young stands of the first age class.

The highest increase in coniferous young growth stands of the first age class is supposed to take place in the well-forested economic regions (the Far East, the Urals and Volga-Vyatka Area).

The average annual increment for the main forest forming species in Russia is estimated to be 1.29 m^3/ha/year (based on data from January 1993). The average increment figure for coniferous species is 1.07 m^3. For the European part the average annual increment for the main forest forming species is 2.04 m^3/ha/year and 1.60 m^3 for coniferous species.

The forested area constituted by site class V or worse, for the main forest forming species, amount to 46.3% of the total stocked area, and only 10.3% fall to the share of forests of I or II site classes (the best site classes). In European Russia, the average site class is 3.5 for all species, and 3.9 for coniferous species. In this part of Russia, the share of forests of lower site class (V–Vb) is high, e.g., in the North economic region (59.8% of the total forested area and 67.2% of the area covered by coniferous).

In many regions of Russia, the average increment could be considerably higher. For instance, in the forests of the Moscow region the increment is 3.7 m^3/ha/year, whereas the natural conditions (climate, soils, hydrology) of that area are rather favorable for the forest growth of valuable species. With a different forest management the average increment could be 7–8 m^3/ha/year.

5.2. Non-wood resources

Non-wood products, collateral forest exploitation, and hunting are of vital importance for the everyday life of local inhabitants who are strongly dependent on forests. Some industrial and fodder raw material, as well as initial material for decorative and applied arts, are traditionally considered non-wood forest products. With respect to fodder raw materials, the most widespread use is vitaminous flour produced from the twigs of coniferous species and utilized as cattle food.

During the past few years there has been an increased demand for handmade goods of decorative and applied arts (baskets made of withes or birch bark, wooden spoons, figurines of animals carved out of wood, etc.). Many handmade goods are exported to other countries.

Non-wood forest products are harvested by people both for their own needs and for official bodies in charge of procurements.

The resources of non-wood forest products are sufficient for satisfying the needs of both the local population and industries. Possible shortage of the non-wood products for industrial purposes is only caused by the lack of labor force needed for the harvesting of the basic products.

Non-wood forest products are traded both in raw and processed state. Nuts, cranberries and cowberries and other species are supplied in a raw condition.

Mushrooms are processed right away (pickling, salting, drying up). Wild fruits (apples, pears, etc.) are used for the production of juices, jams, beverages, and wine. Birch sap is traded as a preserved product.

Historical analysis of the harvests of non-wood forest products show that the harvest is driven by the socio-economic conditions in the country and not by availability. The existing potential of non-wood products is utilized to a limited extent in Russia. A comparison between the average harvest level during many years and the average yield of forest food products suitable for industrial processing, shows that not more than 30–40% of the yield is utilized.

In a number of regions in Russia and especially in Siberia, the value of forest food products exceeds the value of the harvested timber. This value will be even higher if the products from hunting and fishing also are taken into account.

In many regions of Russia, it is not possible to use the non-wood products due to a lack of developed infrastructure and a low density of population.

The available information on the yield of non-wood products in Russia is rather scarce. Therefore, there is a need to establish an efficient inventory system, which measures all kinds of production and functions of the forests.

6. Indigenous People in the Russian Boreal Forests

The population living in the boreal zone consists mainly of Russians, Karelians, Komis, Yakuts and other people of southern Siberia. In addition, these lands are also inhabited by people, small in number, that are traditionally called "people of the North." Twenty-six different groups are referred to this category (from the west to the east): Lapplanders, Nenets, Khanties, Mansis, Ents, Nganasans, Selkups, Kets, Evenks, Dolgans, Yukaghirs, Chuvants, Evens,Chukchi, Koryaks, Eskimos, Aleutians,Itelmens, Tofalars, Ulchi, Nanaians, Nivkhis, Udegeis, Nighedals, Orokis (Ultas), and Orochi.

Seven autonomous districts with a total area of 4 million km^2 (Nenetski, Yamalo-Nenetski, Khanty-Mansiiski, Evenkiiski, Taimyrski, Chukotski and Koryakski Autonomous Districts) are populated by more than 95,000 people that can be referred to as "people of the North"

(51.6%), These districts are inhabited by Nenets, Ents, Khanties, Mansis, Selkups, Evenks, Dolgans, Nganasans, Chukchi, Koryaks, Evens, Itelmens and Eskimos. Nearly 13.5% of the "people of the North" (Evenks, Evens, Yukaghirs) are residents of the Republic of Sakha (Yakutia). The rest of these groups (35%; Lapps, Kets, Nighedals, Nanaians, Ulchi, Udegeis, Nivkhis, Orokis (Ultas), Orochi, Aleutians, Tofalars) do not possess any autonomous territories, and they are scattered among different regions and territories of Russia.

The extreme North and similar areas (11 million km^2, or two-thirds of the Russian territory) provide a home for 10 million people (6.6% of Russia's population). According to data of January 1989, "people of the North" numbered only 184,478 persons (*Table 13*).

Official data concerning the dynamics of "people of the North" are available only with respect to the census of population in 1989. The increase of the indigenous people between 1959 and 1989 is estimated to be 40%. This growth rate is much higher in comparison with the national average for Russia. The birth rate is 2–2.5 times higher among the indigenous people in comparison with the national average.

The infantile mortality rate in the northern regions is very high. While it averages to 17.8 per 1,000 persons all over the country, it is equal to 19.5 in the north on the whole, and 30 per 1,000 persons among the "people of the North." There are no data concerning the average life duration of the indigenous people. However, according to data derived from statistical ethnographical studies, there are very few people who are more than 60 years of age among the "people of the North." The share of people who died before the age of 60 is 70%, whereas it is 30% at the national level.

As pointed out earlier, there has been an increase of the "people of the North" during the period 1959–1989, due mainly to a high birth rate. But, in actual numbers the increase is very small. A particularly difficult situation is observed for the Lapps, Itelmens, Orokis, and Ents with hardly any growth. Moreover, one can conclude, when comparing data on the increase of "people of the North" and aboriginals who reside in the USA and Canada, that the increase in Russia is much smaller during the last 30 years.

At present, the situation is very critical for the indigenous people due to the current development of traditional economic activities of the "people of the North" (reindeer breeding, hunting, collecting, fishing, etc.). These activities are disappearing, step by step, from the economic life in Russia. Such development is caused by different factors: increased ecological degeneration, loss of reindeer pastures, loss of land of economic significance due to ongoing industrial exploitation of the North, increased costs for technical equipment and transportation, and ousting of the "people of the North" from hunting and trade with hunting products by amateur and professional hunters. As a result, very few people are now engaged in the traditional economic activities of aboriginal people. Unfortunately, there exist no exact data on this matter. About half (47%) of the people referred to "people of the North" are employed in agriculture.

