International Institute for
Applied Systems Analysis
IIASA www.iiasa.ac.at

Social and Economic Consequences of Forest Decline in Czechoslovakia

Stoklasa, J. and Duinker, P.

IIASA Working Paper

WP-88-028

April 1988

WORKING PAPER

SOCIAL AND ECONOMIC CONSEQUENCES
OF FOREST DECLINE IN CZECHOSLOVAKIA

Jaroslav Stoklasa and Peter Duinker

April 1988
WP-88-28

PUBLICATION NUMBER 65 of the project:
Ecologically Sustainable Development of the Biosphere

IIASA
International Institute
for Applied Systems Analysis

SOCIAL AND ECONOMIC CONSEQUENCES OF FOREST DECLINE IN CZECHOSLOVAKIA

Jaroslav Stoklasa and Peter Duinker

April 1988
WP-88-28

PUBLICATION NUMBER 65 of the project:
Ecologically Sustainable Development of the Biosphere

INTERNATIONAL INSTITUTE FOR APPLIED SYSTEMS ANALYSIS
A-2361 Laxenburg, Austria

ABOUT THE AUTHORS

Jaroslav Stoklasa is head of the Department of Anthropoecology in the Institute of Landscape Ecology. His research interests are oriented towards synthesis of economic and ecological approaches for decision-making. His address is: Institute of Landscape Ecology, Czechoslovak Academy of Sciences, Na Sadkach 702, 37005 Ceske Budejovice, Czechoslovakia.

Peter Duinker is a research scholar with the Biosphere–Project's Forest Study. His research interests include forest decline in Europe, forest policy and management, environmental impact assessment, and approaches to interfacing policy-makers and scientists.

FOREWORD

Within IIASA's Environment Program, the Project on Ecologically Sustainable Development of the Biosphere seeks to clarify the policy implications of long-term, large-scale interactions between the world's economy and its environment. The Project conducts its work through a variety of basic research efforts and applied case studies. One such case study, the Forest Study, has been underway since March 1986, and is focusing on the forest-decline problem in Europe. Objectives of the Forest Study are:

(a) to gain an objective view of the future development of forest decline attributed to air pollution and of the effects of this decline on the forest sector, international trade, and society in general;

(b) to build a number of alternative and consistent scenarios about the future decline and its effects; and

(c) to identify meaningful policy options, including institutional, technological and research/monitoring responses, that could be pursued to deal with these effects.

The problem of forest decline is not equally serious across all countries in Europe. The Forest Study is trying to capture the spatial variability of the decline phenomenon by, among other things, examining in detail the patterns of decline and its consequences in selected countries. In this vein, a series of papers on national conditions and outlooks related to forest decline have been commissioned from scholars throughout Europe. To prepare this paper, Dr. Jaroslav Stoklasa of Czechoslovakia teamed up with Forest-Study scholar Dr. Peter Duinker to take an in-depth look at the implications of forest decline in Czechoslovakia, particularly in the mountain areas, on water regulation, recreation, and the forest-products industry. Accounts such as this one surely indicate that, while forest decline may not be a serious problem in some European countries, it has had and likely will have grave environmental and socio-economic consequences in other countries unless massive expenditures are made on schemes to mitigate those effects.

R.E. Munn
Leader
Environment Program

PREFACE

Czechoslovakia belongs to those Central European countries whose forests are most severely damaged by industrial pollutants. Although the mechanisms of forest decline have not been fully explained yet, the present state of forest decline, including the expected deterioration, brings about serious ecological, economic and social effects which will grow in connection with further deterioration during the coming years.

For these reasons, owing to Professor Sten Nilsson's initiative, we prepared this paper on behalf of the IIASA Forest Study. The investigation is aimed at the social consequences of forest decline and their economic effects. The main problem during its preparation and elaboration was the limited possibility to collect enough basic data and material. Therefore, it was not possible to complete some thoughts and theses, mainly in the sphere of recreational problems, by way of thorough and detailed research. Accordingly, the results can hardly be considered as complete and comprehensive, and therefore yield limited conclusions. However, we believe that the study points out the seriousness of the problem, and will bring some inspiration for further investigations of this problem in the framework of the outlook of social and economic development. As well, it should also be useful for further research and for political decision-making in Czechoslovakia.

In preparing this working paper, the senior author (JS) collected basic materials and data in Czechoslovakia and wrote the first draft, and the junior author (PD) participated in revisions of the draft manuscript and production of this version. By way of acknowledgements, we wish first to express our gratitude to Professor Nilsson at whose instigation the paper was written. We are grateful for the helpful attitude of V. Perina, T. Lokvenc, V. Krecmer, and V. Oberhauser in our search for the necessary data and for permission to use their studies. We thank J. Pospisil, J. Vanek, M. Landa, and M. Gottlieb for helpful discussion and expert comments. Our thanks are due also to Acad. V. Barus, M. Bus, M. Gabriel and J. Materna for careful perusal of the study. Technical help was provided by J. Lukasova and M. Brandl to whom we also express our gratitude.

ABSTRACT

The forests of Czechoslovakia are seriously endangered by air pollution. Another factor contributing to forest decline could be the historical development of silviculture. The study discusses the contemporary state of forests in Czechoslovakia and the outlook to 2000. Continued forest decline could seriously endanger the non-timber functions of forests. The importance of the water-controlling function of forests and its economic efficiency are broadly discussed. The largest part of the paper deals with the influence of forest decline on recreation. Even with limited data, one can observe a continually growing demand for recreation in mountain areas with damaged forests. The reasons lie in the historical development and peculiar features of recreation in this socialist society. The difficulties of forecasting peoples' behaviour and their recreational demands is recognized. The last part of the paper deals with the influence of forest decline on production in the wood-processing and pulp-and-paper industries and strategies for their future. It will be necessary to change the structure of the forest-products sector and to investigate the newest technologies for the best utilization of all wood grown, which due to forest damage and the ensuing compulsory sanitation fellings will increase first and then after some years decrease. The study shows that forest decline in Czechoslovakia will lead to high economic losses and high consequent costs and investments in future decades, and can also have serious social consequences even if none have yet been manifested.

CONTENTS

LIST OF TABLES

LIST OF FIGURES

SOCIAL AND ECONOMIC CONSEQUENCES OF FOREST DECLINE IN CZECHOSLOVAKIA

Jaroslav Stoklasa and Peter Duinker

1. Development of Forestry in Czechoslovakia

1.1 Historical Background

For understanding the present situation in forestry in Czechoslovakia (Table 1-1), its historical background must be taken into account. Till the end of the 12th century, the territory of today's Czechoslovakia (Figure 1-1) was sparsely settled and the majority of its area was covered by natural forests. That time was the period of the first colonization associated with wood cutting. "Although large quantities of timber were required for the building of new settlements and, since the 13th century, towns, and the increasing population and development of brewery and mining raised the consumption of firewood and timber, the immense stock in forests was then sufficient to satisfy all the not very low demands" (Nozicka, 1975, p. 33). The increased consumption of wood stimulated the issuing of the first Forest Regulations as early as 1379. Silver mining in Kutna Hora compelled extensive tree felling in the Giant Mountains from which logs were rafted via the Labe river; the annual average volume of wood rafted from the Giant Mountains in 1567-1610 was 35,000 m^3 (Lokvenc 1978, p. 29). Such large-scale felling (e.g., Table 1-2) had a devastating effect, particularly because forest stands of more or less uniform age and up to then untouched were cleared from the valleys upwards as far as the timberline.

Because of the serious forest liquidation over large areas, even on steep mountains, felling was then stopped and transferred to the Orlicke Hory mountains. At present the total wood production in the Giant Mountains region is approximately the same, although the yield per hectare is lower. Since the 1980s, felling has also been increased in this region because of forest damage by pollutants, reaching a value of 50,000 m^3 in 1984.

Progress in industry, mines, glass works and iron works in the late 17th century was associated with growing forest devastation, and this trend continued in the 18th century as population density increased and industry expanded further. It was only the Forest Act issued in 1852 that put a stop to the constant reduction in forest area in Bohemia; some areas of unfertile agricultural land were even afforested. Extensive felling in the 18th century brought about a decrease in the economic efficiency of forestry, and therefore, starting from the late 18th and early 19th centuries, forests have been artificially restored and intensively tended. In this connection, the initial mixed composition of forest stands gave way to rapidly growing coniferous and deciduous trees, and pine and spruce monocultures, which provided a rapid supply of technically superior wood. This had a far-reaching effect on the ensuing development of forestry. Since the mid-18th century, specialized education in forestry started to develop, contributing to the restoration of forests and afforestation of extensive bare areas. As early as then, some experts tried to draw attention to the possible negative impacts of growing monocultures, particularly in ecologically unsuitable sites. Nevertheless, efforts made to achieve a greater economic benefit led to additional expansion of monocultures.

Table 1-1. Some basic data about the Czechoslovak Socialist Republic, as of 01 January 1987.

Indicator	CSSR[a]	CSR[b]	SSR[c]
Population (thousands)	15,479	10,336 (66.8%)	5,143 (33.2%)
Total Area (km^2)	127,903	78,864 (61.7%)	49,039 (38.3%)
Forest Land - Area (km^2)	45,820	26,060	19,560
- Prop. of Total (%)	35.8	33.0	39.9
Population density (persons/km^2)	121	131	105

Source: FSU-SNTL, 1985b.

[a] Czechoslovak Socialist Republic
[b] Czech Socialist Republic (Bohemia and Moravia)
[c] Slovak Socialist Republic (Slovakia)

Table 1-2. Annual fellings around 1600 and in 1975 in the region currently managed by the Horni Marsov Forestry Enterprise.

Year	Total area	Total area minus dwarf pine stands, etc.	Annual wood production	
	ha	ha	m^3	m^3/ha
ca. 1600	8,300	7,800	40,000	5.1
1975	11,700	9,500	40,000	4.2

Source: Lokvenc, private communication, 1987.

This brief account of the historical development of forests in the Czech countries[1] (Nozicka 1957, pp. 394-403) reveals some of the possible causes of forest damage in this territory. The main cause of the present forest damage is naturally pollutants, along with other factors, some of which are still under examination (Materna, 1985, par. 51.1-51.11); the fact that 87% of the forests in the Czech countries consists of extensive monocultures, particularly conifers of uniform age, contributes to forest damage as well[2].

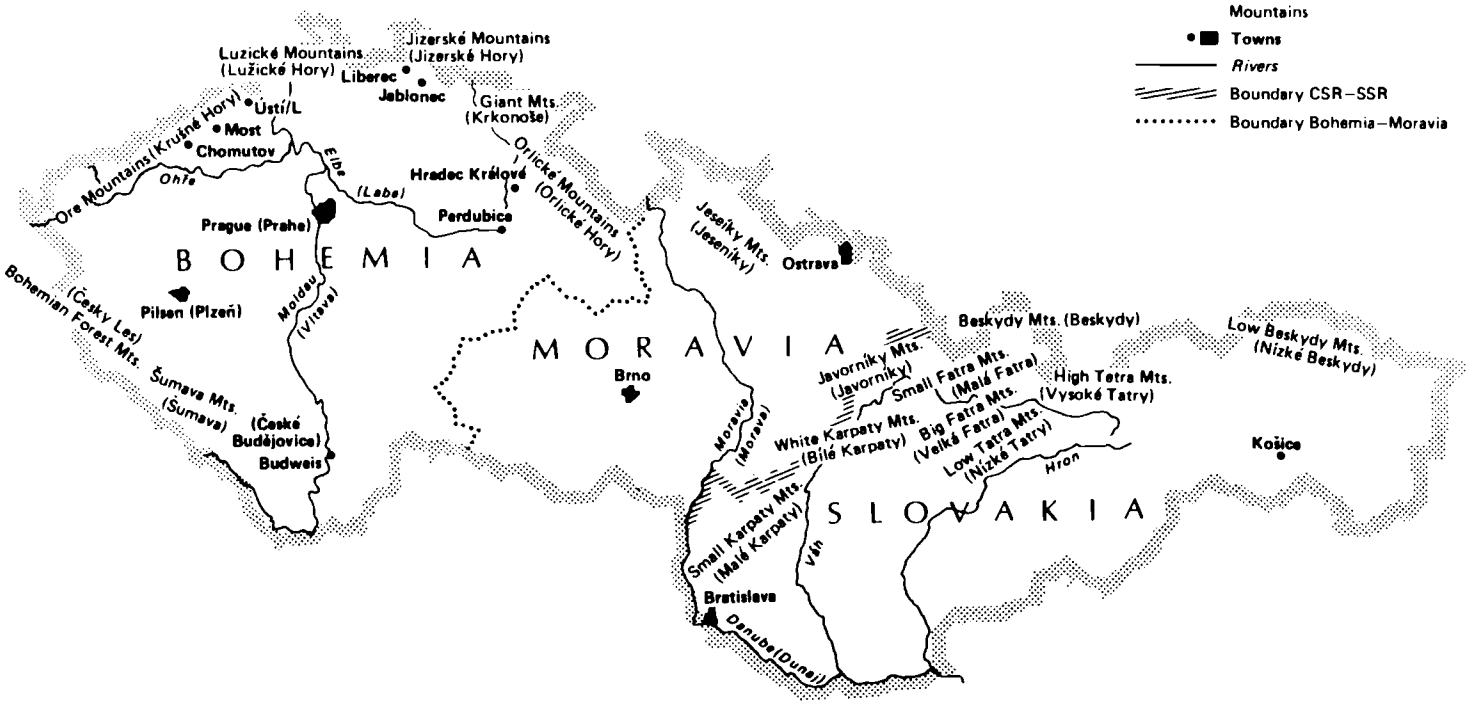

Figure 1-1. The mountain regions of Czechoslovakia.

Due to past developments in the Czech countries, on some sites today's forests are third or fourth generation spruce monocultures, which are often unsuitable from the point of view of the complex of natural conditions. This has brought about soil depletion, podsolization and mineralization, acidification and reduction in the nutrient stocks within the soil profile. This may be a cause of the natural weakening of the present stands.

Sanitation felling, accomplished in 1922-1925 when the forests were attacked by the black arches (Lymantria monarcha) and other pests, may have contributed as well. As much as 23 million m^3 had to be felled at that time (Figure 1-2), which is more than the present felling (Figure 1-3). Thereafter, coniferous monocultures (spruce, pine) were grown again, and since autochthonic seeds were unavailable in sufficient quantities nonautochthonic species were imported from Saxony and Austria. These stands are much more susceptible to wind and pollutants than the initial ones. A very extensive wind calamity, for instance, hit South Bohemia in 1984 and again necessitated large-scale sanitation felling.

Another reason could be the old age of the stands, which thereby already have a lower vitality. The differences between Central European and British silviculture have been elaborated by Kuusela (1987), who argued that Central European stands are in general too old, especially those in mountainous areas where difficulties with mechanical harvesting has led to postponements of final fellings.

The fundamental damage factor, though, is ever-increasing pollutant emissions. The occurrence of pollutant damage has been known for a long time but it was not until the late 19th century that the problem became subject to investigation. The topic was dealt with particularly by Stoklasa (1923), who drew attention to the fact that "air pollution by sulphur dioxide has been increasing day by day". Since the 1950s, electricity consumption has been increasing in most European countries, as have the amount of coal burned and the associated generation of pollutants and their long-distance transfer between countries. All these trends are now under detailed examination (e.g., IIASA's Acid-Rain Project).

1.2 Development of Czechoslovak Foresty since 1945[3]

The development of forestry and the wood-processing industry in Czechoslovakia relies on a rich tradition. This tradition has arisen from the wealth of forests in the country and the utilization of wood for satisfying the needs of its population. Out of the total area of approximately 128,000 km^2, 53.4% is agricultural land, 35.8% is forest land, 2% is water, 1.8% is built-up area, and 7% is other areas (see Table 1-1). The current 35.8% forested area provides enough wood to cover Czechoslovak consumption of raw wood material. Forests, one of the basic components of the environment and a permanent source of wood for our national economy, are among the major natural wealths of the Czechoslovak Socialist Republic.

Czechoslovak forestry is noted in Europe for its high standard, with active advancement of knowledge, legal measures and a complex system of forest management. After World War II it was necessary to ensure proper forest management rapidly and to eliminate damage caused by inappropriate management during the war and pre-war periods. Many steps of fundamental character were taken; of prime importance was the solution of the problem of forest ownership. At that time, forests were owned by a great number of

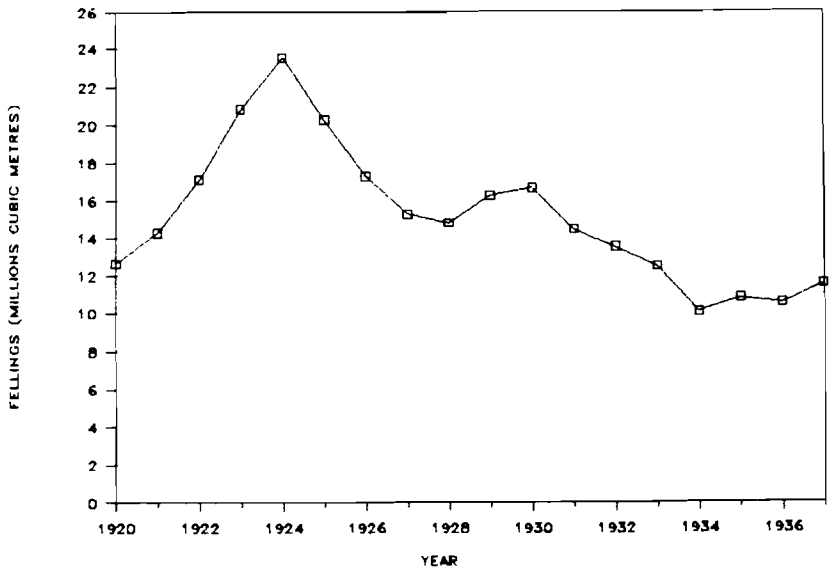

Figure 1-2. Total annual fellings in Czechoslovakia during the period 1920 to 1937.

