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PROCEEDINGS OF THE

SYMPOSIUM ON THE CO-OPERATION OF FORESTRY BETWEEN FINLAND AND BRAZIL

AUGUST 10–11, 1987

EDITED BY JARI PARVIAINEN

HELSINKI – JOENSUU 1987

FINLAND

SURFACE AREA	337,000 SQUARE KILOMETRES
LAND AREA	305,000 SQUARE KILOMETRES
POPULATION	4,8 MILLION INHABITANTS
FOREST AREA	199,000 SQUARE KILOMETRES
—"—	65% FROM LAND AREA

POLAR CIRCLE
ROVANIEMI
OULU
KAJAANI
VAASA
KUOPIO
JOENSUU
JYVÄSKYLÄ
SAVONLINNA
PORI
TAMPERE
MIKKELI
HÄMEENLINNA
LAHTI
TURKU
HELSINKI

M E T S Ä N T U T K I M U S L A I T O K S E N

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Proceedings of the

S Y M P O S I U M O N T H E C O - O P E R A T I O N O F F O R E S T R Y B E T W E E N F I N L A N D A N D B R A Z I L

August 10-11, 1987

EDITED BY JARI PARVIAINEN

HELSINKI

JOENSUU

PREFACE

In 1985 the Finnish Forest Research Institute and the Federal University of Parana (Curitiba) in Brazil signed an agreement on cooperation in forest research. The aim was to promote research of mutual interest and to increase the exchange of forestry information in general. Forest research, being part of wider scientific and technological cooperation, was also seen to promote economic and industrial cooperation between the two countries.

The importance of forestry cooperation has been emphasized in meetings of the Joint Finland-Brazil Commission on Economic and Industrial Cooperation. In the second meeting of the Joint Commission, in Brazil in 1986, it was agreed that the strengthening of cooperation be discussed in separate forestry seminars to be held in both Finland and Brazil. In accordance to this idea, the first seminar took place in Helsinki on 10th and 11th August 1987 and was followed by some excursions. The papers delivered at the seminar are included in this publication.

On behalf of the Finnish Forest Research Institute I wish to express our gratitude to the University of Parana for its excellent cooperation. Sincere thanks are also due to the sponsors of the cooperation, Department for Economic and Commercial Policy in Finnish Ministry for Foreign Affairs and Finnish Ministry of Trade and Industry.

Aarne Nyyssönen
Director
The Finnish Forest Research Institute

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  Ministry of Trade and Industry, Head of department Pertti Valtonen
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- Finnish forestry research and international co-operation
  Director, prof. Aarne Nyyssönen/The Finnish Forest Research Institute

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- National Forest Research Program - PNPF
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  Faculty of Forestry

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14.30-15.00 Coffee Break

15.00- DISCUSSION
17.00

- Possibilities for financing the co-operation

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SYMPOSIUM ON THE CO-OPERATION OF FORESTRY
BETWEEN FINLAND AND BRAZIL
August 10-11, 1987

Brazilian delegation

Bianchetti Arnaldo	EMBRAPA - Curitiba
Carneiro Jose Geraldo de Araujo	Universidade Federal do Parana (Curitiba)
Gomide Jose Livio	Universidade Federal de Vicosa
Kengen Sebastiao	IBDF - Brasilia
Malinovski Jorge	Universidade Federal do Parana (Curitiba)
Murakami Etsuro	Rigesa, Celulose, Papel e Embalagens Ltda
Gauch Glaudia	Embassy of Brazil in Finland

Finnish participants

Brotherus Tapani	Ministry of Foreign Affairs
Eskola Antti	Ministry of Trade and Industry
Gunn Reijo	Finnish Foreign Trade Association
Hakkila Pentti	The Finnish Forest Research Institute
Harstela Pertti	The Finnish Forest Research Institute
Kanninen Markku	The Society of Forestry in Finland
Kanon Pertti	The National Board of Forestry
Kellomäki Seppo	The University of Joensuu
Koljonen Kauko	Pellervo Economic Research Institute
Korvenheimo Pekka J.	Ministry for Foreign Affairs
Laitinen Olli	Ministry of Trade and Industry
Leikola Matti	The University of Helsinki
Mattila Reijo	SKOPbank of Finland
Määttä Matti	The National Board of Forestry
Nyyssönen Aarne	The Finnish Forest Research Institute
Parviainen Jari	The Finnish Forest Research Institute
Penttilä Matti	Finnish Foreign Trade Association
Riihinen Päiviö	The University of Helsinki
Turakka Antti	Enso-Gutzeit Oy
Tähtinen Tuija	SKOPbank of Finland
Valtanen Hannu	The Central Association of Finnish Forest Industries
Valtonen Pertti	Ministry of Trade and Industry
Uronen Reino	Ministry of Agriculture and Forestry

Ambassador **Pekka J. Korvenheimo**
Ministry for Foreign Affairs

Ladies and Gentlemen
Estimados Amigos Brasileiros,

Finland and Brazil have a long history of excellent relations. The diplomatic relations were established as early as the 1920's - soon after Finland gained independence. Today, as throughout their history our relations remain excellent. Today's Brazil, which has in a few decades developed into one of the leading industrial and economic powers in the world, offers many opportunities for cooperation. On the other hand, as one of the most advanced European States Finland can offer Brazil many such products and technology as Brazil does not have. Nevertheless, trade contacts and economic and scientific co-operation, in general are far too few in comparison to possibilities. It is our wish therefore that our co-operation will be increased and obstacles for co-operation be removed. Economic and co-operation between our two countries can be promoted through more efficient dissemination and an improved knowledge of each other. An important instrument to this end is the Finnish-Brazilian Joint Commission which has been established according to the Agreement on Industrial and Economic Co-operation which was signed in 1981. The Joint-Commission has held two meetings, the first one in 1984 in Helsinki and the second one in 1986 in Brasilia.

Proposals on economic and industrial cooperation included areas like forestry and wood processing, mining and metallurgy, shipbuilding, cargo handling and energy technology. Finnish companies have been operating in these fields in Brazil and are looking for further possibilities of industrial cooperation.

Scientific and technological cooperation was discussed in both Joint Commission meetings. Exchange of experts and joint research projects have been started in the fields of forestry and geology. Both Finnish and Brazilian research institutes have expressed their interest in expanding the cooperation into new areas such as biotechnology, Antarctic research, new materials, semiconductor research and energy technology.

The research cooperation has been most active in forestry research. Brazil has enormous forest resources ranging from tropical forests in the north to coniferous forests in the south. Joint research has concentrated on planted forests, which have been expanded rapidly, especially in the Southern Brazil. Finnish companies have advanced forestry technology with applications from reforestation to harvesting machinery. We hope that this seminar could promote introduction of Finnish forestry technology in Brazil and increase economic cooperation between Finnish and Brazilians companies.

This seminar will be followed by a similar one next year in Brazil. We consider these seminars as an important means of presenting the research activities, technology and forestry policy of our two countries. We hope that the cooperation can be deepened in this area so important to all of us!

I would like to wish you all welcome once again and declare this seminar opened.

Estimados Amigos'

Para mim e um grande prazer inaugurar este importante Simposio de Cooperacao Florestal. Estou satisfeito em ver tantos pesquisadores brasileiros interessados em nosso pais e isto me faz recordar o prazer que tive em viver no Brasil por mais de cinco anos.

Espero que os senhores apreciem sua estadia na Finlandia e possam aproveitar bem o campo florestal do pais como tambem as iversas outras areas que os senhores certamente terão a oportunidade de conhecer.

Charge d́ Affairs of Brazil
Glaucia Gauch
Embassy of Brazil in Finland

Let me, first of all, express to the organizers of this symposium my deep appreciation for the generous hospitality that the members of my delegation have enjoyed in Finland as well as for the excellent arrangements which have been undertaken in order to ensure a smooth beginning of this meeting.

Allow me also to express my sincere gratitude to Ambassador Pekka Korvenheimo for the kind words addressed to my delegation and to my country. In the scope of his Ambassordship in Brasilia, one cannot ignore that much was done to improve the relations between Brazil and Finland. Some enunciations of his untiring work in this regard were the visits paid to my country by several Finnish authorities, in particular that one of Mr. Kalevi Sorsa in his capacity as Prime-Minister of Finland. Mr. Sorsa's visit, held in June of 1986, constituted without any doubts in an important turning-point in the relations between our two countries. Ambassador Korvenheimo's efforts aiming at the improvement of the bilateral relationship were also reflected in the successful results of the two Joint Commissions on Economic and Industrial Co-operation, held in 1984 and 1986, which represented in both occasions the most useful guiding instruments for the dialogue between the Brazilian and Finnish authorities and businessmen. Ambassador Korvenheimo's diplomatic action, his political acuteness and his remarkable personality explain the prestige that he has enjoyed in Brazil. These qualities are also the real key that he has left in the heart of all Brazilians.

Ladies and gentlemen,

The relations between Brazil and Finland have been characterized by a solid and traditional friendship. This friendship has already paved the way to a valuable and significant bilateral cooperation.

At first sight, there seems to be little in common between two countries located so far away from each other, with obvious differences in climate, language, culture and historical background. However, when we carry out an accurate analysis of our national objectives and compare the aims and ideals of our two foreign policies, it becomes easy to verify that the coincidences are far more numerous than it may appear to be the case at first sight. Our two countries proclaim the unconditional respect to the basic principles of trust and good relations among nations. We also proclaim that constructive dialogue and international cooperation are essential elements in favour of social and

economic advancement in the world. Such coincidences have contributed to the increasing identification of mutual interests in several areas of cooperation, having as background our excellent political understanding.

Among the nordic countries, Finland already occupies a relevant position in the economic, commercial, scientific and technological cooperation with Brazil. On the other hand, Brazil has been the main partner of Finland in Latin America. One outstanding example of this cooperation is the existence in Brazil of many Finnish enterprises which have been operating with success in the fields of industry and services. Moreover, the performance of the bilateral trade exchange and the continous joint action developed in the technical, scientifical and technological fields have also reflected the good level of cooperation between our countries.

Not disregarding the satisfactory results already obtained, we may recognize that still is much to be done, taking into account the great potentialities of our two countries. The favourable prospects of understanding in this regard are well illustrated by the ingenous cooperation forms which have been identified during the II Meeting of the Joint Commission Brazil-Finland on Economic and Industrial Cooperation, held in Brasilia, in October of last year.

In fact, this II Joint Commission led to the indentification of concrete opportunities for the diversification and enlargement of bilateral cooperation in several important sectors, among them, that one of forestry and agricultural machinery. The Finnish research works in this field have been internationally recognized for their high specialization level. On the other hand, as well known, Brazil is a country with large area of forests and fertile soil for agricultural purposes. For these reasons, the Finnish research works cannot help to be of great interest to Brazil.

The convergence of interests in this respect explain the cooperation agreement signed between the Finnish Forest Research Institute and the Brazilian Federal University of Parana as well as the joint research projects already under way. It is also in the context that, in the recent Second Joint Commission Brazil-Finland, the two Institutions, searching for further cooperation in the field of forestry, decided to promote two Symposia, the first of which we have the pleasure to see inaugurated today.

The agenda of this first Symposium, which reveals the participation of so many Brazilian and Finnish experts, is enough for us to certify the importance given to the meaning of this event.

Ladies and Gentlemen,

The joint efforts aimed at strenghtening our dialogue and increasing the bilateral cooperation raise the hope of the Brazilian delegation concerning the results of this first Symposium. We trust that the event meet its main purposes. We trust that, besides the continuation of the projects already approved in other occasions, we may proceed to a debate with creative proposals for future implementation.

Thank you.

Permanent secretary
Reino Uronen
Ministry of Agriculture and Forestry

SYMPOSIUM ON THE CO-OPERATION OF FORESTRY SECTOR
BETWEEN FINLAND AND BRAZIL

Ladies and getlemen, dear Brazilian guests,

It is a pleasure for me to welcome you all to Finland to this forestry symposium. Forestry and forest industries have been of exceptional importance for the development of Finnish society and the country's economy, for large scale forest industries began in Finland already one hundred years ago. Today, the forest industries account for almost 40 per cent of the value of the total exports of Finland. Its share used to be even higher, but anyway, forestry will stay as one of the most important sectors for our country. Because of that, we also need contacts with other forestry countries, not just in the form of commerce, but in the forms of changing experiences and information. As Brazil has one of the greatest forest potentials in the tropical forestry, we do appreciate our possibilities of co-operation. Brazil has also had a great influence on the development of forestry in the neighbouring countries and it will still be greater in the future.

Even though the distance between our countries is very long and there are great differences in the conditions, we still have similar goals for forestry. This fact gives a special interest for our co-operation.

The forestry contacts between Brazil and Finland have started in the fields of machinery and forest industries consulting. The co-operation in the field of research has started just a couple of years ago, which does not mean that it would be less important. The results of research work should always be the basis for forestry and forest industries in any country. The research results which have been reached in one country, cannot always be directly applied in another, for the circumstances do change. The mistakes that we make in the forests may sometimes be noticed just after several years and it may mean a great loss of money and severe problems in the balance of nature. As the Finnish Forest Research Institute, our biggest one in this field, has worked with the problems of forestry since the beginning of this century, I think the co-operation with it will prove to be useful. But, it is not just the basic facts about forestry that we need from the researchers, but the commerce also needs research results to be able to adapt the equipment and machinery to the conditions where they will be used. So, there are several reasons to wish that this co-operation will be successful.

When beginning a co-operation project, it may be difficult to find at once the most interesting fields with the best possibilities to succeed. As our first co-operation project now is reaching its end, it would be important to get a profound evaluation about the results, including the conceptions and wishes of both sides. One possibility for changing the experiences and discussing about the problems will be found in the symposiums. So, I wish that you will gain good results during these days. I also wish that our Brazilian guests will enjoy their stay in Finland.

Head of Bureau
Pertti Valtonen
Ministry of Trade and Industry

Ladies and gentlemen,

I would like to welcome you on behalf of the Ministry of Trade and Industry to this Symposium on the Cooperation of Forestry Sector between Finland and Brazil.

Scientific and technological cooperation between Finland and other European countries has long traditions and it is expanding rapidly. We have seen that scientific and technological cooperation could also promote economic and industrial cooperation, and thats why we would like to utilize this channel to increase our contacts also outside Europe.

In spite of the great distance and differences between our two countries, Finland and Brazil have a number of areas with good possibilities for cooperation. The forestry sector is one of the most natural ones, as both countries have vast forest resources and realize the importance of developing these resources in the most efficient way. We expect this cooperation to become a model for other fields, where we are starting joint research projects.

We know that the Brazilian forestry research has close contacts with the forestry industry of Brazil. Finnish companies have also supported research cooperation and are eager to apply their technology in Brazilian conditions.

The Ministry of Trade and Industry would like to encourage the participants of this symposium to start concrete research projects. The Ministry is ready to support such projects with its funds available for international technological cooperation.

We think that in the long run the cooperation in forestry sector can form a natural basis for expanding the cooperation for example to biotechnology and energy technology, which both have their applications in the forestry sector. My ministry has already financed studies on cooperation possibilities with Brazil in these fields.

I wish the work of this symposium the best success and once again wish you all, and especially our Brazilian guests, most welcome to this symposium.

Prof. **Jose Geraldo de Araujo Carneiro**
Head of the Brazilian Delegation

Welcome address

I would like to reinforce Miss Glaucia Gauch's words and in my name and in the name of my collegues I would like to thank for our invitation to this technical visit in Finland. As a part of the cooperation between a Brazilian University (the Federal University of Parana) and the Forest Research Institut of Finland I spent in 1982 some days in Finland and at that time I could realize the high technological development of the forest science in your country. You are a well developed forestry country as worldwide recognized. We are sure that we can adapt to the Brazilian climate and soil conditions many aspects of the techniques you have developed here over the years.

The forest science in Brazil is only about 27 years old. During those years we have worked hardly to improve our knowledge in forest science. My colleques are going to try to give you a general view since 1960 when our first school of Forestry was established. We believe that in this short period we have accomplished quite a lot. We have managed to develop a short rotation forest of Eucalyptus. These stands are ready to be endcut in only 7 years with a production of about 300 cubic meters/hectar. Our pine stands produce 900 cubic meters in 20 years.

We try to develop our research based on practical results. But we also realize that knowledges from a country like yours can be very useful for us. The results obtained during last two years through cooperation agreement between Finland and Brazil confirm it. Dr. Parviainen and I myself will speak today about the subject. We need to improve our forest techniques mainly in quality control of seedlings, tree improvement, desease control, pulp and paper, logging, forest exploitation, ergonomics, silviculture and mechanized operations in general.

On the other hand, we believe that getting to know tropical and temperate forests could contribute to an important experience for our collegues from Finland.

We hope that from now on the technical knowledge exchange between Finland and Brazil will be improved a great deal.

In our group there are representatives of two governmental research institutions, universities and private industry. All of us have high interest on this technical contact. We will certainly meet in Brazil with our Finnish counterparts in the second semester next year to continue our conversations and exchange of ideas. On this way we will precisely define the priority of the cooperation themes of the both sides for our eventual future cooperation.

Thank you very much for your attention.

Director **Aarne Nyyssönen**
The Finnish Forest Research Institute

FINNISH FORESTRY RESEARCH AND INTERNATIONAL COOPERATION

A real problem in Finland eighty years ago was the organization of higher forestry education and forest research. To solve this problem international cooperation was found to be necessary. By studying the corresponding arrangements in both Central European and other North European countries, a proposal was prepared concerning the necessary requirements in Finland. The transfer of the higher forestry education from a separate institution in Central Finland to the University of Helsinki and the establishment of the Society of Forestry were soon implemented. The implementation of the third proposal, the establishment of Forest Research Institute took about ten more years.

The importance of international cooperation to Finnish forest research had, in fact, been understood even earlier. In order to establish a forestry administration system, a German expert was invited to Finland in the 1850's. We may quote even older examples. Around about 1750 a Finnish professor (Kalm) became aquainted with forests of the present U.S.A. After that several dissertations on forestry were written at the University in Turku.

Our topic is the state of international cooperation in Finnish forestry research today. However, it may be helpful firstly to have a look at the existing research institutions in the field of forestry and wood science from Table 1 next page.

Table 1

FOREST RESEARCH INSTITUTIONS IN FINLAND

Forestry

Finnish Forest Research Institute
Universities (Helsinki, Joensuu)
Research Council for Agriculture and Forestry
Work Efficiency Association
Foundation for Forest Tree Breeding
Metsäteho (Efficiency in Forestry)

Wood Science

Helsinki University of Technology
Technical Research Centre of Finland
Finnish Pulp and Paper Research Institute

Society of Forestry in Finland

We may notice that in addition to two groups of research institutions there is the Society of Forestry which is a kind of coordinating agency in all the forest research in this country.

It can be roughly estimated that the total number of research workers in these organizations is around 400, and in forestry research alone some 300 with an annual research budget of some FIM 130 million. About two thirds of the total budget and manpower in forest research are accounted for by the Forest Research Institute. Thus, the number of scientists at this institute is almost 200. Total personnel is about 700, including temporary assistants. The annual work input is in the order of about 1000 man-years. About one half of the people work at the central units in the Helsinki area and the other half elsewhere. There are 8 research stations in different parts of the country. The surface area of research forests and nature conservation areas administered by the institute is 140 000 hectares.

The main activity of these institutions, forest research, involves publishing and extension activities. In addition, the Forest Research Institute has to be ready to prepare reports requested especially by government agencies. Another important activity is international cooperation.

Professional forestry education often means a start in the international cooperation. The present academic curricula in Finland include some courses in forestry in developing countries. These are partly being arranged as a common effort between the Nordic countries. The quantity and content of the international ingredients depend largely on the experience of the teachers. Forestry education is in a relatively favourable situation in this respect, since many teachers have international experience.

Possibilities to have practical training abroad and at the same time to collect materials for academic thesis work in foreign conditions have grown with increasing development operation. There are several countries in South-East Asia, Africa and also Latin America which cooperate in this respect. Among these countries Mexico is a special case: three years ago twelve advanced forestry students worked there in a Finnish bilateral project for a period of four months and thereby added significantly to the number of Finnish foresters in command of Spanish.

Among the fellowship programs for post-graduate studies available for Finnish professional foresters, the one for studies in the United States has been important. On the other hand, a number of foreign students have practised post-graduate studies in Finland. They come mainly from the African countries involved in development cooperation with Finland, but also from other countries. Some of them have also prepared their doctorates in Finland. A good step forward was taken a few years ago when a professorship in tropical silviculture was established at the University of Helsinki. Another field in which Finland has been rather active is the training in mechanical wood industries.

Possibilities for a closer coordination of forestry studies in the Nordic countries have been discussed since the early 1970's. Each main area of forest education has been discussed in a special conference and courses in modern research methods have been arranged.

In discussing international organizations in forest research, special attention has to be given to IUFRO, the International Union of Forest Research Organizations, which will soon be 100 years old. The main aim of this union is

to promote international cooperation in scientific studies embracing the whole field of research related to forestry, including forestry operations and forest products. In particular, its functions are exercised:

- By facilitating exchanges of ideas among individual research workers throughout the world,
- By creating and maintaing contacts between Member Organizations and by encouraging the establishment of common programmes of research and cooperation in their execution,
- By promoting the dissemination and application of research results,
- By cooperating with national and international organizations of a scientific, technical or cultural nature and more especially with the Food and Agriculture Organization of the United Nations (FAO),
- By working towards the introduction of a uniformity of nomenclature and for standardization in matters such as information storage and retrieval, and
- By arranging periodical meetings, often combined with excursions.

Members of IUFRO are research organizations, not countries nor individual research workers. There are about 600 member organizations in about 100 countries, among them 12 from Finland. The most conspicuous form of IUFRO activities are the world congresses held normally at five-year intervals. However, the activity proper takes place in about 250 groups - subject, project and working groups. The executive board of about forty members meets annually.

In principle, IUFRO activities mean the global cooperation of forest scientists, but the meetings may also have regional character. Since 1981 the orientation of cooperation took a new dimension when the World Bank and FAO came to the Kyoto congress asking: would it be a time for reappraisal of forestry research priorities in developing countries. A review of research needs had indicated that traditional forestry research was not making a sufficient contribution to rural development, existing institutional arrangements were inadequate to meet the needs for promotion of research and that the resources allocated to research in developing countries were inadequate.

The congress gave to following main recommendations concerning these matters:

- additional research is required to improve the contribution of forestry to rural development emphasizing the role of forests and trees in agriculture, to energy production and use, and to conservation,

- governments, multilateral international agencies and bilateral donors should review their forestry policies and support the efforts in generating strategies for the expansion of research and its redirection towards currently perceived needs, and

- IUFRO should examine its own structure in the light of such needs and consider modifying its organization to take full account of changing emphases in forestry.

As a follow-up to these recommendations, the IUFRO executive board hired a special coordinator for developing countries to assist in planning practical measures. Between the Kyoto and Ljubljana congresses, the special program succeeded in organizing workshops, disseminating information, stimulating research activities, and gaining acceptance and support among forestry professionals, research institutions, and governments in developing and developed countries, as well as among bilateral aid agencies and international organizations.

In the Ljubljana congress last year the International Council of IUFRO took an important step to institutionalize the special program. Based on the proposal of the new president of the organization, the council authorized and directed the executive board to

(1) take all necessary measures, consistent with IUFRO's statutes, to establish an International Council for Forestry Research and Extension (INCOFORE) whose task shall be to promote and foster forestry research and extension in developing countries;

(2) solicite support for INCOFORE from international organizations, countries, public and private institutions, private individuals and others;

(3) establish contacts and seek cooperation with such agencies, organizations and institutions as will contribute to encouraging coordination and support of forestry research and extension in developing countries, especially in the Tropics.

The proposed budget for INCOFORE for this five-year-period is USD 8 million. It is likely that also a Finnish financial support will be available for implementation of the program.

There are a number of other organizations of importance for special branches of forest research. These may have links with e.g. biology, genetics, and statistics. Examples of the organizations in which Finnish forest researchers have made contributions are IIASA, IEA, and IPS.

The cooperation between Nordic Countries has long traditions in various areas of life, including forestry. The experiences of this cooperation are in general very positive. A traditional feeling of solidarity, personal initiatives and similarity in conditions and problems in agriculture and forestry form the natural basis for the Nordic connections. Special progress has recently occured in the field of forest research.

The central organization for forest research is SNS, the Council of Cooperation for Nordic Forest Research, established in 1972. The budget of the Nordic Council of Ministers has channelled separate funds to SNS since 1978. Although these funds represent 1 to 2 % only of the total expenses of forest research in Nordic Countries, the relative importance of the SNS coordination has only increased with time.

For joint efforts in various fields of forest research there exist at present 17 working groups; e.g., Scandinavian Society of Forest Economics was founded 30 years ago already. The number of active research projects receiving common funds is of the same quantity. For the time being, forest technology projects enjoy the greatest share of the funds. In 1984, an important decision was made to establish a new forestry magazine, "Scandinavian Journal of Forest Research."

Cooperation based on bilateral agreements can involve forest research as one component. A number of countries can be mentioned in this context: China, France, both German states, Hungary, Poland and the Soviet Union. The exchange of scientific information has been continuing between Finland and Soviet Union in an organized form since 1970. Themes for long-term activities concern the mechanization of forest work, forest plantation, forest genetics and tree improvement, drainage of peatlands, and the application of mathematical methods and computers in forestry planning.

Forest research is an important component also in some bilateral agreements for international development cooperation. Actions have been taken in various regions. In Zambia our Forest Research Institute has been engaged in the project of forest research development. Some research tasks have also been included in forestry projects in Kenia and Sudan. The same is true with the project for mechanization of nursery and plantation practices in South Kalimantan of Indonesia. Similarly, Thailand is long-term cooperation partner with Finland in both forestry education and research.

We then come to Latin America where we have had contacts with many countries. Two of them may be specially mentioned: Mexico and Brazil. In Mexico we have been working since 1982 for the development of forestry and forest industries in the state of Guerrero. It has been a versatile, demanding and difficult project in which social aspects have been important. The problems at the national level have gained more importance at the second stage of the project which was started this year. Finally, the agreement between the University of Curitiba and Forest Research Institute has brought us to this symposium.

Our discussion today has dealt mainly with the forms of the international cooperation in forest research. I hope that during these days we will also be able to discuss the subject matters of this cooperation and that we will find our efforts worthwhile. We feel in Finland that international contacts have been of considerable benefit to our forest research. The cooperation has helped us to maintain international standards in our work and it has been of assistance in the orientation of our research activities and in the development of required norms and terminology. In some cases we have gained rather immediate benefit from the foreign studies whose results could be adapted to our own conditions. The participation in international cooperation may mean additional efforts and even sacrifices on the part of each individual. We should nevertheless be ready to assume our responsibility in the international development cooperation and in building international understanding.

Dr. Jari Parviainen
The Finnish Forest Research Institute
Joensuu Research Station

COOPERATION IN FORESTRY RESEARCH BETWEEN THE FINNISH FOREST RESEARCH INSTITUTE AND THE FEDERAL UNIVERSITY OF PARANA (CURITIBA, BRAZIL)

1. Background

Forestry research cooperation between Brazil and Finland has now continued for three years following the official agreement which was signed by representatives of the Finnish Forest Research Institute and the Federal University of Parana (Curitiba) in Curitiba in 1985. The project is being financed by funds from the Department for Economic and Commercial Policy of the Finnish Ministry for Foreign Affairs.

Although there have been contacts between Finland and Brazil in the forestry field already for a long time, this cooperation project is the first of its kind. The impetus for initiating cooperation has originated from Finnish participation in cooperation between the Albert Ludwigs-University of Freiburg, Federal Republic of Germany, and the Federal University of Parana (Curitiba), Brazil. Prof. Carneiro's activity for promoting the Finnish-Brazilian cooperation was crucial. Freiburg University has supported the activities of the Faculty of Forestry at Federal University of Parana since 1970. The West German organization for promoting cooperation with foreign countries (GTZ = Deutsche Gesellschaft fur Technische Zusammenarbeit) financed, within the framework of their cooperation agreement, a visit by three Finnish forestry experts to Brazil at the beginning of the 80's.

Both Brazil and Finland have considered that cooperation in the forestry field is interesting and beneficial to both parties. A paragraph outlining the development of forestry cooperation was included in the joint protocol of the economic and industrial cooperation negotiations held between the two countries in 1984 and 1986.