Over the last five years, some measures have been taken to stimulate the development of the traditional economic activities of the "people of the North": purchase prices have become higher with respect to fur-skins, fish, etc.; they have been allowed to sell products (like fur and fish) at free market prices, the allocation of land for industrial enterprises has been restricted, and some areas of economic significance have been given back to the local people. However, these measures have not been executed everywhere.

The development of documents and a special legislation for protection of the rights of the "people of the North" ("Status of areas of economic significance for small peoples of the North," and "Areas for traditional exploitation of natural resources by small peoples of the North," etc.) have played a positive role in the revival of traditional methods and ways of forest exploitation. This work was initiated in 1990 and continued 1991 through 1992.

A number of enactments of the Russian government and decrees of the president of the Russian Federation (in particular, "Urgent measures to protect the areas of residence and economic activities of the small people of the North") were also of significant importance in the mentioned direction.

According to Article 78 of the "Principles of Forest Legislation of the Russian Federation," ownership, disposal and use of the forest lands in the Russian Federation takes place in the interests of the people inhabiting the territories and in the interests of all people of the Russian Federation.

Practically, this clause is implemented by giving substantial rights to the local people (and their local authorities) in the sphere of management and exploitation of the forest resources. Thus, local administrations have the fundamental rights as a forest owner, and the right to receive and dispose forest incomes. Furthermore, in the sphere of forest regulation the rights of the local (District) authorities include:

- to participate in the establishment of regional programs for forest development;
- to establish the forest tax rates and leasing fees;
- to make decisions, jointly with the owners of forest lands, on transfer of forest land for long-term lease;
- to control the utilization, regeneration, and protection of the forests; and
- to limit, and terminate given rights for utilization of forest lands.

The traditional economic structures of the local inhabitants have remained, just as in former times, as part of the ecological systems of Russia. That is why it is still important to take into account the experiences of nature utilization accumulated by many generations of native people and based upon a good knowledge of the local conditions. The attempts to create a social reorganization and to intensify the commodity production in the economy have come into conflict with the traditional experiences of nature utilization. In many places, the cultural and ecological systems have lost balance and resulted in economic recession.

At present, all members of the Nanais in workable age and employed in traditional economic activities, have already gone through boarding schools in which they lived out of touch with their parents and traditional forms of work and everyday life. Therefore, the native hunters and fishers of today are less skillful in comparison with the representatives of older generations.

The present state of the Nanais gives rise to serious concern. It is obvious that uncontrollable influence of industrial and urbanized forms of life upon the local inhabitants, as well as the influence of numerous new settlers in the region result in loss of traditional culture and knowledge.

In order to ensure legitimate rights and interests of the indigenous people, to preserve and develop the traditional forms of their economic life under the conditions of market reforms,

and as well as to establish new mechanisms aimed at conservation and improvement of the environment in the regions inhabited by native nations, the President of the Russian Federation issued (on 22 April 1992) the Decree No. 397 "Urgent measures directed to protection of areas and economic activities populated by small nations of the North." A corresponding resolution was issued (23 February 1993) by the Soviet of Nationalities of the Supreme Soviet of the Russian Federation No. 4537-1 "Conservation of natural environment in the regions inhabited by the Udegeis, Nanais and Oroches in the Primorski Territory."

7. Forest Industry

7.1. General

The notion of "Timber industry complex," or "Timber and chemical industry complex" includes the timber industry, pulp and paper, and woodworking industry. "Timber industry" includes activities connected with timber harversting, the logging. The organizations dealing with forest management (forestry) are not considered as part of the timber industry complex.

The "Timber industry complex" was earlier among the most important sectors of the Russian national economy, determining the development of socio-economic development of regions and raising hard currency reserves for the State based on wood product exports. However, during the seventies and eighties the importance of this sector in the national economicy decreased. The decline has taken the form of:

(a) decreased contribution to the gross national product;
(b) less investments in the sector; and
(c) less employment.

At the end of the 1980s the major State timber purchasers (USSR Ministry of Timber Industry, USSR State Committee of Forest and USSR Ministry of the Interior) bought 293.8 million m^3 (81.6%) of all the purchased timber. So-called independent purchasers harvested 66.2 million m^3.

With the disintegration of the USSR, the role of the former USSR Ministry of Timber Industry as a coordinator of the timber purchases disappeared. In December 1992, the Union of Timber Merchants of Russia was established, a body uniting over 800 companies, firms and enterprises of timber industry, and lobbying groups of the sector in different federal legislative and executive bodies. In January 1993, the Russian State timber industrial company "Roslesprom" was established intended to coordinate the timber industry complex at the federal level.

In 1993, "Roslesprom" had 59% of the total timber harvesting (174.0 million m^3 of monitored final felling), the share of the Association "Rossiyski les" was 9%, Ministry of Agriculture and Food 10%, Ministry of the Interior 10%, Russian agency of fuel industries 4%, and Ministry of Defence 1%. The bulk of the industrial (merchantable) wood, boards, pulp and paper is manufactured by enterprises of the "Roslesprom" Company.

7.2. Timber industry – the harvesting

From the 1960s to 1975, the timber harvest increased every year. During this period the average harvested volume increased by 1.6 million m^3/year. During the period 1970–1975, the increase was 3.6%, or 2.6 million m^3/year.

In 1976 a destablilization of the timber industry complex began with a sharp decrease of the timber harvest as a result. The decrease lasted until 1982 and was in the size of 14% (7.7 million m^3/year) in comparison with the 1975 harvest level. Some increase in the harvest level, mainly from Siberia and the Far East, was observed during 1980–1988 (average 3.2 million m^3/year), but the harvest level of 1975 was never reached.

One reason for the decrease was that the obsolete harvesting equipment was not replaced. Other reasons were limitations in the forest utilization in the European-Ural part of Russia, transfer of harvesting equipment to Asian Russia, reduction of capital investments, and endless reorganizations of the harvesting organizations.

An intensive utilization of the forests in the European-Ural part during the post-war period, contributed to a rapid recovery of the national economy but was accompanied by overcuts of the AAC (Annual Allowable Cut). First of all, coniferous stands suffered during this period due to the non-appropriate technology for wood harvest and the demands of predominantly coniferous wood. This later became the main reason for the limitation of forest use in the European-Ural part.