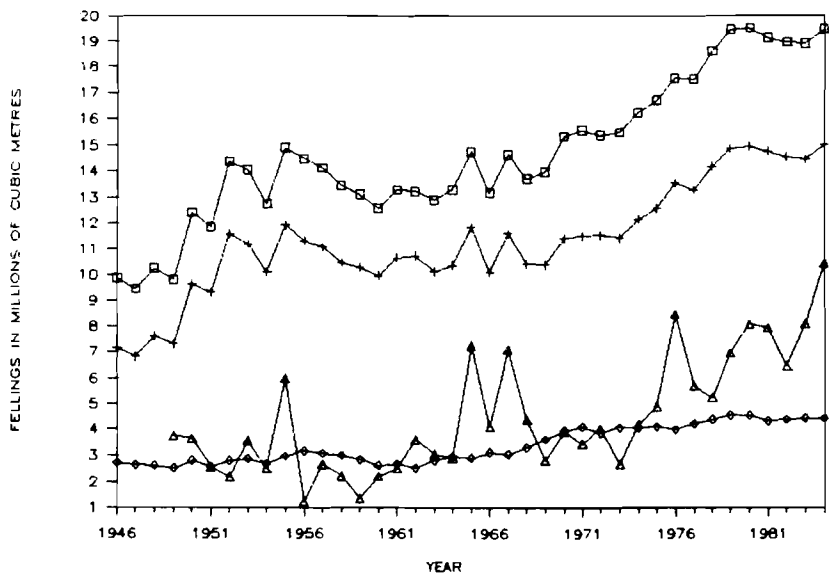

Figure 1-3. Annual fellings in Czechoslovakia during the period 1946 to 1984. The curve marked with squares is total, that with stars is coniferous, that with diamonds is non-coniferous, and that with triangles is sanitation fellings.

proprietors (Table 1-3) whose momentary interests greatly affected forest management. Socialization of forest resources was a prerequisite for a concerted management, both for the production of timber and for promoting all the other forest functions. This process was related to the overall nationalization process in the country. The share of state forests increased from 63% in 1950 to 97% in 1985 at the expense of the private sector; the remaining 3% is owned by cooperatives.

Czechoslovak forest-economy plans for ten-year periods are a tool for purposive forest management, owing to which forests are better capable of fulfilling all their functions. These plans are set up based on state-of-the-art scientific and technological knowledge and involve important goals and tasks with respect to such elements as silviculture, forest protection, environmental protection and management, and fellings.

Forests constitute an important component of Czechoslovak national wealth. Systematic forest care, both past and present, has been associated with the productive role and other useful functions of the forest. With 36% of the country's area occupied by forests, these aspects are also significant from an ecological point of view. The important role of forests in environmental management as well as in the Czechoslovak national economy has led to a purposive expansion of forest land area and forest production (Table 1-4). With respect to growing stock per ha, Czechoslovakia assumes the 3rd position in Europe, with ca. 220 m^3/ha (ECE/FAO, 1986). Nevertheless, the share of forestry in the creation of "social product" in Czechoslovakia is small, being only about 0.5% in 1984, even with a share of employees within the national total of 1.2% (Table 1-5).

Out of the total forest area, the share of land immediately serving timber production is 98%. The species structure of the Czechoslovak forests has changed only very slowly. In 1950, the forests contained 67% coniferous species (47% spruce, 14% pine); of the deciduous broadleaved trees, beech (18%) and oak (80%) predominated. By 1970 the share of conifers had dropped to 63% (this decrease primarily concerned spruce); as for the deciduous trees, the absolute increase was contributed to mainly by beech. Significant differences exist in this respect between the western (Bohemia and Moravia - CSR) and eastern (Slovakia - SSR) parts of the country. In the Czech territory, the proportions are 87% coniferous and 13% deciduous trees, while in Slovakia they are 52% coniferous and 48% deciduous trees.

The favorable development of growing stock, which increased by 55% in the post-war period, resulted primarily from intensification measures in forestry, increases in the official forest land base and forested land area, and aging of the forests. Fellings also increased by 58% from 12.4 million m^3 in 1950 to 19.6 million m^3 in 1985 (Figure 1-3). As Figure 1-3 shows, sanitation fellings are growing, especially in recent years. This is partly due to fellings necessitated by air-pollution damage, but also to wind and frost damage and pest calamities. The sanitation fellings of 1984 were a result mainly of a wind calamity in South Bohemia.

In addition to a purposive care of forest resources, considerable attention has also been paid to a qualitatively higher valuation of wood production with specific emphasis on the industrial use of hardwood. Over the past 35 years, the industrial use of softwood has increased from 88.2% to 94.3% of the total softwood supply (absolute volume increase 6.4 million m^3), and that of hardwood from 31.7% to 87.0% (2.6 million m^3).

Table 1-3. Ownership patterns of the Czechoslovak forests in 1945.

Ownership	Proportion of the Total Czechoslovak Forests (%)
State forests	16
Common forests	11
Forests owned by	
- companies	6
- the Church	11
- landowners	42
- small proprietors	14
Total	100

Source: Oberhauser, 1986.

Table 1-4. Expansion of total forest land and total forested land* in Czechoslovakia since 1950. Figures are in 1,000 ha.

Forest Land Category	Year				
	1950	1960	1970	1980	1985
Forest Land	4243	4285	4437	4534	4589
Forested Land	4200	4243	4394	4433	4475

Source: Oberhauser, 1986.

* Total forest land is all that land dedicated to forestry, while total forested land is that land currently occupied by trees. The land comprising the difference between these two categories is part of the forest landbase that is or was not occupied by trees.

Table 1.5. Participation of forestry in the national economy of Czechoslovakia.

Category	YEAR			1985 / 1984
	1975	1980	1984	
Social Product*				
Total (in million Kcs cur. friels)	987,671	1,235,783	1,489,768	150.8
From Forestry	6,403	8,744	7,958	124.3
Forestry Proportion of Total	0.65	0.71	0.53	
Employees				
Total (thousand ferzous)	7,060	7,358	7,534	106.7
In Forestry	95	94	93	97.9
Forestry Proportion of Total	1.35	1.28	1.23	

Source: FSU-SNTL, 1985b.

* The method of calculating social product is different than the calculation of GNP in western countries.

Since the 1970s the development of forests has been increasingly disturbed by unfavorable external effects, particularly by expansion of the fuel and energy base in this country and in neighbouring countries. Our electricity production was until now based on combustion of brown coal. Its extraction increased from 26.4 million tons in 1950 to just over 100 million tons in 1984. The production of electicity increased over the same interval from just over 9 billion kwh to almost 80 billion kwh in 1984. The nuclear-generated share in 1984 was 9.2%, but today it is around 15%, and new nuclear plants are under construction. Czechoslovakia's goal is to decrease consumption of brown coal and the resultant noxious emissions.

The forest-decline situation has been further aggravated by unfavorable development of climatic factors particularly in the western part of Czechoslovakia. Pollutants are not only of domestic origin; long-distance transfer from other countries contributes appreciably as well. Steps taken in the Czechoslovak Socialist Republic to reduce pollutant emissions would therefore have little effect if similar reductions are not made in all of Central Europe at least. Czechoslovakia is a participant in the international treaty on the reduction of industrial pollutants (the so-called 30% Club).

2. Present State and Outlook of Forest Damage Attributed to Pollutants

Forest damage arising from air pollution has become a serious problem over the past decades in Europe, particularly in Central and Northern Europe. Although comparable data are difficult to gather, data of May 1985 demonstrate that about 7 million hectares of forests, which is about 5% of productive forests, are disturbed in Europe (Table 2-1). Out of this, 250,000 ha are dying or dead forests. Felling in damaged forests is estimated to be 4% of all forest fellings in Europe.

Based on an examination of data on the extent of forest decline in Europe during the mid-1980s, expressed in volume terms (Table 2-2), Nilsson (1986) stressed that no comparison between different countries should be made. According to the damage criteria used, the figures for the Nordic Countries are rather high. However, "natural factors like climatic stress and aging overshadow possible effects of air pollutants on tree activity" (Nilsson, 1986).

The latest estimates of the extent of European forest decline (Nilsson, 1987) indicate that for Czechoslovakia in 1986, decline for coniferous forests amounted to 16.4% of total volume, and for hardwood forests 3.8%. Thus, the total volume in damaged stands in the country in 1986 was 20.2% of the total growing stock. These data are lower than those given by Materna (1985) for CSR only, where 700,000 ha of all species are in decline. This represents about 27.5% of the total forest area in CSR. Slovakia (SSR) has not only a more balanced forest structure (i.e., 52% conifers), but the local influence of air pollutants is rather limited here to a few metallurgical works. The pollutants here, in addition to some sulphur dioxide, include hydrogen fluoride, magnesite and heavy metals, all of which have rather local effects. The forests of CSR are under the influence of heavier SO_2 depositions from both local and distant sources. As well, the forests here are comprised of 87% conifers, making them generally more susceptible to air-pollution damage. The difference between the Materna (1985) and Nilsson (1987) estimates may be attributable not only to different monitoring methods, but also to different classes of forest decline being included in the estimates, as Nilsson (1987) did not include the lowest class of endangered forests in the estimates above but separated it as a "potential risk group", with 32.8% of the coniferous volume in this class.

Regarding the factors inducing forest decline, Materna (1985) summarizes the results of about 25 years of studies.

> "Over the past 25 years, we have been able to observe both the progressing air pollution and the response of forest stands, and so some conclusions concerning the processes leading to the damage can be drawn. Apart from the damaged area mentioned, the all-round status of stands, particularly spruce, has been deteriorating also in relatively clean regions since 1979. This process accelerated particularly over the 1982-1983 period, also in regions with the lowest air pollution levels in this country. Even though we believe that the forest disturbance is caused by air pollution also in these regions, the processes leading to these changes will be probably somewhat different." (Materna, 1985, paragraph 55.1).

Table 2.1. Estimated area of visible damage to tree crowns attributed to air pollution. Figures are in 1000 ha, as available May 1985.

Country	Light Damage	Moderate Damage	Dying/ Dead	Total
Austria	240*	80*	10*	330
Belgium	17*	2*	1*	20
Czechoslovakia	514*	123*	54*	691*
France	86*	11*	3*	100*
Germany, F.R.	2,424	1,163	111	3,698
Hungary	103*	13*	4*	120
Luxembourg	25*	5*	-*	30
Netherlands	80*	20*	-*	100
Poland	419	199	36	654
Switzerland	295	76	13	384
Total ten countries above	4,203	1,692	232	6,127
Europe total (estimated)				6,900

Source: Schotte, 1986.
* Unofficial estimate of the secretariat of the ECE Timber Committee.

Table 2.2. Extent of forest decline in Europe during the mid 1980s. Figures are expressed in million m^3.

Decline Classes and Regions	Forest Type		
	Conifers	Deciduous	Total
Monitoring method reported; moderate, severe and dead decline classes -			
Central Europe	370	345	715
Nordic Countries	725	n.a.	725
Monitoring method not reported; all decline classes -			
Central Europe			465-500
Slight decline (defoliation less than 20-25%) -			
Central Europe	725		725
Nordic Countries	70		70

Source: Nilsson, 1986.

On the basis of numerous regional investigations, Perina et al. (1984, p. 52 on) state that:

> "The harmful effects of emissions result in general decrease of productional abilities of forest ecosystems. Harmful influence intensity depends above all on the sort, composition and concentration of harmful substances, on influence duration, and on harmful substances chronic or acute effects. Besides this primary factor, the intensity is modified by further factors, e.g. by meteorological factors, altitude and orographic conditions, geological base rock and soil conditions. The intensity of damage is also influenced by stand conditions (species composition, age and structure of the stand, stand margins state, etc.). As further biotic and abiotic cofactors we consider frost, drought, wind, snow, fungi, insects, etc. The ecosystems are able to resist the negative effects of emissions and maintain their productional potential to some limits in some cases, during the initial phases of the exposure to emissions the increment can even be temporarily higher due to the positive changes in the environment".

An examination of forest damage in the regions of the Czech Socialist Republic (Table 2-3) shows that damage is most serious in the North Bohemia and East Bohemia regions, which are under the impact of pollutants from Czechoslovak sources and, in some areas, mainly from abroad. Unfortunately, the intensity of increment losses can be precisely expressed neither by amount of emissions, concentrations of harmful substances in the air, nor by external manifestations of damage in particular trees or stands. Thus, it is very problematic and methodologically difficult to evaluate especially the influence of global air pollution and the negative soil changes on production capability of large forest areas. Nevertheless, even a relatively small decrease in increment can be cumulative over large areas of forest stands affected by pollutants.

According to Perina (1984, p. 53), the increment losses in the CSR caused by air pollution are estimated at about 15% of current increment, i.e. 2.5 million m^3 of wood per year. Till 2000 they are estimated to increase to 3.3 million m^3 per year. Besides the losses in increment there are further losses caused by premature clear-cutting, by quality decrease and wood deterioration, delayed afforestation, neglect of free usable areas, by changed species composition, higher costs of forest management and low incomes. The total financial sum represents about 2 milliard Kcs yearly. Schotte (1986, p. 5), claimed that annual losses in Czechoslovakia are 1.6 million m^3, which is 10% of the wood increment. He estimated that damage arising from pollutants amounted to 6.4 milliard Kcs in 1981.

Nilsson (1987, p. 20) calculated that in 1986 the volume of trees showing damage symptoms in Czechoslovakia was 112.5 million m^3 for conifers and 9.1 million m3 for non-conifers. Considering Nilsson's (1987) own discussions of the problems of estimating the areal extent and volume of declining forests, these figures may well be overestimates.

We can once more see the differences in estimations caused not only by different methods of evaluation but especially through the difficulties to include and quantify the non-timber forest functions, as we try to show in later sections of the paper. A major problem is not only to monitor forest decline on a stand-area basis but also to estimate the volume of the trees showing damage. Volume estimates are essential for analyses of the effects of forest decline on future wood supply and subsequently on the wood-

Table 2.3. Extent of forest damage in the Czech countries in the early 1980s. Figures are in thousand ha.

Region	Coniferous stands*						Deciduous Stands (all decline classes)	Area Cleared Due to Damage	Total Damaged	Fraction of Total Regional Forests
	slightly damaged	medium damaged	strongly damaged	very strongly damaged	dying	dead				
	I	II	IIIa	IIIb	IVa	IVb				(%)
Central Bohemia	97	5	0	0	0	0	1	0	103	41
South Bohemia	0	0	0	0	0	0	0	0	0	0
West Bohemia	95	16	3	0	0	0	0	1	115	29
North Bohemia	75	22	10	4	5	3	5	26	150	61
East Bohemia	199	11	2	1	0	0	1	1	215	60
South Moravia	1	0	0	0	0	0	0	0	1	0
North Moravia	79	8	2	0	0	0	16	3	108	28
Total	546	62	17	5	5	3	23	31	692	27
Percent fraction of total forest area	21	3	1	0	0	0	1	1	27	

Definitions of the coniferous (spruce and pine) damage classes are as follow:

Stands of damage class I have up to 5% of their trees in a state of heavy damage.
Stands of damage class II have 6-30% of their trees in a state of heavy damage.
Stands of damage class IIIa have 31-50% of their trees in a state of heavy damage.
Stands of damage class IIIb have 51-70% of their trees in a state of heavy damage.
Stands of damage class IVa have 71-99% of their trees in a state of heavy damage.
Stands of damage class IVb have 100% of their trees in a state of heavy damage.

Source: Perina, 1984.

processing industries. Unplanned sanitation cutting of damaged trees may in the short run flood the roundwood market with lower quality materials.

The wood from dying and dead trees is mostly chipped on site and used in the pulp industry. This wood has a low bark content and the resin is oxidized or chemically affected in other ways. Thus, while processing is facilitated somewhat, the mechanical pulp has lower strength and lower degree of brightness. As well, when logs from dying or dead trees are sawn, yields and quality of the products are lower (Schotte, 1986, p. 7).

This big influence of pollution in combination with other factors brings serious complications to forestry and its economic efficiency. The first indications of forest decline in Czechoslovakia occurred in the Ore Mountains (Erzgebirge) as early as the 1960s. Later, extensive damage and death of conifer trees was evident. Because of acid rain, soils have become seriously acidified. After removals over large areas, priority was given to regeneration. The first step was intensive site treatment with fertilizer and lime. Schotte (1986) wrote that:

> "An impressive job is being made of replanting, with rows of stumps and tree remains -- sown with birch and rowan -- as windbreaks for the areas in between. Colorado spruce (Picea pungens) has so far been the only coniferous tree found capable of surviving and producing timber. But the costs involved are high. It is estimated that the total cost from seedlings to a closed canopy will be Kcs 60,000-90,000 per hectare, compared with a normal cost of Kcs 12,000. Even if this planting program is successful in the long term, the older type of forest will never be re-established. The aim of recreating ecological systems has been allowed to take precedence over the aim of producing raw timber for the forest products industry, as well as over economic considerations."

It is very difficult to predict the development of forest decline; there are just too many unknown factors. For example, Schotte (1986, p. 5) estimated that in 1990, about 42% of the forests in Czechoslovakia will be under pollutant stress, leading to a loss of 3.4 million m^3 and 21% of normal growth. A similar situation is predicted for 2000 by which the 30% pollutant reduction following from the international treaty will have been achieved. Alleviation of negative impacts on forests, however, will not effect a recovery of forests in a short period of time. In addition to lowering the increment, pollutants also bring about a poorer quality of timber from sanitation felling and poorer conditions for natural forest restoration. Tree felling and transportation, as well as protection of forests and forest soil, will require increased costs.