Certain Finnish companies active in the field of forestry have long experience of cooperation with the Brazilians. The most striking examples of such cooperation have concerned the manufacture of tractors (Valmet Oy), and consultation work for the Brazilian forest industry (Jaakko Pöyry Oy). In 1984, Intersilva, the body responsible for coordinating the Finnish forestry organizations' contacts abroad proposed to the Ministry for Foreign Affairs that coopera-

tion with Brazil in the field of forestry be expanded. At the instigation of the Finnish Forest Research Institute, the Department for Economic and Commercial Policy of the Finnish Ministry for Foreign Affairs started to fund forestry research cooperation with the Federal University of Parana (Curitiba) in Brazil in 1984.

2. Aims

The cooperation projects has been directed expressly at regeneration, cultivation and timber-harvesting questions associated with plantation forests in Brazil. The programme for establishing forest plantations in Brazil is one of the most extensive in the world. Among the countries in the Tropics, Brazil has been a pioneer in the establishment of plantations.

Since current forestry thinking in Finland follows lines similar to those in the establishment of plantations in Brazil, there is extremely great potential for cooperation between Finland and Brazil. The vast majority of the plantations established in Southern Brazil are pine (Pinus taeda, Pinus elliottii). The main tree species in Central Brazil is eucalyptus. Owing to the land ownership structure and tax concessions offerred by the Brazilian government, the prime mover in establishing plantations has been private companies. At the present time, the area of forest plantations in Southern and Central Brazil totals about 6 million hectares.

Joint studies have been directed at topics of interest to both countries. Research is being used to create a basis for expanding economic, industrial and technological cooperation. The project is also being used to establish contact between forestry experts from different organizations and quarters, and to increase their knowledge of forestry conditions in the two countries. For this reason, the dissemination of information about forestry in Brazil and Finland through lectures or seminars at the universities and forest industry factory visits, has held a central positions.

3. Implementation

The cooperation work has been implemented through exchange visits by researchers from the two countries. So far, a total of eight exchange trips have been arranged, of which four have been trips by Brazilian forest researchers to Finland, and the other four corresponding trips to Brazil. During the visits, the Finnish representatives have given eight lectures in Brazil, and the Brazilians five lectures in Finland. The coordinators for this cooperation have been Dr. Jari Parviainen from the Finnish Forest Research Institute and Prof. Dr. Jose Geraldo de Araujo Carneiro from the Federal University of Parana.

The individual projects in the joint research programme are as follows:

1. Comparison of methods for producing containerized tree seedlings for the establishment of forest plantations

So far, the majority of the pine plantations established in Southern Brazil have utilized bare-rooted transplants. However, the regeneration results could be probably improved if containerized seedlings were to be introduced in planting work. However, we still do not know which containerized seedling production methods would be best suited to Brazilian conditions. The present rate of plantation establishment (ca. 300,000 ha/annum) requires a yearly seedling production of over 500 million transplants.

Joint research is attempting to determine which containerized seedling production methods would be the most suitable for the raising and planting of Pinus taeda and P. elliottii seedlings. In addition to Brazilian methods, containerized seedling methods developed in Finland are also being compared. Paper pots (Lännen Tehtaat Oy), peatpots (A. Ahlström Oy), Ensopots (Enso-Gutzeit Oy) and Vapo pots (Vapo Oy) have been sent from Finland for testing in raising experiments. The Brazilian methods are Tubete, Jacatron and Taquara. The seedlings have been grown at Parana University's seedling nursery, in Curitiba, and then planted in comparison trials in the field. The intermediate results of the experimental series are to be analysed by autumn 1987. The preliminary results have already been published in Brazilian reports.

The preliminary results indicate that, of all the different Finnish seedling production methods tested, the paperpot method at least has good prospects for future use in Brazilian forest regeneration. In the economic and industrial cooperation negotiations held in Brazil in October 1986, it was decided that one primary aim of future cooperation work would be to establish a seedling nursery for testing purposes in Brazil. The nursery could be used for the large-scale production of, for instance, paperpot transplants, whose suitability for use in reforestation work could then be tested under practical conditions.

2. The variation in growth of Araucaria in virgin forests

Araucaria (Araucaria angustifolia) is tropical coniferous tree which forms clearly distinguishable annual rings. This phenomenon offers the possibility to compare the variation in annual-ring thickness with variation in the climatic conditions. This study

is unique in that it has been possible for the first time to analyse the growth variation of virgin forests, and the factors affecting this process, under tropical conditions. The variation in Araucaria growth has been determined for a period of over 80 years using sample trees.

Two reports have already been published on the results of this part of the cooperation project. The preliminary results indicate that, of the different climatic factors, precipitation is the factor most closely connected with the variation in the diameter growth of Araucaria. It can be assumed that the year-to-year variation in the seed crop of Araucaria has a strong effect on the diameter growth of the tree. Identification of this factor provides useful information for the development of suitable silvicultural methods for this tree species, especially as regards natural regeneration. Araucaria is a valuable conifer, which occurs naturally in the states of Parana and Sao Paulo, and whose conservation through the establishment of virgin forest reserves and forest plantations, is an extremely urgent task.

3. Development of timber harvesting methods and the mechanization of harvesting

Effective utilization of forest plantations presupposes rationalized timber harvesting methods. At the present time there is a special need to develop and test different mechanization solutions for use in the thinning of plantations.

Questions associated with the felling of eucalyptus stems have been investigated in the joint research programme. The study material has been collected from cutting sites of Klabin, an industrial forest enterprise. The aim has been to improve the work productivity of present-day work methods and working techniques in the forest. The results are providing the basic information needed in developing harvesting methods. The forest worker's equipment developed in Finland has aroused considerable interest in ergonometric studies on forest workers, and there are considered to be immediate applications for such equipment in Brazil. Finnish pulse meters are also to be sent from Finland for studies on the working positions and working techniques of the forest workers.

In addition to concrete research themes, the identification of different mechanization solutions for timber harvesting in forest plantations has also played a central role. Finnish harvesting machines have aroused considerable interest in Brazil, especially the small and agile machines which have been developed for thinning work. The Valmet do Brasil company, which has been operating in Brazil already for considerable time, has taken development aspects

of thinning and harvesting methods into consideration. Contacts have been made in Finland with e.g. Rauma-Repola Oy, which is responsible for the manufacture of Makeri harvesters.

The first international symposium to be held in South America on "Harvesting, Transport, Ergonomics and Forest Work Safety in Plantation Forestry", was arranged by the Federal University of Parana (Curitiba), together with IUFRO, in April 1987. A representative from the Finnish Forest Research Institute participated in the seminar within the framework of the cooperation project.

4. Investigations into the use of harvesting residues from pine plantations as an energy source

The aim of this part of the research programme has been to determine how much of the energy bound in biomass can be obtained from logging residues produced during thinnings or clear cuttings in pine plantations. The majority of the eucalyptus plantations in Central Brazil have been established with the express purpose of energy production. On the other hand, the energy value of wastewood from thinnings and harvesting in pine plantations is so far unknown. However, it is an important energy source in Brazil.

Material has been collected from loblolly pine plantations in Parana state for this study. Measurements on the energy content of samples were performed in Finland, within the framework of the cooperation programme, at the Domestic Energy Laboratory of the State Technical Research Centre. Estimates of the biomass and energy values obtainable from thinnings have been drawn up on the basis of these measurements. A report on this study has been finished and will be published shortly.

In addition to the research projects already completed and described above, equipment for planting of tree seedlings, material associated with mechanized planting (Serlachius planting machine) and equipment suitable for pruning pine plantations have been supplied from Finland. Two Finnish companies, Fiskars Oy and Lojar Oy, have been prepared to send pruning equipment for testing in Brazil. Trials were to be started with the equipment, but so far it has not been possible owing to lack of funds.

4. Conclusions

The implemented forest research programme shows that forestry cooperation work is of benefit to both parties. It has become apparent in a number of connections that cooperation between forestry organizations in Brazil and Finland

and the other Nordic countries is beneficial because the forest production methods and timber production principles in the Nordic countries correspond to a large extent to the production aims of plantation forestry in Brazil.

A prerequisite for the application of forest regeneration, forest cultivation and thinning methods developed in Finland to Brazilian conditions is that sufficient background information has been obtained about the suitability of the methods. An unbiased approach to the research problems is the key factor here. For this reason, an attempt has been made in the studies carried out so far to test the applicability of Finnish methods in the regeneration cultivation and harvesting of Brazilian forest plantations. It has been possible, through cooperation work of this sort, also to evaluate more comprehensively the competitiveness of the Finnish and Brazilian forest industries in the world markets. At the same time, it has been possible to consider ways of procuring rawmaterials from fast-growing plantations forests for the woodprocessing industry.

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Prof. Dr. **Jose Geraldo de Araujo Carneiro**
The Federal University of Parana (Curitiba)

THE FOREST RESEARCH COOPERATION BETWEEN THE FINNISH FOREST RESEARCH INSTITUTE AND THE "UNIVERSIDADE FEDERAL DO PARANA" IN BRAZIL - COMPLEMENTARY REMARKS

In a few words I would like to make a report on the history of teaching Forest Engineering in Brazil. Our first faculty was founded in 1960. An agreement signed in 1962 between the Brazilian Ministry of Education and FAO - Food and Agriculture Organization - allowed for the establishment of career training subjects. Such agreement was effective until 1968. The first concern, besides preparing Brazilian forest engineers for the future, was the formation of a new team of teachers who would take over substituting the FAO consultants. I am glad to have been a member of this team from 1967 onwards, together with a group of colleagues.

In 1970, the signature of another agreement, now with the Albert-Ludwigs University of Freiburg, Federal Republic of Germany, was the springboard for the development of forest research and teaching. This agreement firstly planned to last five years, has been consecutively renewed due to the success achieved in the areas of silviculture, forest management and wood technology. This bilateral activity, which is still effective, allowed for the continuity of professional improvement of Brazilian teachers who went for postgraduation courses in Freiburg, Munich and Hamburg. At the same time, other colleagues went to Seattle and Michigan in the United States of America as well as to England and Australia. The group became gradually bigger and many colleagues got degrees abroad, which led to the formation of a multi-disciplinary team. Our laboratories have also been equipped with funds coming from this agreement. It was then possible to found the first Post-Graduation Course on Forest Engineering in Brazil, thanks to the valuable contribution of hundreds of counterparts from both sides who during these last 17 years often came to live in Curitiba for a long time. This is a grade "A" course, a level regarded as the highest in Brazil.

As years went by, some other faculties of Engineering have been opened in different places all over the country. There are now 13 faculties scattered in the North, North-East, Centre-West, East and South of Brazil, from Manaus in the Amazon Region to Santa Maria in Rio Grande do Sul, in the extreme south of the country. Despite all efforts made, some of them do not operate satisfactorily yet, which

makes us even more concerned both as professionals and as Brazilian citizens. For this reason the admission of teachers to the post-graduation course is our first priority. The Federal University of Parana started playing an important role in the qualification of teachers of seven faculties, accepting them to our course or teaching courses and providing guidance on research work at their places of origin, with special emphasis being given to the Foundation of the University of Amazon and the National Institute of Research in Amazonia.

Nowadays, despite financial and economic constraints we have been faced with due to the serious crisis Brazil has been going through, which leads to numerous domestic difficulties, the level of the work done has remained the same, as verified annually by the scientific community. Our work is now acknowledged beyond Brazilian borders. Our postgraduation course receives Latin American students coming from Honduras, Panama, Colombia, Ecuador, Peru, Bolivia, Paraguay, Chile and Argentina. We also have students from Taiwan and even from West-Germany itself, which amounted to a total of 35 foreign students and 229 Brazilians (3 naturalized) between 1973 and 1986. The Brazilian students come from almost all the states and belong to various institutions such as universities, research institutes and foundations and also from private companies.

Such intensive work led naturally to a remarkable improvement in the level of the graduation course, which has 350 students. With better qualified teachers and conditions of work, the quality of both practical and theoretical teaching became much higher. Contacts made with private forest companies provided better chances for the compulsory practical training of at least 120 hours. We consider the academic level of the Forest Engineer graduated at the Federal University of Parana, who needs five years to obtain his degree, as reasonably good.

From 1984 on we have been invited by the government of the People's Republic of Mozambique for the exchange of scientific and technological knowledge with the teachers of the Eduardo Mondlane University, of the capital city of Maputo, in the fields of Genetic Ammelioration, Wood Technology, Dendrology, Forest Protection, Inventory, Silviculture and Harvesting. This invitation has probably been a consequence of the work we have done in the state of Niassa in the North of the country, one of the poorest regions in the world. These activities of planning and installation of various experiments in different fields of Forestry, aiming at the future operation of a paper and pulp industry, have been undertaken upon request of the Department of Forests and Wild Animals of the Ministry of Agriculture.

In February 1985, the Federal University of Parana started a joint venture with the Finnish Institute of Forest Research in some fields of research. You have seen Dr. Jari Parviainen's report on this respect. I have no doubt about the success of the program agreed between these two institutions. We have regularly informed Dr. Parviainen of the progress of our work, of which the final version shall be finished by the end of the first semester next year, when the agreement is due to expire.

I would like to make a parenthesis here to explain the origin of this agreement. Exactly ten years ago, in March 1977, I moved to Freiburg to take my Doctor's degree. I stayed there for three years and two months. Dr. Parviainen was there working in the same room. A closer relationship developed from the professional exchange of ideas. We later became good friends as a consequence of common personal characteristics. Our families, both wives and children, have also developed a friendship. We started meeting at weekends. I soon realized that Dr. Parviainen's objectivity and professional competence would be very valuable for the development of research work in Brazil. Through our agreement with the University of Freiburg, we invited him to visit Curitiba in 1981. In 1982 it was my turn to get to know Finland. During the visit I was really impressed by the stage of development of forest techniques used in the country, mainly when compared to those used in a developing country such as Brazil. We have exuberant tropical, subtropical and temperate forests but very little tradition in Forestry. In 1984, Prof. Matti Leikola and Dr. Parviainen also came to Brazil through the agreement with the University of Freiburg. Their contribution was highly valuable. Interest from both sides increased during these years and in 1985 Prof. Nyyssönen and the Rector of our University formalized the bilateral agreement for scientific cooperation.

Therefore, with the support we initially received from FAO, later from the Albert-Ludwigs University and more recently from the Finnish Institute of Forest Research, Curitiba has soon become a centre of multiplication and dissemination of ideas on forest teaching and research in Brazil and Latin America. The current agreement between the Albert-Ludwig University and the Federal University of Parana might be used as a model for future cooperation with the Finnish Institute of Forest Research. The fields of research may consist of quality control of seeds and seedlings, pruning, thinning, harvesting, management, soils, environmental protection, boards and natural regeneration.

Based on the above mentioned and on the activities that our group of researchers have successfully developed with high professional level, I am sure that we have been taking firm steps towards the improvement and knowledge of forest techniques. It is therefore essential for us to count on the

support of those countries which have a long tradition in the world of forestry. On the other hand, the friendship which links me to Dr. Parviainen may contribute to the development of the activities programmed. For the above mentioned reasons, I can assure you that an eventual expansion of our agreement would bring new experiences with benefits for both parts and with the success we all expect from it. That is what we all wish for.

Thank you very much.

TIME OF ATTENDANCE OF STUDENTS AT THE POST-GRADUATION COURSE

ON FOREST ENGINEERING - UFPR MASTER´S DEGREE 1973 TO 1986

FIELDS / POSITION	SILVICULTURE	FOREST MANAGEMENT	ECONOMY	WOOD TECHNOLOGY
NUMBER OF MONTHS	2,111	1,021	55	1,265
DISSERTATIONS CONCLUDED	52	46	02	29
AVERAGE	40,60	22,20	27,50	43,62

GENERAL AVERAGE FOR THE FEDERAL UNIVERSITY OF PARANA : 33,5 MONTHS FOR DEGREE

GENERAL AVERAGE FOR BRAZIL : 49,0 MONTHS FOR DEGREE

POST GRADUATION ON FOREST ENGINEERING - UFPR
MASTER´S DEGREE FOR 1973 TO 1986

FIELDS / POSITION	SILVICULTURE	FOREST MANAGEMENT	ECONOMY	WOOD TECHNOLOGY	TOTAL
DISSERTATIONS CONCLUDED	52	46	02	29	129
STUDENTS TAKING SUBJECTS ONGOING DISSERTATIONS	49	47	15	27	138
TOTAL	101	93	17	56	267
PERCENTAGE	37,8	34,8	6,4	21,0	100

CHART OF DISTRIBUTION OF FOREIGN STUDENTS IN THE POST GRADUATION COURSE ON FOREST ENGINEERING - UFPR MASTER DEGREE FROM 1973 TO 1986

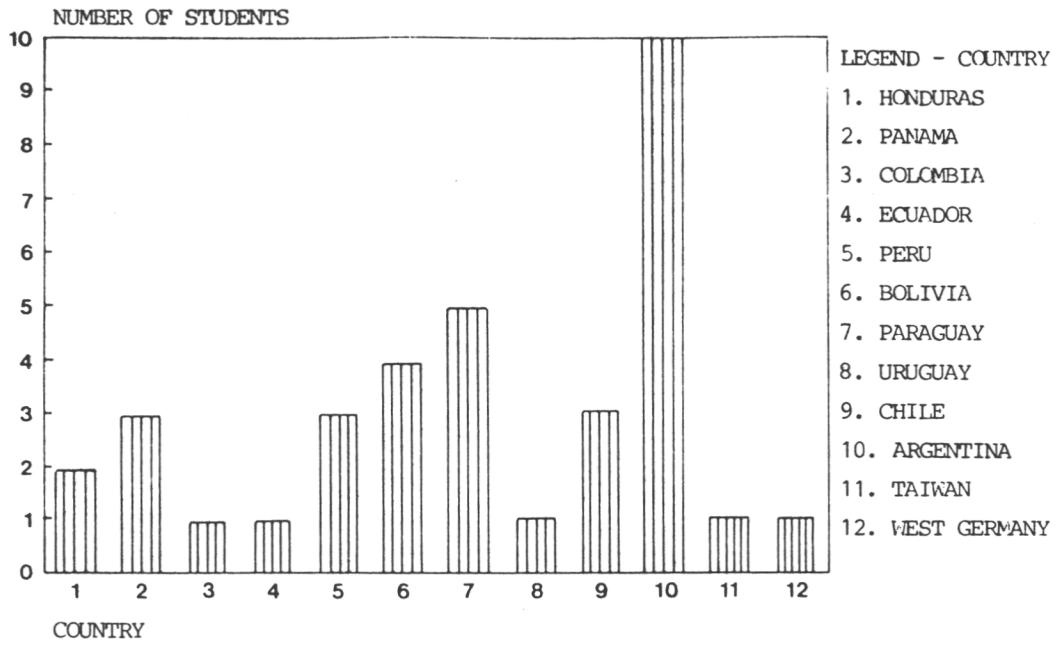


CHART OF DISTRIBUTION OF STUDENTS
IN THE POST GRADUATION COURSE
ON FOREST ENGINEERING - UFPR
MASTER´S DEGREE FROM 1973 TO 1986

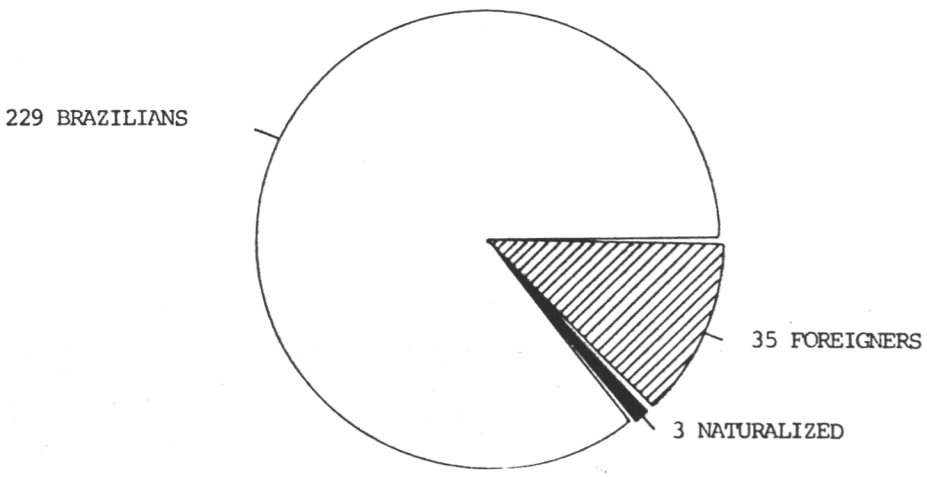


CHART OF DISTRIBUTION OF FOREIGN STUDENTS

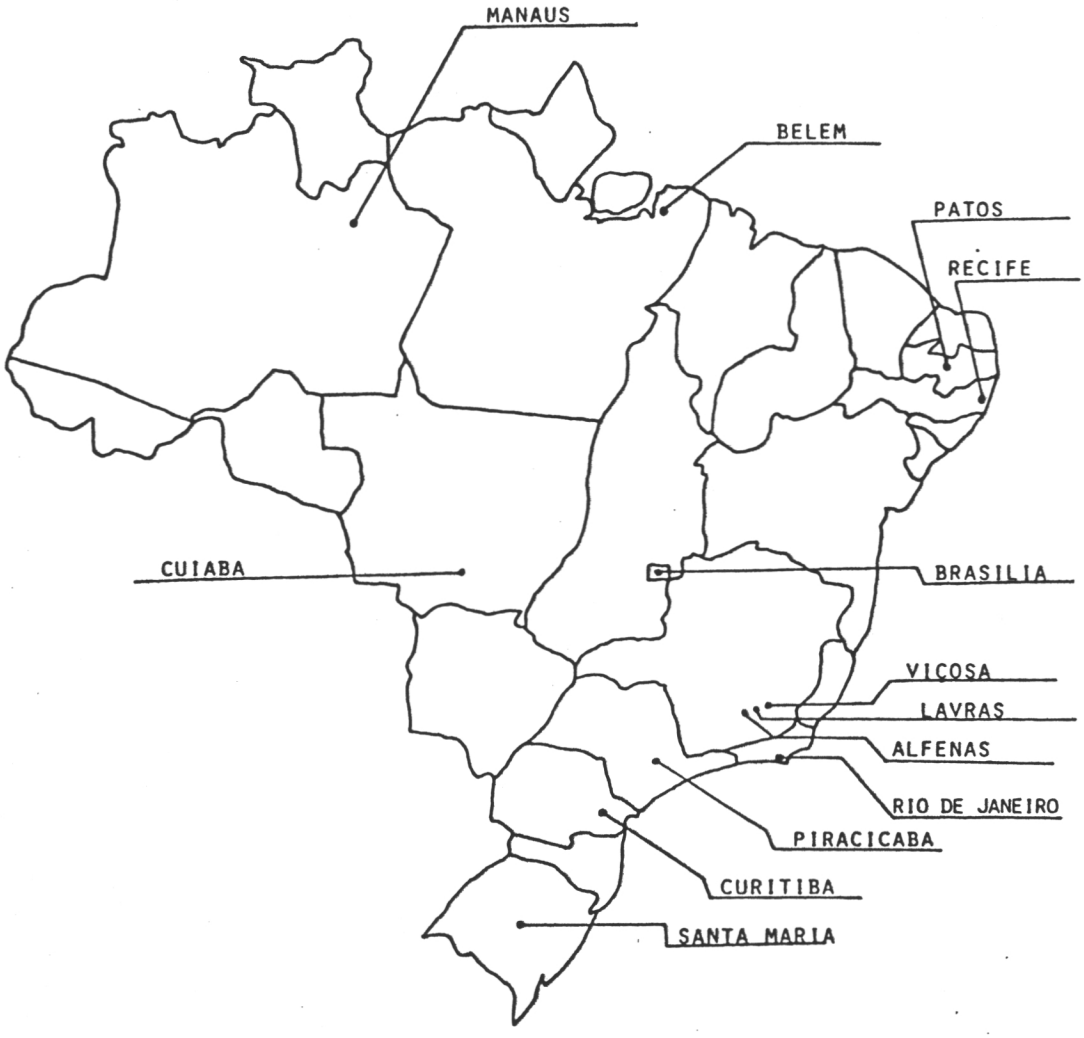
IN THE POST GRADUATION COURSE

ON THE FOREST ENGINEERING - UFPR

MASTER DEGREE

FROM 1973 TO 1986

CHART OF DISTRIBUTION OF FORESTRY SCHOOLS IN BRAZIL



Head of Department
Hannu Valtanen
The Central Association of
Finnish Forest Industries

THE FUTURE TRENDS FOR FORESTRY AND FOREST INDUSTRY IN FINLAND

Finland has not been able to build her economic growth on an abundant supply of natural resources such as metals and oil. The source of Finland's prosperity is in renewable natural resources: the Finnish people and the Finnish forests. The high standard of education and stable political climate have permitted the sort of economic and social progress that has made Finland one of the top welfare states of western Europe.

Forest cover two-thirds of Finland's land area. Pine, spruce, birch and mixed forests are an integral part of the Finnish landscape - and the Finnish way of life.

The forests have always been a source of building material, of wood for burning; it has provided the people with food and with skins to protect them for the cold. Later, wood was used to build ships and to distill the tar for sealing ships' timbers.

FORESTS AND METAL - A BASIS FOR FINNISH EXPORTS

The middle of the 19th century witnessed the start-up of the first steam-operated sawmill, soon to be followed by the first groundwood mill. From this point on the history of Finland's industrialization is largely the history of the forest industry.

The war preparations that Finland had to pay after World War II gave birth to a metal industry. Today, the country's metal and forest industries are equally strong, each accounting for 40 per cent of total exports. One special feature of forest industry production, however, is the high domestic input, which currently stands at over 85 per cent.

The know-how Finland has acquired in wood processing is clearly seen in the "synergy" from which Finnish companies benefit greatly: wood is grown, harvested, sawn, converted into groundwood, refiner mechanical pulp, chemical pulp and finally paper.

The same company may also build timber harvesting equipment, paper and board machines, their components and control systems, and even sell design services covering some parts of the sector worldwide.

FOREST RESOURCES DEVELOPED WITH CARE

This know-how is also reflected in the way in which forest resources are cared for. The volume of wood harvested from Finland's forests over the last 30 years is equal to today's entire standing reserve.

Yet there is more wood, with a higher felling value, in the forests today than ever before. This has been accomplished through a carefully implemented forest policy, which includes the following long-term targets for wood production:

* improving tree stands by silvicultural thinnings so as to increase the production of high-quality saw logs
* increasing stand density to make maximum use of the site potential
* regeneration of poorly productive and over-mature stands together with establishments of new stands, including soil preparation, planting and tending seedling stands
* fertilization of the best growing tree stands
* draining and fertilization of bogs and wetlands
* construction of forest roads.

These targets have been achieved. At present Finland has around 3.6 million hectares of artificially regenerated forest. Almost 6 million hectares of bog and wetland have been drained and dried for forest planting. This represents 61 percent of the country's total bog area. Close on 3 million hectares of forest have been fertilized.

The area of productive forest has risen from 17.4 million hectares in the early 1950s to over 20 million hectares today, while during the same period 76,000 km of forest roads have been built.

PRIVATE FOREST - THE BASIS FOR SUCCESSFULL SILVICULTURE

These achievements have been made possible by the fact that forest owners have shown a desire to have their property sensibly managed. Over 60 per cent of Finland's forests are owned by private individuals.

Forest holdings currently average just over 30 hectares, and there are more than 300,000 owners. The agricultural population is relinquishing more and more of its forest holdings to people whose main source of income is other than primary production.

GROWING NEED FOR FELLING

The forest still provides a basis for improving the well-being of the Finns. According to the recently published FOREST 2000 programme, the best way of further developing Finland's forest resources is to use a power saw. The land drainage and cultivation carried out in the past few decades has now produced a major crop. The annual cutting area needs to be raised by a third over the next ten years or so. More thinning should be carried out, but the regeneration of old spruce stands in southern Finland will mean an increase in the amount of clear cuttings, as well.

Implementation of the programme would mean increasing the annual volume of felling from the present 49 million m^3 to 61 million m^3 in the year 2000. This would enable the forest products industry to increase its annual consumption of wood by 1.2 per cent a year up to the end of the century.