The establishment of timber industry facilities to the new (perspective, but non-developed) regions of Siberia and Far East began, in accordance with a political decision by the USSR leaders, in 1966. This establishment was explained by the necessity to develop the economy in remote areas and to set up a base for development of all the sectors of the heavy industry. As a result the harvest in the European-Ural part of Russia by the main wood purchaser, Ministry of Timber Industry, decreased by 13.2 million m^3 from 1966 to 1989.

During the period 1988–1993 the timber harvest was reduced by half, production of sawn wood decreased by 53%, plywood production by 41%, board production by 23%, pulp and paper production by 48–54%. This recession continued in 1994 and in the first half of 1995. The profit from forest products export decreased more than three times during this period.

The decrease of the harvest (monitoried final felling) in 1993 was 179.6 million m^3 or 51% in comparison with the harvest level of 1988. The average annual decrease during 1988–1993 was 10.2%. The most expressed decreases took place in North Caucasus (72.7%), the Far East (55.5%) and North West (52.8%) economic regions. In 1994 the timber harvest in Russia decreased by an additional 50 million m^3 to 124 million m^3 and to 115 million m^3 of final fellings in 1995.

Between 1970 and 1988 the per capita harvest was reduced from 2.72 to 2.43 m^3. In 1993 per capita harvest was only 1.18 m^3, which is two times less than in 1988.

Today there are 3,500 state-ruled specialized logging and woodworking enterprises in Russia. There are nearly 33,000 various firms dealing with harvesting, forest restoration, and wood-working.

7.3. Roads and transportation

Roads and transportation in Russia have always been a difficult problem. There are many sayings on this topic in Russia: "Russian forests are saved by the lack of roads."

Traditionally the log transportation in Russia was operated by tree-length hauling (95% of the hauling). Therefore, the main performances of forest transport means (and hence of the total logging and hauling process) are determined by two major factors: (a) availability of roads, (b) reliable transportation equipment. Of the money invested in logging enterprises in the former Soviet Union 25% to 40% were spent on the construction of haulage roads and purchases of transporation equipment. The transportation costs constituted 45–50% of the final price of the forest product.

In 1986 the logging enterprises of the USSR Ministry of Timber Industry had 125,000 kilometers of haulage roads to their disposal; (0.58 km per 1000 m^3 of haulage). Roads with a gravel surface constituted 45,700 km, roads with surface of ferro-concrete blocs were 4,700 km, roads without hard surface 60,900 km, narrow-gauge railroads 11,300 km. The narrow-gauge railroads can be subdivided into main (magistral) – 7–10%, secondary (branches) – about 15–20%, and spurs – 70–80%. Hauling roads are usually abandoned after termination of the work in a given harvesting area, while main roads and part of branches require serious reconstruction or capital repair, if they are to be used for future forestry purposes.

During the 1980s, the average annual increase of main and branch haulage roads was 2%. At the same time, the roads for all-year-around use was reduced by an average rate of 0.6% per year.

The haulage roads of the existing network in Russia are mainly without hard surface and cannot be used all year around by modern transportation means with full use of the carrying capacity and the possible speeds. Within the Forest Fund area there are about 610,000 km (or 44% of the roads) for public use. Solidly surfaced roads are 157,000 km. Public roads play an essential role in the forest sector, they constitute nearly half of all transportation ways in the forests. Moreover, their standards are rather satisfactory due to regular maintenance. They also serve as the base for the development of new haulage roads. As a rule, the public roads are natural links between forest tracts, enterprises, logging terminals, work shops, forest districts, railway stations, harbours, and administrative centers of districts and regions.

Forest roads are mostly former cart-tracks and natural paths, with no special passage over waterstreams, and no embankments in lower places. Only 6.7% of the forest roads are solidly surfaced, 16.2% of the haulage roads, and 31.3% of public roads have a solid surface. The total length of solid surface roads within Forest Fund is nearly 110,000 km, or 20% of the total road network.

7.4. Sawmilling and pulp and paper production

During 1960 and 1975 there was an intensive development of the forest industry in Russia. However after that period, due to political decisions concerning planned economic development of the former USSR and Russia, the forest industry started to decline in comparison with other leading industrial sectors.

The most considerable capacities for mechanical woodworking production are located in the European North and in the Central economic region. The sawmills are situated mainly in regions with the most intensive timber harvest (North, Urals, East- and West-Siberia and the Far-East), as well as in Central and Volga-Vyatka economic regions.

The plywood production is mainly concentrated in the Urals and East Siberia, as well as in the northern regions of European Russia. The board capacity is concentrated in regions with high timber harvest and sawmilling capacities, as well as in the Central and North-Caucasian economic regions, which have a developed furniture industry. Pulp and paper enterprises are mainly concentrated in the European North, East Siberia and the Urals. The current capacities of the pulp and paper industry in Russia is presented in *Table 14*.

From the viewpoint of electric power provision, the regions most suitable for the establishment of a forest industry are considered to be West and East Siberia. The cost of power is also low in the Urals and in the Volga region, and highest in the Northern, North-West, North-Caucasian and Baltic economic regions.

The labor force is most expensive in the Far East and East Siberia, as well as in the Northern and Ural economic regions. Plywood production, pulp production, and printing and writing paper production are featured with the highest investment costs, while furniture, roundwood and lumber production are most expensive with respect to transportation costs.

The major part of the wood processing is concentrated in the European part (about 75% of the total wood consumption). The main part of the timber resources (67.4% of the standing volume) are located in the Asian part of Russia. As a result, roundwood was earlier exported from Siberia to the European part (and within the European part, from well forested regions to sparsely forested ones).

The area covered with exploitable forests in the Asian part of Russia is more than two times larger than in the European part. The forests of well-forested regions have been considerably drained by intensive industrial harvesting carried out by so-called "timber bases." In 1989, there was altogether 353 million ha assigned to those bases.

The "timber bases" were intended for the long-term provision of wood for the major enterprises of pulp and paper and other woodusing industries. Timber bases were assigned to different loggers for a long period of time for the exploitation of the forests and with the purpose to make it possible to create favorable conditions for the logging activities.

The largest areas of "timber bases" were located in Arkhangelsk (12.7 million ha), Irkutsk (10.8 million ha) regions, the Komi Republic (10.3 million ha), Karelian Republic (10.0 million ha), Tyumen (9.1 million ha), and Perm (7.3 million ha) regions.

In 1989, there were 2,349 "timber bases" (258.2 million ha) in the 1st, 2nd and 3rd groups of forests, 1,305 of them (93.4 million ha) were located in European Russia, and 1,044 (164.8 million ha) in the Asian part of Russia. The largest number of "timber bases" were in the Northern region (543), East Siberia (536), the Urals (368), the Far East (258), and West Siberia (250).