2.1 Conclusions

Pollutant depositions on forests in Czechoslovakia, both from inland and abroad, have large consequences on the forests' condition, especially in the western and northern part of the country. The decline significantly affects the efficiency of forestry, and the costs of reforestation in the future will rapidly increase. Current forest research is focusing above all on methods of keeping regenerated forests alive. One of these methods which is very promising is the inoculation of mycorrhyzae in the roots of small plants. Other approaches are to select more resistant species of trees, on extreme sites to plant economically unimportant species such as

birch or rowan, and in some situations planting fast-growing species, e.g. popler.

The forest-decline situation will continue at least till the end of the century even if pollutant emissions in Europe decrease. This is due to the fact that the forests have been under the influence of pollutants already for a long time, and their cumulative effects on trees and soil will, in combination with other factors, for longer periods still detrimentally influence the forests.

Thus, it is necessary to be prepared not only for continued forest decline as such, but also for its economic, social and ecological consequences. From an economic point of view, it means not only higher costs and influence on GNP but also higher cost for water management and water supply. Last but not least, it will necessitate structural changes in the forest-products industry which of course will be rather expensive. Forest decline will also have great social and ecological consequences, some of which will be discussed in the following sections. In general, forest decline is a great political problem; political authorities and decision-makers now strongly focus their attention to the future development of forest decline and to solving the problem in all consequences.

3. Effect of Pollutants on Non-timber Forest Functions

3.1 The Value of Non-timber Forest Functions

Forest damage caused by pollutants has a serious negative impact on the non-timber forest functions. In some regions these functions predominate from the social point of view over the productive functions and are the principal reason for the restoration of damaged forests. Such situations occur particularly in mountain areas where the soil-protective, water controlling, bioclimatic, ecological and recreational functions are dominant.

The most serious consequence (beyond the timber-production sphere) of forest damage by pollutants consists in the endangerment of the following functions, which are mutually linked in most cases:

(a) bioclimatic functions, both microclimatic and macroclimatic, whose disturbance consists particularly of changes in the radiative situation, air streaming, precipitation and water retention and release. This problem is dealt with later (section 3.2);

(b) water-controlling functions, which are among the most important and therefore are treated in a separate section later (section 3.2);

(c) counter-erosive and soil-protective functions, which are related to the water-controlling functions, particularly in mountain and water spring regions; these are dealt with in section 3.2 as well;

(d) recreational functions, discussed in section 3.3;

(e) ecological functions, which are of prime importance. These encompass not only protection and conservation of various ecosystems and communities of plants and animals in the forest itself, but also the effect on a wider neighborhood of the forest. Changes affect the structures of plant and animal communities on large clearings where the altered ecological conditions pose a hazard to some species due to unfavorable living conditions and over-reproduction of aggressive competitive species. The forest also functions as a part of the skeleton of ecological stability of the landscape; it exerts a soil-protective effect by forming a barrier against wind and water erosion, offers refuge to animals and sustains the diversity of ecosystems and thereby, the stability of the landscape. Even small forest stands in the landscape are of great importance in the biological fight against field vermin and weeds and as barriers against their propagation, and also as refuges for birds that can play a major role in this fight. If the nesting and breeding possibilities for these birds are restricted, their loss must be made up for by using pesticides in large quantities, with all the adverse repercussions and increased costs. Particularly serious is the fact that forest damage by pollutants occurs also in national parks, protected landscape regions and natural reserves, posing a hazard to the protective and conservative functions of these territories. The structure of ecosystems is altered by tree felling, and rare and protected plant and animal species are endangered.

(f) social functions, of which the recreational function is only one, though highly important (section 3.3). Significant, although so far rather neglected and little examined, is the psychic role of forests. Looking at damaged and dying forests is depressing and may stimulate

different reactions of the populace; it could be either a feeling of precariousness, if the populace is not informed thoroughly about effective measures for stopping additional damage and about sanitation and afforestation approaches; or the effect is opposite, stimulating, as is seen with our youth that participates actively in efforts made for forest sanitation, conservation and restoration, e.g. within the "Brontosaurus" movement of the Czechoslovak Socialist Youth Organization ("the brontosaurus has not survived", implying that man will not survive unless he conserves his environment). Other social organizations develop their voluntary activity as well. Without this help, today's forestry would hardly manage. Forest damage is an example of disturbance of the whole environment, having influence on people's realization of the seriousness of this problem. This stimulates activation of the populace not only in the Organization for Nature Conservation, comprised mostly of amateur conservationists, but also in other social organizations (Czechoslovak Gamekeepers Union, Czechoslovak Anglers Union, etc.) to direct their efforts to nature and environmental protection and conservation. The psychic impact of forest damage thus is dual, with negative and positive aspects. This topic, however, has not been so far subject to detailed investigation in this country, and only tentative results from abroad are available (e.g. Fietkau et al., 1986).

(g) No less important is the aesthetic function of the forest in landscape, associated, naturally, with the psychic function. Healthy forests are an integral part of the landscape and its beauty. Forest damage spoils the aesthetic value of the landscape most markedly, and even if, after clearing, damaged forests are replaced by new stands, it will take tens of years for the landscape to regain its initial character. This is again most important in mountain regions.

From a forestry point of view, non-timber forest functions are hardly separable from the timber functions. It is clear, however, that the increasing importance of non-timber functions will call for many steps to be taken particularly in forests damaged by pollutants, and these will have an impact on the economics of forestry. Forest disturbance has many consequences -- economic, ecological and social -- that are inter-related and mutually linked. A complex solution to the ever-increasing problems of forest damage, its prevention and remedy, becomes an exceedingly important social and political task; political and economic authorities and executive bodies in Czechoslovakia are paying great attention to the topic.

3.2 Effect of Pollutants on Water-controlling Forest Functions

Water management and supply are among the most serious problems in Czechoslovakia. Except for a very short part of river Danube, which flows near the south boundary of Slovakia, all rivers whose sources are in Czechoslovakia are flowing away. Sometimes, therefore, this country is called the "roof of Europe". This means that all water demands must be met ultimately by water precipitating on the country's territory. Thus, it is necessary to manage all water resources carefully, not only ground water but also surface waters, some of which is used for industry and irrigation but also for human consumption (Table 3-1). Significant water pollution comes from industry, households, and agriculture, the latter as a result of overuse of fertilizers and pesticides which are leached out of the soil.

Table 3-1. Development of water supply and water treatment in CSSR in the period 1948-1983.

Indicator	Year					1983 / 1960
	1948	1960	1970	1980	1983	
Production of Drinking Water (million m3)						
Total	290	547	919	1488	1646	3.1
For Households		266	344	625	710	2.7
Consumption per inhabitant (l/day)		53.4	65.8	111.8	126.2	2.4
Inhabitants supplied by public water pipes (%)		48.6	57.8	70.3	74.5	
Inhabitants connected to public sewage systems (%)		40.6	46.5	57.4	60.5	

Source: FSU-SNTL, 1985a.

The growing demand and increasing consumption of water means that it has to be used several times for different purposes during its flow through our territory. In 1984, 5.49 billion m^3 of water was taken from Czechoslovakian water resources.

Forests play an extremely important role for water retention, accumulation and flood prevention, especially in the mountain spring regions. Forest decline in these spring areas has the potential to give rise to water-supply problems. For example, the drinking-water supply of the large, densely inhabited region Liberec-Jalblonec/N. is dependent on water resources from the Jirerske Mountains where forest decline has been very dramatic in the last ten years. Even Prague is partly supplied by the river Jizera which has its source in this mountain range. The influence of forest decline on water quality and quantity could therefore be very serious for our economy; some possible consequences are discussed below.

The Czechoslovak Forest Act (Act No. 61/1977) charges the Czechoslovak forestry community with the duty of taking care of both the timber and non-timber forest functions. Among the most significant is the water-controlling function. In this connection, forest damage in the water source regions of the Ore Mountains (Krusne Hory), the Jizerske Hory mountains, the Giant Mountains (Krkonose), the Orlicke Hory mountains, the Ash Mountains (Jeseniky) and the Beskids (Beskydy) is of particular concern. Each of these water source regions plays a specific role with respect to the corresponding river basin, which is seriously disturbed by forest damage and the associated tree clearing.

Active technical and silvicultural steps must be taken in the Czech countries to secure the water-controlling functions of forests, on approximately 33-44% of the forest resource area. For an additional 46% of the forest area, the so-called passive water function, fulfilled by normal good silvicultural practice, is sufficient (Krecmer, 1984).

Thus, the extensive forest damage by pollutants in the Czech countries, including forest dying and decay, clearing and changes in species structure, has a substantial negative impact on the hydric and soil-protective role of forests. Particularly adverse is the effect on water supply sources in protected water-management forest zones, on the counter-flood and counter-erosion forest functions, which can have a serious impact along the entire river basin, and on water quantity as well as quality, all of which have direct economic consequences. The characteristics of forests in the Czech countries from this point of view are such that approximately 35% of the forests in river-basin areas of water supply importance and more than 60% of the forests in water spring regions are disturbed by pollutants (Table 3-2).

According to Krecmer (1984, p. 57), disturbance of the hydric and soil-protective forest functions consists primarily of:

(a) changes in the vegetation cover due to destruction of coniferous stands;

(b) changes in the soil properties due to the diminishing area of forest stands and to pollutants; and

(c) changes in the environment due to economic activity associated with sanitation felling.

Changes in the vegetation cover include thinning of spruce stands and their subsequent removal and formation of substitute stands. These activities affect the bioclimatic and soil factors and, consequently, the basic hydrological factors such as water balance in stands, retention, retardation and accumulation of precipitation. Furthermore, according to Krecmer (1984), microclimatic and mesoclimatic changes also occur in the air and soil through changes in forest stands, leading to such influences on the water-controlling forest function as:

(a) reduced retention of precipitation: this retention can be 50-70% lower with substitute birch stands than with spruce stands, and even more severe for discontinuous stands;

(b) reduction in the water supply for transpiration of forests through replacement of spruce stands, with a high production potential, by other species that have lower biomass and productivity; and

(c) reduced formation of horizontal precipitation from mountain fogs.

All this has many other consequences with respect to the hydric forest functions; in particular, the retention capacity and retarding effects are reduced, less water is given off by evapotranspiration, water supply from the snow cover is changed, and the thawing regime is different and poses a flood hazard.

Table 3-2. Forests of water-controlling importance in the Czech countries and the extent of their damage by industrial pollutants.

Class	Functions	Proportion of total forest area (%)	Prop. under pollution stress (%)
Forests in river basins of water-management importance	Water source formation, protection and sustenance -- complex water-controlling function with emphasis on water protective and detention functions	15	35
Forests of spring regions	Sustaining the appropriate counter-flood and -erosion protection of productive landscapes -- qualitatively detentive water-control functions	16-26	60
Forest stands of local water-protective importance	Water and water-regime protection on smaller areas, e.g. in protected zones of sources of underground water, riverside stands, forest barrier zones, etc. -- complex or qualitative (water protective and detentive) water control functions	2	not established

Source: Perina, 1984.

According to Perina (1987), flood flow rates can be expected to increase 20-30%, flood volumes 20%. This would result in a 20-25% increase in the economic damage caused by floods. Stream regulations carried out previously would be disturbed and their efficiency would drop due to higher flood volumes.

This situation is particularly severe with modified torrents, whose length is 19,650 km in the Czech countries and 21,520 km in Slovakia. Out of this, only 6% and 32%, respectively, is regulated; the value of the engineering structures is more than 2 milliard Kcs, and more than one-half of the existing structures require maintenance, rebuilding or renewal. Moreover, the mountain areas concerned are officially protected regions of natural water accumulation, out of which 64% in the Czech countries are subject to pollutant stress. With respect to the disturbance of their water-controlling function, it is therefore imperative to ensure effectiveness of the existing regulation of streams and to build new structures with a view to reducing the flood damage hazard in submontane territories.

Equally important is water draining from waterlogged forest land exhibiting reduced productivity and exposed to increased hazard of tree-uprooting by winds, and also contributing to the formation of flood surges in precipitation seasons; to date, the area of waterlogged forest land amounts to several hundred thousands of hectares, due to extensive tree felling.

Tree felling in polluted areas often leads to extensive soil erosion, and where tractors are used for tree transportation in forests, the surface outflow is as much as 12 times more intensive than where cableways are employed (Krecmer and Perina, 1981). The vehicles and machines affect soil compaction, whereupon water outflow concentrates in the tracks, and erosion follows.

Erosion of forest soils now threatens about 130,000 ha in the Czech countries and about 500,000 ha in Slovakia, mostly in the mountains. In CSR, these areas coincide closely with the areas under the most intense influence of air pollutants and where sanitation fellings are abundant. This calls for effective protective measures to be taken, in particular, recultivation of erosion trenches formed by mechanized felling and the associated activity. Water outflow is also promoted on the newly built roads. As a concomitant effect of mechanized felling, soil is contaminated from leaking fuels and lubricating oils.

If sanitation fellings are carried out in water-supply regions, water in the supply basins and streams can be polluted by entrained soil and petroleum products as well as by washed-out phosphates and nitrates, aluminium and other substances, whereupon drinking water of poorer quality emerges, and beds and basins become silted up.

For remedy and restoration of all of the non-timber functions of forests, Czechoslovak forestry will have to fulfil some significant tasks that will require increased expenditures. Recently, the expenditures for restoration relative to the total direct annual expenditures for forestry actually decreased, viz., in the Czech countries, from 2.58% in 1970 to 1.98% in 1975, to 1.19% in 1985. In Slovakia this share is about 5%. The calculations of Perina (1987) show that for securing the water-controlling function of forests for the nearest future, these non-investment expenditures should be increased to approximately 10% of the total annual expenditures on forestry.

The economic efficiency of forestry for securing the water controlling and management functions has been dealt with in detail by Krecmer (1986). First, he attempted to estimate the efficiency of forest stands in water spring regions from the point of view of their importance for buffering extreme water stages on small streams (detention) because increased flood hazard can be expected where this function is impaired. In this, Krecmer proceeded from the study by Becvar (1978), investigating the consequences of the forest calamity in the Ore Mountains and the associated costs compelled by the necessary compensating water-management and technological measures such as strenthening of stream banks and construction of dikes and dams. According to that study, expenditures for reinforcing protection against floods at flow rates corresponding to centennial floods (Q_{100}) would amount to 176 million Kcs; this amount would increase to 330 million Kcs for flow rates corresponding to quincentennial floods (Q_{500})[4]. These investments would be necessary to compensate for the natural water-protection function of the forests on an area of 22,000 ha in the Ore Mountains where forest damage is widespread. On a per-ha basis, these

investments amount to 7,820 Kcs for centennial floods, and 14,660 Kcs for quincentennial floods.

To compare the efficiency of healthy forests in providing the water-controlling function with engineering works, we take a 3% annual depreciation on investments. If the costs for maintaining the water-controlling function of healthy forests amount to about 450 Kcs per ha, then according to the Steffensen-Paul formula of economic efficiency, the use of healthy forests to control for the centennial flood is 2.2 times more efficient, and for the quincentennial flood 4.2 times more efficient than technical solutions. Krecmer drew attention to the fact that this example holds for a locality with extreme demands with respect to flood protection, because it protects the Ore Mountain mining and industrial regions which is of high economic value. Calculations of actual compensating measures for other regions are not available.

Based on qualitative estimates of the aftermath of pollutant calamity in mountain forests, Krecmer constructed plots of the probable effect of the weakening in the hydric detention efficiency of forests due to altered outflow in the river basin areas (Figure 3-1). In the more favorable variant (curve b in Figure 3-1), centennial floods would become 48-year floods unless the initial forest area is reforested in a short time after sanitation felling. The changes would be more serious if the clearings remained permanently bare. By a comparison in the Javorniky mountains, Valek (1962) found that Q_{100} in a forested river basin is equivalent to Q_{16} in a paired basin with pastures.

Furthermore, based on the work of Komarek (1983) for the Ohre river basin, Krecmer dealt with the quantitative aspects of flood damage and came to the conclusion that a 10% change in alpha (Figure 3-1) and a 4-day prolongation of the flood duration would cause a 22% increase in the current annual damage by floods.

Another important water-controlling function of forests is protection of water sources, particularly water supply basins, against washed-off soil and phosphate, nitrate and other water pollutants. Krecmer (1986) claimed that weakening in the counter-erosive forest function, e.g. by pollutant calamity or careless tree felling and transportation, would bring about an increase in the amount of eroded spill particles as high as 600%, which can have a serious impact on water quality for drinking purposes. He demonstrated quantitatively that conservation of the water-controlling and protective function of forests is 11 times more efficient per unit cost than engineering works for water cleaning and purification.

Thus, it follows that forestry management of the outflow situation and water quality in forests of water-supply importance has a high economic value, and from the national-economy point of view can be classed as efficient or highly efficient. Furthermore, in case of disturbance of these functions by pollutants it is necessary to apply extraordinary measures, even rapid reforestation with substitute woods, to mitigate the damage.