The growth areas for the Finnish forest products industry would appear to be in products with a high know-how input but for which the raw material has little signifigance. Although Finland is only a small country in terms of forest, with less than half a per cent of the world's forest resources, Finnish printing and writing papers account for a quarter of global exports of these grades.

GOOD PROSPECTS FOR GROWTH

According to the FOREST 2000 programme, an annual increase in wood consumption of just over one per cent would enable an increase of more than 3 per cent in the volume of annual production up to the end of the century. If this growth were to continue to be in printing and writing papers, it would make to the use of wood far more productive.

The long-term timber trend study published towards the end of last year by the United Nations Food and Agriculture Organization (FAO) and the Economic Commission for Europe (ECE) predicts that world consumption of paper, sawn timber and woodbased panels will continue to grow.

Building activity in Europe is expected to slow down, which in turn will mean an end to the growth in consumption of sawn timber and wood-based panels. On the other hand, consumption of sawn timber in Europe is expected to be at least 20 million m^3 higher and that of wood-based panels 10 million m^3 higher in the year 2000 than at the beginning of 1980s.

Printing and writing papers would appear to form a clear growth sector. Consumption of these grades in Europe is forecast to grow by 3.2 - 4.7 percent annually. Last year these amounts accounted for almost two-thirds of Finland's total paper exports.

The growth in the raw material base predicted by the FOREST 2000 programme seems to correspond quite closely to the market picture revealed by the FAO and ECE surveys. Wood-containing printing papers employ the special characteristics of long-fibre spruce raw material. Wood-free printing papers, on the other hand, contain short-fibre birch pulp. The sulphate pulp produced from pine is needed to improve the strength characteristics of virtually all printing and writing papers.

Renewable natural resources in the shape of forests and centuries of expertise in forest utilization and wood prosessing will ensure that the Finns continue to enjoy a high standard of well-being - both materially and in terms of their environment.

F I N L A N D :

THE SHARE OF GLOBAL

– FOREST RESOURCE	0.5	%
– CONIFEROUS FORESTS	≈1	%
– TOTAL REMOVALS	1.5	%
– REMOVALS OF INDUSTRIAL ROUNDWOOD	2.5	%
– PRODUCTION OF FOREST INDUSTRY	5	%
– EXPORTS OF FOREST INDUSTRY	≈15	%
– EXPORTS OF PRTNG&WRTNG PAPERS	≈25	%

FINLAND: REMOVALS 1960 – 2000

	1960–62	1980–82	2000
	MILL.M3/A		
INDUSTRIAL WOOD	32.4	42.3	56.8
EXPORTS	5.5	1.9	0.5
FUELWOOD	16.3	4.6	3.7
TOTAL REMOVALS	54.2	48.8	61.0

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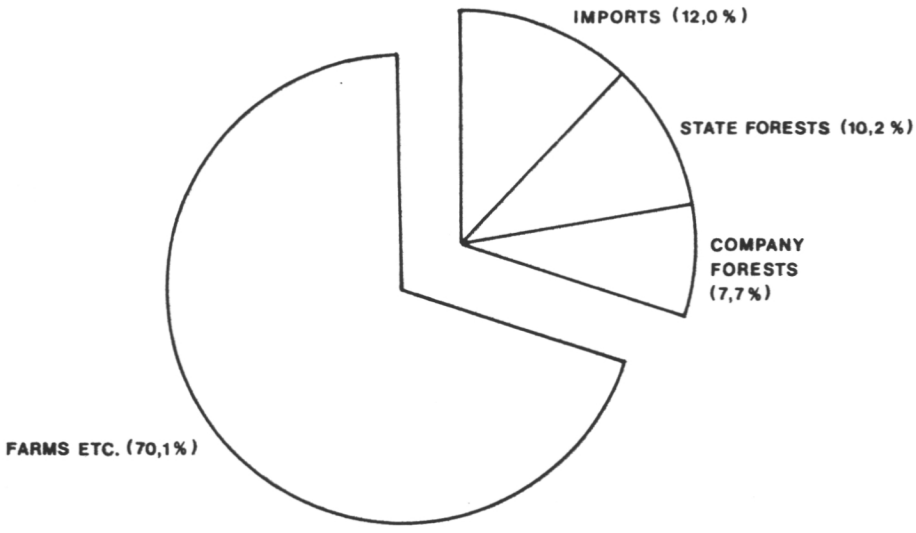
ANNUAL WOOD PROCUREMENT
BY FINNISH FOREST INDUSTRIES, 1980-85



ANNUAL CONSUMPTION OF ROUNDWOOD 47 MILL. M3

+ 7.5 MILL. M3 CHIPS, PARTICLES & SAWDUST

IN NON-INDUSTRIAL PRIVATE FORESTS

* 150 000 TIMBER SALES ANNUALLY
* AVERAGE VOLUME 200 – 300 M3

FINLAND: CONSUMPTION OF INDUSTRIAL WOOD 1960–2000

	1960–62	1980–82	2000
	MILL.M3/A		
ROUNDWOOD			
– DOMESTIC	32.4	42.3	56.8
– IMPORTED	0.5	4.5	5.0
TOTAL ROUNDWOOD	32.9	46.8	61.8
– RESIDUES	2.3	7.4	7.5
TOTAL WOOD RAW MATERIAL	35.2	54.2	69.3

FINLAND: PRODUCTION OF FOREST INDUSTRIES 1960–2000

	1960–62	1980–82	2000
	1000 M3/A		
SAWN GOODS	7316	8522	8500
PLYWOOD	419	613	772
OTHER PANELS	511	970	1000
	1000 T/A		
WOOD PULP	3924	7101	12100
– MECHANICAL	1086	2387	5800
– CHEMICAL	2838	4714	6300
PAPER AND PAPERBOARD	2291	5983	12000

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FAO: FOREST PRODUCTS CONSUMPTION 1984–2000

PRODUCT – AREA	CONSUMPTION V.1984 MILL. M3/T	FAO 1984–2000 %/A	CHASE 1984–2000 %/A
SAWN GOODS			
– WORLD	449	+1.9	+1.6
– W–EUROPE	71	+1.3	+0.9
PANELS			
– WORLD	107	+4.9	+4.1
– W–EUROPE	27	+4.5	+4.1
PRTNGS&WRTNGS			
– WORLD	49	+4.3	+3.9
– W–EUROPE	15	+4.1	+3.6
PAPER&PAPER–BOARD, TOTAL			
– WORLD	187	+3.1	+2.7
– W–EUROPE	47	+2.5	+2.0

THE FOREST 2000 –PROGRAMME

THE TASK:

TO DRAW UP A LONG–TERM PROGRAMME FOR FINNISH FORESTRY

AIMS:

* FULLER UTILIZATION OF FINNISH FORESTS

* TO IMPROVE THE YIELD OF FINNISH FORESTS

* TO ESTIMATE THE WOOD RAW–MATERIAL SUPPLY FOR FINNISH FOREST INDUSTRIES

THE FOREST 2000 –PROGRAMME

INTEREST GROUPS WHICH TOOK PART IN DRAWING UP THE PROGRAMME

* RESEARCH ORGANIZATIONS (FORESTRY, ECONOMICS)
* GOVERNMENTAL AUTHORITIES
* FOREST OWNERS' ORGANIZATIONS
* FOREST INDUSTRIES' ORGANIZATIONS
* EMPLOYEES' ORGANIZATIONS
* NATURE CONSERVATIONISTS' ORGANIZATIONS

THE FOREST 2000 –PROGRAMME

FOUR WORKING GROUPS:

* SILVICULTURE AND FOREST MANAGEMENT
* TIMBER PROCUREMENT
* THE DEVELOPMENT POSSIBILITIES OF THE FOREST INDUSTRIES
* THE MULTIPLE USE OF FORESTS

THE FOREST 2000 -PROGRAMME

METHODS USED:

* MELA – FOREST CALCULATION PROGRAMME
  (SIMULATION MODEL FOR FINNISH FORESTS
  AND FORESTRY BASED ON INVENTORY DATA
  FROM THE PERIOD OF 1920 – 1980)

  IDENTIFICATION OF MANAGEMENT ALTERNATIVES:
  - COMBINATIONS OF MEASURES DESIGNED
    TO PRODUCE DESIRED REMOVALS
  - ECONOMICALLY OPTIMAL SOLUTIONS

* COST–BENEFIT -ANALYSIS
  SELECTION OF "THE BEST ALTERNATIVE"

FOREST 2000 –PROGRAMME

MAIN RESULTS

* MORE ATTENTION SHOULD BE PAID ON THE NEEDS OF MULTIPLE USE OF FORESTS
  - THIS WILL DECREASE THE ANNUAL CUTTING POTENTIAL BY 2.2 MILL.M3 (3–4 %)

* CUTTINGS SHOULD BE INCREASED IN ORDER TO MAINTAIN GOOD FOREST MANAGEMENT

FOREST 2000 –PROGRAMME

MAIN RESULTS

1980 ➡ 2000

CUTTINGS

AREA CUT ANNUALLY	+ 30 %
– THINNINGS	+ 70 %
– CLEAR CUTTINGS	+ 10 %

REMOVALS

TOTAL REMOVALS	+ 25 %
– LARGE SIZED LOGS	+ 30 %
– SMALL SIZED LOGS	+ 20 %

FOREST 2000 -PROGRAMME

THE DEVELOPMENT POSSIBILITIES OF THE FINNISH FOREST INDUSTRIES 1980 ► 2000

► RAW MATERIAL THE ONLY LIMITING FACTOR ◄

PRODUCT GROUP	% / YEAR
SAWNWOOD	+1.8 ... 0
-REDWOOD	+0.6
-WHITEWOOD	+3.2 ... -1.0
PLYWOOD	+1.2
OTHER WOODBSD PANELS	. .
WOODPULP	+2.0 ... +2.9
-MECHANICAL	+2.8 ... +4.9
-CHEMICAL	+1.5
PAPER & PAPERBOARD	+3.5 ... +4.9
TOTAL VOLUME	+2.6 ... 3.3

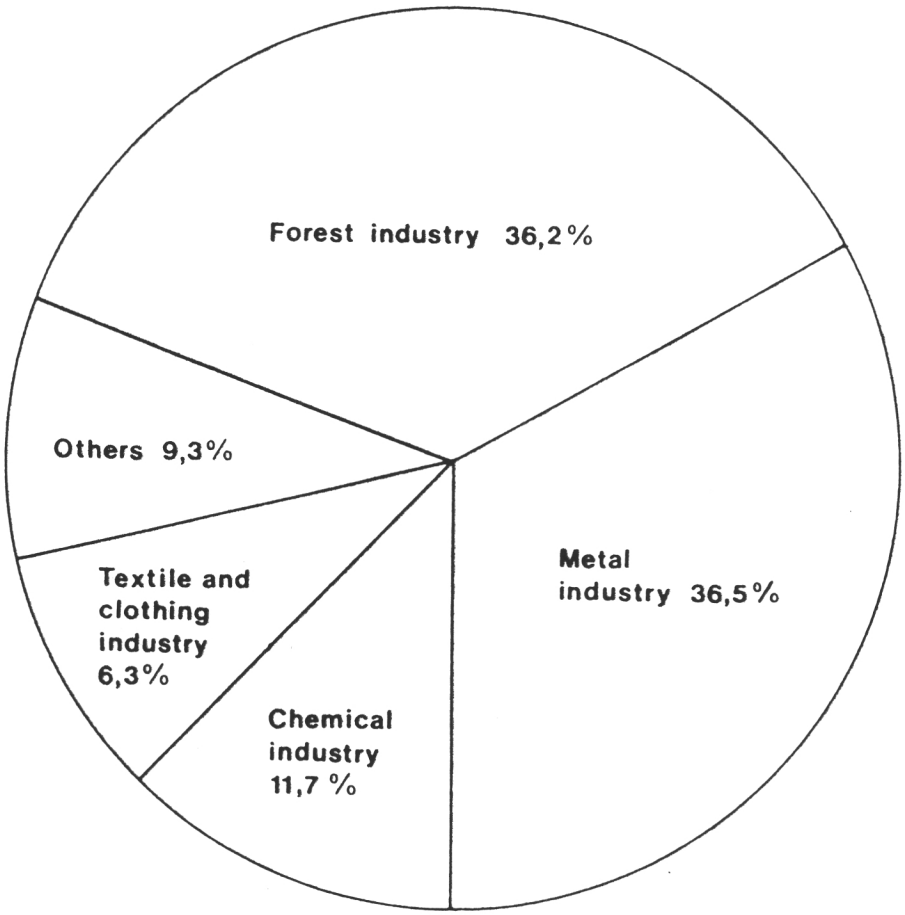
CONSUMPTION IN EUROPE INCREASES – ACCORDING WITH THE ESTIMATED REMOVALS IN FOREST 2000 – PROGRAMME

1981 – 2000, % / A

PRODUCT GROUP	F2000		ETTS IV	
	ALT1	ALT4	LOW	HIGH
SAWN SOFTWOOD	+1.8	−0	+0.5	+1.4
– REDWOOD	+0.6	+0.6	..	..
– WHITEWOOD	+3.2	−1.0	..	..
PLYWOOD	+1.2	+1.2	+1.0	+2.1
PAPER&PAPERBOARD	+3.5	+4.9	+1.9	+3.4
–PRINT.& WRIT.	..	..	+3.2	+4.7

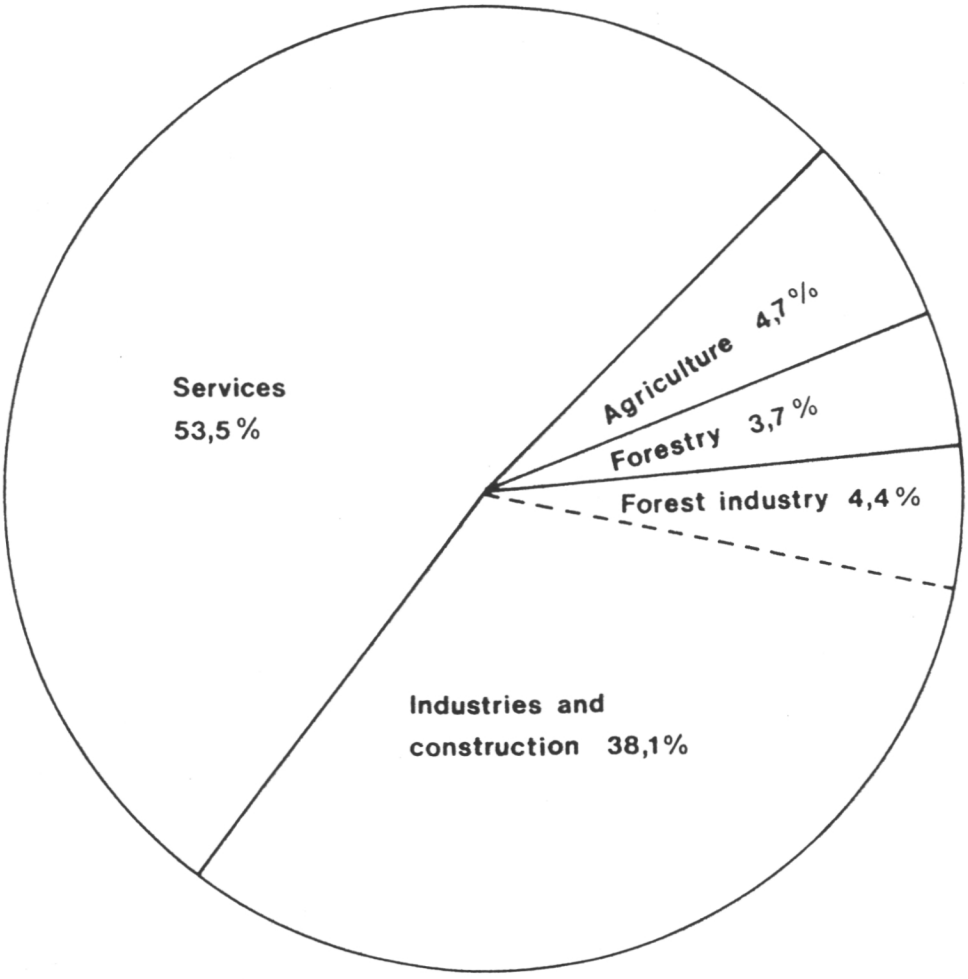
SMKL/H.VALTANEN 04.12.86

Distribution of Finnish exports in 1985



Total value of Finnish exports 84 023 million FIM

Finland's total production in 1985

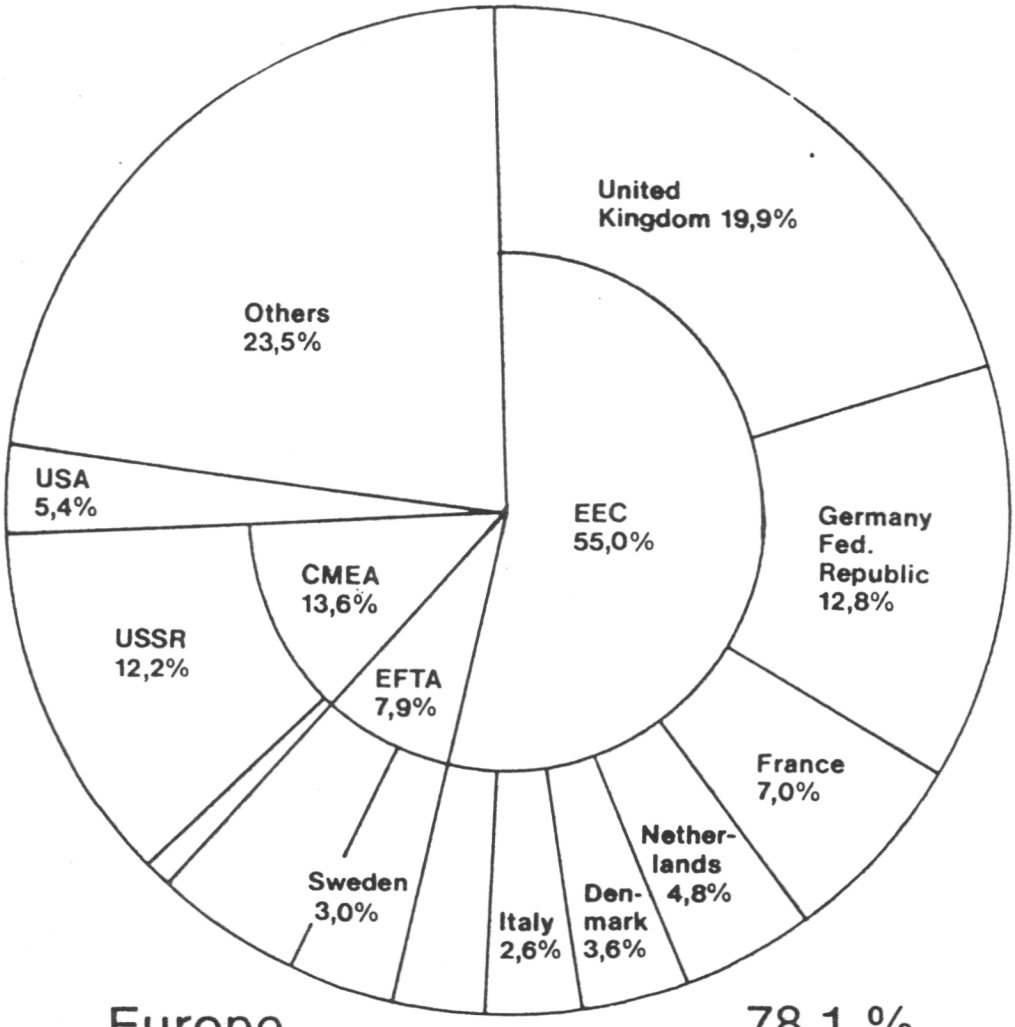


GNP 337 428 million FIM

Distribution of Finnish exports by branches (%)

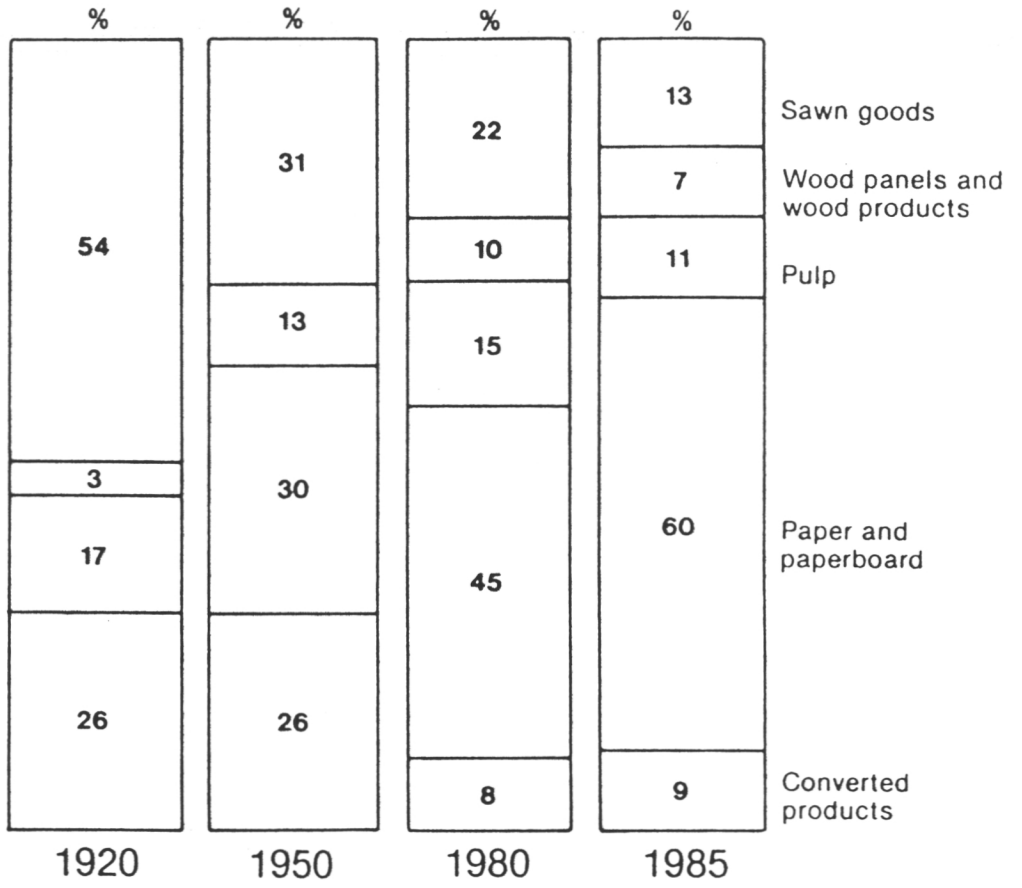
	1920	1950	1980	1985
Forest industry	88	78	42	36
Agriculture and forestry	8	12	2	3
Metal industry	1	4	29	37
Textile and clothing industry	—	1	8	6
Chemical industry	1	1	11	12
Foodstuffs industry	—	1	3	3
Others	2	3	5	3
	100	100	100	100

Finnish forest industry exports by countries and regions in 1985



Europe	78.1 %
Asia	7.5 %
Africa	4.9 %
North America	6.0 %
Latin America	1.3 %
Oceania	2.2 %

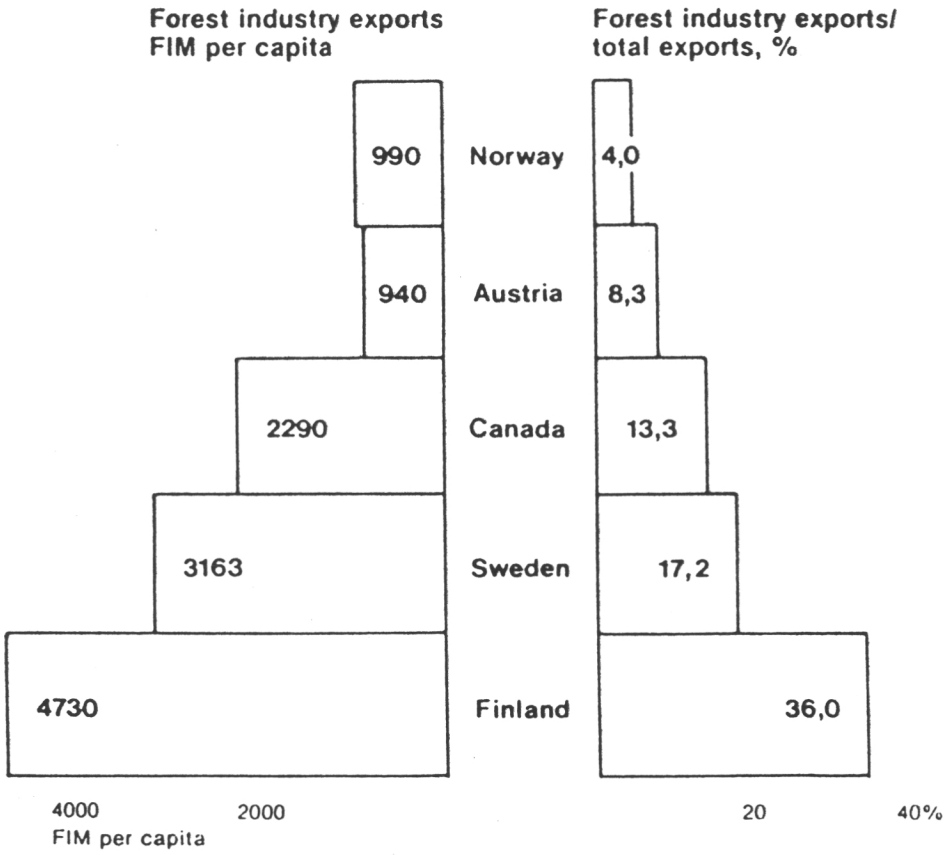
Finnish forest industry exports by main product groups in 1920, 1950, 1980 and 1985



In 1985 Finnish

sawn goods	were exported to	51	countries
pulp	was exported to	60	"
paper	" " "	108	"
paperboard	" " "	97	"
converted products of paper and paperboard	were exported to	109	"

Value of forest industry exports per capita and share in total exports in 1983



Mechanical forest industry in 1985

	Number of production plants	Employed labour force	Production	Exports	Share of exports in production
Sawmill industry	290[1)]	16 000	7.3 mill.m³	4.9 mill.m³	67%
Plywood industry	26	7 000	0.6 mill.m³	0.5 mill.m³	85%
Particle board industry	12	1 100	0.6 mill.m³	0.2 mill.m³	34%
Wallboard industry	3	700	0.1 mill.tons	0.06 mill.tons	52%

[1)] In addition, sawmills supplying local needs number approx. 6,500.
Other mechanical forest industry employs about 12,000 persons.

Chemical forest industry in 1985

	Number of production plants	Employed labour force	Production	Exports	Share of exports in production
Mechanical and chemical pulp industry[1)]	46	11 500	8.0 mill.tons	1.5 mill.tons	19%
Paper industry	30	20 000	5.8 mill.tons	4.9 mill.tons	84%
Paperboard industry	16	2 900	1.6 mill.tons	1.3 mill.tons	78%

1) sulphite and sulphate pulp mills and mechanical wood pulp mills. The main part of mechanical, thermomechanical, sulphite and sulphate pulp is used in the integrated paper mills, whose products are mainly exported. In Finland there is only one mechanical wood pulp plant for exports.

— A part of the paper and paperboard production is further processed into consumer goods. This processing industry employs about 8,000 persons. Employed labour force in the printing industry amounts to over 38,000.

— The multiplier impact of the forest industry in providing employment is essential. About 50,000 of the indirect jobs are in the forestry, and the rest, 80,000 in transportation, energy supply, chemical industry and engineering.

— As the forest industry directly provides work for about 102,000 persons, considering the multiplier impact, the total number of productional jobs is about 230,000.