The "timber bases" had a total exploitable volume of 14.5 billion m^3, by a prescribed annual harvest of 384.3 million m^3 to be carried out normally during a period of 35–40 years. In

1989, 35.8% of the "timber bases" of the European part were allowed to extract timber during 5 to 10 years, and only 40.2% during a period longer than 21 years.

Thus, timber exploitation within the "timber bases" was carried out very irregularly, in a number of cases with overcutting of the prescribed annual harvest and in some cases at the expense of others. With respect to the harvests, it can be stated that the harvest did not meet the basic principle of sustainable forest management.

Overcuts (which were admitted by the authorities for a period of several decades) led to depletion of the forests of the European part, worsening of the ecological condition over vast territories, and losses of high productive capacities. In the end it resulted in the decline of the timber supply to the industry. Examples of the overcut is presented in *Table 15*.

The drained "timber bases" of the European part have, at present, a very low potential for any industry expansion. The timber resources assigned earlier to the logging enterprises were exploited in a very unsustainable manner. The most productive (coniferous) stands were harvested, while the less productive ones and deciduous species stands were hardly used at all. As a result, a steady increase of swampy forests of lower site classes took place, which could only be exploited at very high costs. This was one of the main reasons for the decline of the coniferous timber harvest in European Russia. In addition, rather huge areas in European Russia are occupied with forests of 1st and 2nd groups in which clear cutting is either banned or considerably restricted. Partial cutting (which is prescribed for these forests) has not become a widespread technique due to a lack of appropriate technology. This is the reason for the abandoned harvest of 100–150 million m^3 of exploitable mature stands in regions with the highest wood demand,

Thus, within the exploitable forests, the most accessible, productive and high qualitative stands in areas with sufficient road networks have already been been harvested. Mature and overmature stands have lost their original productivity within the "timber bases" of the Northern and Ural economic regions. It has become more difficult to harvest coniferous sawlogs. At the same time, the growing stock of deciduous species stands have increased, which are hardly used in the processing industry.

According to data of the latest State Forest Account (January 1993), the area classified as exploitable forests under the jurisdiction of forestry organizations amounts to 351.1 million ha, of which 115.6 million ha (32.9%) are located in European Russia. The area of accessible mature and overmature forests under the jurisdiction of forestry organizations equals 156.2 million ha (44.5% of the forested area), of which only 44.6 million ha (28.6%) are in European Russia. The major part of the mature stands (71.4% of area and 68.1% of growing stock) are concentrated in Siberia and the Far East.

Between 1988 and 1995, the annual allowable cut has been reduced, on the national scale, by 119.3 million m^3 of which 99.4 million m^3 in coniferous stands (this information applies to the forests being under the direct management by the Federal Forest Service of Russia).

The grounds for the reduction of the Annual Allowable Cut are:

(a) Better assessment of the timber resources (total reduction of 45.9 million m^3, of which 40.5 million m^3 are coniferous).
(b) Clarification of the category of unproductive and unaccessible stands (total reduction of 25.8 million m^3, of which 20.9 million m^3 are coniferous).

(c) Changed rules for utilization within forested areas for protection of spawning grounds for valuable merchantable fish and pre-tundra forests (total reduction of 22.5 million m^3, of which 20.1 million m^3 are coniferous).
(d) Prohibition of industrial harvests of Siberian pine (total reduction of 11.9 million m^3, of which 9.9 million m^3 are coniferous).
(e) Transfer of forests to different protective groups and categories (total reduction of 6.8 million m^3, of which 3.8 million m^3 are coniferous).
(f) Increased areas of national parks, forest reserves, and protected territories (total reduction of 5.1 million m^3, of which 3.2 million m^3 are coniferous).
(g) Increase of the optimal harvesting age (total reduction of 0.46 million m^3, of which 0.28 million m^3 are coniferous).
(h) Increase of prescribed partial harvest (total reduction of 0.22 million m^3, of which 0.19 million m^3 are coniferous).
(i) Other reasons (total reduction of 0.56 million m^3, of which 0.47 million m^3 are coniferous).

Thus, despite considerable forest resources suitable for utilization in Russia, there will remain a shortage of high-quality coniferous wood over the coming decades, and it will be most expressed in European Russia. This will also limit the possibilities for expansion of the current industrial capacity strongly directed toward utilization of coniferous wood.

Analysis shows that the reasons for the decline in the forest industry are rooted in the centralized planning system not taking into consideration the socio-economic conditions of the country at large. In short, the collapse of the forest industry complex was driven by the enforcement of an artifical organization of the supply and the wood markets.

The financial situation of the majority of wood enterprises is critical today. The existing credit and tax regulations result in too low profits for the forest enterprises which are not sufficient for any capital investments or expansion of the operations. Today one can not observe any renewal of the existing industrial capacities, or any introduction of new technologies or equipment. At the same time, the extent of obsolete capacity has increased dramatically.

There is a need to establish a new forest management system, which will make it possible for an efficient market allocation in forestry and the forest industry.

The existing forest management system can be improved on the basis of the new forest legislation that paves the way for a new regulation on forest exploitation under changed economic and political conditions. This forest legislation provides some new approaches, such as ownership of the Forest Fund, lease of forest land, state funds for reproduction, protection and conservation of forests with the new legislation. Forest owners are responsible for the execution of the forest management, forest conservation and reforestation, a reasonable forest exploitation (sustainable), as well as obligations connected with increased productivity and quality of the forests. The institution of forest lease is introduced instead of the former system of assigning "timber bases."

The system of payments for forest exploitation includes stumpage fees, costs for reproduction, conservation and protection of forests. These costs are paid by the forest owner as a percentage of the price of the wood harvested, and sold, and as well for the wood utilized by the owners themselves. These taxes are transferred to a special state fund designated to finance reproduction, protection and conservation of forests.

At present, the relation between forestry management units and forest users is regulated in "Regulations concerning lease of forest land in the Russian Federation" adopted by the Russian government on July 23, 1993 (enactment N 712). A specific form for licensing the long-term lease of the Forest Fund was approved by the Federal Forest Service of Russia on August 26, 1993 (order N 222). Such regulations provide for a transfer of forest land to a long-term use on the basis of a license and lease agreement, which determine the rights, and responsibilities concerning the forest utilization

By the middle of 1994, there were 2,884 claims submitted for lease of forest lands of an area of 94.5 million ha, of which 78.6 million ha concerned timber harvesting. Of the submissions provided 2,019 were accepted and accompanied an area of 32.9 million ha of forest lands. The rent for these leases amounted to 16.7 billion roubles, of which 16.5 billion roubles stem from harvesting.