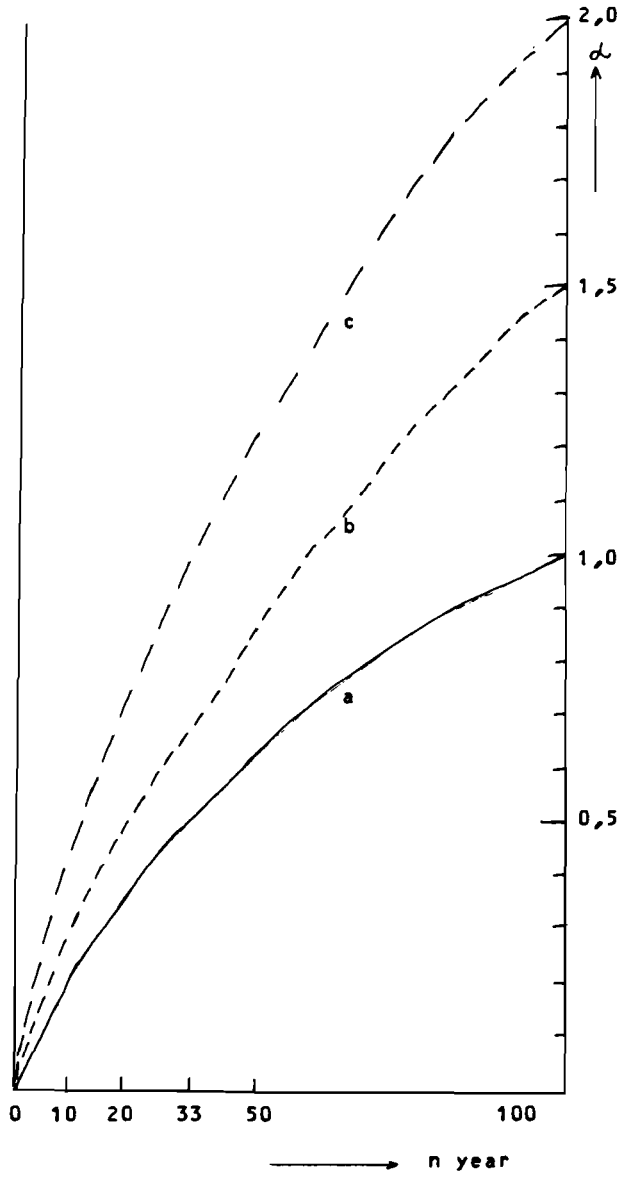

Figure 3-1. Relationship between severity of flood (n-year flood) and the ratio of peak flow-rates of floods at n years and 100 years (alpha). Curve "a" represents watersheds where forests are healthy and intact; curve "b" is an optimistic variant and curve "c" a pessimistic variant for watersheds where forests are disturbed by air pollutants. For all three curves the Q_{100} used in the calculation of alpha is that for a healthy intact forest.

Perina (1987) concluded:

> "All this shows that the non-timber forest functions in the landscape are seriously threatened; this applies particularly to the water controlling function in regions where forest stands damaged by industrial pollutants are being cleared. For securing these functions, the extent of works and budget for this branch of forestry must be increased as fast as possible. Only in this manner, multiply higher losses in our national economy caused by flood damage can be prevented".

The current implementation of new economic mechanisms in Czechoslovakia will also ensure better conditions for securing these non-timber functions of forests.

3.3 The Effect of Damaged Forests on the Development of Recreation in Czechoslovakia

A stay in the forest has an irreplacable significance for man's mental and physical health. This is evident from the increasing frequency of forests visits not only in the vicinity of cities but also in mountain areas. Zundel (1985, p. 1102) pointed out that only 7% of the inhabitants of the Federal Republic of Germany (FRG) never goes to the forest, and that the forests there are visited annually by 1.2 billion people. On average, each hectare of the forest is visited 169 times per year which is 40 times more than the frequentation of museums in FRG. In addition, we believe that recreation demands on the natural environment are to be considered not only as a fashion wave of "return to nature" as some people fallaciously suppose, but an integral part of the lifestyle of modern people.

This is, of course, connected with a number of negative effects on the forest environment, e.g. disturbance of wildlife and other animals, damaging trees and soils in sloping terrains or even excessive mushroom picking which leads to the decrease of their reproductive fitness. Especially in forests adjacent to cities, this may mean a further increase in expenses devoted to the maintenance of walking paths and eventually to building up specific equipment for recreation such as benches and arbours.

As most forms of outdoor recreation are connected with nature and thus with forests, it is necessary to investigate the consequences of forest decline on demands for recreation. To understand this question better in the Czechoslovakian context, we explain briefly some specific features of the development of recreation in this country.

3.3.1 The Development of Individual Recreation in Czech Socialist Republic[5]

Between the World Wars, demands for recreation developed similarly in all industrial countries. Rich citizens had built exquisite summer residences in attractive districts, and eventually such localities became summer resorts. Middle classes, to a smaller extent, built weekend houses[6] in the neighborhood of forests and water, prevalently near cities. Moreover, the so-called "hikers' movement"[7] was developing among young proletarian people with a close relation to nature, who started to construct primitive timber chalet colonies in forests. The majority of families without means spent their holidays -- if ever they did so -- in rural inns but mainly in rented

rooms in peasants' houses or at their relatives in the country. Stays at mountain hotels or in spas could only be afforded by the rich.

The principal socioeconomic changes after World War II completely changed the situation. Exquisite summer residences mostly passed to state possession and were used for various social purposes or for permanent inhabitation. Socialization of the villages and gradual elevation of the living standards of their inhabitants resulted in a lack of interest in renting rooms. Thus, since the 1950s mainly families with children have been engaged in construction of weekend houses in recreation areas. As a matter of fact, these houses were imitations of original hikers' chalets with markedly higher standards of construction and equipment, but without other manifestations of hikers' subculture, without a close relation to nature and with certain tendencies to petit-burgeois tastes. The construction of weekend houses continued en masse during the 1960s and was supported by the production of prefabricated houses and by state credit. As these weekend-house colonies started to cover more and more sites suitable for recreation, namely agricultural land, in the 1970s this activity was permitted only in restricted districts according to territorial plans which were oriented to infertile land, or in as yet undeveloped lots in the original colonies. Nowadays,the construction of new weekend houses is significantly reduced.

At the end of the 1950s and at the beginning of the 1960s, the interest in adaptation of rural houses for recreation started to grow. In this era mainly houses in frontier mountain areas were used for this purpose because complicated living conditions made permanent settlement rather uncomfortable there. Later on, rural properties in small outlying communities were gradually converted to summer houses as the original inhabitants started to migrate to the so-called central villages where the necessary services were available.

In spite of the limited construction of weekend houses in the early 1970s (Table 3-3), the number of recreation properties increased very quickly during the period (i.e., by 25% in five years). The fastest growth occurred in South, North and East Bohemia, regions characterized by vast forests which were not yet visibly injured by pollutants (with the exception of the Ore Mountains). At the same time, North and East Bohemia have the greatest proportion of summer houses, which gives evidence for a large proportion of mountain recreation area in which it is not practical to build weekend houses. This is especially the case in mountainous sub-districts, where for example the number of summer houses in the district of Jablonec u. Neisse (the Jizerske Mountains) forms 73% fo the total recreational buildings, or in the Semily district (the Giant Mountains) 66%.

On the other hand, the majority of weekend houses is to be found in the regions of Central Bohemia and South Moravia which represent the main recreation background for Prague and Brno. This is influenced by the fact that for weekend houses a short commuting distance is preferred.

As evident from Table 3-3, already in 1976 there were 195,155 properties for so-called "individual recreation" registered in CSR. If we suppose that in each property there were at least five beds, the minimum lodging capacity was roughly over 1 million beds. Since 1976 the number of properties and their lodging capacity has markedly increased, although comprehensive data are not available. But the 1976 capacity in recreational properties is more than 6.5 times higher than that of all

Table 3.3. Number of properties for individual recreation in the regions of CSR.

Region	1971 Total %	1976 Total %	Weekend Houses	Summer Houses	Prop. of CSR Total %	Total 1976/ Total 1971 X 100
Capital-Prague	1,326	4,080	99.8	0.2	2.1	307.7
Central Bohemia	56,388	59,878	95.3	4.7	30.7	106.2
South Bohemia	10,604	15,797	82.4	17.6	8.1	149.0
West Bohemia	15,810	21,105	84.2	15.8	10.8	133.5
North Bohemia	16,460	20,448	56.2	43.8	10.5	124.2
East Bohemia	15,729	20,420	69.0	31.0	10.5	129.8
South Moravia	24,946	33,948	95.1	4.9	17.4	136.1
North Moravia	15,139	19,479	84.0	16.0	10.0	128.7
CSR	156,402	195,155	78.2	14.9	100.0	124.8

Source: Terplan, 1981.

public accommodation establishments in CSR in 1983, and 5 times higher than the capacity of whole Czechoslovakia (see Figure 3-2). A large proportion of the owners of properties of individual recreation comes from Prague - about 25% of Prague families own such an property. In spite of this, according to an inquiry by Marsalkova and Todlova (1985), in 1979 only about half these owners spent holidays in weekend or summer houses and more than 40% spent their holidays abroad. Their desire was, however, even more controversial as only 27% wished to spend holidays in their recreation houses, and over 60% respondents would prefer to go abroad. The difference between reality and desire was evidently caused by financial reasons.

3.3.1.1 Conclusions

With respect to forest decline, the majority of individual recreational weekend houses and especially summer houses are located in regions with severe or imminently severe forest decline. Nevertheless, owners of these properties are not disposed to sell them even if they do not fully utilize the accommodation capacity. The most important reason is probably that there is almost no possibility of further construction of new recreational houses or of obtaining similar properties in attractive, pollution-free areas of the country. As well, the prices of such properties is rising very quickly. Finally, most owners cling tightly to their recreational properties because they expended much personal labor and sometimes a lot of money to reconstruct and maintain them. Very often, the reconstruction of some rural houses has preserved historically valuable properties in traditional folk style which would otherwise fall into ruin, and the owners are very proud of such restorations. For all these reasons, the demand for these properties exceeds the supply.

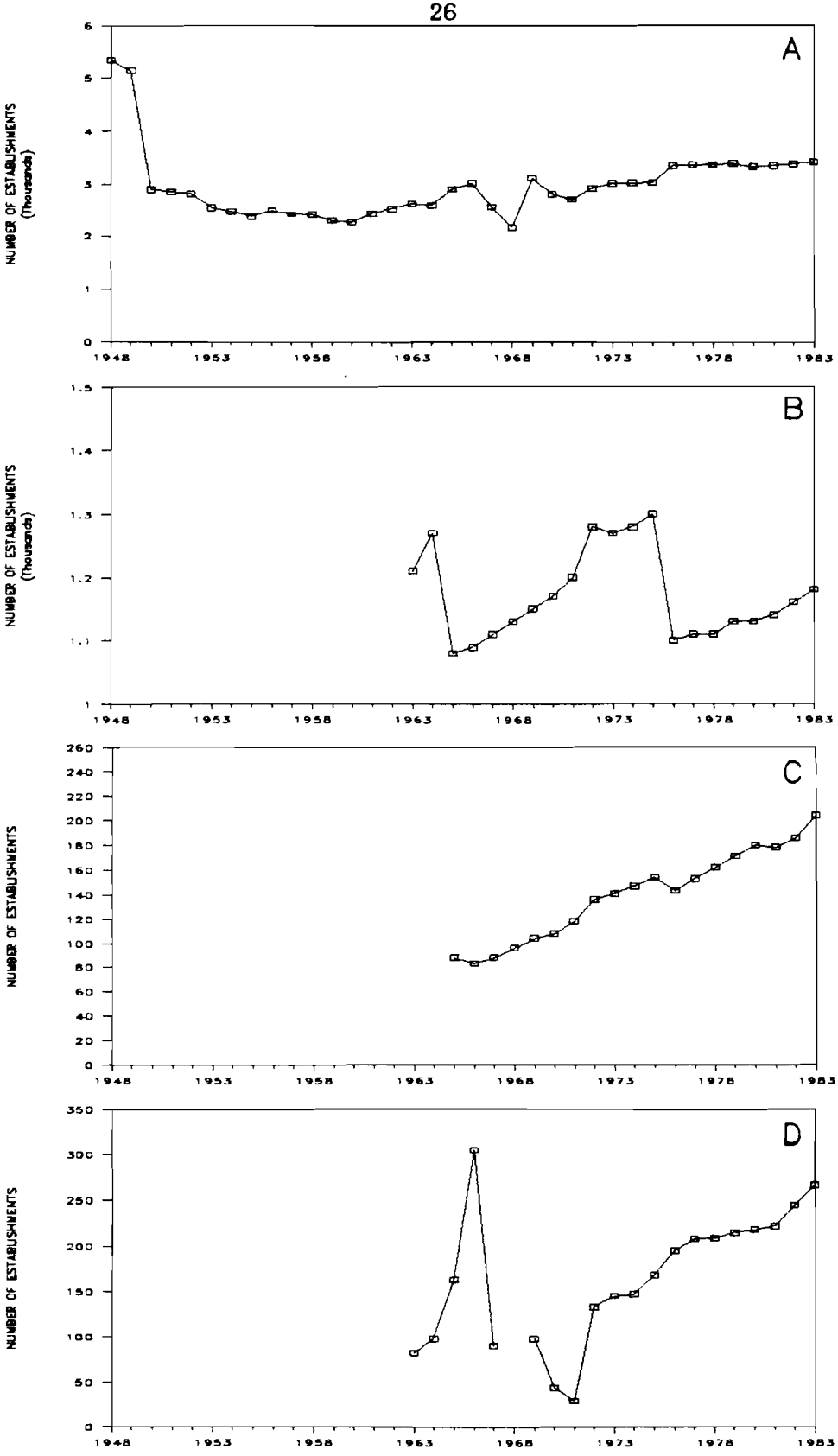

Figure 3-2a. Trends in number of accommodation establishments and number of beds over several decades in Czechoslovakia. (a) Number of accommodation establishments. Curve A is totals, curve B represents hotels, motels, and boatels, curve C represents deluxe hotels, and curve D represents caravan (trailer) and tent accommodations.

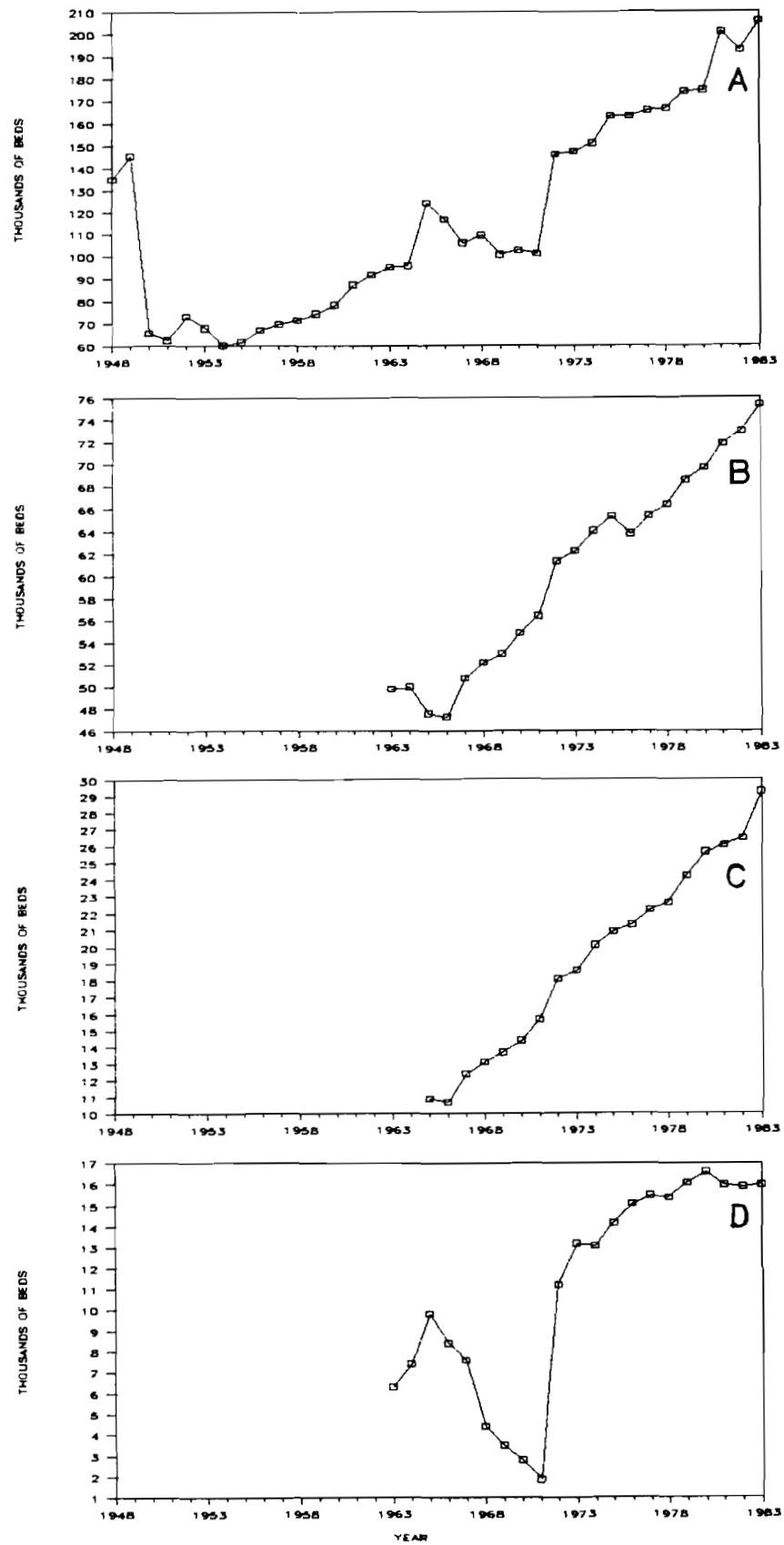

Figure 3-2b. Trends in number of accommodation establishments and number of beds over several decades in Czechoslovakia. (b) Number of beds. Curve A is totals, curve B represents hotels, motels, and boatels, curve C represents deluxe hotels, and curve D represents caravan (trailer) and tent accommodations.

Based on an informal inquiry at a Prague realty office (see Appendix I), it seems that the supply of properties of individual recreation offerred for sale, namely rural recreation houses in frontier mountains affected by pollutants, is negligible. Therefore, the pollutant situation and resulting forest damages seem not to have prompted owners to sell their recreation properties.