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THE FUTURE TRENDS OF FORESTRY SECTOR AND FOREST POLICY IN BRAZIL

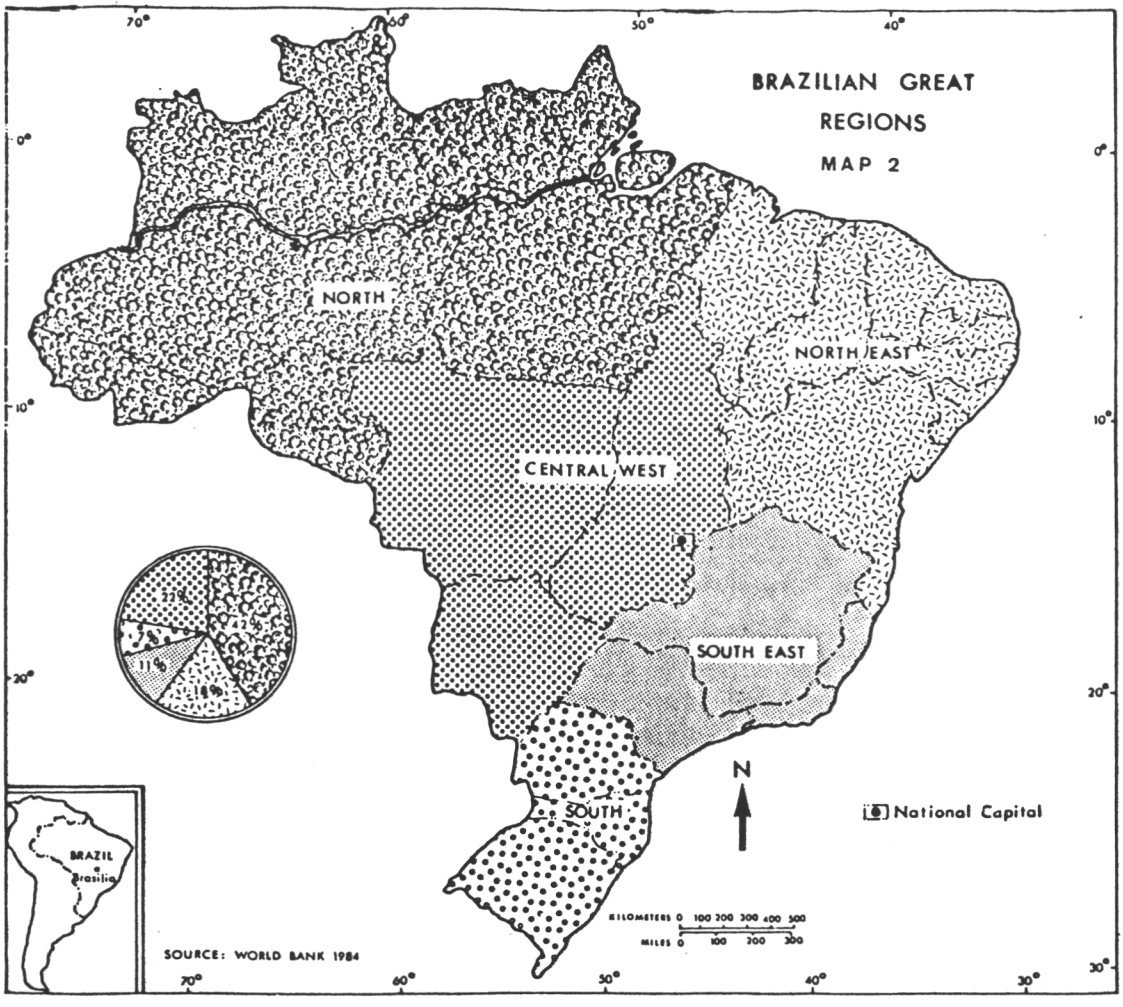
1. INTRODUCTION

Brazil covers about two thirds of the South America. It is the fifth largest in the world. It lies between parallels 50 16' 19" latitude North and 330 45' 09" latitude South and meridian 340 45' 54" and 730 59' 32" West. It covers a total area of 8,511,965 km^2. Brazil is a Federative Republic which comprises 23 States, 3 Federal Territories and the Federal District where its capital - Brasilia - is located (see Map 1). The States and Territories are grouped into five great regions according to their common physical, human and economic characteristic (see Map 2). The total population is of about 140 million inhabitants of which around 70 % live in urban areas and 30 % in rural areas.

Given its continental dimension Brazil has a diversity of social and economic conditions, allied to this, there is a wide range of climatic and ecological conditions which are reflected on its great variation of vegetation types.

It has a forest cover of approximately 320 million hectares (38 per cent of the country), 140 million hectares of " cerrado" which looks like savanna (17 per cent of the country), 46 million hectares of "caatinga" which is a semi-arid forest formation of the Northeast (5.4 per cent of the country) and some 10 million hectares of other forest cover (1.2 per cent of the country), from which about 6 million hectares are man-made Eucalyptus and Pinus forests, being some linked to industrial projects (Carneiro, 1987). This paper will examine the forestry sector and forest policy within Brazil's process of development with special emphasis on the fiscal incentives scheme, which has contributed to integrate forestry into the economy and has led to vast areas of industrial forest plantations being established throughout Brazil.


SOURCE: WORLD BANK 1984
MAP 1
BRAZIL
VENEZUELA
COLOMBIA
GUYANA
SURINAME
FRENCH GUIANA
Boa Vista
RORAIMA
AMAPÁ
Macapá
Manaus
Rio Amazonas
Belém
São Luis
Fortaleza
AMAZONAS
PARÁ
MARANHÃO
Teresina
CEARÁ
RIO GRANDE DO NORTE
Natal
PARAÍBA
João Pessoa
PIAUÍ
Recife
PERNAMBUCO
ACRE
Rio Branco
Porto Velho
Maceió
ALAGOAS
Aracaju
SERGIPE
RONDÔNIA
GOIÁS
BAHIA
PERU
MATO GROSSO
Salvador
Federal District
Cuiabá
BRASÍLIA
ATLANTIC OCEAN
BOLIVIA
Goiânia
MATO GROSSO DO SUL
MINAS GERAIS
ESPÍRITO SANTO
PACIFIC OCEAN
Campo Grande
Belo Horizonte
Vitória
SÃO PAULO
RIO DE JANEIRO
CHILE
PARAGUAY
PARANÁ
São Paulo
Rio de Janeiro
Curitiba
N
SANTA CATARINA
Florianópolis
RIO GRANDE DO SUL
ARGENTINA
Porto Alegre
URUGUAY
National capital
State capital
State boundaries
International boundaries
River
KILOMETERS 0 100 200 300 400 500
MILES 0 100 200 300


BRAZILIAN GREAT
REGIONS
MAP 2
NORTH
NORTH EAST
CENTRAL WEST
SOUTH EAST
SOUTH
N
National Capital
BRAZIL
Brasilia
SOURCE: WORLD BANK 1984
KILOMETERS 0 100 200 300 400 500
MILES 0 100 200 300
70°
60°
50°
40°
30°
0°
10°
20°

2. THE BRAZILIAN PROCESS OF DEVELOPMENT

A complete review of the Brazilian process of development would be both an exhaustive task and beyond the scope of this paper. So, only an overview of the overall process will be presented.

Portuguese explorers first landed in Brazil in 1500. Its early economic history was characterized by a series of production cycles, during which the country became the World's leading producer, e.g. sugar and gold, but than lost that position. There is an exception, coffee production, in which Brazil is still the World's leading producer, although Brazilian exports are no longer based exclusively on its export.

This sort of economy remained until the 1930's when an important domestic political event, the "Revolution of 1930", occurred concurrently with the "Great Depression". This was the basis for much of what subsequently shaped the contemporaneous Brazilian State. A shift began to take place, away from the dominance of agriculture towards the industrial sector of the economy.

Despite the moves towards industrial economy and urbanised society, Brazil still remained essentially an agricultural country and a major exporter following primary goods, a development pattern of what ECLA (Economic Comission for Latin America) classified as a "Primary Export Model". The first deliberate approach to a development policy of intensified industrialization did not start until the 1950's (Lessa, 1983).

The period 1956/61 saw the consolidation of Brazilian industrialization through an agressive policy of "Import Substitution Industrialization - ISI" sanctioned by literature on Latin American development, especially in the ECLA'S works (Pereira, 1983; Tavares, 1983).

The government played a crucial role in this process through policies of massive public investment to eliminate some of the "bottle-necks" in the Brazilian economy. Thus, investments were made in infrastructure, especially energy and transport; basic industries and regional development schemes to promote development of "backwards" regions. Along with these investments, the government initiated a set of policies creating incentives, such as tax concessions to attract private investments, both domestic and foreign (Lessa, 1983).

However, despite the high rate of economic growth, the diversification of industrial production, and the efforts of the government to reduce regional imbalances, economic development was uneven in sectorial and regional aspects. For example, the structure of the primary sector was virtually unchanged, and its growth in the period can be attributed more to an expansion of the agricultural frontier than to any increase in productivity. No major reform of the primary sector was considered and Brazil's anachronistic and unjust agrarian structure remained (Tavares, 1983).

The rapid economic growth of Brazil's economy in the period from 1956 to 1961 was followed by a development hiatus which lasted until 1967. In short, the Brazilian economy faced another of its crises.

Along with the economic crisis, a political crisis also evolved polarizing around the extremes, i.e. popular masses and conservatives. These crises intensified until finally, in 1964, a coup d'etat took place.

After the coup d'etat, the development hiatus remained to be tackled. To restore economic growth, combat inflation and solve the balance of payments situation became the major concerns of the new government. Of these, combating inflation became the top priority since it was perceived as a pre-condition for restoring economic growth. To do so, a stabilization plan was launched based on the orthodox Keynesian approach of restriction of demand.

In 1967, there was a change of government, which also meant a change in the economic policy leadership. Control of inflation was no longer the priority. However, the apparent contrast between this policy and the previous one can lead us to erroneously assume that a major shift had occurred in the overall economic policy. On the contrary, the previous policy was continued and even expanded.

A complete commitment to the promotion of economic growth at any cost evolved while the question of distribution of income was not at issue. Supported by a favourable, international economic situation for exporting and borrowing, Brazil started to experience high rates of economic growth. This was in such a way that later on became known as "Brazilian economic miracle".

The "miracle" started to disappear as favourable external conditions started to decline, especially after the shock to the world economy caused by the oil crisis in 1973.

Hard times commenced and the world economy slowed its growth in this new era dictated by the oil crisis. This situation required adaptation of new policies in order to cope with new times. The "euphoria" of the time of the "miracle" started to vanish and a new reality arose.

However, despite evidence show this new reality the government seemend to be slow, or even reluctant, to admit what was occuring and that consequently the Brazilian economy could no longer expand as in the "miracle" period. The rapid increase of the Brazilian total foreign debt is a good illustration in support of this agreement.

In pursuing its growth strategy the government announced the National Development Plan for the period 1974-79. Among its goals it can be detached programmes to be introduced for major increase export. From these two are of particular interest due to their contribution in promoting and expansion of large scale industrial forest plantations. The first was the National Programme of Pulp and Paper - PNPC which and as its major goal an expanding production of pulp and paper enabling Brazil to become self-sufficient and a major exporter. The second programme was the National Programme of Siderurgy Based on Charcoal. As in the previous programme, this one had as its major goal to increase the production of steel in order that Brazil could also become self-sufficient and a major exporter. In both cases it was necessary a great and realiable supply of wood to cater for an expanding production.

To achieve such ambitious goals, the government adapted an expansionist policy. The public sector acted through a large variety of subsidized credit schemes, tax incentives, tariff preferences and other policies, together with its own direct investments, and progressively substituted for the market as the principal allocator of investments in the economy. The extensive foreign borrowing which was necessary to do this, was facilitated by the liquidity of the international financial market.

Despite its pitfalls, the National Development Programme succeeded in some aspects, such as the reduction in imports of intermediary goods and in promoting on average annual growth rate of GDP of over 7 % during the rest of the decade 1973/80 (Serra, 1983; Coutinho & Belluzzo, 1983; The World Bank, 1984).

Nevertheless, Brazil's potential vulnerability to further external shocks became evident when, from 1978 to 1980, there was a new wave of oil price increase followed by higher international interest rates. Hence, oil imports, high interest rates, high debt service payments - around 80 % of the total Brazilian exports, along with accelerating inflation, considerably reduced the government's potential to mano euvre. Little could be done, the economy receded and the crisis still persists (Furtado, 1982).

Indeed, this crisis facing Brazil is just one more in its process of development. However, the outcome will depend, in the short term, on the recovery of the international economy and, in the longer term, on achieving a development path which combines rapid growth of employment opportunities with somewhat more modest growth of output than that experienced. In other words:

> Brazil, like the U.S. is a nation of newcomers, and there is still room to grow and to make mistakes. It often teeters on the edge of an abyss, it is said, but never falls in... becaus Brazil is bigger than the abyss itself (Veslind 1987: 354).

Following this overview of the Brazilian process of development the next section will review forestry in Brazil, to see how it fits into the whole process of development.

3. FORESTRY DEVELOPMENT IN BRAZIL

As it was reviewed in the previous section, the process of development of Brazil was marked by a series of economic cycles, each associated with a particular commodity. Increases in the production of plantation crops, such as sugar-cane and coffee, were more an expansasion of the agricultural frontier through clearing forest than to any increase in productivity due to a technological improvement.

A similar pattern of disregard for the forest resources was present in other countries of the so called "new world". In the USA and Australia, for example, the pioneer cleared away forest for agriculture and to supply his wood requirements. On the other side, for the pioneer settler the forest resources seemed to be endless.

This process of deforestation referred to above can be better visualized in the following table.

TABLE 1: Forest Cover of Brazil [1].

Unit: 1,000,000 ha

	PERIOD			
	1500's (a)		1980's (b)	
TYPES	Area	% of the country	Area	% of the country
Forest [c]	523	61,4	320	38,0
Cerrado	173	20,3	140	17,0
Caatinga	66	7,8	46	5,4
Other	90	10,5	10	1,2
TOTAL	852	100,0	516	61,6

Sources: a. Magnanini 1959: 300-301
b. Carneiro 1987: 1

From the table above one can note a significant reduction of the forest cover, especially of the "forest". Most of this removal ocurred close to the coast since it was in this area that most settlement ocurred, and there was the expansion of large scale plantations, in particular sugar-cane and coffee. As far as the Amazon region in concerned, i.e. where, at present, in concentrated the major part of Brazilian forest resources, the great expansion towards there, and consequently its deforestation, ocurred from 1970's onwards when the Brazilian government started to direct policies stimulating the expansion of the agricultural frontier.

Without refuting the effects of the agricultural expansion on forest resource, it is worth to mention that the Portuguese crown was aware of the adverse effects of some economic activities, and efforts, even if motivated by economic rather than conservationist impulses, to protect the environment and resources. On example of such, it was the attempt ro restrict the use of "tapinoma" to shipbuilding because of its scarcity [2] (Delson & Dickenson, 1984).

(1). Because the basic works which we have used (Magnanini and Carneiro) have been done at different times, for different purposes, by different people and using different material, and sources, one might question the validity of such a comparison. However, our intention is to provide the reader with a clue regarding overall forest removals.

c. Under this title "forest" it was grouped the different types, such as "Araucaria Forest", "Tropical Forest", "Sub-Tropical Forest" and the like to allow a better comparision between both works.

(2). For more details about the Brazilian forestry administration in a historical perspective see, for example: Volpato (1985).

Despite these attempts to preserve, or at least to avoid over-exploration, of the forest resources, the mercantilism prevailed. Forest continued to be cleared to provide land for agricultural expansion. The climax of this occurred during the nineteenth century with the expansion of coffee production under the plantation system. An example is given by Beattie who tells that "the forest removal for coffee plantations, in Minas Gerais, is considered more important, in terms of devastation, than the wood removals for charcoal production for use in the pig-iron industry" (Beattie, 1975: 18).

Brazil's search for economic progress and the utilization of its resources has been characterized by the paradox between a tendency to exploitation and attempts to conserve. In a territory which is still endowed with virgin land and diverse resources, it is a difficult paradox to resolve. An example is the policy adopted by the post-1964 governments of expansion of Brazil's agricultural frontier, especially for cattle raising towards North and Centre-West regions in the Amazon basin. This expansion is illustrated in Table 2.

TABLE 2: Rate of Change of Forest Cover in the Amazon Basin (3)

Period	Area Cleared (1.000 ha)	Annual Rate of Change (%)
1975/78	4,857.5	39,0
1978/80	4,629.5	26,0
1975/80	9,487.1	33,0

Source: IBDF/DE 1983: 16

This process of deforestation was encouraged by governmental policies of fiscal incentives for development in the Amazon basin and of settling colonists along roads built in the region. The fiscal incentives scheme encouraged many entrepreneurs to establish large farms, especially for cattle raising (4).

In response to deforestation, an internal conservation lobby emerged. It has exerted pressure on the government to adopt measures in its programme, plans and projects which minimize the ecological damage, and promote a rational use, i.e. avoiding the exhaustion of the country's resources.

(3). The Amazon basin considered here is the so-called "Legal Amazon" which covers the States and the Federal Territories of the Northern region (Acre, Amapá, Amazonas, Pará, Rondonia, Roraima) and also encompasses part of the states of Maranhao, Goias and Mato Grosso. This division was done by the Federal Covernment to delimit the concession of fiscal incentives to promote regional development of the Amazon basin.

(4). For more details about forestry in the Amazon Basin see, for example; Nascimento, 1985.

3.2. The Forestry Sector within the Economy

The emphasis of the Brazilian development model, discussed above, has been on moving from an agricultural economy to a more industrial economy. This process was expanded in the 1950's and from 1964 onwards its present form evolved.

The forestry sector share in the total Brazilian GDP fell from 3.3 % in the 1949 to 2.6 % in 1974. The average annual rate of this decline was gradual from 1949 to 1970, around 0.7 % yearly and more accentauted from 1970 to 1974, around 1.8 % yearly. In absolute terms the forestry sector grew more rapidly from 1970 onwards than in the previous period, however its growth was not enough to follow the high growth rates experienced by the overall Brazilian economy in the same period. The only industry in the forestry sector to increase relatively was the pulp and paper industy, however it was not enough alone to increase the proportion of forestry in overall GDP (Prado, 1977a).

Prado (1977a) further divided the forestry sector into two components, agricultural and industrial. This division showed that the agricultural sub-sector decreased more than the industrial subsector. In 1949 the contribution of the agricultural component of the forestry sector to the Brazilian GDP was 1.7 % while the industrial component was 1.6 %. In 1974 it was of 1.1 % and 1.6 %, respectively. This is not surprising due to the overall Brazilian model of development and its emphases, in particular in the period 1967/74 - the "Brazilian economic miracle" - when emphasis was on industries, such as consumption goods, transportation equipment, chemical and non-metal mineral products.

The government launched two programs of particular interest to the forestry sector, in 1974, as referred to above the National Programme of Pulp and Paper and the National Programme of Siderurgy Based on Charcoal. From 1976 onwards with the decelaration of the National Development Plan, these programmes were also gradually faded. However, despite this the forestry sector, in 1980, increased its contribution in the total GDP to about 4 %. It also represented 4.5 % of total Brazilian exports (5).

(5). For more details regarding Brazilian exports of wood, timber and forest products see: the complete set of Anuario Brasileiro de Economia Florestal, Nos. 1-19, published by the INP. In 1967 with the creation of the IBDF the INP ceased its activities and consequently, the yearbook was no longer published. However, the statistic presented in the yearbook can provide the reader with a historical series of Brazilian exports of wood, timber and forest products since the 1950's. For more recent details regarding the forestry sector within the Brazilian trade balance see: Prado, 1977b; Ribeiro & Machado, 1981; Santos et al., 1982, 1983, 1984 & 1985. These last publications also present Brazilian imports.

Importantly it supplied the charcoal used as a reducing agent in the production of 3.9 million metric ton of pig-iron which correspond to 40 % of national output (Galvao & Lupatelli, 1982) [6].

Both programme and more recently the production of industrial energy from wood, have based on large scale industrial plantations established since 1967 as a response to fiscal incentives. During the last two decades the Brazilian forestry sector has envolved around, or been a function of, these plantations.

3.3. The Fiscal Incentives Scheme for Establishing Large Scale Industrial Forest Plantations

3.3.1. Proposal's Antecedents: A general review

Demands for concessions or governmental incentives for establishment of industrial forest plantations have been a constant theme of forestry meetings between the private and public sectors. Indeed, both shared a similar perception that concessions or governmental incentives were necessary to stimulate the sector. This is shown in the review below of meetings and working group on the sector, all of which had representatives from both the public and private sectors (Kengen, 1985).

The conclusions of a national forestry conference in 1957 stressed the need for the government to develop policies to grant finance, at a subsidized interest rate through "Banco do Brasil", to those interested in creating forest plantations (INP, 1958).

In 1958 after analysing the sector, a working group argued that the stimated rate of planting (10 - 12,000 hectares a year) was too low to restore the natural forest's being exploited. So, it concluded that the government should create a Forestry Fund, managed by the Banco do Brasil, to lend money to those interested in establishing forest plantations. To make the loan attractive, its interest rate should

(6). For a more detailed analysis of the Brazilian forestry sector within the Brazilian economy see: Muthoo (1977); Prado (1977a); Mendes et al. (1978). In 1978 the Planning Coordination Unit (COPLAN) of the IBDF carried out the diagnosis of the Brazilian forestry subsector which was published under the colletion: "Desenvolvimento e Planejamento Florestal", serie "Estudos Perspectivos para o Periodo 1979-1985". This diagnosis encompasses five volumes and was done by many authors, all experts from COPLAN. For more recent material see: IBDF (1982b & 1985).

not exceed 2 % and the government should cover the difference between it and the market rate. To support the Forestry Fund, an addition al fraction of the income tax was to be paid by people and firms with a total income over Cr 200,000.00 (Cruzeiros of 1958). The fund was justified on the basis of the need to create a financial system which could cope with the alleged peculiarities of forestry. It was also proposed to allow tax deductions for capital used to develop forest plantations (INP, 1959).

During the Second World Conference on Eucalyptus held in Brazil in 1961, the low rate of forest plantation establishment was again blamed on the lack of a special financial scheme. However, despite the lack of any special incentive, plantations were being established, almost exclusively with Eucalyptus. These were concentrated in the States of Sao Paulo, Minas Gerais, Rio Grande do Sul, Santa Catarina and Parana (Table 3).

TABLE 3: Area Under Forest Plantations by State - 1961

State	Area (ha)	Annual Planting Rate (ha)
Sao Paulo	447 000	24 900
Minas Gerais	60 000	9 900
Rio Grande do Sul		
Santa Catarina	34 000	2 200
and Parana		
Others	19 000	
TOTAL	560 000	37 000

Source: INP 1961: 83-84

In 1962, a Working Group from the Ministry of Agriculture prepared a study of forestry as a basis for drafting a new Forestry Law. It estimated the total area planted with forests at 500 000 hectares and the annual rate of planting about 20 000 hectares of only 0.6 % of the total area harvested per year (INP 1963: 87). It noted that this situation required action on the part of the government to help reserve, or at least slow, the destruction of the forest resources, especially in south of Brazil. Again this group claimed that the area reforested and the planting rate were low due to the lack of a special financial scheme which could cope with the peculiarities of forest plantations. Therefore, it suggested that:

i. a special financial scheme should be created through private banks as well as the Banco do Brasil;

ii. incentives and legal protection should be provided to existing firms, or those established in the following five years, whose major aim was to establish forest plantations on a large scale;

iii. the revenue from exploitation of man-made forests should be exempt from income tax, and

iv. forest plantations should be exempted from paying land taxes (INP 1963: 106-107).

The major arguments repeated in support of all of these demands for concessions and government incentives were that:

a. the Brazilian forest resource had been over-exploited historically;

b. the availability of forest resource close to the major consumption centres had declined at an increasing rate, consequently their wood-based industries needed to import wood from long distances, in some cases more than 5,000 km (7);

c. to cope with an increasing demand for wood and wood-based products at domestic and international levels required a realible source of raw material and not just natural forests; and

d. an increasing international demand would lead to a shortage of wood-based products, including timber, and price rises, allowing Brazil to expand its share of the international market, consequently benefiting Brazil's trade balance (INP, 1963; Kengen, 1985).

It is clear that attempts were made for a long time to convince the government to grant special concessions to promote the establishment of large scale industrial forest plantations.

Finally, in 1966 the forestry proponents succeeded in getting the government concessions in the form of the fiscal incentives scheme which offered tax incentives to individuals and corporations. The arguments cited to support the introduction of the scheme were basically as above.

(7). i.e. from the Amazon basin to the Southern region.

However, more important than the particular arguments was the fact the fiscal incentives scheme ocurred within the context of the Brazilian economic development model being followed at that time. In other words, the Brazilian economic development model provided a "fertile land" for this sort of policy. Furthermore the beginning of the fiscal incentives scheme for reforestation coincided with the start of many other similar scheme in other sectors and the so-called "Brazilian economic miracle" (Kengen, 1985).

3.3.2. The Fiscal Incentives Scheme and the Economic Model

To clarify this arguments, let us recall some points from above. The Brazilian economic model, especially after 1964, assumed ambitious economic growth which involved increasing industrial growth. To realize this growth, the government looked to attract and funnel large sums of foreign and domestic capital into key growth export sectors of the economy. Extremely generous terms and conditions were offered to both foreign and domestic investors through a fiscal incentives system for programmes of regional development with emphasis on the Northeast and the Amazon regions (8) and, for development of specific economic sectors, such as forestry (9), fishery and tourism.

The major aim of the fiscal incentives scheme for establishment of large industrial forest plantations was stated by a former IBDF president:

> ...to induce the private sector to expand its activities into a sector (forestry) which requires a long period for the investiment to mature and so to assure to supply raw material - at low cost - to industries whose expansion would strongly contribute to the economic growth of the country which, at that time, was the top priority... (Reis 1983: 9).

(8). The concession of fiscal incentives in these regions are administered by "Superintendency for the Development of the Northeast - SUDENE" and "Superintendency for the Development of the Amazon - SUDAM", respectively. These jurisdictions are larger than the North and Northeast Regions (see map 3). Any enterprise that could in any way contribute to regional development of the respective region may qualify.

(9). Concession of fiscal incentives for the forestry sector is restricted to establishment of large scale industrial forest and fruit tree plantations. It does not encompass all activity within the forestry sector. It is administered by IBDF.


BRAZIL'S DEVELOPMENT
AGENCIES
MAP 3
SUDAM
SUDAM
SUDENE
SUDENE
BRASÍLIA
N
BRAZIL
Brasília
SOURCE: WORLD BANK 1984
KILOMETERS 0 100 200 300 400 500
MILES 0 100 200 300

This statement vindicates the claim that the fiscal incentives scheme for reforestation is part of the overall Brazilian development model, specially of the post-64 era.

Fiscal incentives can offer a relatively straightforward mean of promoting economic development when compared to other long term of complex measures that are more difficult to implement. On the other hand, the adoption of incentives without prior analysis can be undesirable (Beattie, 1975). However the government was apparently not interested in waiting for a long theoretical study and demonstration, and opted for incentives.

In 1966 at the beginning of the fiscal incentives scheme for reforestation, several governmental agencies shared responsibility for the forestry sector. This fragmented administrative structure seemed inadequate for the expected boom in the forestry sector due to the scheme. Hence, by the Decree-Law No 289 of 28 de February, 1967 the "Instituto Brasileiro de Desenvolvimento Florestal - IBDF" (Brazilian Institute for Forestry Development) was created and the old agencies, such as the INP were closed and all of their responsibilities and operations put under IBDF's mandate (IBDF, 1967). Within this context, any reforestation project to be granted fiscal incentives must be approved by the IBDF. A document known as the "Carta de Brasilia" (Brasilia's Charter) elaborated the basic guidelines for the IBDF and gave reforestation high priority. One of the first tasks of the IBDF was to formulate a national ten years programme for forest plantations with the goal of establishing two million hectares by 1978 (IBDF, 1968).

Having positioned the fiscal scheme within the context of the overall Brazilian economic model it will be reviewed the scheme itself and how it works.

3.3.3. The Fiscal Incentives Scheme and Pertinent Legislation

Since the initial Law 5,106 [10] of 2nd September, 1966 many other laws have been enacted to bring additional improvements, especially to match the reality dictated by the economic crisis that Brazil has been facing. The complete legislation is complex and extensive, so only aspects of the legislation which are relevant to this work will be reviewed [11].

(10). This Law is no longer effective.

(11). A full account of the legislation is available at the Department of Reforestation of IBDF.