However, the leaseholders are unprotected against inflation and cost developments in the agreements and are not sure of the reliability of their long-term relation with the State. These conditions raise reluctance by the leaseholders to invest in forestry in excess of the measures stipulated in the lease agreements. Thus, some additional measures are needed in the agreements in addition. The leaseholders are not stimulated to a multi-purpose forest exploitation (only harvesting) in the lease agreements.

8. Domestic Consumption of Forest Products and Exports from Russia

The development of the consumption of forest products is very important for the development of the total forest sector and, in particular, for the improvement of the forest management. On the other hand, volumes and quality distributions of the raw material flow from the forests influence the development potentials for the forest industry.

Official statistics claim that by 1 January 1990, the total consumption of wood in the former USSR (roundwood equivalents) was 369.8 million m^3. In 1993, the consumption of so-called commercial wood by the forest industry was 122 million m^3 according to official statistics.

The demand is dominated by containers and packages (17.1%), construction lumber (14.5%), pulp and paper (13.0%), furniture (9.0%), for different repair and maintenance (8.3%), and export (8.9%).

Most of the wood is consumed in the European-Ural part of Russia. At the end of the 1980s this region imported about 4.0 million m^3 per year of roundwood. Long-range interregional transportation of wood raw material within the former USSR accounted for approximately 50 million m^3 per year at this period of time.

In 1989 Russia exported 36.7 million m^3 of commercial wood, and 17.7 million m^3 of sawn wood to Union republics. Major consumers of the commercial wood were Ukraine (8.3 million m^3), Kazakhstan (2.4 million m^3) and Uzbekistan (1.5 million m^3).

Of the total Russian consumption of commercial wood (235.9 million m^3 by January 1, 1990) the most considerable volumes were consumed in the following economic regions: Northern, 49.1 million m^3; North West, 10.6 million m^3; Central, 21.5 million m^3; Volga-Vyatka, 17.3

million m^3; Urals, 27.1 million m^3; West Siberia, 21.9 million m^3; East Siberia, 56.7 million m^3; and the Far East, 16.3 million m^3.

Already at this time forest products were in shortage with relation to the demand. Some estimates indicate that the shortage of supply reached 100 million m^3 of roundwood equivalents. Therefore, the domestic demand is bound to grow in the future. Estimates made by the Russian federal government indicate a domestic demand of 304 million m^3 (roundwood equivalents) in Russia by year 2005.

The transition of the Russian economy has had a negative influence on the export of forest products. The share of forest products in Russian foreign trade has decreased continuously during the past years. The development of the production, domestic consumption and export of forest products over time is illustrated in *Table 16.*

The export is hampered by the decreased supply of wood raw materials. If 50% of the possible harvest (based on silvicultural requirements) is harvested, the exportable volume will not exceed 10 million m^3 in the European-Ural part of Russia, and 17–21 million m^3 in Siberia and the Far East. A sharp jump in the transportation tariffs (see *Table 17*) sharply increased the costs of the Siberian wood delivery to European Russia and made it unprofitable for the domestic market in this part. Domestic prices of wood products are yet lower than the prices on the world export markets.

In 1993, the Russian wood export remained mainly in the form of unprocessed raw material. In addition to deliveries to former Union republics, Russia exported 11.5 million m^3 of roundwood (in terms of money US$662.2 million). The second largest currency income was the sulfate pulp US$153 million (641,900 tons). The total earnings from newsprint and other kinds of paper and board (coated and uncoated) were US$171.6 million (707,400 tons). Low-grade paper prevailed in this group of paper export. Earnings from sulfate pulp export were US$43.4 million, fiberboards US$55.7 million. Much smaller was the income from sawn wood (US$5.3 million), flake-boards (US$3.4 million), and veneer (US$0.37 million).

The most imported forest products in 1993 were coated paper and board, high quality pulp, and veneer.

In 1993, the number of countries importing Russian roundwood were 40 with the European countries dominating from an economic point of view. The most important importing countries of forest products from an economic point of view were in the following order: Japan, Finland, Germany, UK, Italy, Sweden, Egypt, the Netherlands, China, and the USA.

The sawn wood is mainly exported to Europe (15 countries – 88.5%), and Asia (3 countries – 11.5%). In 1993, the main customers of Russian sawn wood were Germany (48.8%) and Finland (23.2%) in Europe and Iran (11.2%) in Asia.

Sulfate pulp was exported to 34 countries in 1993, mainly to Europe (70.0%), with the biggest volumes exported to France (19.5%) and Italy (18.4%). The sulfite pulp was purchased only by 22 countries, and mainly in Europe (97.3%), and more than half of deliveries were exported to Sweden (51.6%).

Newsprint was exported to 50 countries, on an equal basis to Europe and Asia. Main customers were Germany (10.5%) in Europe and India (10.4%) in Asia. High-grade paper was exported mainly to Asia (90.8%), and the share of Iran was 73.3%.