3.3.2 The Development of Open and Organized Travel in Czech Socialist Republic

The development of so-called "organized" travel in Czechoslovakia can be advantageously examined in terms of accommodation capacities of the central selective recreation of the Revolutionary Trade-Union Movement (ROH), capacities of trade-union recreation of individual enterprises (firms), and capacities of social organizations such as sports clubs or various associations. These recreational possibilities are rendered either to selected members of all trade-union organizations as a reward for their working achievements (selective ROH recreation), to employees of certain enterprises (enterprise recreation), or to members of certain organizations. This type of recreation is very advantageous from an individual's point of view because it is realized at cost or subsidized prices.

As for this kind of recreation, big hotels (central ROH recreation), and even smaller properties and eventually big houses in mountain areas, were gradually being sold in the 1950s, and the accommodation capacities of the so-called "open" travel were consequently reduced. These were properties accessible to the public, such as hotels, inns, hostels, and dormitories (Figure 3-2). The growth of capacities started in the 1960s and continued to develop especially in connection with increasing foreign travel (Figure 3-3). As Figure 3-3 indicates, there are about 14 million visitors coming to Czechoslovakia annually, about equal to the total population of the country. The number of visits peaked in 1978 with 19.4 million visitors. The decline since that time was influenced mainly by the limitations on Polish travel abroad since 1982. Hotels of higher standard are being built (Figure 3-2) which serve predominantly foreign visitors. Since the 1960s tourist and caravan sites have also been established as a result of improved motoring. These substituted - mainly in summer - the limited accommodation capacities in recreational areas and served mainly people of modest means (Figure 3-2).

The number of properties and beds of central ROH recreation has remained fairly constant over the past 20 years (properties dropped from 109 in 1965 to 96 in 1983; beds remained around 13,000 for the entire period), but use of the facilities has doubled (317,000 participants in 1965 to 641,000 in 1983, up by 102%) as they have remained open in off-seasons. Big new properties are being built or adapted mainly in the Giant Mountains (Krkonose). Also, the number of participants in this ROH recreation from abroad has significantly increased (from 1963 to 1984, up by 58%).

The main cause of the decrease in accommodation capacities of open travel in the 1950s was - especially in the mountains or in other attractive areas - that smaller properties suitable for recreation were transferred to enterprises which adapted them for their employees' recreation. At first, these properties were adapted by employees themselves but after establishment of the Fund of Social and Cultural Needs, administered by the Workers' Council of ROH in each enterprise, there were sufficient financial

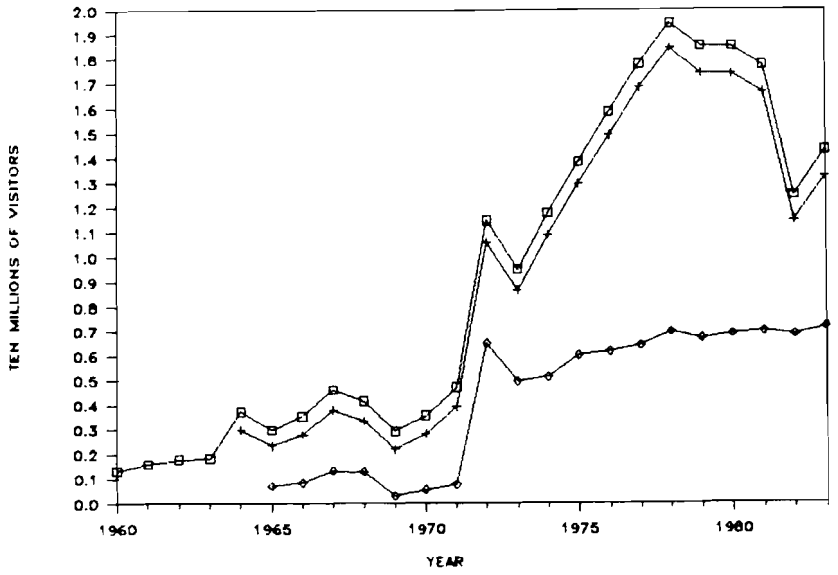

Figure 3-3. Annual number of visitors to Czechoslovakia over recent decades. The curve marked with squares is total, that with stars represents visitors from socialist countries, and that with diamonds represents visitors from GDR.

means for adaptations or even construction of new recreation properties. These funds, which are not, of course, used only for recreation, reached 7.9 billion Kcs by the end of 1984, and during 1984 this sum was augmented by 800 million Kcs. Employees' recreation is one of most important social programs in CSSR and it can be assumed that these capacities have been substantially increased in the last years and are markedly larger than capacities of public accommodation establishments. Moreover, some properties belonging to large, rich enterprises have high standards, sometimes comparable with five-star hotels.

Organized travel (i.e. mainly enterprise recreation) forms 71.1% of the total accommodation capacity in some mountain recreation areas (Table 3-4). The proportion in areas suffering from excessive pollution (the Ore Mountains, the Giant Mountains, the Luzicke Mountains and the Jizerske Mountains) is above this average. At the same time, demands for the construction of further recreation properties, and eventually for increases in their present capacity through adaptations, are constantly growing. Therefore we can suppose that the proportion of organized recreation in the majority of these areas has increased. Data on the contemporary situation -- with the exception of the Giant Mountains (see later) -- are not available.

Free capacities of enterprise recreational establishments stimulate the interest of employees to utilize them. As the increased interest is mainly in winter and summer recreation, free capacities are being offered in the other seasons to pensioners who are former employees, and employees of enterprises in other socialist countries (mainly the GDR), but mostly to the so-called "outdoor schools". Outdoor schools are organized for children from cities with polluted environments and are situated in the

Table 3.4. Capacities of free and organized travel in mountain recreation areas in CSR in 1976.

Area	Free		Organized		Total Beds
	Number of Beds	% of Total for Area	Number of Beds	% of Total for Area	
Ore Mountains	3,529	27.8	9,179	72.2	12,708
Luzicke Mountains	2,033	21.8	7,316	78.2	9,349
Jizerske Mountains	2,554	19.2	10,752	80.8	13,306
Giant Mountains	5,645	16.7	28,119	83.3	33,764
Orlicke Mountains	4,057	37.0	6,914	63.0	10,971
Sumava Mountains	4,315	27.5	11,353	72.5	15,668
Jeseniky Mountains	5,061	25.3	14,952	74.7	20,013
Beskydy Mountains	5,112	24.3	15,960	75.7	21,072
CSR Total	94,705	28.9	232,852	71.1	327,557

Source: Terplan, 1981.

mountains during the school-year. Besides regular lessons, children have plenty of opportunities to play in the open air and this -- as has been demonstrated by medical investigations -- improves their health. Outdoor schools are usually organized in one-month cycles and are repeated annually in the off-seasons.

That the pollution situation has not yet influenced the interest in recreation in these areas is supported by a comparison of data on the development of accommodation capacities of open and organized travel in two main recreation areas -- one of them is heavily polluted (the Giant Mountains) and the other relatively clean (the Sumava Mountains) (see Table 3-5). These data demonstrate that accommodation capacities were growing faster in the Giant Mountains than in the Sumava mainly due to the growth of organized travel thanks to enterprise recreation (central recreation was stagnating there at that time). The growth of capacities of open travel was relatively slow. Capacities in the Sumava were growing slower than in the Giant Mountains, and the difference between the growth of open and organized travel was not significant. This follows from the specificity of these mountain areas; the Giant Mountains form the recreational background of Prague, while the Sumava Mountains are visited in winter mainly by tourists from big cities of South and West Bohemia, and in summer by visitors from all Czechoslovakia as well as from abroad, mainly the GDR (who mainly use tourist caravan and tent accommodations, capacities which are not included in Table 3-5).

As further construction of enterprise recreational properties in attractive areas has been reduced since in the 1970s, many of the trade-union organizations of individual enterprises started to organize one-day

Table 3.5. Development of capacities in free and organized travel from 1976 to 1981. Figures are numbers of beds.

Type of Travel Capacity	Giant Mountains	Sumava Mountains
1976		
Free	5,645	4,315
Organized	28,119	11,353
Total	33,764	15,668
1981		
Free	6,106	5,134
Organized	43,872	14,557
Total	49,978	19,711
1981/1976 (%)		
Free	108.1	118.9
Organized	156.0	128.3
Total	148.0	125.8

Source: Terplan, 1981.

excursions to the mountains, especially in winter. The number of one-day visitors to attractive centers of winter sports even reaches the number of accommodated recreationists (see later). Thus, these centers are even overcrowded on weekends and are not able to provide visitors with sufficient services, mainly cableways and ski lifts, because their capacities were installed in relation to accommodation capacity, and such a quick development of one-day excursions had not been taken into account. In addition, further construction of cableways and ski lifts is limited in these regions for ecological reasons. Additional deforestation of damaged forests would disturb their structure and would contribute to further pollution damages with all their negative influences on the soil-protective and water-economic functions of these forests in sloping terrain.

In mountain areas, mainly the Giant Mountains, since the 1960s, the possibility of private lodging has been increasing. Local inhabitants rent rooms in their houses. These capacities are rented through the mediation of Cedok Travel Bureau or by means of accommodation services of National Committees. Interest in this type of accommodation, particularly in the Giant Mountains, greatly exceeds offerred capacities and for this reason they are being booked a long time in advance. Even these capacities are, however, insufficient, resulting in considerable demand for accommodation in the near environs from which visitors have to commute even tens of kilometers daily.

3.3.2.1 Conclusions

In considering the influence of forest decline on the development of open and organized travel, it is important to keep in mind the financial advantage of central and enterprise recreation. Also the limited

capacities of open travel significantly influence this relation. Even if some visitors wanted to reduce their recreation in pollutant-affected areas, they would not have many possibilities to go elsewhere. Open travel is mainly reserved for travel bureaus which release a considerable part of their capacities to foreign travellers, a major source of foreign currency income. This income is partly used by the bureaus to organize trips of Czechoslovakian citizens abroad.

As shown above, new capacities are still being built in polluted areas, for example the Giant Mountains. Travellers from Prague apparently value these mountains for their nearness and their excellent facilities and conditions for skiing and other sports. Thus, it seems reasonable to conclude that recreationists are more influenced by the availability of affordable central and enterprise recreational opportunities than they are by the fact that these facilities are located in areas where forest decline is severe.

3.3.3 The Effect of Damaged Forests on the Recreational Exploitation of Mountain Areas of Czech Socialist Republic

As has been stated before, forests damaged by pollutants are found mainly in mountain areas of CSR where mountain climatic conditions add to pollutant stresses. As individual mountains have specific and very different recreation and pollutant characteristics, we shall examine some of them in more detail. Special regard is given to the Giant Mountains where these relations are very marked and for which there is a good deal of fresh data at hand.

It is necessary to take into consideration the difference between winter and summer recreation because there exist different relations to the problems of damaged forests. Generally, winter recreation, particularly skiing, is very popular in Czechoslovakia. Over three million people own skis, and from this standpoint Czechoslovakia holds one of the foremost places in the world in the ski/person ratio. Suitable downhill skiing areas have been well equipped with lifts, hoists and other facilities. Thus, they serve as a skiing background not only for foreign visitors but also for big cities in the environs from which visitors arrive for both weekends and one-day trips. Interest in skiing is continually growing. Of course, in winter pollutant-injured forests are covered with snow and so the psychologic effect of their damage is probably somewhat moderated. It is also possible that visitors, their attention being directed intensely at their sporting activity, do not perceive this damage.

In summer pollutant-induced forest injury is more visible. Visitors are becoming direct witnesses of pollutant-injured forests which experience extensive wood extraction and afforestation works. Since this psychological effect is reflected in the frequentation of individual mountain areas in different ways, we will try to explain this effect in detail. We emphasize that these considerations are completely subjective and only in part supported by factual data.

3.3.3.1 The Ore Mountains (Krusne hory)

In the Ore Mountains, forests have been under the influence of pollutants for several decades, and thus are severely damaged, particularly in top zones. At present all the coniferous forests here are affected by

pollutants. The damage is not so evident at first sight on many slopes that are covered with deciduous trees.

In these mountains there are several large skiing centers serving the inhabitants of adjoining districts which are also influenced by pollutants from energy installations. The countryside here is also damaged by open-cast coal mining. Moreover, these places are also haunted by skiers from more remote districts, even from Prague. The exploitation of these centers has apparently not decreased because of their convenient commuting distance from nearby settlements which enables visitors to come for weekends or only for one day. In addition, there are relatively large accommodation capacities of organized travel which have probably increased since 1976. At that time there were 9,179 beds, i.e. 72.2% of the total capacity in the region (see Table 3-4).

We can presume that summer recreation in the Ore Mountains is rather different. For week-long and longer stays, capacities of enterprise recreation will probably be utilized, but the degree of their exploitation could not be ascertained for this study. Short-term frequentation, i.e. weekend or one-day visits, to the Ore Mountains have probably been significantly influenced by measures which enabled people living in mining and pollutant-affected districts to take advantage of bus excursions to clean areas at very low costs. This considerable compensation preference is extensively utilized and therefore it can be assumed that short-term recreation in the Ore Mountains has been markedly restricted. It is, however, probable that properties for individual recreation continue to be in full use.

The psychological effect of injured forests in the Ore Mountains is probably more oppressive to visitors from other parts of Czechoslovakia or to foreigners because local inhabitants accept this state as a part of their affected environment where they have to live throughout the year.

3.3.3.2 The Jizerske Mountains

In the Jizerske Mountains whole complexes of forests are injured by pollutants and wood extraction and afforestation are carried out over vast areas. These mountains serve as a recreational background mainly to the Liberec-Jablonec a.Niesse agglomeration and even to Prague. There is a relatively large number of properties of individual recreation. In 1976 there were 2,939 properties of this kind, 2,166 being rural recreation houses (73.7%). If we assume five beds for one property, we get a capacity of 14,695 beds, a slightly higher capacity than that of open (2,554 beds) and organized (10,752 beds) travel altogether (13,306 beds). As mentioned above, an increased tendency to sell these properties was not evident.

In these mountains there are good conditions for winter recreation, not only in several centers of downhill skiing, but especially for cross-country skiing. This possibility is used mainly for one-day trips from the nearby agglomeration Liberec-Jablonec a.Niesse because of its short distance. Also, the rate of frequentation from Prague is quite high (weekend and one-day trips). Many Prague enterprises have their recreation properties here. Organized travel reaches 80% which is the second highest level in the mountains of the CSR. Information and data on further development and on their present utilization are not available. From experience, however, it can be judged that winter recreation has not been influenced by damaged forests yet.

It is well possible that this does not hold for summer recreation. Capacities of enterprise as well as open travel were probably fully utilized, but it is possible that one-day trips from the nearby agglomeration have already stabilized or even decreased. However, for this statement there are no data at hand. In constrast with the sub-Ore Mountains' districts, no compensation recreational bus trips to other regions are organized. In addition, these mountains are easily accessible from the agglomeration by public transport. The psychologic effect of damaged forests, wood extraction and afforestation is considerable during summer as it affects large areas.

3.3.3.3 The Orlicke Mountains

The situation in the Orlicke Mountains is relatively favorable because only about one fifth of the forests here have been affected by pollutants. According to our estimation, there were in 1976 perhaps 1,300 properties of individual recreation with about 6,500 beds, forming approximately 60% of the accommodation capacity of open and organized travel (10,971 beds). Of this, enterprise recreation reached 63%. The Orlicke Mountains have become a recreational background for nearby districts, particularly for the agglomeration Hradec Kralove-Pardubice, but despite a relatively long distance tourists from Prague even visit these mountains. The Orlicke Mountains have relatively good conditions for winter recreation and, due to the construction of new downhill run centers, the number of visitors has increased. Summer recreation has probably stabilized, with a moderate growth of passing visitors. As forest damage does not have a significant character here, it probably will not unfavorably influence travel.

3.3.3.4 The Giant Mountains (Krkonose)

In the highest Bohemian mountains, the Giant Mountains, which are at the same time the only national park in CSR, pollutants, mainly from foreign sources, have afflicted approximately half of the forests over the past two decades. Another important factor contributing to environmental degradation is the growth of travel. The Giant Mountains are not only a recreational background of Prague and of entire East Bohemia, but visitors from all Czechoslovakia arrive here for long-term recreation. Tourists from abroad, mainly from the GDR, also visit these mountains regularly. In spite of various efforts to regulate the number of visitors, the interest is continually growing. To make easier the elaboration of the new Territorial Plan, The Giant Mountains have been divided into the mountain part, including big recreation centers, and the submontane part in which enterprise and individual recreation is concentrated (Terplan, 1987).

Although the Giant Mountains are far from being our most extensive mountain range, they have the largest accommodation capacity (Table 3-4). During the past nine years, the total accommodation capacity increased by 37%, i.e. 64,378 beds (Table 3-6). The fastest increase has been observed in individual recreation in the submontane part where it reached 253%, and in organized travel, particularly enterprise recreation. This latter type of recreation increased in the Giant Mountains by one third, but in submontane parts up to 272%. This follows from the fact that new properties are obtainable only in this region, while in the mountain part the construction

Table 3-6. The development of accommodation capacities in the Giant Mountains in 1976-1985. Figures are numbers of beds.

Region / Type of accommodation	Year		Increase from 1976 to 1985
	1976	1985	(%)
Mountain Part			
1. Open travel -- total	4,612	5,128	111
1.1. Hotel capacities	2,283	2,310	101
1.2. Non-hotel capacities (hostels, etc.)	2,329	2,818	121
2. Organized travel -- total	32,393	40,599	125
2.1. Central selective ROH recreation and other organized travel	3,122	3,918	125
2.2. Enterprise recreation	29,271	36,681	125
3. Total open and organized travel	37,005	45,727	124
4. Individual recreation	4,848	6,824	141
5. Montane total	41,853	52,551	126
6. Beds in privacy [1]	-	2,749	-
Submontane Part			
1. Open travel -- total	929	978	105
1.1. Hotel capacities	192	284	148
1.2. Non-hotel capacities (hotels, etc.)	737	694	94
2. Organized travel -- total	1,202	3,273	272
2.1. Central selective ROH recreation and other organized travel	-	-	-
2.2. Enterprise recreation	1,202	3,273	272
3. Total open and organized travel	2,131	4,251	199
4. Individual recreation	2,984	7,576	253
5. Sub-montane total	5,115	11,827	231
6. Beds in privacy [1]	-	4,932	-

Table 3-6. (continued).