One of the first alterations was the Decree-Law 1134 of 16 November, 1970 which allowed only corporations to have tax concessions of up to 50 % of their income tax due, for reforestation projects. Among its provisions, it allowed a corporation to deposit its tax credits with the "Banco do Brasil" in frozen account and to draw on these funds as they proceeded with approved projects. This was the opposite to what was required by the Law 5106, which had required that the project had been undertaken before a list of the expenses incurred could be submitted, for fiscal incentives. This act did not require a corporation to plan and execute its own projects, as had been required by the Law 5106, but accepted that this could be done by a contractor. It only grants fiscal incentives to corporations while the Law 5106 granted for both corporations and individuals. Finally, in its fifth article it required that the income tax deducted must not exceed 75 % of the projects's total cost.

Following these alterations, the federal government created "Mandatory Development Programmes - National Integration Plan (PIN) and Programme of Land Redistribution and Stimulus to Agriculture (PROTERRA) [12]. The major aim the government was to funnel resources to sectors that involve high risks and large amounts of capital and therefore attract little private investments. The funds for these programmes were subtracted from the incentives previously offered under the regional and sectoral fiscal incentive programmes. Hence, of the original 50 % of tax liability allowed as tax deductions in reforestation projects, only half could now be spent directly on the projects, while 30 % went to PIN and the other 20 % went to PROTERRA. For example a corporation with a total tax liability of 2000 could deposit 1000 in the Banco do Brasil in a frozen account for reforestation (as referred to above). The investor could then apply just 500 to the actual reforestation project while the other 500 would go to PIN (300) and to PROTERRA (200) funds administered by the federal government.

In 1974, another step reduced the tax deduction applying to reforestation projects. According to the fourth article of Decree-Law No. 1307 of 16 January, 1974 the tax deduction for reforestation projects would be gradually reduced by 5 % per year from the 1974 fiscal year onwards. Thus the maximum percentage of tax due, which could be diverted to reforestation, fell from the original 50 % to 45 % in 1974, to 40 % in 1975 and so on and at 25 % since 1978. Thus the same hypothetical corporation with the 2000 tax liability would now deposit only 500 to the special account, and use 250 for reforestation directly, with the balance going to PIN (150) and PROTERRA (100).

(12). "PIN" was created by the Decree-Law No. 1106 June, 1970 and PROTERRA by the Decree-Law No. 1179 of 06 July, 1971

SUDENE and SUDAM alleged that the increasing preference of investors for reforestation projects was responsible for the decrease of their funds. Although there is no concrete evidence to support this allegation, they succeeded in their claim. Currently, the maximum effective tax allowed for reforestation project is 25 % for projects established within either SUDENE's or SUDAM's areas of influence and 17.5 % elsewhere (IBDF/DR, 1983). These backward areas have been a matter of great concern for the Brazilian government which has made all sorts of efforts to promote their economic development. Thus, granting of higher tax deductions for projects to be established there, was expected to create economic activity. However, this policy has been criticized by entrepreneurs from the South and Southeast regions who claim that it has driven forest plantations away from the major industrial centres (13).

Decree-Law No. 1376 of 12 December, 1974 created "Investment Funds". The "Sectorial Investment Fund - FISET" combined the resource from the sectorial incentives schemes - reforestation, fishery and tourism - into a single fund. The resources from the regional development incentive scheme for Northeast and Amazon regions were pooled into the "Northeast Investment Fund - FINOR" and "Amazon Investment Fund - FINAM", respectively. Most of funds' resources come from incentive deductions of income tax due by the investor. The investor can choose to apply his tax deduction into one of these funds, thus becoming a shareholder in a company in which the money is invested, i.e. the company which had its project approved by one of the funds. The resources of the FISET are managed by the Banco do Brasil, of the FINOR by the "Banco do Nordeste do Brasil" and of the FINAM by the "Banco da Amazonia". The FINOR and FINAM are under the supervision of SUDENE and SUDAM, respectively. The FISET is under the supervision of the government agency in charge for the sector; for FISET - reforestation this is IBDF.

In the 1970's, complaints were made that large scale industrial forest plantations were taking over agricultural land to solve this problem, Decree No. 79046 of 27 December, 1976 in its fourth article, determined that from the fiscal year of 1977 only projects to be established in "Priority Regions for Reforestations and/or Forestry-Industry Districts" (14) would be entitled to fiscal incentives. This Decree also restored the concession of fiscal incentives to individuals as well as corporations (2nd article).

(13). See, for example: INDI (1975).

(14). It was responsability of each State to define which region or regions within the State would be considered the "Priority Region for Reforestation" and/or "Forestry-Industry District". Once it was defined, the State submitted the report for the consideration of the IBDF for approval.

The minimum area for reforestation projects eligible for fiscal incentives has been changed since the scheme began. Originally, according to Law 5106, a project had to plant a minimum of 10,000 trees to be entitled to fiscal incentives. Considering that the trees were planted at a spacing of 2 x 3 meters, a density of 1,666 trees per hectare, the minimum area was only 5 or 6 hectares. Later, the minimum area increased to 100 hectares (COALBRA, 1983). The Decree 79046, referred to above, determined that the minimum area should be 1,000 hectares (13th article). Decree No. 84097 of 16/10/79 again introduced changes in the minimum area which was decreased to 200 ha (1st article).

The economic crisis since 1973/74 has affected the fiscal incentives scheme for reforestation. Decree No. 88207 of 30 March, 1983 was passed to define priorities in granting fiscal incentives and made other provisions (IBDF/DR 1983). First, it limited the area to be reforested under fiscal incentives to 200,000 hectares. Secondly it determined that from 1984 onwards 50 % of the total resources of FISET must be directed to projects in the SUDENE area [15].

Thirdly, it determined that the concession of fiscal incentives for reforestation would be provided on condition that a firm provided some of its own funds for pre-establishment and site preparation works, according to the following schedule:

Category	Area of the Annual Programme	Part of the Firm's Own Funds
A	up to 200 ha	Nil
B	From 201 to 1 000 ha	5 %
C	From 1 001 to 3 000 ha	10 %
D	Above 3 000 ha	15 %

Source: IBDF/DR 1983: 68-A

Fourthly, it determined that the projects must conform to priority programme of the federal government. From 1983 these were:

- fruit trees and xerophytes in the Northeast region and semi-arid areas;
- pulp and paper;
- charcoal for the steel industry;
- substitution of fuel oil;
- timber (IBDF/DR 1983: 65-A).

(15). This again suggests that SUDAM and SUDENE succeeded in their claim as referred to above.

The most recent changes in the fiscal incentives scheme occurred on 21 November, 1986, when were launched the Decree No. 93607 and the Decree-Law 2304. These legal acts promote great changes in the fiscal scheme. However, they are not going to be discussed since they are not fully effective.

3.3.4. The Response of the Investors to Amendments to the Fiscal Incentives Scheme.

From section 3.3.1. it was seen that the total area reforested in Brazil before the fiscal incentives scheme was modest, having established a total area of about 560 000 hectares, at the rate of about 37 000 hectares per year.

In its first year (1967/68) the fiscal incentives scheme attracted great interest from the private sector. IBDF received 610 requests for incentives of which 351 were approved, totaling 163,000 hectares (IBDF 168: 27). The plantations have been concentrated, like the major economic activities. In the Southeast and South regions, especially in the States of Sao Paulo, Minas Gerais and Parana and to a lesser degree in other states. The principal genera have been Eucalyptus and Pinus and to a lesser extent, some other native species, especially Araucaria angustifolia and fruit trees, up to 1970 the genus Pinus predominated vis a vis Eucalyptus but from 1971 onwards Eucalyptus has predominated. Plausible explanations are the increased plantations in states and regions which are more suitable for Eucalyptus and increased plantations for charcoal production, for which Eucalyptus is more suitable.

Since the introduction of the fiscal incentives scheme, a large number of firms have specialized in reforestation, specially through the establishment of subsidiaries of companies in the pulp and paper, steel and pig-iron, plywood, particle board, fibre board and veneer industries. Steel and pig-iron industries established plantations because they use charcoal as the reducing agent. There are also some independent firms which establish plantations for third parties, such as small companies which use wood as raw material, but which are not able to establish their own plantations. During the energy crisis, the biomass from reforestation began to be perceived by the government as an alternative source of energy, so it encouraged some industries, (e.g. cement) to change their source of energy from oil to charcoal. Along with charcoal, other technologies have been developed, for example production of alcohol from wood, distillation of wood an production of tar. The know-how acquired during this period started to be exported, especially to other countries in Latin America [16].

(16). For more detail see, for example: Brazil Trade & Industry (1983).

Like any other capitalist activity, reforestation is undertaken to generate profits. One of the factors which affects the profits of it is the price of land. As the price of land increases, reforestation can be expected to decrease, ceteris paribus. Berger (1979) argued that with the consistent increase in the price of land from 1969 to 1972, and more rapidly thereafter, the rate of planting decreased rapidly in Sao Paulo. According to Berger (1979) the real land prices in Sao Paulo increased by more than 400 percent from 1969 to 1976. This phenomenon was not restricted to Sao Paulo. This increase in the price of land has been one of the major concerns of others, including COALBRA (17) which conducted a survey and found that:

> ... in the beginning, i.e. after the launching of the fiscal incentives, the more active centres of reforestations were concentrated close to industries, such as pulp and paper, steel and so on, in the States of Sao Paulo, Santa Catarina, Parana and Minas Gerais. Then, due to factors such as an increase in the price for land, mainly in Sao Paulo, the necessity of extensive and contiguos areas, and especially because forest plantations can be established in infertile lands which are not suitable for agricultural uses, firms moved to areas each time further away. So, because of these factors forest plantations shifted towards other regions, such as the inland savannas of Minas Gerais (COALBRA 1983: 106).

Brazil is a market economy and prices of any good, including land, change according to demand and supply for it. Thus the increase in the price of the land cannot be simply attributed to the reforestation programme, although no doubt it had a considerable effect. In fact any other programmes which promoted an increasing demand for large tracts of land would have the same effects. Also contribuing to this increase in the price of land was the speculation factor which can be stimulated by programme, such as the fiscal incentives scheme and by inflation itself. The high inflation rates in Brazil lead people to invest, amongst other things, in land as a hedge against inflation.

(17). COALBRA is a firm created in 1980 by the Ministry of Agriculture which aims to develop and disseminate throught the country the necessary technology to produce, on an industrial scale, different liquid and solid combustibles from biomass (COALBRA 1983: 15). This firm was closed down.

However, it was not only the increase in price of land that became a constraint in the expansion of the reforestation, but also the required minimum area which increased to 1,000 hectares before declining to 200 hectares, as discussed in the previous sub-section. This decline can be attributed to the lobby of entrepreneurs who found obtaining large and continous tracts of land became a constraint in some states, for example in Rio Grande do Sul (18). Because of its agrarian structure, finding a contionous area of 1,000 hectares was difficult of required to buy many small estates. This claim is supported in the following quotation from an interview with the director of IBDF's Department of Reforestation (DR) who stated:

> ... the State of Rio Grande do Sul is suigeneris, since it is a state with a great number of small proprieties and its edaphic-climatic conditions are good to grow soybean and wheat, so the price of the land is very expensive. These factors, make an expansion of an intensive reforestation effort difficult... we (IBDF) have talked with representatives from the South, with the Association of Reforestation Firms of the State of Rio Grande do Sul and so on, looking for an alternative solution to the problem... some projects could not be established because firms could not acquire land, in time to establish forest plantations. For example, on firm to make viable the establishment of an area of 1,000 hectares needed to make 110 covenants (IBDF 1982: 54).

However, it was not only these pressures that led the firms towards other regions, especially towards the Northeast. The government, as discussed above, through its incentive policies has played an important role in this shift. For example, IBDF approved projects totalling 534,930 hectares during the period 1967-1986 just for the State of Bahia in the Northeast region (IBDF/DR). This is part of the overall policy to develop and integrate the North an Northeast regions into the overall process of development. Implicit in the policy is the idea that these plantations will attract industries to the lesser developed regions.

Thus given the high price of land and the difficulty in finding large tracts it is not surprising that reforestation firms shifted their activities to regions, were these constraints were not as binding, even though these regions are far way from the major industrial and comsumption centres. In addition to these market forces, the government through its selective policies stimulated this push.

(18). The concern of the investors of this State regarding this alteration in the minimum area is expressed in newpaper articles, such as: "As novas opçoes de localizaçao" in: Gaxeta Mercantil of 29/12/76 and, even by IBDF see: IBDF (1982).

4. OTHER FORESTRY POLICY

In addition to the fiscal incentives scheme the IBDF has been trying to implement a complementary forestry policy which can be summarized into the following five major lines of action:

a. Forestry policy to the Amazon region;
b. Conservation and/or preservation of all national parks, national forests, biological and ecological reserves of the country;
c. Promotion of social forests;
d. Promotion of the rehabilitation of the tropical coast forest (which extends from North of South to South occupying today a maximum of 5 % of the original cover);
e. Promotion of national programme of watershed management with special reference to the reforestation of river margins and lakes as well as the rehabilitation of specific riparian forests (Carneiro, 1987).

These lines of action are expected to orient the forest sector activities to establish harmony between the utilization of the renewable natural resources, necessary to the process of national development, and the preservation of the existing ecosystems. However, it is worth to note that establishment of large industrial forest plantations still plays a major role in the Brazilian forestry sector and as such they continue to receive a greater attention.

5. FINAL REMARKS

Regarding to trends of the Brazilian forestry sector, it is a quite difficult theme to talk about. As it was mentioned in the early part of this paper the Brazilian economy has been characterized by a frequent up-and-down movement. At present, as you know, it is facing one of its down period. However, evidence has shown that Brazil has survied to other crises. So, it is expected that it will survive to this one, too.

As far as the forestry sector is concerned its future trend will depend on how the crisis will be managed and which will be the new course of the whole economy. Within this context, it does not seem to be fair, at this stage due to the hard time faced by the Brazilian economy, to assume anything. However, given previous experience and the large investments already made in the forestry sector, in particular by the pulp and paper and the siderurgy industries one can expect that it will overcome the present economic crisis and will come back to grow at higher rates. Like Brazil, the forestry sector is also at edge of the abyss, but it is greater than abyss.

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APPENDIX

Area Approved for Afforestation with Resources from Fiscal Incentive Scheme by Region - 1967 a 1986

Region	AREA (HA)	%
North	164,663	2,6
Northeast	1,152,089	18,4
Centre-West	728,054	11,6
Southeast	2,707,987	43,4
South	1,499,690	24,0
Brazil	6,252,483	100,0

Source: IBDF/DR

Area Approved for Afforestation with Resources from Fiscal Incentive Scheme by Specie and Year - Brazil

Unit: Ha

Species / Year	Pinus	Eucalyptus	Araucaria	Natives	Fruit Trees	Palmito	Others	Total
1967	18,159	13,877	1,729	822	173	-	-	34,759
1968	60,899	30,057	7,330	1,892	2,063	-	669	102,910
1969	96,798	53,800	7,670	2,717	1,278	-	120	162,383
1970	119,913	83,609	12,029	4,451	1,779	26	196	222,005
1971	98,053	129,053	8,080	3,843	2,410	3,350	3,689	248,478
1972	101,059	172,441	7,756	3,448	9,089	3,266	7,298	304,357
1973	86,181	161,132	7,828	6,536	7,023	21,802	3,651	294,153
1974	83,245	188,336	7,530	3,804	8,857	28,088	4,519	324,379
1975	94,222	222,718	6,618	5,891	6,816	58,519	3,456	398,240
1976	87,001	262,337	4,845	4,502	11,345	73,193	6,024	449,249
1977	99,277	194,352	758	851	30,270	20,048	876	346,432
1978	140,726	228,068	902	1,036	29,799	10,000	1,206	411,737
1979	117,944	282,420	1,332	228	49,621	10,650	11,523	473,718
1980 *	88,650	271,550	200	-	50,275	5,800	19,100	435,575
1981 *	117,160	229,675	350	-	43,990	-	26,700	417,875
1982 *	158,335	186,820	500	-	54,640	-	30,690	430,985
1983 *	73,565	91,035	230	-	31,518	-	18,652	215,000
1984 *	70,750	124,360	500	-	54,800	-	35,790	286,200
1985 *	65,236	130,718	700	-	56,562	-	31,816	285,032
1986 *	85,220	174,320	1,000	-	100,535	-	47,940	409,015
1967/86	1,862,393	3,230,678	77,887	40,021	552,843	234,742	253,915	6,252,483

Source: IBDF/DR

* projects proposed

Fruit Trees: apple, mango, cashew, coconut, palm, Brazilian nut and citrus.

Others: dende, algaroba, bambu, erva-mate and acácia negra.

Area Approved for Afforestation with Resources from Fiscal Incentive Scheme by Specie and State - 1967 a 1986

Unit. Ha

States \ Species	Pinus	Eucalyptus	Araucaria	Natives	Fruit Trees	Palmito	Others	TOTAL
Acre	-	-	-	-	1,479	-	-	1,479
Amapá	29,660	1,500	-	-	600	-	1,140	32,900
Amazonas	-	800	-	-	29,065	13,632	500	43,997
Pará	7,500	4,000	-	-	20,507	42,260	10,900	85,167
Rondônia	-	-	-	-	150	-	-	150
Roraima	-	-	-	-	970	-	-	970
Alagoas	-	2,800	-	-	8,415	-	8,040	19,255
Bahia	295,427	203,792	-	1,306	25,495	5,200	3,710	534,930
Ceará	-	-	-	-	104,368	-	8,511	112,879
Maranhão	6,300	19,040	-	1	55,509	-	6,200	87,050
Paraíba	-	1,000	-	-	9,115	-	66,940	77,055
Pernambuco	-	4,800	-	3	14,047	-	32,810	51,660
Piauí	-	32,100	-	-	116,955	-	-	149,055
Rio Grande do Norte	-	3,450	-	-	77,932	-	36,424	117,806
Sergipe	-	500	-	-	1,899	-	-	2,399
Distrito Federal	9,091	16,125	-	468	1,249	-	-	26,933
Goiás	34,370	88,601	1,400	3,068	14,996	-	6,007	148,442
Mato Grosso	961	20,250	-	11	950	-	-	22,172
Mato Grosso do Sul	66,026	459,728	-	2,212	1,196	-	1,345	530,507
Espírito Santo	1,213	147,571	45	2,126	686	-	126	151,767
Minas Gerais	190,540	1,606,757	560	14,693	15,799	-	570	1,828,919
Rio de Janeiro	2,551	22,845	15	1,039	1	55	-	26,506
São Paulo	193,118	434,632	3,204	7,241	21,783	37,314	3,503	700,795
Paraná	572,784	68,170	49,969	4,773	12,166	131,294	2,059	841,215
Santa Catarina	290,162	38,828	14,773	1,230	7,245	3,759	798	365,795
Rio Grande do Sul	162,689	53,391	7,921	1,852	10,266	1,228	64,333	301,680
BRASIL	1,862,393	3,230,678	77,887	40,021	552,843	234,742	253,915	6,252,483

Source: IBDF/DR

Fruit Trees: apple, mango, cashew, coconut palm, Brazilian nut and citrus.

Others : dendê, algaroba, bambu, erva-mate and acácia negra

dendê: Elaeis guineensis L.
algaroba: Prosopis sp.
bambu: Bambusa sp.
erva-mate: Ilex paraguariensis St. Hil.
acácia negra: Acacia sp.

QUADRO 01 - EVOLUÇAO DO SALDO DA BALANÇA COMERCIAL DO SETOR FLORESTAL

DISCRIMINAÇAO	Quantidade (t)						
	1980	1981	1982	1983	1984	1985	% *
Exportaçao	2.075.645	2.188.447	1.835.019	2.308.798	2.613.384	2.391.899	2,8
Importaçao	736.369	603.223	609.531	525.946	1.168.036	913.855	3,6
SALDO	+1.312.276	+1.585.222	+1.225.488	+1.782.852	+1.445.348	+1.478.044	2,4

DISCRIMINAÇAO	Valor 1000 US$ FOB						
	1980	1981	1982	1983	1984	1985	% *
Exportaçao	1.063.449	1.073.143	846.736	977.832	1.222.861	971.777	-1,7
Importaçao	272.473	294.187	225.442	199.790	238.033	212.323	-4,8
SALDO	+ 790.976	+ 778.956	+ 621.294	+ 778.042	+ 984.828	+ 759.454	-0,8

* Taxa crescimento medio anual

Fonte: CACEX/SRF/MF
Elaboraçao: IBDF/DC/DEM

Quadro 14 - Evolução das Exportações de Produtos Florestais

1000 US$ FOB

DISCRIMINAÇÃO	1980	1981	1982	1983	1984	1985
A- Produtos Básicos	72.408	58.216	53.073	59.831	47.594	47.498
1. Plantas vivas da Floricultura	4.570	3.272	2.015	1.764	2.319	2.650
2. Castanha do Brasil	26.821	24.734	32.240	36.038	24.330	25.153
3. Erva-Mate	37.422	28.296	15.041	17.633	15.649	14.083
4. Especiarias	5	27	4	9	1	35
5. Sementes e Frutas	15	5	30	35	63	-
6. Plantas e Suas partes p/ uso em perfumaria, medicina ou inseticida.	389	30	583	721	667	449
7. Materiais-primas vegetais p/ tinturaria ou cortume	219	421	503	336	-	-
8. Gomas, Resinas e Bálsamos naturais	-	-	-	-	472	315
9. Materiais Vegetais: Bambú, Rotim, Junco e Rafia	37	32	6	26	10	19
10. Material Vegetal (Piaçava)	1.241	1.284	910	849	806	473
11. Borracha em Bruto	91	110	76	13	-	18
12. Cortiça em Bruto	-	-	-	2	-	-
13. Serragem e desperdícios ou Resíduos de Madeira	16	15	13	13	21	8
14. Carvão Vegetal	1.582	-	282	984	1.215	1.845
15. Toras	-	-	1.370	1.408	2.041	2.446
B- Produtos Industrializados	991.041	1014.927	793.663	918.001	1.175.267	924.279
B.1. Semimanufaturados	478.657	459.277	353.624	405.547	479.487	367.160
1. Sucos e extratos vegetais	35	-	180	126	89	21
2. Óleos vegetais em bruto	4.726	1.848	9	8.258	11.977	4.183
3. Ceras Vegetais	16.983	17.797	14.579	13.112	10.561	12.710
4. Cortiça Semimanufaturada	-	2	-	2	-	-
5. Madeira serrada	84.570	61.150	47.525	54.622	36.936	47.007
6. Dormentes	17	2.357	773	1.514	-	-
7. Madeira beneficiada (arcos, cavacos etc.)	4	61	5	24	9	7
8. Pasta para Fabricação de papel (celulose)	362.703	363.179	275.291	311.100	389.377	281.881
9. Extratos Tanantes Vegetal	9.619	12.883	15.262	16.789	21.538	21.351
B.2. Manufaturados	512.384	555.650	440.039	512.454	695.780	557.119
1. Óleos Vegetais	4.265	2.851	4.698	4.151	6.176	3.711
2. Palmitos em conserva	34.633	23.652	19.996	27.021	25.685	10.213
3. Óleos essenciais	6.977	7.237	4.916	6.829	15.681	10.035
4. Lacas	-	7	4	4	6	13
5. Tall oil	-	-	-	-	-	24
6. Essência de Terebentina, essência de Madeira de Pinho	6	2	4	3	68	594
7. Cologonias e ácidos resínicos	193	197	54	58	493	2.501
8. Alcatrões de madeira, óleos de alcatrões de madeira	-	-	-	-	-	5
9. Madeira beneficiada	171.978	146.837	119.457	137.247	149.027	114.823
10. Madeira laminada	34.354	32.062	29.360	30.732	33.328	34.293
11. Madeira Compensada	41.282	48.071	32.342	48.410	63.322	64.429
12. Placa ou Chapa de Madeira Aglomerada	603	1.724	165	467	409	109
13. Painéis de Fibra de Madeira	48.717	57.779	42.972	43.482	44.037	37.795
14. Cortiça manufaturada	293	392	142	18	302	216
15. Papel, Cartolina, Cartão e Suas Obras	155.543	219.915	174.196	208.434	345.560	262.786
16. Móveis	13.540	14.924	11.733	5.598	11.686	15.572
TOTAL	1.063.449	1.073.143	846.736	977.832	1.222.861	971.777

Fonte: CACEX
Elaboração: IBDF/DC/DEM

Quadro 15 - Evolução das Exportações de Produtos Florestais

Unidade (t)

DISCRIMINAÇÃO	1980	1981	1982	1983	1984	1985
A- Produtos Básicos	76.810	54.694	54.128	63.058	82.392	93.922
1. Plantas Vivas da Floricultura	1.469	905	665	548	719	808
2. Castanha do Brasil	22.436	18.610	18.105	21.962	19.664	24.911
3. Erva-Mate	25.676	24.328	23.768	22.321	20.062	22.253
4. Especiarias	0,689	2	1	2	0,227	15
5. Sementes e Frutas	0,210	0,620	0,123	1	57	-
6. Plantas e Suas partes para uso em perfumaria, medicina ou inseticida	68	35	73	95	93	71
7. Materiais primas vegetais para tinturaria ou cortume	195	135	70	234	-	
8. Gomas, Resinas e Bálsamos Naturais	-	-	-	-	464	339
9. Materiais vegetais: Vime, Bambú, Rotim, Junco e Ráfia	88	61	15	25	82	111
10. Material vegetal (Piaçava)	922	1.094	681	631	708	381
11. Borracha em Bruto	-	42	39	8	-	9
12. Cortiça em Bruto	68	-	-	5	-	
13. Serragem e desperdícios ou Resíduos de Madeira	51	47	36	27	51	57
14. Carvão Vegetal	25.837	9.435	2.860	6.741	10.980	16.539
15. Toras	-	-	7.815	10.458	29.512	28.428
B- Produtos Industrializados	1.998.835	2133.753	1.780.891	2.245.740	2530.992	2.297.977
B.1. Semimanufaturados	1.131.104	1.133.669	980.788	1.185.270	1.139.303	1.121.752
1. Sucos e extratos vegetais	1	-	4	2	2	-
2. Óleos vegetais em bruto	5.303	2.356	10	12.038	12.737	5.617
3. Ceras Vegetais	9.676	-	8.480	10.440	10.013	9.419
4. Cortiça semimanufaturada	-	-	-	0,253	-	-
5. Madeira Serrada	210.633	144.358	131.619	143.425	101.271	140.203
6. Dormentes	160	19.309	6.430	8.548	-	-
7. Madeira beneficiada (arcos, cavaco, etc...)	3	269	11	50	25	43
8. Pasta p/ fabricação de papel (celulose)	885.776	944.643	814.494	986.648	982.004	937.075
9. Extratos tanantes vegetal	19.552	22.734	19.760	24.119	33.251	29.395
B.2. Manufaturados	867.731	1.000.084	800.103	1060.470	1.391.689	1176.225
1. Óleos vegetais	4.847	3.369	5.106	5.551	6.001	5.066
2. Palmitos em conserva	10.056	8.292	8.766	10.691	9.884	5.129
3. Óleos essenciais	1.462	1.737	1.172	1.348	2.654	2.373
4. Lacas	-	2	1	2	4	4
5. Tall Oil	-	-	-	-	-	30
6. Essência de terebentina, essência de madeira de pinho	2	1	0,010	1	148	1.398
7. Colofonias e Ácidos resínicos	153	67	82	83	1.296	5.991
8. Alcatrões de madeira, Óleos de alcatrões de madeira	-	-	-	-	-	16
9. Madeira Beneficiada	386.189	341.996	239.776	275.857	300.423	248.082
10. Madeira Laminada	29.890	31.935	35.193	40.502	39.115	39.031
11. Madeira compensada	64.030	73.305	52.810	95.514	133.708	148.773
12.. Placa ou Chapa de Madeira Aglomerada	1.446	5.495	417	1.510	2.537	279
13. Painéis de Fibra de Madeira	173.505	197.990	181.583	185.879	185.608	166.431
14. Cortiça manufaturada	71	82	37	6	65	57
15. Papel, cartolina, cartão e Suas Obras	190.648	329.353	270.240	440.605	702.640	543.383
16. Móveis	5.432	6.460	4.920	2.921	7.606	10.182
TOTAL	2.075.645	2.188.447	1.835.019	2308.798	2.613.384	2391.899