Figures and Tables

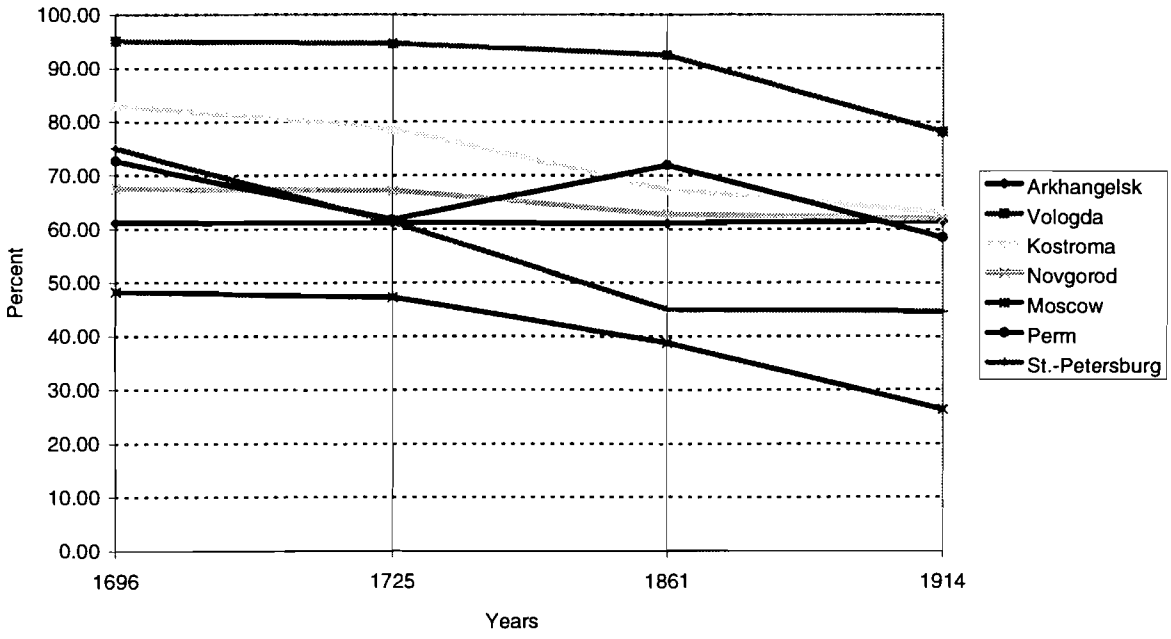

Figure 1. Forest cover rate dynamics.

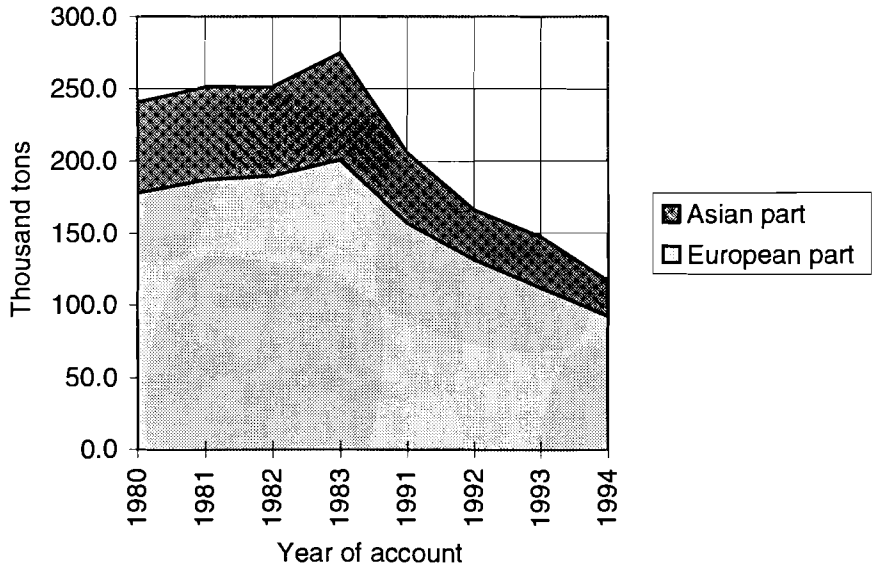

Figure 2. Hay procurement by forestry enterprises. Expressed in 1000 tons.

Table 1. Changes in the forested area covered by main forest forming species and under the auspices of the Russian Federal Forest Service during 1966–1993 and with a forecast for year 2000. Expressed in million ha and percentage.

		Forested areas				
			Including by age groups			
Species group	Year	Total	Youngs	Middle-aged	Immature	Mature and overmature
Russia						
Coniferous	1966	479.3	41.9	66.3	46.0	325.1
		79.8	8.8	13.8	9.6	67.8
	1973	493.0	59.9	73.9	44.2	315.0
		79.8	12.1	15.0	9.0	63.9
	1978	500.3	72.2	79.1	42.9	306.1
		79.8	14.4	15.8	8.6	61.2
	1983	506.2	77.9	87.0	47.1	294.2
		79.8	15.4	17.2	9.3	58.1
	1988	506.0	84.4	96.8	48.2	276.6
		80.0	16.7	19.1	9.5	54.7
	1993	476.8	85.4	107.2	46.2	238.0
		79.1	17.9	22.5	9.7	49.9
	2000	480.5	88.4	115.3	48.1	228.7
		79.1	18.4	24.0	10.0	47.6
Hard deciduous	1966	14.3	2.5	3.1	1.5	7.2
		2.4	17.5	21.7	10.5	50.3
	1973	17.1	2.9	4.4	2.4	7.4
		2.8	17.0	25.7	14.0	43.3
	1978	17.5	2.9	5.3	2.4	6.9
		2.8	16.6	30.3	13.7	39.4
	1983	18.8	2.8	5.8	3.0	7.2
		3.0	14.9	30.8	16.0	38.3
	1988	17.7	2.6	5.3	2.4	7.4
		2.8	14.7	29.9	13.6	41.8
	1993	15.4	2.0	4.3	1.7	7.4
		2.6	13.0	27.9	11.0	48.1
	2000	15.0	2.1	4.3	1.3	7.3
		2.5	14.0	28.7	8.7	48.6
Soft deciduous	1966	107.3	22.6	27.0	12.8	44.9
		17.8	21.1	25.2	11.9	41.8
	1973	107.5	22.5	28.1	13.0	43.9
		17.4	20.9	26.1	12.1	40.9
	1978	108.7	25.5	30.9	12.4	39.9
		17.4	23.5	28.4	11.4	36.7
	1983	109.3	25.4	33.8	12.5	37.6
		17.2	23.2	30.9	11.5	34.4
	1988	108.8	23.6	35.8	12.6	36.8
		17.2	21.7	32.9	11.6	33.8
	1993	110.6	24.2	36.6	11.8	38.0
		18.3	21.9	33.2	10.7	34.2
	2000	112.4	24.5	37.0	11.5	39.4
		18.4	21.8	32.9	10.2	35.1
Total	1966	600.9	67.0	96.3	60.3	377.2
		100.0	11.2	16.0	10.0	62.8
	1973	617.6	85.3	106.4	59.6	366.3
		100.0	13.8	17.2	9.7	59.3
	1978	626.5	100.6	115.3	57.7	352.9
		100.0	16.1	18.4	9.2	56.3
	1983	634.3	106.1	126.6	62.6	339.0
		100.0	16.7	20.0	9.9	53.4
	1988	632.5	110.6	137.9	63.2	320.8
		100.0	17.5	21.8	10.0	50.7
	1993	602.8	111.7	148.1	59.6	283.4
		100.0	18.5	24.6	9.9	47.0
	2000	607.9	115.0	156.6	60.9	275.4
		100.0	18.9	25.8	10.0	45.3

Table 2. Development of the growing stock of the major species in Russia. Expressed in billion m^3.