Region Type of accommodation	Year		Increase from 1976 to 1985
	1976	1985	(%)
Total Giant Mountains			
1. Open travel -- total	5,641	6,106	110
1.1. Hotel capacities	2,475	2,594	105
1.2. Non-hotel capacities (hostels, etc.)	3,066	3,512	114
2. Organized travel -- total	33,595	43,872	130
2.1. Central selective ROH recreation and other organized travel	3,122	3,918	125
2.2. Enterprise recreation	30,473	39,954	131
3. Total open and organized travel	39,136	49,978	127
4. Individual recreation	7,832	14,400	184
5. Giant Mountains total	46,968	64,378	137
6. Beds in privacy [1]	-	4,932	-

Source: Terplan, 1987.

[1] For the year 1976 there are no data available for "beds in privacy" because they were not hired through organizations and thus were not on record.

of new properties is limited and it is only possible to increase the capacity of existing recreation properties. It can be presumed that further elevation of accommodation capacity will be oriented to more remote submontane areas and recreationists will have to commute. This will, of course, increase the traffic and consequently the emissions of automobile pollutants.

A further increase in frequentation is caused by one-day recreation trips organized by enterprises that do not have their own recreation property in the Giant Mountains. An investigation on one March weekend in 1979 (Stoklasa, 1981) found that 59.4% of all surveyed visitors arrived for one day, and 88.8% of them arrived by bus on Saturday.

Increases in frequentation are also confirmed by counting passing tourists on mountain ridges (KRNAP, 1987). The first counting of this kind was done in 1970 which was lately compared with those in 1981, 1982, 1984 and 1986. Growth coefficients in summer 1986 kept within 138% to 950%[8] in comparison

with the year 1970. All twelve places of transit experienced increased numbers of passing visitors. In winter 1982, in comparison with 1970, coefficients ranged from 0.64 to 10.83; in three localities, a decreased number of passing visitors was observed, and in nine localities an increase. The results were partly influenced by bad weather. These augmentations were higher in winter than in summer in the same year. Winter counting registers only those visitors who mount the ridges, so about 65% of the visitors (downhill runners) are not included in this investigation.

Winter frequentation, especially in recent years, is significantly increasing. As accommodation capacities in the mountain part are limited, visitors have to commute partly from the submontane part or from the near environs, and partly for one day from more remote places or from Prague. Also, visitors from the GDR contribute to the high frequentation. By counting cars on a park-site in Spindleruv Mlyn on a Monday in March (thus accounting only for long-term visitors with accommodation), it was found that cars from the GDR form 41.8% (Stoklasa, 1981). Also, in summer and mainly in off-seasons, the proportion of visitors from the GDR is relatively high. Because of a lack of accommodation capacities they stay in camps where their enterprises have installed caravans for the season. The proportion of foreigners from socialist countries (predominantly from the GDR) accommodated in the camp in Spindleruv Mlyn in 1981 was as high as 89%; in terms of number of overnights, it was 93.1%.

According to data accumulated for the preparation of the new Territorial Plan of the Giant Mountains (Terplan, 1987), in some parts of these mountains the number of visitors has already exceeded by 25% the directive frequentation supposed for the year 2000.

3.3.3.5 Conclusions

Even though data are generally incomplete, it seems that in spite of increasing forest damage, the number of visitors in the mountain regions of Czechoslovakia is generally growing. Exceptions could be found only in one-day visits to the Ore Mountains, as specific measures have enabled inhabitants of mining regions to use unpolluted recreation areas elsewhere at very low costs. In other mountains, the number of visitors is stable or increasing. In the Giant Mountains, despite rapid escalation of forest decline, there have also been rapid increases in the rate of tourist visits. This might be partially explained by increased general demands among Czechoslovakians for outdoor recreation, especially in winter, and the limited possibilities for residents of Prague to find such proximate, well-equipped skiing facilities elsewhere.

3.3.4 The Development of Travel in Slovakia

If we want to determine the effect of damaged forests on recreation in Slovakia, we have to take into account that the damage levels here are significantly smaller than in the CSR and reaches a total of about 14% by area. This is caused partly by more favorable composition of wood species in the Slovak Socialist Republic (SSR) where 48% of the forests are deciduous trees in comparison with 13% in CSR (Oberhauser, 1986, p.3), partly by a greater distance from sources of airborne pollutants, and partly by better soil conditions. Therefore, in Slovakia damaged forests are found only in some districts and are affected by pollutants from local

industry of specific character. Forests in recreation areas are not markedly damaged. In the greater part of the high mountains, and in recreationally attractive areas, the environment is more likely burdened by excessive tourism, making it necessary to regulate visitors' movements, especially in the High Tatry (Vysoke Tatry) and in the Small Fatra (Mala Fatra).

The development of travel in the SSR had a rather different character from that in the CSR (Table 3-7). Individual recreation has not developed so strongly and the proportion of its accommodation capacity is only 38.1% of the total, in comparison with 75.4% in the CSR. Of the total Czechoslovak accommodation capacity, the SSR share amounts to only 13%, although Slovakia has very suitable conditions for the development of travel. After subtraction of accommodation capacities of individual recreation, which distorts these data in favor of CSR, the SSR share still amounts to only 28.2% of the total accommodation capacities of open and organized travel in the CSSR. Slovakia covers 38.3% of the area of the country and the proportion of inhabitants forms 33.2% (see Table 1.1).

Plans for the year 2000 suppose increases in capacities of open travel up to 88,726 beds (i.e. to 188% in relation to 1976), of organized travel to 124,142 beds (i.e. to 151%) and of individual recreation to 120,582 beds (i.e. to 152%). These speculations result from the calculation of capacity of the total of 24 recreation areas in Slovakia and demonstrate that for the development of travel there are still unexploited reserves. At the same time only capacities of open travel are to be elevated.

3.3.4.1 Conclusions

The development of recreation and travel in Slovakia has different features than that of the CSR, in particular because of the higher proportion of open-travel accommodation capacities. The demand for recreation from citizens of this country and from GDR and Hungary is far higher than the capacities. Forest decline is now, and is expected to continue to be, of a local character and could not influence recreation. Thus, Slovakia possesses regions still unexploited for travel that could be developed. The most famous Slovakian recreation region, the alpine mountains, is already overcrowded and its accommodation capacities could not be expanded. But even with expansions of capacities elsewhere in the SSR, the visitor frequency to the CSR mountain regions will likely not change because such a high proportion of these visits are one-day visits, and the Slovakian regions are too far away from CSR population centers to be used for this purpose. An exception is the Ostrawa mining region from which some of the SSR recreation areas are accessible for one-day visits.

3.3.5 General Factors of Recreation Demand and Development

If we want to consider the influence of forest decline on the contemporary and future development of recreation, we must take into account several factors influencing the development of recreation demand. First, the deterioration is observed not only in forests but in the environment as a whole, including recreation areas. It is well known that the coast of the Mediterranean Sea is overcrowded with recreationists, that its waters are being polluted by wastes from cities, that the Alps are interweaved with cableway ropes, that recreation centers are overcrowded, that it is

Table 3-7. Recreational capacities in Czechoslovakia in 1976.

Type of Capacity	CSR	SSR	Total
Open			
Beds	94,705	46,946	141,651
% of region total	7.1	22.6	9.2
% of total this type	66.8	33.2	100
Organized			
Beds	232,852	81,820	314,672
% of region total	17.5	39.3	20.5
% of total this type	74.0	26.0	100
Individual			
Beds	1,000,000[1]	78,984	1,078,984
% of region total	75.4	38.1	70.3
% of total this type	92.7	7.3	100
Total			
Beds	1,327,557	207,750	1,535,307
% of country total	86.5	13.5	100

Sources: MLVH-SSR and MVT-SSR, 1980; and Terplan, 1981.

[1] Estimate from 195,155 properties of individual recreation.

difficult to find suitable places for camp sites, that we are surrounded by noise. If we compare this situation with that 20-30 years ago, the picture of recreation seems to have changed markedly all over Europe.

What are the causes of this rapid and devastating development of recreation? At first, recreational demands on the environment in all industrialized countries are not only a contemporary fashion wave of "return to nature" which could be in future converted to the fashion of, for example "return to the city". It is not only a natural reaction to the present urban style of life, hurry and stress situations, noise and devastation of the environment; it does not only mean air and water pollution and accumulation of wastes, but total degradation of the environment with consequent dehumanization of interpersonal relations. Thus, all types of recreation are becoming not only a hygienic need of the body but also of the spirit. People are feeling that they must for at least a short time of their holidays or weekends change their surroundings, they have to change their conventional style of life. Recreation of all kinds has become an integral part of the life of modern people, an integral part of their living style. This is true not only for urban inhabitants but more and more even for people living in close proximity to nature, e.g. for farmers exposed to the monotony of mechanized work.

In our opinion, there are additional factors supporting the necessity of recreation in all highly industrialized countries. Here, we will try to demonstrate them in the context of Czechoslovak development. These additional socioeconomic factors include:

(a) Growth of living standards, documented by the fact that real incomes have grown 4 times from 1953 to 1980. This growth has occurred after the saturation of vital necessities reflected in increased sums of money expended on recreation, because only in leisure time do people "materialize" their buying power. Over the same time in Czechoslovakia, citizens' expenses for recreation and spa treatment (without the contribution paid by the state) increased 21 times.

(b) Growth of leisure-time, although in the haste of our everyday life we seldom observe it. Not only are working hours being reduced, but most people have free Saturdays, holidays have been prolonged, and due to the development of services and modern household equipment, even the time necessary to attend to our housework has been shortened.

(c) Activization of leisure-time on the basis of propagation of outdoor exercise. People try to utilize their leisure-time not only after working hours (e.g., jogging) but mainly during holidays. While the number of members of the Czechoslovak sport and physical training organizations has doubled since 1957, the number of members of tourist organizations has increased threefold in the same time. Over the last 15 years, so-called long-distance marches have become very popular; thousands of people take part in them on various tracks.

(d) Growth of motoring. In comparison with 1971 the number of personal cars increased 2.7 times, and with 2.6 million cars in Czechoslovakia, we are approaching the level of developed industrialized countries. These cars, however, accumulate only small amounts of kilometers per annum because there is a very dense network of public transport at low prices to limit the use of cars for commuting. Thus, cars are used mainly on weekends and on holidays, that is, for recreation. Moreover, in 1984 enterprise-chartered coaches transported 80 million persons to various cultural centers and recreation areas, mainly in winter to the mountains.

(e) Development of trade-union recreation, a form of recreation enabling millions of citizens annually to spend, under advantageous financial conditions, their holidays or weekends in the country. And last but not least, we cannot forget organized holiday camps for children financed by trade-unions of individual enterprises.

(f) Increases in foreign visitors, which culminated in 1978 when our country was visited by 19.4 million foreigners (see Figure 3-3). The greatest proportion of the visitors came from the GDR.

On the one hand, all these trends can be considered as positive. We greatly appreciate the growth of living standards and leisure-time, that people look after their health with outdoor exercise, that we have more cars, that working people can recreate in trade-union holiday homes, that income from foreign travel increases. On the other hand, if we put together all these positive growth trends into a continuous flow of visitors into the Czechoslovakian environment, we are justifiably anxious about its future.

Furthermore, due to large-scale agricultural production, agricultural land, which covers 53.4% of the nation's area, can no longer be easily traversed by recreationists. Thus, the flow of visitors is directed to the remainder of the environment, i.e. to the forests, whose area covers 35.8% of our state. If we do not take into account forests in the vicinity of cities, the most frequented areas are state nature reserves (which form 15% of our total area) with numerous and beautiful forests. Most of these places are also in the mountains. Because a considerable part of our country is under the influence of pollutants, whether from local or remote sources, a great part of our recreation areas is situated in polluted territory. They are attractive recreation areas in which tourism has been developing at great expense since the last century.

3.3.6 Conclusions

Until now, there is no evidence that forest decline has had any effect on recreation patterns in Czechoslovakia. Even with increasing levels of forest damage in the mountain areas, recreational demand there has increased as well. Some stagnation of one-day visits in the most polluted parts of the Ore Mountains is evident, but mainly because of specific measures to provide low-cost recreational opportunities in non-polluted areas.

But the most important task is to assess the development of the influence of forest decline on recreation demand in the future. In such assessments, which by definition must be speculative, more questions are raised than answered. We believe that, if due to forest damage these areas lost a certain degree of their attractivity, it would be favorable because it would only reduce redundant frequentation, and accommodation capacities would reach a more "normal" level. It is disputable whether, due to forest decline, foreign visitors would lose their interest in visiting our country frequently; tourists from neighboring countries like to arrive not only because of natural beauties but also because of the proximity.

There is another question - in the case of reduced recreational possibilities in North Bohemia caused by injured forests, where could the mass of visitors be directed? South Bohemia could hardly cope with such a problem because recreation capacities and facilities are already now insufficient. It is questionable whether it would be reasonable to stimulate a transfer of interest by, for example, building up new capacities in the Sumava Mountains which are up to the present time relatively clean, and also relatively quiet and, with the exception of several localities, also less frequented than the Giant Mountains.

With regard to the efforts of foresters to afforest damaged areas, it can be presumed that they will succeed to keep even the worst places green. It means that in the course of ca. 20-30 years, such areas could again become attractive for recreation. Of course, it is supposed that they will not be destroyed beforehand by erosion caused by forestry itself or by excessive tourism. A certain form of travel regulation will therefore be necessary by means of concentrating travellers into well-equipped centers and by dispersion of such centers to additional areas suitable for recreation. Thus, it is contemplated in the country to revise the present territorial division and to locate new recreational areas, not as a consequence of decreased attractivity of recreation areas due to injured forests, but of their contemporary overload.

Although it is very difficult to forecast such a complicated phenomenon as recreation undoubtedly is, we suppose in future one can expect some decreased interest in visits to areas with damaged forests, mainly in one-day visits, first from more distant places, but later also from neighbouring agglomerations (of course, only if they have other possibilities). This will be more evident in summer than in winter. Even the enterprise capacities will stabilize after a small continued increase. It is well possible that the least tendency to abandon these localities will be found in the owners of individual recreation properties. There are three reasons for this: (a) owners have an emotional relation to their properties and would not like to part with them; (b) they will have no chance to obtain such a property in a clean area; and (c) prices of these properties in polluted areas could decrease in future and owners will try to cope with the critical forestless era. An example is the situation in the Ore Mountains where people recreate in surroundings of declining forests and wait patiently for new ones.

This examination of the effect of damaged forests on recreation in Czechoslovakia has intended to show that there are significant differences in the development of recreational behavior and demands in Czechoslovakia in comparison with Western developed countries. Individual recreation properties are a privilege of the most wealthy. As far as we know, enterprise recreation is rather an exception which is more likely the achievement of big firms. On the contrary, there exists a great accommodation capacity in hotels and boarding houses of various price categories. This capacity has rapidly increased due to a quick development of interest in recreation not only in developed countries, but mainly in southern Europe. The "overproduction" of capacities could lead, in our opinion, to the decreased interest to visit places with damaged environments (including pollutant-damaged forests), and to overcrowding in recreational centers which decreases their recreation value. This could have a considerable impact on the profitability of travel bureaus and travel establishments in these areas; hotels, smaller accommodation facilities, boarding houses and small country lessors that are economically weak would be destroyed first.

4. Development of the Czechoslovakia Forest-products Sector

4.1 Past Development[3]

Post-war activities aimed at the recovery of the damaged Czechoslovak national economy compelled, among other things, advancement in the traditional branches of Czechoslovak forest-products sector[10]. This included particularly a sufficiently high production of timber and constructional joinery products for housing and other buildings. Primary wood production was a prerequisite for the subsequent production of railway wagons and railways, for example. The production of furniture and built-in cabinets for the newly constructed flats was important as well.

As a result of activation of the forest-products sector for the satisfaction of all needs of the recovering Czechoslovak national economy, the pre-war level of production of the major commodities was surpassed (Table 4-1). The production levels shown in Table 4-1 were based on annual fellings amounting to an average of 10 million m^3, thus just exceeding the annual fellings in the crisis years before World War II (Figure 1-2). Till 1945 wood processing was rather scattered, consisting mainly of small-scale manufacturing. The situation in the pulp-and-paper industry was similar. The technological equipment in wood-processing plants and pulp-and-paper mills was obsolete and the labor organization standard was lower than in industrially developed countries.

The process of nationalization of Czechoslovak industry accelerated the integration of economy control and management in the forest-products sector (Table 4-2). A dynamic development of the forest-products sector set in after 1950 when in addition to the traditional products, the production of fibreboards and chipboards began. Technologies for the industrial processing of beech wood, previously used only as an energy source, also started to progress. This enabled the production of hardwood timber to double compared with the pre-war level, and the production of rayon pulp also commenced. This country was the first in Europe to launch the production of chipboards from beech waste (the Fahrni system). Similarly original was the use of sulphate technology with aqueous prehydrolysis in rayon pulp production.

An important prerequisite for updating the forest-products sector was the concentration of production associated with the building of large-scale, specialized, integrated production units. The building of integrated works was necessary for fulfilling the program of complex wood processing, which in this manner became a reality. New technological procedures were worked out and new delignification bleaching agents were discovered. A novelty in pulp production was development of continuous cooking processes. Measuring and controlling instrumentation was introduced. The production of agglomerated boards and other primary products continued to advance. These trends resulted in an exceedingly rapid development of this sector in the 1960s. Many pulp-and-paper mills, plywood works and saw mills were then built, and the total industrial production increased by a quarter.