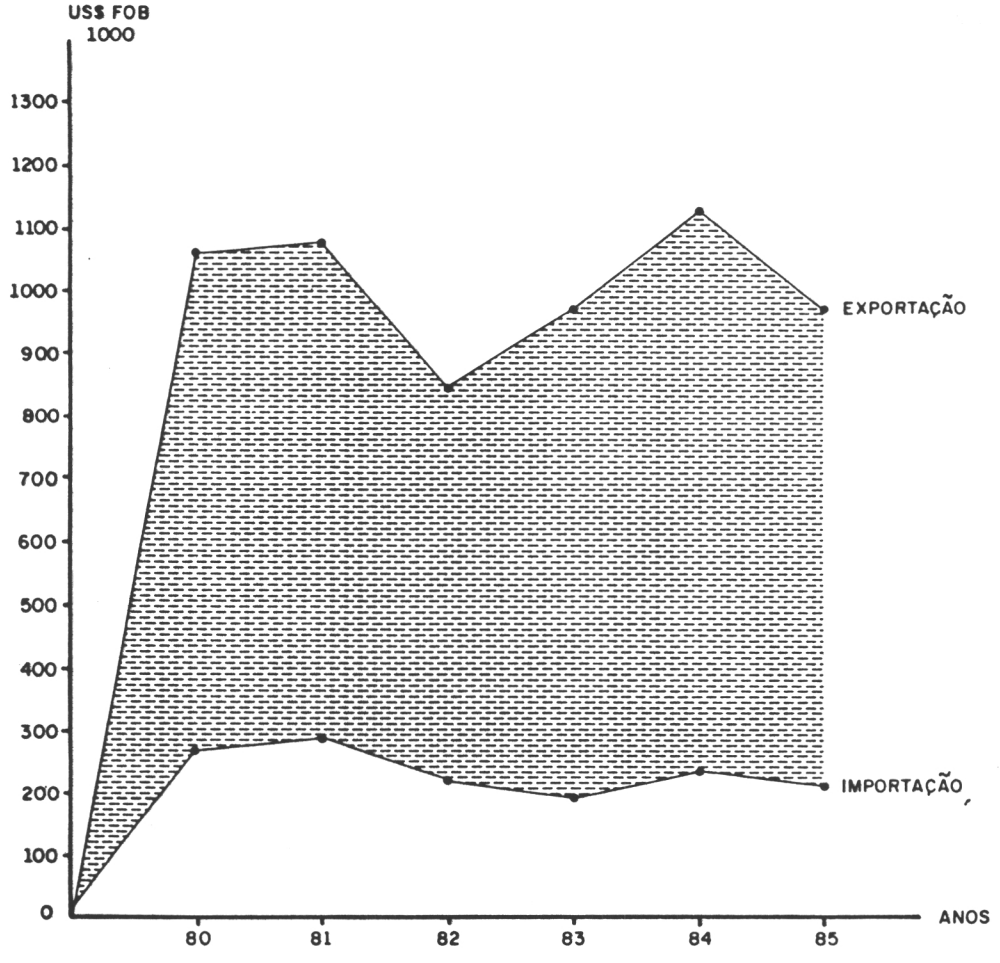
Fonte: CACEX
Elaboração: IBDF/DC/DEM

QUADRO 16 - IMPORTAÇÃO EFETIVA DE PRODUTOS FLORESTAIS - 1985/1984

DISCRIMINAÇÃO	1985				1984				PREÇO MÉDIO		VARIAÇÃO PERCENTUAL		
	t	%	1000 US$ FOB	%	t	%	1000 US$ FOB	%	1985	1984	t	US$ FOB	US$/t
A. PRODUTOS BÁSICOS	173.580	19	72.256	34	154.544	13	82.510	35	416	533	12	-12	-22
1. Plantas Vivas da Floricultura	11		2		-		-		181	-	-	-	-
2. Castanha do Brasil	2.880		528		7.474	1	691	0,5	183	92	-61	-24	99
3. Especiarias	608		702	0,5	380		428		1.154	1.126	60	64	2
4. Sementes e Frutos	2		556		2		242		278	121	-	130	130
5. Plantas e suas partes p/ uso em perfumarias, medicina ou inseticida	4		8		9		18		2.000	2.000	-56	-56	-
6. Matérias-primas vegetais p/tinturaria ou curtume	450		2.142	1	617		1.358	1	4.760	2.200	-27	58	116
7. Materiais vegetais Vime, Bambú, Rotim, Junco e Rafia	18		29		6		11		1.611	1.833	200	164	-12
8. Borracha em Bruto	62.112	7	50.793	24	60.099	5	62.128	26	817	1.033	3	-18	-21
9. Cortiça em Bruto	54.664	6	9.495	4,5	43.947	4	9.510	4	173	216	24	- 0,2	-20
10. Toras	52.831	6	8.001	4	42.010	3	8.124	3,5	151	193	26	- 2	-22
B. PRODUTOS INDUSTRIALIZADOS	740.275	81	140.067	66	1.013.492	87	155.523	65	189	153	-27	-10	23
B.1. Semimanufaturados	522.980	57	40.988	19	727.481	62	33.851	14	78	46	-28	21	69
1. Cortiça Semimanufaturada	243.270	26,5	12.567	6	465.192	40	10.096	4	51	21	-48	24	143
2. Pasta Química de madeira (Celulose)	34.382	4	13.916	6	27.734	2	11.865	5	404	427	24	17	- 5
3. Extratos Tanantes Vegetal	2.059		1.944	1	1.972		1.846	1	944	936	4	5	1
4. Madeira Serrada	243.269	26,5	12.561	6	232.583	20	10.044	4	51	43	4	25	19
B.2. Manufaturados	217.295	24	99.079	47	286.011	25	121.672	51	455	425	-24	-19	7
1. Óleos essenciais	44		379		68		528	0,2	8.613	7.764	-35	-28	11
2. Lacas	22		269		40	0,1	379	0,1	12.227	9.475	-45	-29	29
3. Tall oil	85		54		400		258		635	645	-79	-79	- 2
4. Essência de Terebentina, Essência de Madeira de Pinho	250		206		606		517	0,2	824	853	-59	-60	- 3
5. Colofonias e ácidos Resínicos	445		847	0,5	465		495		1.903	1.064	- 4	71	79
6. Alcatrões de Madeira, Óleos de Alcatrões de Madeira	52.774	6	6.607	3,5	51.214	4,5	7.373	3	125	143	3	-10	-13
7. Madeira Beneficiada	4.309	0,5	687	0,5	4.910	0,5	955	0,5	159	194	-12	-28	-18
8. Madeira Laminada	48.430	5,5	5.889	3	46.207	4	6.200	3	121	134	5	- 5	-10
9. Placa ou Chapa de Fibra	-		-		75		195		-	2.600	-	-	-
10. Madeira Compensada	6		19		6		14		3.166	2.333	-	36	36
11. Placa ou Chapa de Madeira Aglomerada	165		224		300		416		1.357	1.386	-45	-46	- 2
12. Cortiça Manufaturada	15		186		17		158		12.400	9.294	-12	18	33
13. Papel, Cartolina, Cartão e Suas Obras	110.513	12	82.976	39	181.670	16	103.998	44	750	572	-39	-20	31
14. Móveis	237		736	0,5	33		186		3.105	5.636	618	296	-45
TOTAL	913.855	100	212.323		1.168.036		238.033		232	203	-22	-11	14

Fonte: SRF/MF
Elaboração: IBDF/DC/DEM

GRAFICO 1 – Comparativo entre as Exportações e Importações Brasileiras de Produtos Florestais.



Fonte: Cacex - SRF/MF
Elaboração: IBDF/DC/DEM

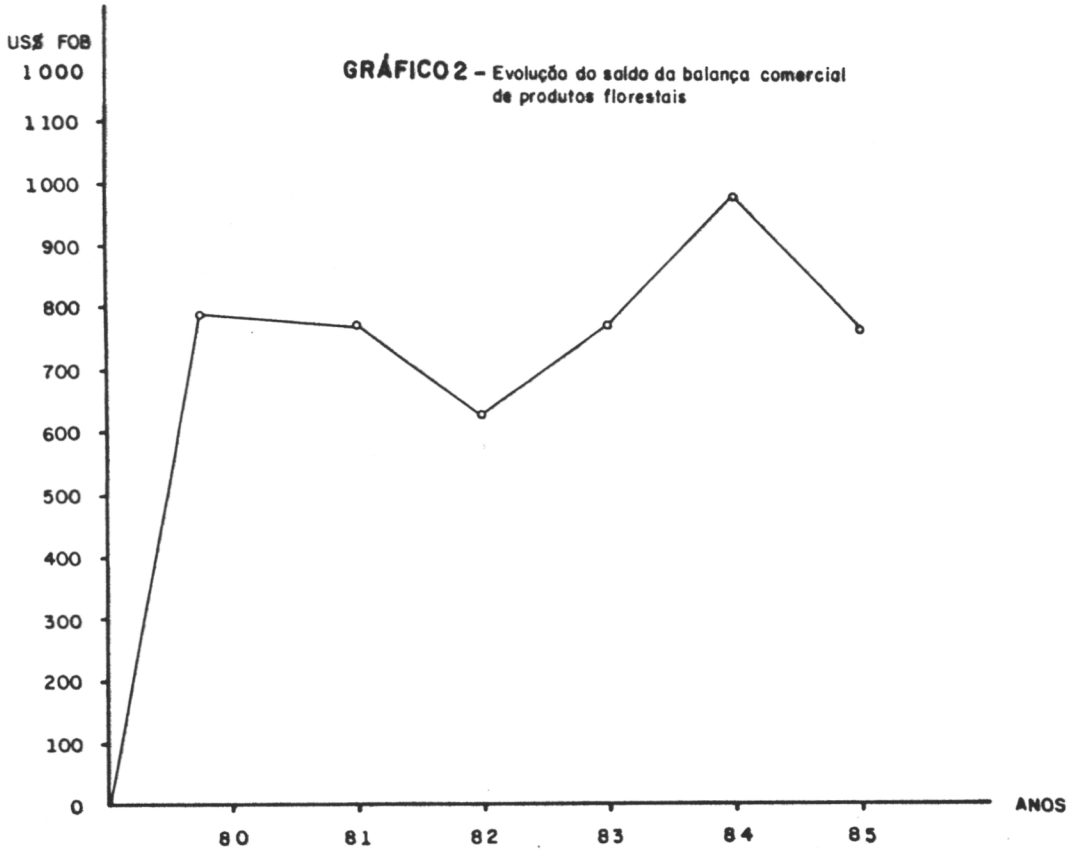


GRÁFICO 2 – Evolução do saldo da balança comercial de produtos florestais

Fonte: Cacex - SRF/MF
Elaboração: IBDF/DC/DEM

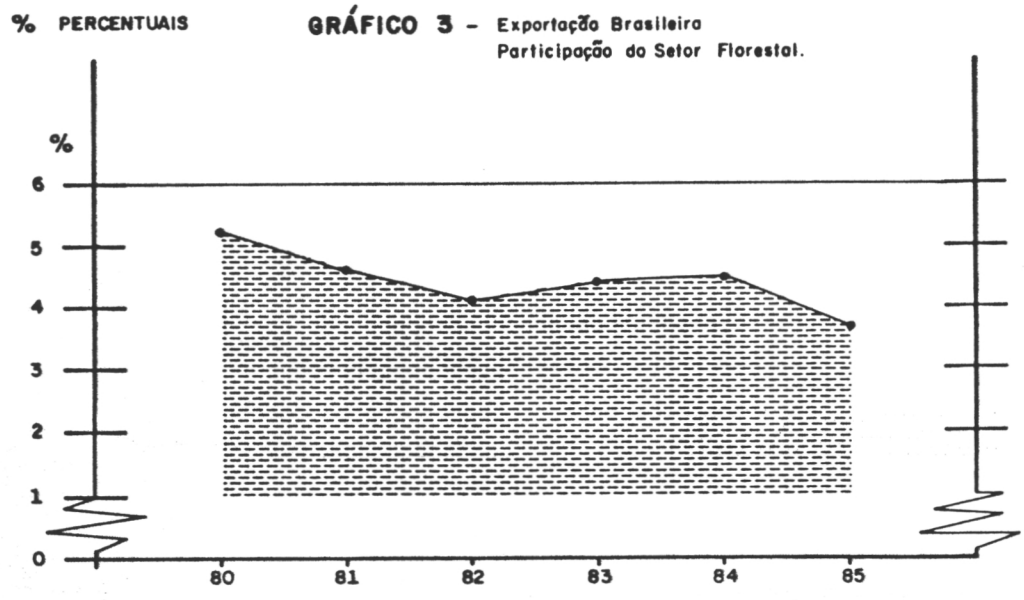


GRÁFICO 3 – Exportação Brasileira
Participação do Setor Florestal.

Fonte: Cacex
Elaboração: IBDF/DC/DEM

Dr. **Etsuro Murakami**
Rigesa, Celulose, Papel e Embalagens Ltda

FUTURE TRENDS FOR THE FOREST INDUSTRY IN BRAZIL

The present stage of forestry development in Brazil emerged from the 1960 decade, when a new forest philosophy became established and tax incentives from the Federal Government were made available for all private companies to apply in reforestation. The objective of the Government was to establish Brazil'self-sufficiency in pulp and paper, and then to export the surplus when it became competitive in overseas markets. During the 1960 decade, Brazil established only 500,000 hectares of pine and Eucalyptus plantations. By 1985 there were 4.9 million hectares planted in pine and Eucalyptus using Federal subsidies. If we include plantations established by companies using their own capital, Brazil has close to 5.5 million hectares of plantations.

Today, our country has been classified as the largest potential competitor in the worldwide pulp and paper market. In 1986, Brazil's ranking was number 11 in paper production, and number 8 in pulp production.

Im mid 1982, a group of professional foresters defined 16.3 million hectares of pine and Eucalyptus plantations as the goal to meet Brazilian wood demands by the year 2000. In 1986 and 1987, an additional 600,000 hectares are projected to be planted, bringing the total to 6.1 million hectares. This is still only 37 % of the 16.3 million hectares needed.

The majority of these 6.1 million hectares were planted by large pulp and paper companies, and large reforestation companies. Very little effort was directed toward forest extension work with small farmers.

For a better overview, future trends of the forest industry in Brazil can be divided into two categories: Category one will describe "Raw Material Production and Trends", and category two "Wood Utilization In The Forest Industry".

CATEGORY ONE: RAW MATERIAL PRODUCTION (Wood Production)

After two decades of Federal tax incentives, which have helped to establish 5.5 million hectares of plantations, one rotation of pine and Eucalyptus have been completed. The results were surprisingly good. With the natural ad-

vantages of favorable climate and very fast growth rates, complimented by the influence of European and American schools of forest management, the Brazilian foresters became mature and experienced professionals. The excellent climatic conditions, combined with fertile soils, arable topography, large land areas and low labor cost, produced growth rates of 15 m^3 to 25 m^3/ha/year during the first rotation. M.A.I.'s of 50 m^3 to 60 m^3 per hectare per year are now achievable goals for timber crops in the near future.

During the 1960 - 1970 decades, unimproved seed and often the wrong species and wrong provenances were used. Yields of 15 m^3 to 25 m^3/ha/ year were achieved with non-intensive silvicultural practices. Today, some of the large companies are committed to programs of advaced applied research, and are adopting innovative techniques in the field. Companies are employing advanced breeding programs and establishing second and third generation seed production orchards. The more innovative research programs include rooting propagation and tissue culture for Eucalyptus species. These advanced research programs should enable us to reach the expected 50 m^3 to 60 m^3 M.A.I. for Eucalyptus, and probably the same for pine.

Studies of the interaction of environmental conditions (i.e. climate, soils, drainage, altitude, degree of site preparation, etc.) with a wide range of genotypes are being conducted in depth. Techniques employed in seed and seedling production, soil fertilization, and the use of herbicides to control competing vegetation place Brazil on the leading edge of technical development in plantation management.

Present trends are to maximize yields and wood quality, while reducing the rotation age. Today it is possible, depending upon the type of forest product desired, to predetermine the forest management system most likely to achieve the highest return on investment. However, we will always need to continue refining our technology and search for alternatives to reduce cost and improve quality if we are to become and remain competitive.

CATEGORY TWO: FOREST INDUSTRIES (Wood Utilization)

Brazil has a great variety of forest based industries, but pulp and paper, plywood and solid wood products are the predominant ones, and consume the highest volume of wood.

Paper and pulp mills, as you know, are usually located close to the ocean to facilitate shipping.

The Forest industry emerged when tax incentives were made available for reforestation during the 1960 - 1970 decades. During the 1970's large industrial complexes were installed for the production of pulp and paper. As a result, Brazil has now become one of the largest producer in the world, with an extraordinary growth rate of 138 % in pulp and 101 % in paper for the nine year period from 1977 to 1986. For more than 10 years, the pulp and paper industry has been utilizing the juvenile wood of Eucalyptus and pine for process. Properties of juvenile wood of Eucalyptus were thoroughly analysed to combine with production goals and the final products. Knowledge of the variability in wood properties are being considered for selection of the most appropriate species and the correct rotation age to obtain better cooking, washing, refining and bleaching. This translates into higher quality paper that will be combined with new and innovative product development, making Brazil very competitive, not only in the internal market but in international markets as well.

The challenge Brazilian industry faces in the production of solid wood products such as lumber, plywood, and particleboard is far different. In the northern regions, including the Amazon basin, native hardwoods are being clear-cut, leaving vast areas that were once covered with virgin forest completely devasted. In the south, native conifer and hardwood stands have been entirely eliminated and the only remaining wood available for lumber and plywood is pine. Equipment used for the large native trees is being replaced with modern equipment designed for small pine log utilization. Plantation management has not been well conducted by the sawmill and veneer industries, and log quality is inadequate for the production of high grade lumber and plywood. New management practices for the pine plantations needed to be implemented immediately and the industry needs to revise their roundwood specifications to permit more complete utilization and better waste control.

During 1980, the pulp and paper industry made a commitment to the Government to drastically reduce fuel oil consumption. Using biomass as a substitute fuel, most companies have reduced their dependency on oil to levels of 10 % to 20 %. The biomass utilized is composed of bark, logging residues and roundwood from Eucalyptus plantations.

In the pulp and paper industry, full tree utilization is becoming a reality, but in the lumber and plywood industry more than 30 % to 40 % of the sawlog volume is lost in the form of residues. Some of these residues are being used for energy in their boilers.

It is apparent to me that there are now much greater opportunities for technological advances in manufacturing than in forest management. During the next decade, based on the 6.1 million hectares of established plantations, solid wood production needs to be critically analyzed if the demands of the internal and export markets are to be met.

CONCLUSION:

Brazil has an excellent potential of emerging during the next decade as one of the five largest producers and exporters of pulp and paper, as well as maintaining an important position in other forest products, providing that certain priorities can be met as listes below:

- An adequate Government policy concerning forestry matters, designed to meet demand for wood products and their derivatives.
- New foreign investment.
- Preservation of tax incentives to stimulate plantation establishment by private companies.
- A more favorable ruling on land ownership by foreign industries.
- A clear definition of the Agrarian Reform Law.
- A definition of Government environmental control regulations.
- The creation of additional Forest Research Institutes.
- Increase scientific exchange with Foreign Research Institutes.
- Better forestry education in the Universities.

Appendix:

ACTUAL ESTIMATES M.A.I. = FUTURE ESTIMATES M.A.I. (2nd rotation)

EUCALYPTUS

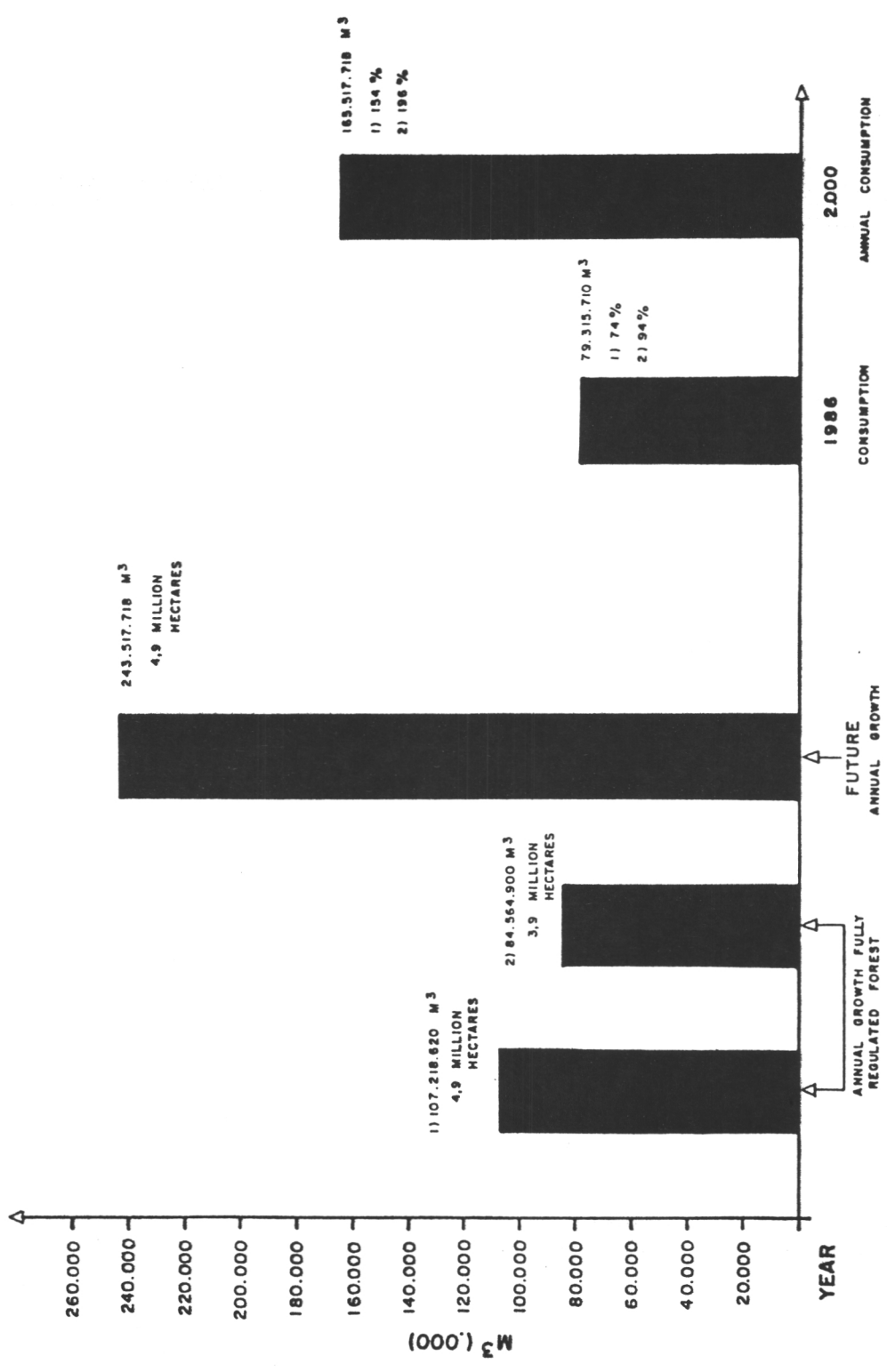
ACTUAL M.A.I. = 20 M^3/HA/YEAR
FUTURE = 50 M^3/HA/YEAR

PINE

ACTUAL = 25 M^3/HA/YEAR
FUTURE = 50 M^3/HA/YEAR

ARAUCARIA = 15 M^3/HA/YEAR

NATIVE = 15 M^3/HA/YEAR


WOOD AVAILABLE X CONSUMPTION
M³ (.000)
260.000
240.000
220.000
200.000
180.000
160.000
140.000
120.000
100.000
80.000
60.000
40.000
20.000
YEAR
1) 107.218.620 M³
4,9 MILLION HECTARES
2) 84.564.900 M³
3,9 MILLION HECTARES
243.517.718 M³
4,9 MILLION HECTARES
79.315.710 M³
1) 74%
2) 94%
1986
CONSUMPTION
163.517.718 M³
1) 134%
2) 196%
2000
ANNUAL CONSUMPTION
FUTURE
ANNUAL GROWTH
ANNUAL GROWTH FULLY REGULATED FOREST

WOOD CONSUMPTION/YEAR

(PINE + EUCALYPTUS)

		ACTUAL 1986		FUTURE 2000
PULP + PAPER (ESTIMATES)	=	14,868,000 M³		24,532,200 M³ (5%/YEAR)
" ENERGY (PULP + PAPER)	=	5,242,000 M³		8,649,300 M³
CHARCOAL { IRON, STEEL AND CEMENT	=	9,340,100 M³		120,738,678 M³ *
PARTICLE-BOARD	=	44,115,610 M³	NATIVE HARDWOOD	-
PLY WOOD { C.CONSTRUCTION FURNITURE	=	2,550,000 M³		3,997,000 M³
SOLID WOOD (CIVIL CONSTRUCTION)	=	3,200,000 M³		7,600,000 M³
WOODEN BOX	=	-		-
		79,315,710 M³		165.517,178 M³

ACTUAL ANNUAL GROWTH = 107,218,620 M³/YEAR (FULLY REGULATED FOREST)

FUTURE ANNUAL GROWTH = 243,189,150 M³/YEAR (FULLY REGULATED FOREST)

" LARGE UTILIZATION IN SUBSTITUTION OF FUEL OIL IN PULP AND PAPER PLANTS

SELF-SUFFICIENCY ANALYSES

1- ACTUAL WOOD CONSUMPTION VERSUS ACTUAL ANNUAL GROWTH

$$\frac{79,315,710\ M^3}{107,218,620\ M^3} = 74\%$$

2- FUTURE WOOD CONSUMPTION VERSUS ACTUAL ANNUAL GROWTH

$$\frac{165,517,178\ M^3}{107,218,620\ M^3} = 154\%$$

CONCLUSION: WITH PRESENT M.A.I. OF EUCALYPTUS AND PINE MINUS AREAS NOT APROPRIATED FOR INDUSTRIALIZATION THE ACTUAL ANNUAL GROWTH DOES NOT SUPPORT THE YEAR 2000 WOOD NEEDS. BUT WITH FUTURE M.A.I. IT IS POSSIBLE.

* ABRACAVE INFORMATION.