	1966	1973	1978	1983	1988	1993
Total growing stock	73.48	73.97	74.70	75.37	74.61	73.03
Coniferous	61.23	61.00	61.15	61.31	60.14	57.68
Soft deciduous	9.56	10.11	10.74	10.98	11.32	12.10
Hard deciduous	2.69	2.86	2.81	3.08	3.15	3.25
Total annual average increment	0.79	0.82	0.86	0.87	0.85	0.83

Table 3. Tapping of gum or resin in Russia.
Expressed in 1,000 tons.

Year	Resin tapping, 1,000 tons
1926	0.4
1930	34.2
1936	85.9
1940	61.9
1945	24.6
1950	99.2
1956	160.4
1965	198.2
1973	87.8
1974	98.5
1975	103.7
1976	101.7
1977	103.2
1978	95.2
1979	88.5
1986	112.5
1987	112.5
1988	112.5
1989	112.5
1990	112.5
1991	88.2
1992	75.8
1993	36.0
1994	13.0

Table 4. National yield of gum or resin per year and ha.

Year	Gum kg/ha/year
1973	71.4
1974	65.9
1975	71.6
1976	72.0
1977	73.6

Table 5. Areas of mature and overmature birch stands of quality index I–III by January 1993. Areas in Long-term lease are not initiated. Expressed in 1,000 ha.

Region	Area	%%
Russia, total	15992.6	100.0
European-Ural part	4438.8	27.8
Asian part	11553.8	72.2
Northern	1427.6	8.9
North West	364.6	2.4
Central	433.1	2.7
Volga-Vyatka	435.8	2.7
Central Chernozem	6.3	–
Volzhski	45.0	0.3
North Caucasus	28.4	0.2
Urals	1693.9	10.6
West Siberia	6382.8	39.9
East Siberia	4234.5	26.5
Far East	936.5	5.8
Baltic	4.1	–

Table 6. Purchase of medical raw material by the Federal Forest Service of Russia, in tons.

	Period, years				
Economic region	Mean for 1976–1980	1980	1981	1982	1983
Russia, total	1410.4	1894.0	1602.3	1873.7	2374.0
European-Ural part	700.6	882.0	714.3	691.2	998.4
Asian part	709.8	1012.0	888.0	1182.5	1375.6
Northern	34.3	44.5	24.6	17.7	22.6
North West	13.4	13.6	12.6	13.1	13.1
Central	70.7	81.0	69.5	79.8	298.5
Volga-Vyatka	69.8	82.9	57.3	69.5	61.7
Central Chernozem	40.1	32.6	25.9	35.2	35.2
Volzhski	39.0	37.8	34.8	38.4	36.3
North Caucasus	332.2	480.1	438.1	389.6	479.0
Urals	100.1	108.4	50.4	46.8	50.8
West Siberia	393.7	608.1	491.2	618.5	797.4
East Siberia	70.2	102.1	46.7	57.1	146.2
Far East	245.8	301.8	350.1	496.9	432.0
Baltic	1.0	1.1	1.1	1.1	1.2

Table 7. Honey procured by enterprises of the Federal Forest Service of Russia, in tons.

	Years			
Economic region	1991	1992	1993	1994
Russia, total	440.0	327.0	299.4	197.1
European-Ural part	312.5	248.3	198.6	139.4
Asian part	127.5	78.7	100.8	57.7
Northern	2.7	4.0	1.1	2.4
North West	–	0.1	–	0.2
Central	26.6	20.4	13.1	21.5
Volga-Vyatka	29.1	39.3	21.7	15.4
Central Chernozem	21.9	21.5	15.1	14.5
Volzhski	94.7	82.6	76.3	42.7
North Caucasus	65.0	39.1	30.9	28.3
Urals	70.6	40.0	39.3	13.0
West Siberia	73.5	44.4	38.9	28.3
East Siberia	20.2	15.5	12.9	20.1
Far East	33.8	18.8	49.0	9.3
Baltic	1.4	1.3	1.1	1.4

Table 8. Production and collection of wild fruit and berries in the Russian forests (including long-term lease forests). Expressed in 1,000 tons.

Region	Berry and fruit producing areas in 1,000 ha	Average biological yield	Commercial or accessible resources	Average annual harvest for purchase 1982–1990	Average annual harvest for household consumption 1982–1990	Percentage of commercial resources harvested
Northern	5082.3	559.0	67.1	9.4	8.0	25.9
North West	458.8	50.5	12.6	3.4	5.0	66.7
Central	676.3	67.6	34.9	1.0	20.0	60.2
Volga-Vyatka	551.8	82.8	33.1	0.5	10.0	31.7
Central Chernozem	37.4	4.7	2.5	0.3	2.0	92.0
Volzhski	217.6	27.0	12.2	0.3	8.0	68.0
North Caucasus	469.0	164.2	73.9	31.8	25.0	76.9
Urals	1559.5	233.9	46.8	1.1	12.0	28.0
West Siberia	4168.6	416.9	37.5	1.8	15.0	44.8
East Siberia	17282.5	1728.2	155.6	2.0	10.0	7.7
Far East	17552.5	1755.2	105.3	2.7	7.0	9.2
Baltic Republics	11.7	1.7	0.9	0.1	0.5	66.7
Total	48068.0	5091.8	582.4	54.4	122.5	30.0

Table 9. Commercial collection of tree nuts in Russia. Average annual collection by commercial organizations and expressed in tons.

Region	Annual average for 1970–1977	Annual average for 1985–1992
Russia	6,829	3,472
European Russia	868	320
Asian part	5,961	3,152
Northern	24	–
North West	–	–
Central	74	–
Volga-Vyatka	31	8
Central Chernozem	24	–
Volzhski	11	13
North Caucasus	627	224
Urals	76	75
West Siberia	1,376	681
East Siberia	3,957	1,870
Far East	628	602
Baltic	1	–

Table 10. Assessment of annual mushroom reserves on the forests of Russia (including long-term lease land) based on the forest conditions in 1993. Expressed in 1,000 tons fresh weight.

Region	Mushroom producing areas in 1000 ha	Net yield kg/ha	Average net biological yield	Commercial or accessible reserves
Russia	6,5741.7	48.5	3,187.2	506.9
European Ural	15,162.4	43.4	658.2	179.8
Asian part	50,579.3	50.0	2,529.0	327.1
Northern	7,260.5	25.0	181.5	29.6
North West	655.4	25.0	16.4	5.2
Central	228.9	50.0	114.4	48.8
Volga-Vyatka	1,655.4	50.0	82.8	24.8
Central Chernozem	57.3	30.0	1.7	1.1
Volzhski	435.2	50.0	21.8	8.3
North Caucasus	156.3	25.0	3.9	1.5
Urals	4,678.4	50.0	233.9	59.6
West Siberia	8,337.6	50.0	416.9	77.1
East Siberia	24,689.2	50.0	1,234.5	166.6
Far East	17,552.5	50.0	877.6	83.4
Baltic	35.0	50.0	1.8	0.9

Table 11. Estimate on the population of major game animals in game management units in Russia in 1993.