The most rapid progress in the forest-products sector occurred in the 1970s and resulted in an 89% increase in production in the wood-products industry, and 73% in the pulp-and-paper industry (Table 4-3). The share of the forest-products sector in the total Czechoslovak industrial production exhibited two different trends: over the 1948-1970 period this share decreased from 8.7% to 4.9% (which actually reflects the more rapid advancement of other industrial branches, mechanical engineering and

Table 4-1. Production of forest products in Czechoslovakia in 1950.

Product Group	Production Level
Softwood timber	3,468 thousand m^3
Hardwood timber	325 thousand m^3
Broad-gauge and narrow-gauge sleepers	196 thousand m^3
Pulp	269 thousand tons
Cardboard and paper	291 thousand tons
Wooden flooring	929 thousand m^2
Original safety match boxes	109 thousand pcs
Furniture production	385 million Kcs
Windows	309 thousand m^2
Blockboards	76 thousand m^3
Sawdust boards	7 thousand m^3

Source: Oberhauser, 1986.

Table 4-2. Changes in the degree of nationalization of Czechoslovak industry from 1947 to 1949. Figures are percentages of total industry.

Sector		1947	1948	1949
State		17	53	78
Private	- Large-scale production	43	10	2
	- Small-scale production	40	37	20

Source: Oberhauser, 1986.

Table 4.3. Development of the forest-products sector[9] relative to total industrial production in Czechoslovakia since 1970. Figures are percentages of data for 1970.

Production Category	1975	1980	1984
Total, Forest-products Sector	138.4	173.8	191.4
Wood-processing Industry	142.4	188.9	209.5
Pulp-and-paper Industry	140.1	172.9	198.0

Source: FSU-SNTL, 1985b.

Table 4.4. Trends in exports of sawnwood, roundwood, and sawlogs from Czechoslovakia. Figures are in 1,000 cubic metres.

Product Category	YEAR						
	1948	1960	1970	1975	1980	1984	1985
Sawnwood	384	559	650	1015	930	1532	
Roundwood				2521	3446		1902
Sawlogs and Veneer logs				599	1163		541

Sources: FSU-SNTL, 1985b, for sawnwood data; FAO, 1986, for other data.

chemical production in particular), whereas over the 1970-1980 period this share increased to 5.3%.

The development of gross production in the forest-products sector (Figure 4-1) was oriented towards a more intensive use of all wood materials, with priority emphasis on reinforcement of the primary production capacities as a prerequisite for the development of the associated secondary production in the periods that followed. New plants were built up for fibreboard and chipboard, plywood, furniture and pulp production. Conditions were established for a gradual reduction in the import of pulps and agglomerated boards for the needs of the national economy. Appreciable improvement took place in satisfying the population's needs for furniture, sporting and technical products, toys and musical instruments.

The new trends were aimed at an increase in the export of timber and half-finished and finished goods, with a forced decreased export of roundwood in the last period (Table 4-4). Exports from the sector rose by ca. 4 times since 1971 (Figure 4-2), with an increase in the active export-import balance. Improvement in protection of the environment was achieved by implementation of new technologies and by extensive building of sewage treatment plants. Technologies for the production of pulp, enabling all kinds of softwood and hardwood to be processed, were developed and implemented. Conditions were thus established for lowering the use of firewood, whereby the wood use in industrial processing increased from 89% to 92.6%.

By the building of the production-technological basis of the forest-products sector over the 1970-1980 period, conditions were formed for rapid progress in production, particularly of agglomerated materials and pulps. This enabled wood material to be better exploited, including use of secondary materials in power generation. In total, the use of wood increased by 25%. In the 1970s the production of sawnwood increased 35%, plywood boards 67%, agglomerated boards 133%, pulps 64%, paper and cardboard 45%, furniture 272%, sporting and technical products and musical instruments 153%.

With respect to the production and consumption of plywood, agglomerated materials and timber, the CSR is at a level comparable with industrially developed European countries. In the per-capita production and consumption of paper and cardboard, Czechoslovakia assumes the 26th position. Over the period from 1950 to 1983, chipboard production increased by about 100 times, furniture production by about 17 times, and production of wooden windows by about 8 times (Table 4-5).

In the 1980s, the building up of the productive and technological basis of the forest-products sector was completed, particularly in the field of primary production and production of furniture. Owing to the adaptability of Czechoslovak forest-products sector to the altered conditions on the world market at those times, our export has continued to increase (Figure 4-2; Table 4-4), with an adequate import increase.

In 1984, the share of the wood-processing industry of the gross industrial production was 2.98%, and of the pulp-and-paper industry 1.83% (Table 4-6). Due to the higher share of handwork in the wood-processing industry (e.g., furniture, sporting and technical products, and musical instruments), the share of labor in this industry (4.4% of all industrial employees) is

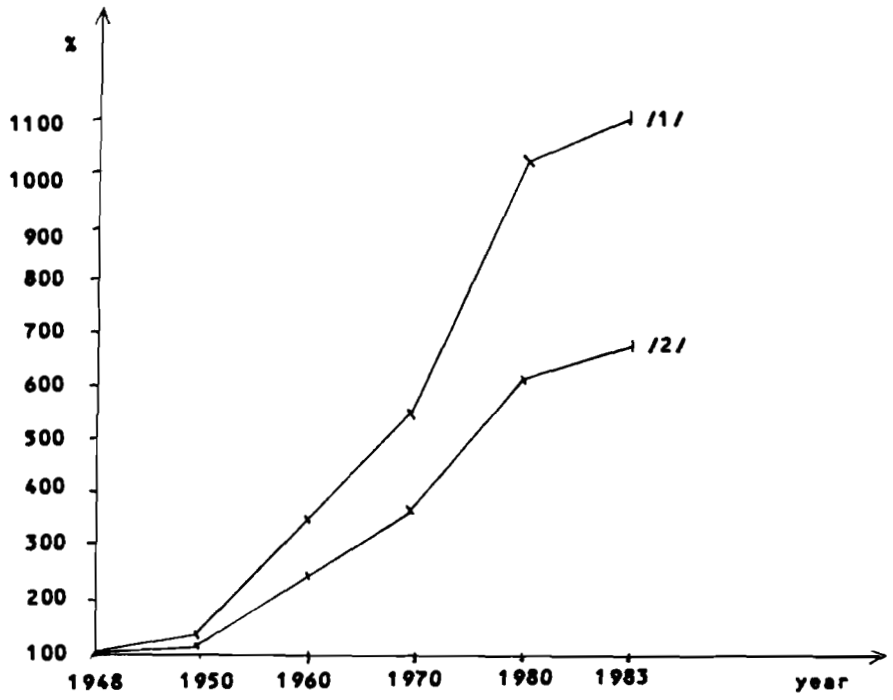

Figure 4-1. Trends in gross industrial production in the Czechoslovak forest-products sector since 1948. Curve 1 represents the forest-products sector, and curve 2 represents the pulp-and-paper industry.

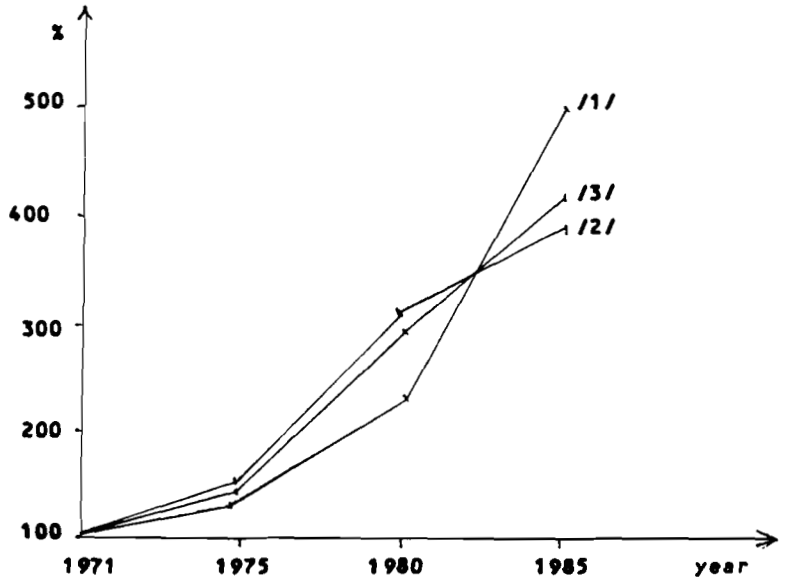

Figure 4-2. Trends in exports from the Czechoslovak forest-products sector. Curve 1 represents the wood-products industry, curve 2 the pulp-and-paper industry, and curve 3 the total from the sector.

Table 4-5. Production of selected forest products in 1950 and 1983 in Czechoslovakia.

Product	Production Level		Change in Production Level
	1950	1983	(1983/1950)
	Cubic Metres		
Softwood Timber	3,470,000	4,210,000	1.2
Hardwood Timber	330,000	810,000	2.5
Sleepers	200,000	130,000	0.7
Wooden Flooring	929,000	1,538,000	1.7
Wooden Windows	309,000	2,504,000	8.1
Blockboards	51,000	70,000	1.4
Chipboards	7,300	734,000	100.5
	Million CSSR Crowns (Kcs)		
Furniture	585	9,915	17.0
	Tonnes		
Unbleached Pulp	270,000	692,000	2.6
Paper and Cardboard	291,000	931,000	3.2

Source: Oberhauser, 1986.

Table 4.6. Participation of the wood-products and pulp-and-paper industries in the gross industrial production in CSSR in 1984.

Industrial Branch	Degree of Participation	
	Value (millions Kcs current prices)	Proportion of Total (%)
Total Gross Industrial Production	902,685	100.
Wood-products Industry	26,861	2.98
Pulp-and-paper Industry	16,526	1.83

Source: FSU-SNTL, 1985b.

relatively high. The share of labor in the pulp-and-paper industry is 1.73%, corresponding roughly to this industry's share in production (Table 4-7).

Table 4-7. Employees in the CSSR economy. Figures are in 1,000 persons.

Sector	Year			Percentage Change
	1975	1980	1984	
				1975-84
National Total	7060	7358	7534	+6.7
In Industry	2712	2779	2831	+4.4
				1980-84
In Wood-products Industry		129	127	-1.6
% from industry		4.6	4.5	
% from national economy		1.8	1.7	
In Pulp-and-paper Industry		48	49	+2.1
% from industry		1.7	1.7	
% from national economy		0.7	0.7	

Source: FSU-SNTL, 1985b.

4.2 Expected Directions of Future Development

Even if success is achieved in the 30% emission reduction in Europe in the early 1990s according to the treaties concluded, it is expected that where forests have been disturbed, this disturbance will continue. Among the primary tasks of forestry thus will be stabilization of forests for both timber and non-timber functions, thus ensuring equilibrium and stability of landscape systems and alleviation of all economic and social impacts of their disturbance. In view of the present and future forest damage, fellings could be expected to increase in the near term, and then to decrease at the end of the century by 600-800 thousand m3 per year (Oberhauser, 1987, p.24). In our opinion, this decrease could be much larger.

As wood is the basic prerequisite for development of the forest-products sector, production of wood in undisturbed forests must be increased both quantitatively and qualitatively by taking steps particularly in wood tending. The role of wood will grow in importance not only in connection with the decrease in the world wood resources but also for its use as a substitute for other deficient natural raw materials. The following steps should therefore be taken in undisturbed forests:

(a) by application of biological and ecological knowledge, the species composition of forests should be altered, and production of wood should be intensified by plantation management;

(b) mechanization of tending works should be increased; and

(c) overmature forests and stands with low growth increments should be felled and replaced by economically productive woods.

At the same time, attention must be given to the maximum exploitation of the wood felled and to the utilization of secondary wood resources, slash and wood-processing wastes, which are unused resources even today.

The forest-products sector then will have to fulfill the following tasks, which should help not only to solve problems associated with the changes in the raw wood material base and its quality and quantity, but also to implement the principal directions of development of the national economy of the CSSR, i.e. to reduce the energy and raw materials demands, increase labor productivity and contribute to environmental protection. Of these aspects, the following are most important:

(a) maximum exploitation of wood mass including processing of secondary wood resources and slash, and reduction in wood-processing losses in the industry;

(b) optimization of the structure of wood-based materials with simultaneous restrictions in the export of raw wood and replacement thereof by final products (e.g., furniture, prefabricated elements for civil engineering, packages, hygienic products);

(c) development of production of wooden buildings and their prefabricated structural systems, with a view to substituting for cement and steel and achieving reductions in the energy demand of the Czechoslovak national economy;

(d) improvement in the quality of packing materials to achieve a higher commercial standard, and in conservation of products by increased production of agglomerated and composite packing materials and cartonage using secondary raw materials (waste paper);

(e) increase in the production of wood-based hygienic products, e.g., sanitary papers;

(f) increase in the share of chemical treatment of wood waste for small-scale chemical productions, wood-processing and pulp-and-paper industries, textile industry, pharmaceutical industry, and production of perfumery and cosmetic goods; and

(g) use of biotechnologies in raw-wood treatment for the needs of some branches of industry and agriculture.

Based on these principal directions of development of forestry and the forest-products sector, Oberhauser et al. (1987) expected that relative to 1985, by 2000 the value of production in the wood complex will have increased by 46%. Taken separately, the value of production in forestry will grow only by 4%, while that of the forest-products sector will grow by 57%.

Due to the difficult situation in forestry associated with (a) compulsory felling in polluted areas, (b) problems of afforestation and reforestation, and (c) compensation for some failing non-timber forest functions by economic measures, costs will grow more rapidly than production in forestry, viz. by 29%, whereby this branch of the economy will become unprofitable and will have to be subsidized by the state to ensure the necessary social, ecological, water-controlling, anti-erosion and other non-timber functions. In the forest-products sector, on the other hand, costs will grow less rapidly than production, viz. by 34%, owing to rationalization measures. The profitability of this branch of industry thus will increase five times relative to 1985, while the profitability of forestry and the forest-products sector together will increase approximately four times. Material and energy costs should rise more slowly than output in the forest-products sector (and thus in the whole wood complex), whereas in forestry they will increase faster. It is also expected that about 1.5 times more money will be spent on wages due to the difficult nature of forestry work and the need to increase the number of employees in forestry. The value of production essentials in the whole wood complex will increase more than one-half, and by 60% in forestry alone. Wood exports, which were especially high in the early 1980s (Table 4-4), will have to be stopped, diverting the wood into production of higher-value-added products for export. By 2000, such exports should increase by 70% compared to 1985. Thus, exports from the whole wood complex would increase by 50% over the period 1985-2000.

As a result of rationalization in production, it will be possible to reduce staff in the forest-products sector to 78%; with a slight increase in forestry, this would make an overall decrease to 88% in the wood complex. This requires a substantial increase in labor productivity in the wood-processing industry, viz. a doubling; together with the slight decrease in labor productivity in forestry, this will make a total of 166% in the wood complex. In both branches of this complex, an increase in the average wages by one-half is expected.

4.3 Conclusions

As shown above, the impact of pollutants on forests will likely continue even if the reduction of emissions by 30% occurs in the early 1990s. After an increase in sanitation fellings of damaged stands, and an accompanying decrease in planned fellings in unaffected stands in the near term, wood supply can be expected to decrease slightly by the end of the century. To meet the planned development of the wood complex, it is thus necessary to apply to latest scientific and technological knowledge, and efforts must be made to exploit more fully all the wood raw material available. This will require extensive modernization of the industry, including (a) an increase in labor productivity and profitability, and (b) a decrease in energy and material demands in the entire wood complex. Huge investments will thus be necessary, for there is no alternative means of efficiently exploiting international markets for forest products at a time when there may be higher production in Czechoslovakia than domestic demand.

It will also be necessary at the turn of the century to re-orient the forest-products sector to the use of non-coniferous species, especially fast growing ones. These have heretofore been unimportant in the sector, but could play a central role in a few decades when coniferous raw material is expected to be in short supply.

5. General Conclusions

In the paper we have attempted to outline, by means of selected data, some consequences of forest decline caused by air pollutants in Czechoslovakia. Despite the fact that emissions in Europe are supposed to decrease by 30% in the early 1990s, it is probable that the damages will continue to increase due to the cumulative nature of the impacts on forests. Accordingly, economic damage, both direct and indirect, is also expected to rise. Direct damages refer to those in forest management, especially in wood increment. These increment losses are expected to grow from a contemporary value of 2.5 million m^3 annually to 3.3 million m^3 by 2000. The direct economic losses to forestry and the forest-products industry are estimated at about 2 billion Kcs per year, as mentioned earlier.

Nevertheless, these direct economic damages seem to be only a part of the total damage, which is very difficult to calculate. As a principal problem, consider the quantification of non-timber forest functions, mainly those connected with water management, as stated above, and the recreational functions. Tosovska (1985) cites references from the FRG and Japan that express the value of the non-timber functions as 5-20 times higher than that of the value of wood production. Some Soviet and Czechoslovak studies (also cited by Tosovska (1985)) determine it to be 3-4 times higher than the value of wood production.

At the same time it is necessary to consider the difference in importance of the non-timber functions in (a) managed forests, (b) forests for other special intentions, and (c) protective forests accomplishing largely the function of water management. For obvious reasons it is very difficult to express even a rough estimate of the total losses caused by air pollutants in forests. Such estimates are always biased by the individual author's approach. However, some non-timber forest functions such as water control and erosion control clearly could not be substituted by technical means, even at unlimited cost. Another serious problem is the potential psychological influence of damaged forests. From current reactions, it is impossible to foresee how this effect might develop and what might be done about it.

This paper covered the influence of forest decline on recreation demands in the most heavily polluted regions of Czechoslovakia. The analysis showed that there is a very high recreational accommodation capacity, especially in the CSR, in small private properties (weekend houses and summer houses) and trade-union properties. Such facilities give Czechoslovakians access to very affordable recreational opportunities. These recreational properties were developed mostly in forested mountain regions where the pollution depositions are greatest. Unfortunately, such generous recreational accommodation capacities have not been developed in areas that today are relatively unaffected by air pollutants. Moreover, private-property owners have invested much money and labour in their holdings and have strong sentimental attachments to them. And due to current restrictions on construction of new recreational buildings, there is little opportunity to move to the unpolluted areas of the country. However, the latest data show that, in recreationally important areas like the Giant Mountains, over the past decade both accommodation capacities and forest decline have increased dramatically.