SOURCES OF VEGETAL CHARCOAL

YEAR	NATIVE HARDWOOD	REFORESTATION	TOTAL
1977	13,650,000	1,602,000	15,252,000
1978	13,320,000	1,833,000	15,153,000
1979	15,116,000	2,184,000	17,300,000
1980	16,867,000	2,777,500	19,644,500
1981	15,577,000	3,653,000	19,230,000
1982	14,928,000	3,732,000	18,660,000
1983	18,423,000	4,086,900	22,509,900
1984	24,597,000	5,010,000	29,607,000
1985	26,085,500	5,501,000	31,586,500
1986	28,646,500	6,065,000	34,711,500
GROWTH	+ 110%	+ 278%	+ 128%

2.2 M.E. = 1 M^3 CARVÃO

1.54 M^3 = 1 M^3 CARVÃO

VEGETAL CHARCOAL CONSUMPTION IN BRAZIL (M^3)

YEAR	LEAGUE IRON	CAST IRON	STEEL	CEMENT	EXPORTATION	TOTAL
1977	756,000	7,975,000	6,521,000	-	-	15,252,000
1978	827,500	8,123,500	6,202,000	-	-	15,153,000
1979	975,000	9,115,320	7,085,000	-	124,680	17,300,000
1980	1,108,000	9,329,280	8,449,500	656,000	101,720	19,644,500
1981	1,543,000	7,753,780	8,835,500	1,060,000	37,720	19,230,000
1982	1,412,000	7,045,320	8,410,000	1,780,000	12,680	18,660,000
1983	1,853,000	9,596,860	8,504,000	2,530,000	26,040	22,509,900
1984	2,170,000	14,010,080	10,168,000	3,215,000	43,920	29,607,000
1985	2,610,500	15,354,840	9,800,000	3,755,000	66,160	31,586,500
1986	2,819,000	17,886,640	10,570,000	3,485,000	48,860	34,711,500
GROWTH	+ 273%	+ 124%	+ 62%	+ 431%	- 61%	+ 128%
*2000						78,480,141

* SOURCE OF ABRACAVE - MINAS GERAIS

PLYWOOD PRODUCTION AND CONSUMPTION (M^3)

YEAR	CIVIL CONSTRUCTION	FURNITURE	TOTAL
1979	480,000	520,000	1,000,000
1980	420,000	480,000	900,000
1981	360,000	460,000	820,000
1982	300,000	510,000	810,000
1983	250,000	450,000	700,000
1984	300,000	600,000	900,000
1985	400,000	700,000	1,100,000
1986	500,000	1,000,000	1,500,000
GROWTH	+ 4%	+ 92%	50%

200 MILLS ARE CONCENTRATED IN THE SOUTHERN PART OF BRAZIL.
PARANÁ IS THE BIGEST PRODUCER OF PLYWOOD.

CAPACITY = 1.5 MILLION M^3/YEAR

SOLID WOOD PRODUCTION IN THE SOUTHERN BRAZIL (M^3)

YEAR	PARANÁ PINE	NATIVE HARDWOOD	PINE	TOTAL **
1979	2,270,000	2,214,000	54,500	4,538,500
1980	1,987,000	2,364,000	130,000	4,481,000
1981	1,430,000	1,870,000	201,000	3,501,000
1982	1,145,000	1,510,000	336,000	2,991,000
1983	740,000	905,000	385,000	2,030,000
1984	740,000	905,000	520,000	2,165,000
1985	480,000	540,000	700,000	1,720,000
1986	350,000	400,000	950,000	1,700,000
*1987	300,000	350,000	1,150,000	1,800,000
*1988	250,000	300,000	1,350,000	1,900,000
1979	50%	49%	1%	100%
*1988	13%	16%	71%	100%
*1990	0%	0%	100%	100%

*PROJECTION

**4,538,500 M^3 ONLY PINE = 7.6 MILLIONS M^3 OF PINE ROUNDWOOD

1,900,000 M^3 ONLY PINE = 3.2 MILLIONS M^3 OF PINE ROUNDWOOD

PULP AND PAPER

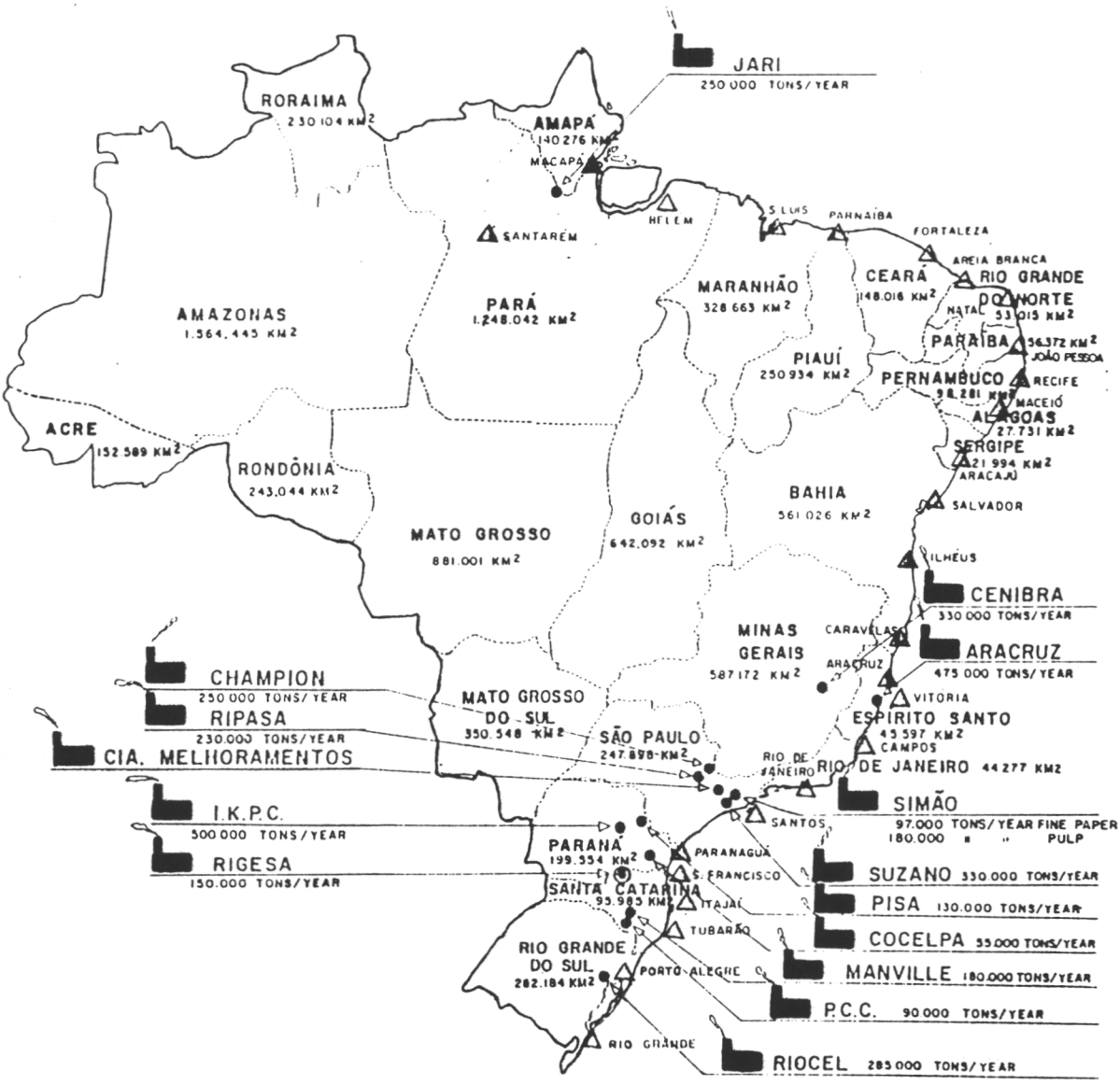
PRODUCTION INCREASE	-	1980 - 1986		YEAR 2000 *
PULP	=	2,873,000 TONS	- 3,580,000 TONS	6.0 MILLION TONS
			(25% ÷ 6 = 4%)	
PAPER	=	3,361,000 TONS	- 4,485,000 TONS	7.4 MILLION TONS
			(33% ÷ 6 = 5.5%)	
TOTAL	=	6,234,000 TONS	8,065,000 TONS	13,4 MILLION TONS

EXPORTATION	-	1980 - 1986		YEAR 2000
PULP	=	803,000 TONS	- 858,000 TONS	
			(7% ÷ 6 = 1.2%)	
PAPER	=	190,000 TONS	- 629,000 TONS	
			(231% ÷ 6 = 38.5%)	
TOTAL	=	993,000 TONS	1,487,000 TONS	
		(15.9%)	(18.4%)	

* 5% per year increase (projection)

PAPER AND PULP MILLS

JARI	250,000 TONS/YEAR	PULP	PARÁ
CHAMPION	250,000 TONS/YEAR	FINE PAPER	SÃO PAULO
RIPASA	230,000 TONS/YEAR	FINE PAPER	SÃO PAULO
RIOCEL	285,000 TONS/YEAR	PULP	RIO GRANDE SUL
P.C.C.	90,000 TONS/YEAR	FINE PAPER	SANTA CATARINA
MANVILLE	180,000 TONS/YEAR	KRAFT LINER	SANTA CATARINA
I.K.P.C.	500,000 TONS/YEAR	KRAFT LINER	PARANÁ
CENIBRA	330,000 TONS/YEAR	PULP	MINAS GERAIS
CIA. MELHORAMENTOS	- TONS/YEAR	FINE PAPER	SÃO PAULO
ARACRUZ	475,000 TONS/YEAR	PULP	ESPÍRITO SANTO
SUZANO	330,000 TONS/YEAR	FINE PAPER	SÃO PAULO
RIGESA	150,000 TONS/YEAR	KRAFT LINER	SANTA CATARINA
	90,000 TONS/YEAR	CORRUGATED PAPER	SÃO PAULO
PISA	130,000 TONS/YEAR	JOURNAL PAPER	PARANÁ
SIMÃO	97,000 TONS/YEAR	FINE PAPER	SÃO PAULO
	180,000 TONS/YEAR	PULP	
COCELPA	55,000 TONS/YEAR	KRAFT LINER	PARANÁ



BRAZIL = 8.511.965 KM2

PLANTATION DISTRIBUTION BY STATE

REFORESTATION WITH INCENTIVE TAX

PERIOD 1967 - 1985 (I.B.D.F. STATISTICS)

Unknown:
Euc.: 629,104 hectares
Pine: 402,874 hectares
1,031,978 hectares

STATE	SPECIES	HECTARES	ACTUAL UTILIZATION
BAHIA	PINE EUCALYPTUS	287,037 203,801	Unknown Energy, charcoal and pulp
RIO DE JANEIRO	PINE EUCALYPTUS	1,626 18,120	Unknown Energy
RIO GRANDE DO SUL	PINE EUCALYPTUS	151,539 46,721	Pulp and paper + sawtimber Pulp and paper + energy
SANTA CATARINA	PINE EUCALYPTUS	279,705 33,848	Pulp and paper + sawtimber Energy
SÃO PAULO	PINE EUCALYPTUS	192,686 415,004	Pulp, paper, sawtimber, energy Pulp, paper, particle-board, sawtimber
ESPÍRITO SANTO	PINE EUCALYPTUS	1,213 142,971	Unknown Pulp, charcoal
MINAS GERAIS	PINE EUCALYPTUS	188,090 1,489,134	Pulp, paper, charcoal Pulp, charcoal, energy
PARANÁ	PINE EUCALYPTUS	543,160 62,230	Pulp, paper Energy, particle-board
DISTRITO FEDERAL (BRASÍLIA)	PINE EUCALYPTUS	9,091 15,725	Unknown
AMAPÁ	PINE EUCALYPTUS	25,660 1,500	Pulp - Jari - Amcel
AMAZONAS	EUCALYPTUS	800	Unknown
MATO GROSSO	PINE EUCALYPTUS	961 16,450	Unknown
MATO GROSSO DO SUL	PINE EUCALYPTUS	63,926 458,228	Unknown
GOIÁS	PINE EUCALYPTUS	29,920 81,051	Unknown
MARANHÃO	PINE EUCALYPTUS	6,300 14,850	Unknown
ALAGOAS	PINE	2,800	Unknown
PARÁ	PINE EUCALYPTUS	3,500 4,000	Pulp - Jari
SERGIPE	EUCALYPTUS	500	Unknown
PARAÍBA	EUCALYPTUS	1,000	Unknown
PERNAMBUCO	EUCALYPTUS	4,400	Unknown
PIAUÍ	EUCALYPTUS	32,100	Unknown

PLANTATION ESTABLISHMENT WITH INCENTIVE TAX RESOURCES

I.B.D.F. DATA (HECTARE)

YEAR	PINE	EUCALYPTUS	PARANA PINE	NATIVE SPECIES	TOTAL	% INCREASE
1967	18,159	13,877	1,729	822	34,587	-
1968	60,899	30,057	7,330	1,892	100,178	+ 190 %
1969	96,798	53,800	7,670	2,717	160,985	+ 61 %
1970	119,913	83,609	12,029	4,451	220,002	+ 37 %
1971	93,053	129,053	8,080	3,835	234,021	+ 6 %
1972	101,059	172,441	7,756	3,448	284,704	+ 22 %
1973	86,181	161,132	7,828	6,536	261,677	- 8 %
1974	83,245	188,336	7,530	3,804	282,915	+ 8 %
1975	94,222	222,718	6,618	5,891	329,449	+ 16 %
1976	87,001	262,337	4,845	4,502	358,685	+ 9 %
1977	99,277	194,352	758	851	295,238	- 8 %
1978	140,726	228,068	902	996	370,692	+ 25 %
1979	117,943	282,419	1,332	228	401,922	+ 8 %
1980	88,650	271,550	200	-	360,400	- 10 %
1981	117,160	229,675	350	-	347,185	- 4 %
1982	158,335	186,820	500	-	345,655	- 1 %
1983	73,565	91,035	230	-	164,830	- 52 %
1984	70,750	125,360	-	-	196,110	+ 19 %
1985	73,468	122,042	-	-	195,510	-
TOTAL	1,780,404	3,048,681	75,687	39,973	4,944,745	-

TOTAL: SOFTWOOD (LONG FIBER = 37 %) = 1,856,091 HECTARES = 4,586,401 ACRES

HARDWOOD (SHORT FIBER = 63 %) = 3,088,654 HECTARES = 7,632,064 ACRES

4,944,745 HECTARES 12,218,465 ACRES

Dr. Markku Kanninen
Society of Forestry in Finland

THE ORGANIZATION, FINANCING, AND PLANNING OF FINNISH FORESTRY RESEARCH

1. Brief history

The industrial revolution, in the middle of the 19th century, stimulated the interest and emphasized the importance of forest resources in Finland. Consequently, the increasing wood consumption by forest industry began to awaken growing concern about the forest resources of the country.

The development described above, lead to the establishment of National Board of Forestry in 1859 and the Forestry School at Evo in 1862, subsequently transferred to the University of Helsinki in 1908. These two institutions were responsable of practically all the research and development activities in forestry until 1920's.

A new phase in the Finnish forestry research began in 1909 with the establishment of the Society of Forestry in Finland. The Society started to publish Acta Forestalia Fennica in 1913, thus being the first publication of forestry research in Finland. Finally, the base of future development was consolidated with the establishment of The Finnish Pulp and Paper Research Institute in 1916 and The Finnish Forest Research Institute in 1917.

2. Organization of forestry research

2.1. Organizational framework

Research organizations can be divided according to their status or subordination, i.e. there are: a) state, b) private, and c) state supported private research organizations.

State organizations are under four ministries, i.e. those of Agriculture and Forestry, Education, Environment, and Trade and Industry (Table 1).

In private sector, research institutions are closely linked to forest industry, whereas financing and other organizations are independent. In addition to these, there are two private organizations for research and development, which receive financial support from the government (Table 2).

Table 1. State research institutions and financing organizations

MINISTRY	RESEARCH INSTITUTIONS	FINANCING ORGANIZATIONS
Ministry of Education	University of Helsinki University of Joensuu Helsinki Technical University Other universities	Academy of Finland
Ministry of Agriculture and Forestry	Finnish Forest Research Insititute National Board of Forestry	Acidification Research Project (1985-89)
Ministry of Environment		
Ministry of Trade and and Industry	Technical Research Centre	Technology Development Centre

Table 2. Private research, financing, and other organizations

ORGANIZATION	STATUS	MAIN ACTIVITIES
The Finnish Pulp and Paper Research Institute	Private Research Institute	Research
Metsäteho	Private Research Institute	Research & Development
Work Efficiency Association, Department of Forestry	Private Association (state supported)	Development
Foundation of Forest Tree Breeding	Private Foundation (state supported)	Breeding, R&D
Society of Forestry in Finland	Scientific Society (state supported)	Publishing, General Promotion
Foundation for Research of Natural Resources in Finland	Private Research Foundation	Financing

Organizations can also be distinquised according to their sphere of activities and line of action. Here, research institution is defined as an independent research organization carrying out research activities using its own personel and installations. Financial organization, on the other hand, devotes its activities mainly in financing and coordinating research work, which is carried out in other institutions. In addition to these, there are other organizations, with other areas of operation distinguishable from those above.

2.2. Research institutions

2.2.1. State institutions

The Finnish Forest Research Institute (1971), subordinated to the Ministry of Agriculture and Forestry, comprises nine research departments: Soil Science, Peatland Forestry, Silviculture, Forest Genetics, Forest Protection, Forest Inventory and Yield, Forest Technology, Forest Economics, and Mathematics.

Since 1961, regional research stations have been established in order to strengten activities carried out in different parts of the country. Now, eight research stations are in operation: Parkano, Rovaniemi, Kolari, Muhos, Suonenjoki, Joensuu, Kannus, and Punkaharju. In addition to these, two field stations and a number of research forests (app. 80 000 has. in total) offer possibilities for experimental field work.

The staff of the Forest Research Institute comprises approximately 700, of which about 190 are researchers. One third of the staff is located at research stations.

Technical Research Centre (1942), subordinated to the Ministry of and Trade and Industry, comprises about 30 laboratories dealing with various aspects of technical research. Within the forestry research, The Forest Products Laboratory is engaged in the research of wood and wood products and their mechanical processing. The laboratory staff is about 90 persons, of which 30 are research officers. Moreover, The Laboratory of Land Use Planning is carrying out research on remote sensing techniques and their applications to forestry.

University of Helsinki, Faculty of Agriculture and Forestry (1908), subordinated to the Ministry of Education, comprises 12 departments serving forestry education and research: Silviculture, Forest Mensuration and Mangement, National Economics of Forestry, Logging and Wood Technology, Peatland Forestry, Business Economics of Forestry, Forest Products Marketing, Agricultural and Forest Zoology, Plant

Pathology, Plant Breeding, and Land Use Economics. The staff involved in research work comprises about 40 researchers and 15-25 post-graduate research students.

The Forestry Library of The University of Helsinki serves as the national central library of forestry, and it provides material and information for all interested organizations and individuals.

University of Joensuu, Faculty of Forestry (1982), subordinated to the Ministry of Education, has three major areas in forestry education and research: silviculture, production of wood and peat for energy, and forestry planning. The staff is approximately 10 persons involved in research work.

Helsinki University of Technology, Department of Forest Products (1942), subordinated to the Ministry of Education, concentrates on five major areas of education and research: mechanical wood technology, paper technology, printing technology, wood chemistry, and pulping technology. The research staff is approximately 15 persons.

National Board of Forestry (1859), subordinated to the Ministry of Agriculture and Forestry, has a special department for development of new techniques and methods in forestry operations. It cannot be regarded as a research unit in sensu stricto, but it provides services for application of research results into practical forestry.

2.2.2. Private institutions

The Finnish Pulp and Paper Research Institute (1916) has 25 forestry companies as stockholders supporting the institute. Its activities are carried out in five research divisions: Pulping, Paper and Board, Paper Converting, Chemical Wood Products, and Technical Services, which have in total 15 departments. The staff of the institute is approximately 300 persons, of which about 100 are graduated researchers.

Metsäteho (1945) is the Forest Work Study Section of The Central Association of Finnish Forest Industries. It is a research institute maintained by the 36 forest industry companies belonging to this Central Association. The major fields of activity are: silviculture, cutting and transportation, planning, and forest operations. The total number of the staff is approximately 40.

Work Efficiency Association, Department of Forestry (1942) aims at the rationalization of forestry operations. The Association is a registered private association enjoyning

state support through The Ministry of Agriculture and Forestry. The main field of activity of this institution is development of new techniques and application of research results into practice. The staff is about 10 persons.

The Foundation of Forest Tree Breeding (1947) is maintained by various forestry organizations. It receives financial support from the state through The Ministry of Agriculture and Forestry. The main activities are: selection and breeding, supply of superior seed material and information, and applying research results to forest tree breeding. The staff of this institute amonts about 10 persons.

2.3. Financing organizations

Academy of Finland, subordinated to the Ministry of Education, is the central governmental organ for research administration, which - through its Research Council for Agriculture and Forestry - supports forestry research carried out mainly at universities. At the present, about 20 researchers, emplyed by The Academy of Finland, are carrying out their research projects in various institutions. Moreover, The Research Council has as duty to promote scientific research work and cooperation.

Acidification Research Project (1985-89), a fixed term research project formed by the Ministries of Agriculture and Forestry and Environment, aims to analyze the effects of acid precipitation and other airborne pollutants to forest and water ecosystems. About 60 % of its financing for forestry research is allocated to the Finnish Forestry Research Institute.

Technology Development Centre, subordinated to the Ministry of Trade and Industry, allocates annually app. 40 mill. FIM as loans for forestry industry (mechanical and chemical processing of wood) for the development of new products and production methods.

In private sector, there are research foundations, such as The Foundation for Research of Natural Resources in Finland, which - by distributing grants and fellowships - support forestry research carried out in various research institutions and universities.

2.4. Other organizations

The Society of Forestry in Finland (1909) is a scientific society receiving financial support from The Academy of Finland. The aim of the society of is to promote forestry research in Finland through: issuing and exchanging publications, holding meetings, and granting financial support

to research. The Society's library, situated in the Forestry Library of the University of Helsinki, provides and important source of information for forestry researchers.

3. Financing

3.1. General

State research institutions listed above are financially directly subordinated to the corresponding ministries. In addition, there are three state organizations, which devote themselves for financing research and development work carried out in various research institutes or in industry.

Private research institutes normally receive their financing either as grants from industry or through contract research agreements with various organizations.

3.2. Allocation of financial resources

At the present, the financial resources for forestry research and development annually amounts to about 200 mill. FIM (Fig. 1). This figure does not include the loans distributed by the Technology Development Centre for forest industry.

Of the total financial resources, about 58 % are from the state and 42 % from private sector. The share of The Finnish Forest Research Institute of is about 73 % of the state and 43 % of all research resources. The Pulp and Paper Research Institute accounts for about 70 % of private and 31 % of all resources. Thus, approximately three quarters of all the financial resources in forestry research and development is allocated to these two institutions.

4. Planning

4.1. Operational planning

The operational planning of research activities is carried out within the research organizations. The process normally involves intensive team work between the scientific and administrative staff of the organization.

In research institutions, annual research programmes form the basis for all the activities. Each individual research project is then accepted, rejected, or adjusted to fit the overall annual programme.

In financing organizations, financial resources are allocated to individual research projects on application. The process normally involves an evaluation of the research plan leading to acceptance, rejection, or adjustment of the project.

4.2. Strategic planning

At the national level, continuous efforts are taken in order to maintain a certain level of strategic research planning. The aim of these activities is, by indicating the main problem areas and future trends, to form a basis to authorities who are responsable for the decision-making associated with forestry research.

The government has promoted national research planning by establishing every now and then ad hoc committees and working groups to formulate long term research plans. They include representatives of ministries, research institutions, and other organizations associated with forestry research. The output of the work of such a committee is a report, which includes proposals for future activities.

During almost eight decades, The Society of Forestry in Finland has had an important role in promoting discussion about the state of forestry research in the country. The Society has organized meetings and seminars, where this topic has been discussed. In addition, the Society has elaborated development programmes for forestry research including a state of the art report of the present situation and propects of future development.

During the last years, Academy of Finland has initiated a series of sectorial evaluations of research and development activities. At the moment, research on forest regeneration is being evaluated by an international expert group. These evaluations can provide useful information about the sector, which then can be used in strategic and operational planning.

5. Concluding remarks

Forestry and forest industry form an important part of the national economy of the country. As a consequnece of this fact, forestry research has had a rather high priority in the national science policy.

During the last two decades, rapid expansion of research and development activities has diversified the field of forestry research. Old organizations have grown and expanded, and new ones have been established. The recent estimates show e.g. that the number of annually printed

pages in forestry research - now about 3500/year - duplicates every 25 years.

The development described above underlines the need of institutional and individual cooperation, sectorial research planning, increasing amount of international contacts, and continuous quality assessment of forestry research.

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NATIONAL FOREST RESEARCH PROGRAM - PNPF

INTRODUCTION

The native forest cover in Brazil is composed by the Amazon Forest (North), Caatinga (Northeast), Cerrado (Center) Temperate Forest (South), Atlantic Coastal Rain Forest (along the Atlantic Coast), and forest plantations distributed throughout the country.

The Tropical Rain Forest in the Amazon covers about 260 million hectars (1/3 of the world reserve) and represents 82 % of the Brazilian forests. The potential for wood product trade is estimated to 15 billion cubic meters. Soil fertility in the Amazon region is generally low. Those soils are usually planted to short rotation crops for periods of 2 or 3 years.

The Caatinga forest is located in the Northeastern semiarid region and covers about 90 million hectars. Its soils are shallow with constraints in respect to reliable water (rain) supply. The productivity in total wood volume is estimated to one billion cubic meters.

The Cerrado Forest covers about 180 million hectars and is located in the Central region. The wood production potential is estimated to 6 billion cubic meters in that region. Much of the Atlantic Rain Forest, located in the Brazilian Coast and the Southern Temperate Forest are set aside as preservations areas.

The distribution of native forest in Brazil is not uniform either in area and volume, or in productivity. The northern region contributes with 82 % of the total Brazilian forest while in the South, where wood consumption is the highest, there are only 2 %. The supply of wood products from the Northern region to the consumers in the South is not economical due to the large distance between these regions.

The deforestation of native forests in Brazil is estimated to 6 million hectars/year. The main causes of these land clearing are the expansion of agriculture and the shortage of wood supplied by manmade forests. The Fig. 1 shows the demand of wood in Brazil to be 267 million cubic

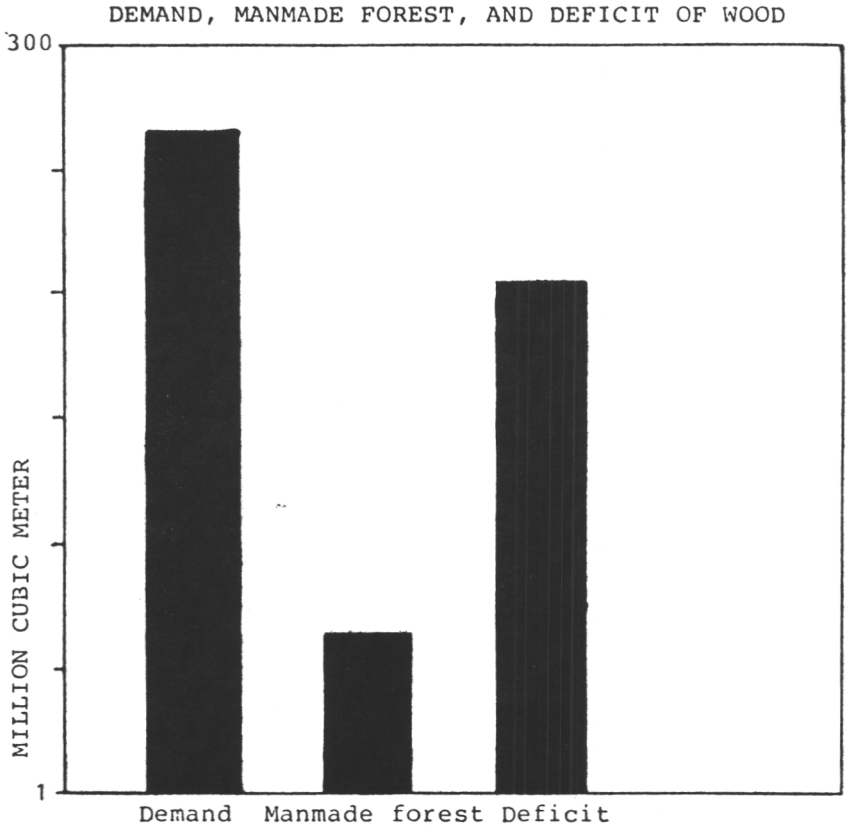

Fig. 1. Deficit, manmade forest, and demand of wood in Brazil in 1987 (million cubic meters).

meters/year of which planted forests can supply only about 5 million cubic meters/year. The deficit of 203 million cubic meters has been supplied through clearcutting of more than three million hectars of native forest.

The present wood demand by several industrial sectors in Brazil is presented in Fig. 2. The wood used for charcoal, fuel wood, and other domestic uses represents 84 % of the total Brazilian wood requirement (224,4 million cubic meters/year). In order to secure wood supply for energy and industrial needs, as well as for foreign trade without further reduction of the native forest reserves, Brazil needs to plant about 16.5 million hectars of forest growing tree species by the year 2000.

FOREST RESEARCH ORGANIZATIONS IN BRAZIL

Forest research in Brazil is done by federal and state government agencies as well as by universities and private companies. Research by private companies is done either independently or in cooperative system centered around existing universities structures.

Government Agencies

Forest research at the federal government level is done through agencies such as the Brazilian Institute for Forest Development (IBDF), Brazilian Company of Agricultural Research (EMBRAPA), Executive Commission of Cocoa Crop (CEPLAC), Superintendence for the Development of the Amazon (SUDAM), Superintendence for the Development of Northeast (SUDENE), and National Institute of Research in the Amazon (INPA). As part of the Ministry of Agriculture, IBDF and EMBRAPA have legal attributions to execute forest research in the country. CEPLAC (also part of the Ministry of Agriculture) conducts some research in forestry with IBDF in specific projects in the Cocoa region in Bahia. SUDAN and SUDENE are regional development agencies of the Ministry of Interior. INPA is a research organization associated with the National Counsel of Technology and Scientific Development (CNPq) and was created to develop research in the Amazon.