Species	European part	Asian part	Total Russia
Ungulates total	1010,000	1815,500	2825,500
– moose	393,000	336,000	729,000
– deer	56,000	1075,500	1131,500
– roe deer	201,500	344,000	545,500
– reindeer	28,500	923,000	951,500
– wild boar	172,000	56,000	228,000
– muskrat	532,000	1622,500	2154,500
Fur-bearing animals			
– squirrel	2280,500	4173,000	6453,500
– marten	144,500	14,000	158,500
– fox	317,500	125,000	442,500
– wild mink	137,000	103,000	240,000
– beaver	202,000	20,500	222,500
– wolf	116,500	18,500	35,000
– brown bear	36,000	67,500	103,500
– hare	3268,500	2986,000	6254,500
Game birds			
– black grouse	728,500	691,500	1420,000
– capercaillie	1820,000	1245,000	3065,000
– partridges	5895,500	5975,000	11870,500
– geese	1157,000	870,000	2027,000
– ducks	9217,500	14265,000	23482,500

Table 12. Animals harvested by game management units in 1993.

Species	European part	Asian part	Russia
Ungulates total	71302	62480	133782
– moose	31161	9974	46135
– deer	2396	39999	42395
– reindeer	706	28785	29491
– wild boar	22632	1823	24455
– roe deer	9739	9875	19614
Fur-bearing animals			
– squirrel	150817	1035973	1186790
– hare	431841	397613	829454
– marten	14239	1847	16086
– fox	20085	6173	26258
– muskrat	127564	195714	623278
– wild mink	12329	14455	26784
– beaver	11363	1034	12397
– wolf	5150	1362	6512
– brown bear	1379	1364	2746
Game birds			
– black grouse	35551	16726	52277
– capercaillie	72203	58792	130995
–partridges	175987	102446	278433
Water fowl			
– geese	57672	48939	103611
– ducks	1995710	1402192	3397902
Furs traded, thousand	2367.3	18316.5	20683.8

Table 13. Growth rate for indigenous people in Russia (number of persons).

Indigenous group	1959	1989
Evenks	24710	30233
Nenets	23007	34665
Khanties	19410	22521
Chuckchi	11727	15183
Evens	9121	17199
Nanaians	8026	12017
Mansis	6449	8459
Koryaks	6289	9242
Dolgans	3932	6929
Selkups	3768	3612
Nivkhis	3717	4673
Ulchi	2055	3233
Lapplanders	1792	1890
Udegeis	1444	2011
Escimos	1118	1718
Itelmen	1109	2480
Kets	1019	1113
Orochi	782	915
Nganasans	746	1278
Yukaghirs	442	1142
Aleutians	421	702
Nighedals	350	622
Tofalars	586	731
Orokis (Ultas)	–	190
Ents	–	209
Chuvants	–	1511
	132020	184478

Table 14. Current capacities of the pulp and paper industry in 1995 in Russia in 1000 metric tons.

Total pulp production	6660
Market pulp	2115
Newsprint	1210
Printing and writing papers	780
Wrapping/Packaging	790
Case making	180
Tissue	85
Specialty papers	225

Table 15. Overharvest of coniferous in 1988. Expressed in 1000 m^3.

Region	Number of investigated enterprises	Annual allowable cut	Actual harvest
Archangelsk	13	3440.1	3831.4
Vologda	13	747.0	1154.7
Karelian republic	14	1132.1	1282.4
Komi republic	15	3305.7	4139.6
Kostroma	7	280.4	307.7
Kirov	8	188.4	597.2
Perm	22	1957.0	2243.6
Sverdlovsk	5	131.8	299.3
Irkutsk	10	1544.3	3067.6
Magadan	1	21.0	25.0
Total	108	12747.8	17128.5
Overharvest by about 35%			

Table 16. Development of production, consumption, export, and import in Russia during 1989–1994.

	Production	Export	Import	Consumption
Roundwood (commercial) in million m^3				
1989	247.3	36.7	–	210.6
1992	164.1	18.5	–	145.6
1993	110.4	14.2	–	96.2
1994	78.9	13.8	–	65.1
Lumber (million m^3)				
1989	81.9	18.5*	–	63.4
1992	53.4	7.2	–	46.2
1993	40.9	6.4	–	34.5
1994	31.0	6.2	–	24.8
Plywood (thousand m^3)				
1989	1,735	572**	–	1163
1992	1,268	378	–	890
1993	1,026	461	–	565
1994	890	648	–	242
Particle Board (thousand m^3)				
1989	5,654	982**	–	4,672
1992	4,522	543	–	3,979
1993	3,960	423	–	3,537
1994	2,625	190	–	2,435
Fibre Board (million m^2)				
1989	497	139**	–	358
1992	427	59	–	368
1993	365	64	–	301
1994	240	50	–	190
Pulp (thousand tons)				
1989	8,11	1,720**	237**	6,628
1992	5,676	836	7	4,847
1993	4,331	1,079	1	3,253
1994	3,239	1,026	5	2,218
Paper & Paperboard (thousand tons)				
1989	8,484	2,596**	710**	6,598
1992	5,765	1,568	72	4,269
1993	4,495	1,394	57	3,158
1994	3,407	1,450	180	2,137

*Assumes all exports from former USSR originated from Russia.
**Assumes all exports from USSR originated from Russia.
Assumes that plywood exports to Near Abroad in 1989 equal to those taking place in 1991.

Table 17. Development of railway tariffs in Russia. Cost in US$ per m^3 of lumber.

	Distance in km				
Date	500	1,000	1,500	2,000	3,000
01.01.1994	4.2	6.9	9.6	12.2	17.6
15.01.1994	6.4	10.3	14.4	18.3	26.5
01.04.1994	7.4	12.0	16.7	21.2	30.7
01.09.1995	9.8	15.3	21.5	26.4	36.5
Increase in percentage	233	222	224	216	206

Example from September 1995: Delivery of lumber from Kvasnoyarsk to the port Novorossyisk (port at the Black Sea) by rail US$63/$m^3$, loading cost in the port US$12/$m^3$, and duties US$6/m^3 = US$81/$m^3$.