There are still good prospects for recreation in Slovakia, which to now is not so polluted, but for the Czech people this is too far away to be enjoyed except during longer holidays. Additional accommodation capacities

are planned for Slovakia, but it is not sure whether they will be sufficient to take care of the demand from both Czechoslovakians and visitors from abroad. Indeed, it is impossible at this time to estimate the future progress of forest decline and its influences on recreational behavior. Until now, no effects of forest decline on recreation are evident; to the contrary, new recreational accommodation capacities are still being planned for the polluted areas.

On the other hand, there will likely be demonstrable effects of forest decline on the forest-products sector. Due to limitations of wood supply by the end of the century, changes are planned in the industry, especially oriented toward better wood utilization. These changes will require much new mechanization and thus investment, leading to higher labour productivity, lower exports of roundwood, and increased exports of higher-value-added products.

Thus, forest decline in Czechoslovakia can be expected to cause a variety of social, ecological and economic difficulties in the next decades. Despite the difficulties in estimating the cost of mitigating such impacts, there can be no doubt that these costs will be very high indeed. First, forestry and silviculture will experience higher costs due to difficult reforestation over large areas in mountain regions where erosion protection is necessary. Replacement of the forest water-controlling function with engineering works will be extremely expensive. While the question remains open whether recreational capacities in the polluted mountain areas will need to be replaced by new capacities in unpolluted areas, if this replacement were necessary it also would require huge sums of money. And finally, comprehensive modernization of the forest-products industry needs much investment.

Thus, we conclude that over the next few decades, one can expect great financial expenditures due to forest decline, with no alternative solution available. The further control of emissions over the next decade will undoubtedly ease the financial burden, but the emissions of the recent past will express their effects on the forests well into the next century. Political and state authorities are now paying much attention to this phenomenon. Their attention is drawn also to comprehensive outlooks for the socio-economic development of Czechoslovakia to the year 2010 and even beyond, with the outlook for the development of forest decline and its consequences assuming a central place in such planning.

NOTES

1. Bohemia and Moravia, which now constitutes the Czech Socialist Republic (CSR), and which together with the Slovak Socialist Republic (SSR) make up the Czechoslovak Socialist Republic (CSSR).

2. In Slovakia the historical background is somewhat different, and also the share of deciduous broadleaved trees is considerably higher there, amounting to 48%. The effect of pollutants is markedly less severe, forest damage being about one-half that in the Czech countries. The forest fraction from the total country area is also higher in Slovakia (39.9%) than in the Czech countries (33.0%; Table 1-1).

3. Oberhauser (1986) serves as the main reference here, with kind permission of the author.

4. A centennial flood (Q_{100}) or quincentennial flood (Q_{500}) means a theoretical flood which could repeat every 100 years or 500 years, respectively.

5. In Slovakia the development of recreation demands was rather different, and because there is less severe forest damage there, these problems are dealt with separately.

6. "Weekend houses" denote small chalets built especially for recreation. By "summer houses" we mean houses that once were permanent dwellings in villages or rural areas, but have been reconstructed for recreational use. These two types of buildings together constitute "properties of individual recreation".

7. The hikers' movement developed in Bohemia in the 1920s. It had a spontaneously protestant character directed against the city, bourgeoisie and social injustice, and was inclined to communist ideals. The movement created not only specific constructions (hikers' timber chalet colonies), but also a peculiar subculture manifested in specific behaviour, clothing, diction and even music. The tradition of the movement has, in a modified form, survived among young people up to the present time.

8. One atypical locality reached 2,250% but it was the consequence of originally low number in 1970.

9. The term "forest-products sector" is used here to denote both the pulp-and-paper industry and all other "wood-processing industries" (e.g., sawmilling, panel manufacturing, etc.). The term "wood complex" includes both the forest-products sector and forestry.

REFERENCES

Becvar, V. 1978. Vodohospodarska opatreni v oblasti SHD po roce 1980 (Water management measures in the North Bohemia Brown Coal Mining District after 1980 - in Czech). Research Institute for Water Management, Prague.

ECE/FAO. 1986. European Timber Trends and Prospects to the Year 2000 and Beyond. United Nations Economic Commission for Europe, and Food and Agriculture Organization of the United Nations, New York. Two volumes.

FAO. 1986. Yearbook of Forest Products. Food and Agriculture Organization of the United Nations, Rome.

Fietkau, H.J., Matschuk, H., Moser, H. and Schulz, W. 1986. Waldsterben -- Urteilsgewohnheiten und Kommunikationsprocesse. Ein Erfahrungsbericht. (Forest Decline - Processes of Estimation and Communication - in German) Report 86-6, Internationales Institut und Gesellschaft, Berlin-West. 63 pp.

FSU-SNTL. 1985a. Historicka statisticka rocenka CSSR (Historical Statistical Yearbook of CSSR - in Czech). Federal Statistical Office and State Technical Publishing House, Prague.

FSU-SNTL. 1985b. Statisticka rocenka CSSR (Statistical Yearbook of CSSR - in Czech). Federal Statistical Office and State Technical Publishing House, Prague.

Komarek, S. 1983. Ekonomicka efektivnost dispecerskeho rizeni pri prevadeni povodni (Economic efficiency of management of flood-control measures - in Czech). Unpublished material, Povodi Ohre, Karlovy Vary.

Krecmer, V. 1984. Ovlivneni vodohospodarskych funkci lesu (Effects on the water-controlling functions of forests - in Czech). In: Obnova a pestovani lesnich porostu v oblastech postizenych prumyslovymi imisemi (Forest renewal and tending in regions disturbed by industrial pollutants - in Czech) (V. Perina, editor), pp. 54-63. Ministry of Forestry and Water Management of the Czech Socialist Republic, and SZN, Prague.

Krecmer, V. 1986. Ekonomicke hodnoceni lesniho fondu jako nositele hydrickych funkci a jejich narodohospodarska efektivnost (Economic evaluation of forest resources in carrying out hydric functions, and their economic efficiency - in Czech). Vodni Hospodarstvi A 35(2):46-52.

Krecmer, V. and Perina, V. 1981. Funkce horskych lesu v ochrane a tvorbe vodnich zdroju v soubehu s funkci drevoprodukcni -- prispevek k problematice funkcni integrace (Function of mountain forests in the protection and formation of water sources, concurrent with the wood-production function -- a contribution to the problem of function integration - in Czech). Opera Corcontica 18:13-51.

KRNAP. 1987. Pruzkum navstevnosti Krkonos (Investigation of visitor frequency in Giant Mountains - in Czech). Unpublished manuscript. Giant Mountains National Park Management (KRNAP), Vrchlabi.

Kuusela, K. 1987. Silvicultural regimes in the cause and effect relationships of the forest-damage situation in Central Europe. WP-87-31. International Institute for Applied Systems Analysis, Laxenburg, Austria.

Lokvenc, T. 1978. Toulky krkonosskou minulosti (Strolling through the past in the Giant Mountains - in Czech). Kruh, Hradec Kralove.

Marsalkova, M. and Todlova, M. 1985. Podklady, informace a namety pro dalsi rozroj rekreace v CSR (Data, Information and Suggestions for Further Development of Travel in CSR - in Czech). Institute of Landscape Ecology of the Czechoslovak Academy of Sciences, Ceske Budejovice.

Materna, J. 1985. Znecistene ovzdusi a skody na lesich (Air Pollution and Forest Damage - in Czech and German). In: Umweltschutz eine internationale Aufgabe, CSR-Nordrhein-Westfalen Symposium, Czech Committee for Scientific, Technological and Investment Progress, Prague.

MLVH-SSR and MVT-SSR. 1980. Aktualizace rajonizace cestovniho ruchu SSR (Actualization of Territorial Distribution of Travel in SSR - in Slovak.). Ministry of Trade of SSR and Ministry of Science and Technology of SSR, Bratislava.

Nilsson, S. 1986. Extent of damage to forests in Europe attributed to air pollution. Swedish University of Agricultural Sciences, Garpenberg, Sweden.

Nilsson, S. 1987. Extent of forest damage attributed to air pollutants -- with update for the situation 1986. Swedish University of Agricultural Sciences, Garpenberg, Sweden.

Nozicka, J. 1957. Prehled vyvoje nasich lesu (A Survey of Development of Our Forests - in Czech). SZN, Prague.

Oberhauser, V. 1986. Rozvoj lesnictva a priemyslu spracovania dreva v CSSR v rokoch 1947-2020 (Development of forestry and the forest-products sector in the Czechoslovak Socialist Republic, 1947-2020 - in Czech). National Report - Czechoslovakia, for the ECE Timber Committee and FAO European Forestry Commission. Institute of Economics and Industrial Management, Bratislava.

Oberhauser, V. (editor). 1987. Spresneny variant prognozy vedecko-technickeho rozvoja lesnicko-drevospracujuceho komplexu CSSR a komplexneho spracovania drevnej hmoty (A refined variant of outlook of the scientific and technological development of the wood-complex of the Czechoslovak Socialist Republic and the comprehensive processing of wood material - in Czech). Institute of Economics and Industrial Management, Bratislava.

Perina, V. (editor). 1984. Obnova a pestovani lesnich porostu v oblastech postizenych prumyslovymi imisemi (Forest renewal and tending in regions disturbed by industrial pollutants - in Czech). Ministry of Forestry and Water Management of the Czech Socialist Republic, and SZN, Prague.

Perina, V. 1987. Nalehavy a neodkladny ukol (A pressing, urgent task - in Czech). Rude Pravo, 9 September 1987.

Schotte, L. 1986. Air Pollutants -- Effects on Forests and Other Vegetation; Forest Resources and Economic Consequences. In: The Nordic Council's International Conference on Transboundary Air Pollution, Stockholm.

Stoklasa, J. 1923. Die Beschadigung der Vegetation durch Rauchgase und Fabrikexhalationen (Vegetation Damage from Smoke and Industrial Emissions - in German). Urban und Schwarzenberg, Berlin.

Stoklasa, J. 1981. Nektere predbezne vysledky orientacniho pruzkumu zimni navstevnosti Spindlerova Mlyna v roce 1979 (Some preliminary results of the orientation investigation on winter frequentation in Spindleruv Mlyn in the year 1979 - in Czech). Opera Corcontica 18:153-176.

Stoklasa, J. 1983. Vysledky ankety mezi zimnimi navstevniky Spindlerova Mlyna v r. 1980 -- Analyza I stupne (Results of Inquiry Among Winter Visitors of Spindleruv Mlyn in the year 1980 -- First Degree Analysis - in Czech). Opera Corcontica 20:153-182.

Terplan. 1981. Aktualizace rajonizace cestovniho ruchu CSR (Actualization of Territorial Distribution of Travel in CSR - in Czech). Terplan, Prague.

Terplan. 1987. Krkonose -- pruzkumy a rozbory (The Giant Mountains -- Investigations and Analyses - in Czech). Vol. B. Terplan, Prague.

Tosovska, E. 1985. Ekonomicke ocenovani vlivu prumyslovych exhalaci na lesni porosty (Economic assessment of the influence of industrial emissions on forest stands - in Czech). Economic Institute of the Czechoslovak Academy of Sciences, Prague.

Valek, Z. 1962. Lesy, pole a pastviny v hydrologii pramennych oblasti Kychove a Zdechovky (Forests, fields and pastures in the hydrology of the Kychova and Zdechovka water spring regions - in Czech). In Prace a Studie. Research Institute for Water Managment, Prague.

Zundel, R. 1985. Die Oekologische Bedeutung des Waldes und die Folgen seiner Zerstorung (The Ecological Importance of Forests and the Consequences of their Decline - in German). Holz-Zentralblatt 72/73:1102.

APPENDIX I

INFORMAL INQUIRY INTO SALES OF RURAL HOUSES IN MOUNTAIN AREAS

An informal inquiry was conducted specifically for this study to determine the extent to which recreational properties with buildings are offered for sale. The inquiry was carried out at the real-estate office TOMOS in Prague, the largest office of its kind in negotiating the sale of realites. According to long-standing employees at TOMOS, there is a permanent interest in recreation houses in mountain areas regardless of the extent of forest damage due to air pollutants. Other areas which are highly desirable are in South Bohemia which is not too industrialized yet and has a beautiful though rather plain landscape. The purchase of recreational properties is influenced by their distance from Prague and from regional cities. Thus, a major criterion for prospective buyers is commuting distance from time-consumption and financial point of views, the latter being very significant after the rise of fuel prices in 1979. In spite of this, however, interest in the purchase of rural summer houses did not decline even though the commuting distance is, in comparison with that of weekend houses, twice as long.

The inquiry sought data on all properties offered for sale during the first six months of 1987. Within this period, a total of 1,718 properties were offered. Of them, 313 (18.2%) were rural houses and 217 (12.6%) were weekend houses. According to the latest published information (Terplan, 1981) in CSR in 1976, there were 166,149 weekend houses and 29,006 rural summer houses; thus, this six months' offering represents 0.13% of the weekend houses and 1.07% of the summer houses. It is necessary to take into consideration that the offerings also included properties which have been up to now permanently inhabited, and for various reasons (e.g., death of the house-holder, moving out) are now offered for recreational purposes. They are most probably properties in inland non-central communities. It is also necessary to take into account that TOMOS resides in Prague and therefore negotiation of sales in Moravia (the Jeseniky Mountains, the Beskydy Mountains) is limited. Thus, if we consider only the proportion of weekend houses sold in Bohemia, we get 0.19%, and for rural summer houses 1.29%.

The inquiry particularly recorded sales of summer and weekend houses in mountain areas affected by pollutants with the following results:

Ore Mountains	5
Jizerske Mountains	11
Luzicke Mountains	4
Giant Mountains	15
Sub-Giant Mountains	5
Orlicke Mountains	6
Jeseniky Mountains	1

From among the unpolluted mountain areas, we followed the Sumava Mountains with 12 rural summer houses offered for sale. The difference in sales between clean and polluted areas is not significant. In these mountain areas there were in total 59 rural houses offered for sale.

From the available data, though somewhat out of date, the following considerations can be constructed considering individual mountain areas.

They have to be taken with a certain reservation because they are based on subjective estimates combined with data within a ten-year range. Nevertheless, they could at least serve as an orientation to the effect of pollutants on individual recreation.

Table A1. Properties for individual recreation and summer houses in the Ore Mountains in 1976.

District	Properties	Summer Houses		Change in Number of Properties Since 1971 %
		Number	Proportion of Properties %	
Chomutov	2,178	646	29.7	126.8
Most	582	128	22.0	150.8
Teplice	942	187	19.9	119.8
Usti u. Elbe	1,922	284	14.8	110.2
Total	5,624	1,245	22.1	121.6

Of the 1,245 summer houses in the four districts shown, it is estimated that 80% of them actually lie in the Ore Mountains, i.e., ca. 1,000 houses. Of these, five (0.5%) were sold during the first six months of 1987.

Table A2. Properties for individual recreation and summer houses in the Jizerske Mountains in 1976.

District	Properties	Summer Houses		Change in Number of Properties Since 1971 %
		Number	Proportion of Properties %	
Jablonec u.N.	2,939	2,166	73.7	109.5

Of the 2,166 summer houses in the district shown, all of them lie in the Jizerske Mountains. Of these, eleven (0.5%) were sold during the first six months of 1987.

Table A3. Properties for individual recreation and summer houses in the Luzicke Mountains in 1976.

District	Properties	Summer Houses		Change in Number of Properties Since 1971 %
		Number	Proportion of Properties %	
Ceska Lipa	3,600	1,998	55.5	140.9

Of the 1,998 summer houses in the district shown, it is estimated that 30% of them actually lie in the Luzicke Mountains, i.e., ca. 600 houses. Of these, four (0.7%) were sold during the first six months of 1987.

Table A4. Properties for individual recreation and summer houses in the Orlicke Mountains in 1976.

District	Properties	Summer Houses		Change in Number of Properties Since 1971 %
		Number	Proportion of Properties %	
Nachod	1,498	1,024	68.4	100
Rychnov u.Kn.	2,254	750	33.3	143.2
Total	3,752	1,774	47.2	122.1

Of the 1,774 summer houses in the two districts shown, it is estimated that 40% of those in Nachod and 30% of those in Rychnov u.Kn. actually lie in the Orlicke Mountains, i.e., ca. 1,280 houses. Of these, six (0.5%) were sold during the first six months of 1987.

Table A5. Properties for individual recreation and summer houses in the Giant Mountains and environs in 1976.

District	Properties	Summer Houses		Change in Number of Properties Since 1971
		Number	Proportion of Properties %	%
Semily	2,065	1,367	66.2	112.5
Trutnov	2,758	1,257	45.6	157.6
Total	4,823	2,624	54.4	134.5

Of the 2,624 summer houses in the two districts shown, it is estimated that 90% of those in Semily and 60% of those in Trutnov actually lie in the Giant Mountains, i.e., ca. 1,980 houses. Of these, 20 (1.0%) were sold during the first six months of 1987. According to these data, it seems that sales in the Giant Mountains are higher than in the other mountain areas. In this case we can make more precise conclusions because for this area we have some orientation data on accommodation capacities in the year 1985 (Terplan 1987). Accordingly, in the Giant Mountains in 1985 the accommodation capacity in properties of individual recreation was 14,400 beds. If we presume that there are at least 5 beds in each property, the estimated number of properties is 3,480, of which 15 houses in this area were sold, i.e. 0.4%. Thus, we get roughly the same proportion as in the other mountain areas, even though for the latter we start from the state in 1976.