The National Program of Forestry Research (PNPF) was conceived through an agreement between EMBRAPA and IBDF in 1977. It is coordinated by EMBRAPA, through its National Center of Forest Research (CNPF) and operates within the structure of a research cooperative system in which several EMBRAPA units and other research institutions, including universities and private companies participate. Active research cooperative members are: Agricultural Research Center of the Cerrado (CPAC), Agricultural Research Center

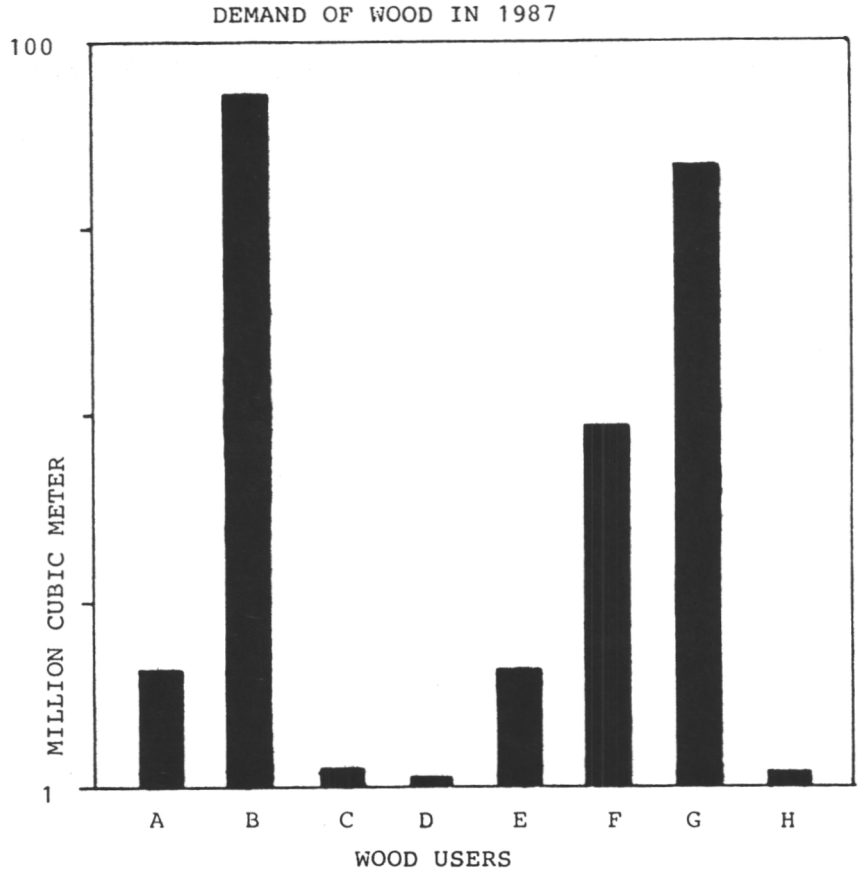

Fig. 2. Demand of wood in Brazil in 1987.

A - Cellulose
B - Charcoal
C - Plywood
D - Particle board
E - Sawn boards
F - Energy
G - Domestic use
H - Other

of the Semiarid Tropics (CPATSA), Agricultural Research Center of the Humid Tropics (CPATU), National Center of Forest Research (CNPF), State Agricultural Research Executive Unit at Manaus (UEPAE), Ataliba Paz Institute of Research in Natural Renewable Resources, Rio Grande do Norte State Agricultural Research Enterprise (EMPARN), Ceara State Agricultural Research Enterprise (EPACE), Paraida State Agricultural Research Enterprise (EMEPA).

Other Institutions which develop forest research with participation of State governments are:

Institute of Forest Research and Studies (IPEF)
Sao Paulo State Forestry Institute (IF-SP)
Pernambuco State Technology Institute Foundation
Research Institute and Forestry Studies (IPEF)
Paran State Forestry Research Foundation (FUPEF)
Society of Forest Investigation (SIF)

Regional or local research cooperatives such as IPEF, FUPEF, and SIF work with direct involvement of university staffs. The major advantage of these arrangements is the possibility to share highly qualified professionals from the universities in pursuit of objectives to develop faster and more efficient technology necessary to increase productivity of fast growing manmade forests.

Universities

There are 13 Undergraduate Forestry Schools in Brazil. However, only five of those do research in forestry in conjunction to teaching. The University of Sao Paulo (USP), the Federal University of Paraná (UFPR), and the Federal University of Vicosa (UFV) work in forest research with private companies through IPEF, FUPEF, and SIF, respectively.

Research in native forests are conducted on a regional basis by institutions such as the School of Agricultural Science (FCAP) in the State of Para, which works in close cooperation with SUDAM. The Federal University of Santa Maria extends its forest research activities in the State of Rio Grande do Sul. The National University of Brazilia is developing studies on native forest species of the Cerrado region. The School of Forestry of the University of Sao Paulo (USP) at Piracicaba is highly involved with fast growing tree species for industrial uses in the tropics. Other academic institution in Sao Paulo which does some work in forestry research is the Sao Paulo State University (UNESP) at Jaboticabal. Its limited action in this field stems from the lack of formal forestry courses in its program.

Private Companies

Private companies participate in the research system mainly through IPEF, SIF, and FUPEF. The most outstanding of those in volume of research work under way are: Companhia Melhoramentos Industrias de Papel S/A (Improvement Industry Company of Paper S/A), Duratex Industria e Comercio S/A (Duratex Commerce and Industry S/A), Champion Papel e Celulose S/A (Champion Paper and Cellulose S/A), Industrias Klabin do Parana S/A (Klabin Industries of Parana S/A), Florestal Acesita S/A (Acesita Forestry S/A), and Belgo Mineira (Belgo Mineira company). However, some companies such as Aracruz Florestal S/A (Aracruz Forestry S/A), Cia. Afgricola e Florestal Santa Barbara (Santa Barbara Agricultural and Forestry Company), Florestal Acesita (Acesita Forestry S/A), Companhia Agro-Florestal Monte Alegre (Monte Alegre Agriculture and Forestry Company),Champion Papel e Celulose S/A (Champion Paper and Cellulose S/A), and Duratex Industria e Comercio S/A (Duratex Industry and Commerce S/A) have departments that develop and execute forest research.

SOURCES OF FUNDS FOR FORESTRY RESEARCH

The following financing agencies have contribute to boost forestry research in Brazil:

FINEP (Department of Planning, Secretary of the Presidency of Republic - SEPLAN)
FIPEC (Scientific Research Incentive Foundation of the Bank of Brazil)
BNDE (National Economic Development Bank)

EXPERIMENTS IN FORESTRY

The several research institution in Brazil are conducting a total of 2343 experiments in many sectors of forestry. Table 1 shows the range of experiments and their distribution per region and subjects.

NATIONAL FORESTRY RESEARCH PROGRAM (PNPF)

The National Forestry Research Program operates in a cooperative system coordinated by CNPF of EMBRAPA. This program was a result of an agreement among government agencies (IBDF, IFSP), research institutions (EMBRAPA, IPEF, SIF, FUPEF, Universities) and private companies in order to rationalize the utilization of resources for research in forestry. The National Forestry Research Program (PNPF) is coordinated by a commission composed of five members: the presidents of EMBRAPA and IBDF, a Director from each one of those institutions, and an Executive Coordinator (Chief of CNPF).

TABLE 1. RANGE OF EXPERIMENTS IN BRAZIL AND THEIR DISTRIBUTION PER REGION AND SUBJECTS.

SUBJECT	NORTH	NORTHEAST	CENTEREAST	SOUTHEAST	SOUTH	TOTAL
AGROFORESTRY	6	8	6	6	7	33
SOIL MANAG AND CONSERV	1	3	0	9	3	16
GENE CONSERVATION	2	0	27	84	42	155
FOREST ECONOMICS	0	0	0	0	2	2
SPECIES INTRODUCTION	26	55	11	99	71	262
BOTANIC	7	2	0	3	4	16
PLANT PHYSIOLOGY	0	0	0	5	0	5
HYBRIDS	0	1	0	8	1	10
FOREST ESTABLISHMENT	39	22	20	139	71	291
FOREST INVENTORY	4	3	0	24	3	34
FOREST MECHANIZATION	5	0	0	27	7	39
ENVIRONMENT	0	2	0	22	0	24
TREE IMPROVEMENT	90	107	98	625	152	1072
PLANT NUTRITION	8	33	7	130	39	217
SEED TECHNOLOGY AND POLLEN STUDIES	2	2	0	7	15	26
VEGETATIVE PROPAGATION	1	1	0	16	10	28
FOREST PROTECTION	1	1	0	31	9	42
TECH AND UTIL OF WOOD PRODUCTS	13	2	3	40	13	71
TOTAL	205	242	172	1275	449	2342

TABLE 2. EXPERIMENTS OF THE NATIONAL FORESTRY RESEARCH PROGRAM AND THEIR DISTRIBUTION PER REGION AND SUBJECTS.

SUBJECT	NORTH	NORTHEAST	CENTEREAST	SOUTHEAST	SOUTH	TOTAL
AGROFORESTRY	3	8	6	4	5	26
SOIL MANAG AND CONSERV	1	1	0	2	0	4
GENE CONSERVATION	0	0	27	74	42	143
FOREST ECONOMICS	0	0	0	0	2	2
SPECIES INTRODUCTION	19	36	3	18	46	122
BOTANIC	1	1	0	0	3	5
PLANT PHYSIOLOGY	0	0	0	0	0	0
HYBRIDS	0	0	0	0	0	0
FOREST ESTABLISHMENT	13	11	5	9	21	59
FOREST INVENTORY	0	3	0	11	0	14
FOREST MECHANIZATION	3	0	0	0	3	6
ENVIRONMENT	0	2	0	2	0	4
TREE IMPROVEMENT	32	57	82	253	92	516
PLANT NUTRITION	2	3	0	4	20	29
SEED TECHNOLOGY AND POLLEN STUDIES	1	1	0	1	4	7
VEGETATIVE PROPAGATION	1	0	0	0	7	8
FOREST PROTECTION	0	0	0	11	9	20
TECH AND UTIL OF WOOD PRODUCTS	2	1	0	3	4	10
TOTAL	78	124	123	392	258	975

PNPF was proposed to the Brazilian forestry community and approved in a meeting in Sao Paulo in 1978. Presently, there are 97 research projects being conducted under PNPF. There can be translated into 975 experiments established in 20 States (Table 2). All these amounts to approximately 40 % of the total experimentation in the country.

GENERAL OBJECTIVES OF PNPF

The general objectives of PNPF, based on government's quidelines and on that of the EMBRAPA/IBDF agreement, were established as to:

- increase productivity of manmade forests without causing undesirable ecological side effects;
- increase the quality of wood products from intensively managed forests;
- provide means (adequate technology) for more efficient and rational utilization of native forest;
- develop silvicultural and agricultural techniques for more efficient land utilization in regions with frail ecological balance;
- develop techniques and equipments to increase profitability of logging, transport, and processing of wood products.

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THE LINKAGE BETWEEN UNIVERSITY AND INDUSTRY FOREST RESEARCH IN BRAZIL: THE FEDERAL UNIVERSITY OF VICOSA EXAMPLE

FORESTRY RESEARCH ASSOCIATION
S.I.F.

1. THE FORESTRY RESEARCH ASSOCIATION

The Forestry Research Association (SIF), a non-profit coorporation, was created in February 19, 1974, and is devoted to the search for technical, scientific, and economic solutions for Brazilian forestry development.

SIF is made up of 10 private forest companies in conjunction with the Department of Forestry Engineering of the Federal University of Vicosa (UFV). Although the Department of Forestry Engineering is responsible for the SIF activities, others university departments are also involved mainly the Department of Soils, Department of Plant Pathology, Department of Animal Biology, and Department of Plant Biology.

The following private forest companies belong to SIF:

- Acesita Energetica - charcoal (steel)
- Cenibra Florestal - pulpwood
- Cia. Agricola e Florestal Santa Barbara: charcoal (steel)
- Cimetal Florestas - charcoal (steel)
- Florestas Rio Doce - pulpwood and sawmill
- Floryl - charcoal (steel)
- Mannesman - charcoal (steel)
- Metalur Florestal - charcoal (steel)
- Pains Florestal - charcoal (steel)
- Refloralje - charcoal (cement)

To achieve its objectives, SIF counts on close cooperation between the UFV and the private companies:

a) The UFV allows its staff to participate in research projects and its laboratories to be used for development of these projects
b) The private companies finance and allow their technical staff to participate in the research projects

2. FOREST RESOURCES

In 1985 the forest plantation area in Brazil was about 5,000,000 ha. The SIF companies owned about 830,866 ha, representing 16,6 % of the total national reforested area spread out over the states of Minas Gerais, Espirito Santo, Bahia, Maranhao, and Piaui. From the total SIF reforested area, 99,5 % are made up of Eucalyptus and are concentrated in the State of Minas Gerais. The State of Minas Gerais has a large steel output and most of its forests are being utilized for charcoal manufacture used by the steel plants.

The importance of the SIF companies can be shown by the following 1985 data:

- Reforested area, up to 1985 (Ha)..... 831,000
- Charcoal production (MDC)..... 3,300,000
- Pulp production (Ton.)..... 330,000
- Wood used (St.)..... 7,000,000
- Taxes (US$)..... 20,000,000
- Income (US$).....120,000,000
- Number of directs jobs..... 33,000

3. SIF RESEARCH

The importance of the research carried out by the Forestry Research Association is demonstrated by its participation in Brazilian forestry development. Basically, the research projects aim at increasing productivity, decreasing environmental impact, and producing high quality wood at lower costs. The Brazilian forestry problems can be very complex, requiring knowledges of pure and applied sciences. The university is an ideal place to study and solve those problems.

The connection between university and industry, as achieved by SIF, can play an important role for the development of forestry research.

4. SIF ACTIVITIES

The SIF acitivities also go beyond carrying out research and can be summarized as follows:

- maintenance of a forestry library
- organization of technical-scientific events (seminar, technical meetings)
- publication of papers: Revista Arvore
  Technical Bulletin
  SIF Newsletter
- exchange of technical information with national and international organizations

5. SIF RESEARCH AREAS

The following research topics have been conducted by SIF:

a) Forest genetic improvment
- interaction genotype/environment
- genetic control for nutrient utilization efficiency
- hybridization
- vegetative propagation
- genetic control for wood quality
- high quality seed production
- project analyses

b) Forest management and economy
- agrosilviculture
- spacing
- cutting cycle
- inventory
- planning
- native forest management

c) Wood technology
- wood quality
- wood carbonization
- avaliation of growth in weight
- sawmill and lumber drying
- pulp and paper

d) Soil and fertilization
- fertility and plant nutrition

e) Environment
- forest ecology
- forest entomology
- forest pathology
- wild life management
- mining rehabilitation
- parks planning
- watershed management

f) Silviculture
- propagation by sprouting
- plantation management
- nursery and planting
- forest seeds

g) Mecanization and forest exploitation
- ergonomics and safety
- forest roads
- planning
- forest transportation
- forest exploitation system

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FORESTRY EDUCATION AT THE UNIVERSITY OF HELSINKI

In the "Age of Enlightenment" at the end of 18th century, there was already some conscious endeavour to promote agriculture and forestry in Finland with the aid of higher education and methodical research. It was not, however, before 1860 when a 2-year Forestry Institute was established at Evo, in southern Central Finland.

The institute-type instruction did not meet the expectations for higher education, and in 1896 the highest education in agriculture was transferred from Mustiala Agriculture Institute to University of Helsinki. It was only natural that higher forestry education would soon be included in the University. This was done in the year 1908 with the leadership of Dr. A.K. Cajander, who became the first professor of Silviculture at the University of Helsinki. For the practical training of forestry students, a special Training District was created and the Forest Field Station, Hyytiälä was established in the years 1910-1912.

In the beginning the number of teachers for forest education was very limited, but gradually the number of professorships and departments grew. At the moment there are 11 Forestry Departments, each headed by a Professor, most of which with one Assistant Professor and one or two Assistants as the instruction staff. In addition, more than 30 researchers, employed by the Academy of Sciences in Finland, work in the Departments.

Within the requirements for the Master of Science in Agriculture and Forestry (which is the principal degree) there are three optional study programmes for forestry:

1. Forest Biology and Silviculture,
2. Forest Management and Planning, and
3. Timber Harvesting and Transport.

In total, 60 students are accepted yearly in Helsinki out of some 600 applicants. The first year studies are common to everyone, but after the second autumn one of the mentioned special degree programmes is chosen. In addition, there is the fourth study programme, Trade in Forestry and Forest Industry. This is divided into two options, that of Marketing of Forest and Wood Industry Machinery and that of Marketing of Forest Products. 20 students are accepted yearly for these programmes.

For the Master's degree a minimum of 160 credits of course work is demanded. One credit is considered to correspond on full weeks work (=40 hours). In Silviculture study programme (see Appendix 1 as an example) almost one half of the credits are gained from courses which are compulsory to all forestry students. Out of the rest of the courses 20 credits are given from the Master's thesis, and 44 credits belong to various Silviculture and Forest Biology courses. The student may decide freely on 5 credit courses out of the total of 160 credits.

In general, succesful studies for Master's degree require from four to five years. Field courses, led by the Faculty members, play an important part of the curricula. The following field courses are compulsory for those students majoring in Silviculture:

1st summer	Basic course in Silviculture	3 weeks
	Forest Protection	1 week
	Basic course in Peatland Forestry	2 weeks
	Forest Mensuration and Mapping	4 weeks
	Loggin and Timber Measurement	1 week
2nd summer	Forest Ecology	2 weeks
	Reforestation techniques	1 week
	Peatland Forest amelioration	1 week
3rd summer	Seed and Plant Supply	1 week
	Study tour to North-Finland	2 weeks

In addition, a special training period of eight weeks time in practice is needed, three weeks out of which must be spent in some forest nursery.

The post-graduate studies include those for Licentiate of Agriculture and Forestry and Doctor of Agriculture and Forestry. Thesis work makes an important part of both degrees. That for the Doctor's degree must be printed and it is defended publicly according to old University traditions. Until now 134 doctoral theses have been accepted in Forestry Sciences in Finland. The post-graduate studies, with theses included, usually last from eight to ten years.

APPENDIX

List of the Credit Courses Requirement in the Silviculture Study Programme at the University of Helsinki

Studies common to all students undertaking the Master of Science degree in Forestry

Course name	Credit(s)	Year
General Studies		
Orientation to Studies	1	I
General Introduction to Forestry	1	I
Botany I	6	I
Aerial Photogrammetry I	1	I
Economics 1	2	I
Business Economics and Basic Accounting	2.5	I
Land- and Water Legislation	1.5	III
Work Legislation	1	III
Computer Science 1	2	I
Statistics 1	2	I
Operations Research	2	II
Basic (course in) Management	2	III
Communication in the Forest Industry or (Course in) Communication Principles	1	III
Principles of Environmental Conservation in Forestry	1.5	III
Principles of Scientific Research	1.5	III
Foreign Language	2	I
Second Domestic Language (Finnish or Swedish)	1.5	II

The students are also required to have studied high school (gymnasium) mathematics and physics to the advanced level)

II Basic Studies in Forestry		
Principles of Silviculture	5	I
Fundamental of Peatland Utilization	4	I
Forest Soil Science 1	2	I
Forest Protection	1	I
Forest Tree Breeding	1	I
Economics of Timber Growing	1	II
Forest Mensuration and Mapping	8	I
Introduction to Forest Management Planning	2	II
Economics of the Forest Unit	1	II
Introduction to Forest Policy	2	II
Fundamentals of Logging	4	I
Timber Assortments and Scaling	1	I
Logging Techniques	1	II
The Timber Buying Enterprise	1.5	II

Roundwood Trade	1	II
Structure, Properties and Defects of Wood	1.5	I
Principles of Wood Utilization	1.5	II
Marketing of Forest Industry Products	1	III
Study Tour of Forestry in Northern Finland		
	72.5	

III Credit Courses in the Study Field of Forest Biology and Silviculture

General Chemistry	2.5	II
Botany	2	II
Meteorology	1.5	II
Forest Soil Science 2	2	II,III
Physiology of Forest Trees	1	III
Forest Tree Genetics	1	II
Dendrology	1	III
Methods of Silviculture	3	III
Peatland Silviculture	1.5	II
Fundamentals of Forest Zoology	3	II
Basic of Forest Pathology	3	II
	21.5	

IV Studies in Silviculture (mainly for those majoring in Silviculture)

Forests of the World	1.5	III
Peat Biology	1.5	II
Forest Site Type Classification	2	III
Peatland Site Type Classification	1.5	II
Field Course in Forest Ecology	2	II
Peatland Forest Amelioration	2	II
Principles of Genetics	2	III
Timber Protection	2	III
Methods of Silviculture	3	III

In addition:

Courses elected by the student from set alternative	6	
Courses freely elected by the student	5	

Advanced Studies in Silviculture

Site Preparation	1	III,IV
Forest Fertilization	1	III,IV
Forest Soil Science 3	3	IV
Methods of Silviculture	2	IV
Seminar	2	III
Advanced Research Seminar	2	III,IV
Advanced Research Literature	3	IV
Esseys, four or more	2	IV
Master's Thesis	20	IV
	64	

Prof. Seppo Kellomäki
University of Joensuu

THE FORESTRY EDUCATION AND RESEARCH AT THE UNIVERSITY OF JOENSUU

Background

The University of Joensuu was established in 1969. It is situated in the city of Joensuu, which is the administrative, commercial and cultural center of the province of North-Karelia. The University is a multi-disciplinary institution for higher education with Faculties of Education, Arts, Mathematics and Natural Sciences, Social Sciences and Forestry. In addition, there are a Teacher Training Institute and School of Translation Studies in Savonlinna and a Research Station at Mekrijärvi, in Ilomantsi. The total number of students exceeds 4000.

Course of Study in Forestry

Forest Sciences were established at the University of Joensuu in 1982. Prior to this, university-level training in Forestry had been organised by the Faculty of Agriculture and Forestry at the University of Helsinki since 1908. The first students in Forest Sciences graduated from the University of Joensuu in Spring 1986. Thirty new students are accepted annually, and there are presently approximately 150 students in the Faculty of Forestry.

The study programme in Forest Science includes four majors, i.e. Forest Soil Science, Silviculture, Growth and Yield Studies and Timber Management Planning, among which the students choose their special field of studies. The study area of the different majors is a follows.

> Forest Soil Science studies the formation and structure of the forest soil including the biological, chemical and physical properties of the forest soil. Water resource engineering and management of the forest soil by burning, cultivation, ditching or other treatments are practical applications of Forest Soil Science.
>
> Silviculture studies the biological basis of the silvicultural engineering of the forest ecosystem and the multiple use of the forest resources. A special emphasis is placed on the theory and practise of the natural and artificial regeneration of forests and the management of seedling and thinning stands.

Growth and Yield Studies investigate the growth processes and the resultant yield of trees growing on sites of varying fertility. Growth and Yield Studies also include the production of wood for energy, and training students for solving special problems of forest production in developing countries.

Timber Management Planning studies the theory and practise of the measuring and inventory methods needed in estimating the quantity and quality of forest resources. A special emphasis is given to developing methods of forecasting the future development of the forest resources as a basis of the decision-making in Forestry.

The training in Forest Sciences are also linked, in particular, to the teaching given by other Faculties, with the Departments of Biology, Chemistry, Computer Science, Economics and Statistics, Mathematics and Physics being engaged in the Forestry curriculum. The Joensuu Research Station of the Finnish Forest Research Institute on the same campus provides unique opportunities for research co-operation in Forestry.

Structure of Studies in Forestry

The curriculum in Forestry covers 160 study weeks, one study week being equal to 40 hour's work. The completion of the Master of Science in Forestry takes four to five years. The studies proceed from the basic sciences to practical application and scientific research in Forestry, the study programme being divided into General Studies, Professional Studies and Scientific Studies.

General Studies contains up to 30 study weeks of the basic sciences like Botany, Computer Science, Economics, Mathematics and Statistics needed in Forestry and the forest research. General Studies also includes courses in foreign languages.

Professional Studies contains up to 80 study weeks, involving the theory and practise of different forest disciplines, the management of forest resources being emphasised most. Lectures, seminars and laboratory courses are complemented by field courses where the theory is applied to the concrete problems of Forestry.

Scientific Studies contains up to 50 study weeks, the main emphasis being in the special problems of the selected major. The methods of scientic research are, in particular, an integral part of these studies, including the preparation of the Master's thesis. The topics of the thesis may either concern the practical problems of timber management or the problems of forest research.

The study programmes for post-graduate studies have also been drafted, the Degree of the Licenciate and Doctor in Agriculture and Forestry being achieved in two to four years.

Research in Forest Sciences

Scientific research in the Faculty of Forestry is oriented towards the problems of the management forest soil, silvicultural engineering of the forest ecosystem, problems in the growth and yield of the forest ecosystem and the energy use of timber and the quantitative methods of the timber management planning of forest resources. In different majors the following research problems are most important.

In Forest Soil Science the effects of ground water table fluctuation on the ecology of peat soils and the effects of the soil preparation of reforestation on soil areation are the problems of the greatest interest.

In Silviculture the nutrient cycle in Scots pine stands and its effects on the productivity, management of Scots pine stands for quality timber and the dynamics of the structure and function of the forest ecosystem are the main topics of research.

In Growth and Yield Studies the frost hardiness of forest trees, problems of the intensive production of wood biomass and the biodegradation of wood components are presently under study.

In Timber management planning methods of forest management planning and forest inventory methods with applications to computer and satellite techniques are the main areas of interest in the research.

Other areas of research are, the genetic basis for disease resistance in forest trees, forestry and the forest industry in regional development, the economics of multiple-use forestry, simulation methods for silviculture and the multiple use of forest resources and expert systems for forestry. The applications of the Computer Sciences are an integral part of many studies, the purpose being to quantify the operations needed for timber and other production based on the forest ecosystem.

Prof. Dr. Jorge Roberto Malinovski
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FORESTRY EDUCATION AND RESEARCH AT THE "UNIVERSIDADE FEDERAL DO PARANA"

1. HISTORY

As higher education, Forestry started in Brazil when the first Forestry College was opened through decree no. 48,247 of 30 May 1960. It started operating in Vicosa, Minas Gerais but was later transferred to Curitiba, Parana through decree no. 52,828 of 14 November 1963.

The course which lasted five years initially was later reduced to four, a situation which lasted until 1973 with annual subjects. In 1974 there was a change in the educational system according to which the four-year schedule was kept but the subjects were made semi-annual. In 1986 the situation was again reversed and once again the course came to last five years with annual subjects.

Post-graduate studies on Forestry for master's degrees started in 1973 and for the doctor's degrees in 1982, these being the first in Brazil.

In 1969, the Centre of Forest Research, an institution linked to the Forestry Faculty, where forest research work was carried out under the supervision of the teaching staff was created. This was the first step towards the integration between the University and forest companies.

In 1972, the Foundation of Forest Research of Parana was set up aiming at financing the development of research work and studies in this area. It has also created opportunities for associations with private companies which sponsored research programmes.

2. FOREST STUDIES AT THE UFPR

2.1. Graduation

A student joining the course on Forestry at the UFPR must have attended primary (8 years) and secondary (3 years) school. He will then be ready to pass the "vestibular", an examination held every year which is compulsory for students who want to enter a Brazilian university.

For students who had entered the course by 1986 all subjects were taken in a minimum of 4 years and a maximum of 8 years, which, in the first case, amounted to a total of 3930 hours as follows:

Obligatory subjects: 3,360
Obligatory practical training: 90
Elective subjects: 330
TOTAL: 3,780
Study of Brazilian Problems: 60
Physical Education: 90
OVERALL TOTAL: 3,930

The hour load could vary from a minimum of 18 to a maximum of 36 hours a week, not including PE or practical training. In recent years the average has been 31 hours.

The total of 3360 hours of obligatory subjects includes 1410 hours of so called basic subjects and 1950 which are part of the practical training scheme.

The syllabus which is now effective was implemented in 1986 as explained above as a way of offering better conditions for the formation of the future foresters.

The number of hours then increased to 4515 as follows:

Basic: 1230
Specific: 2475
Obligatory complementation: 180
Elective complementation: 360
Obligatory practical training: 120
TOTAL: 4325
Study of Brazilian Problems: 60
Physical Education: 90
OVERALL TOTAL: 4515

The weekly hour load may vary from a minimum of 14 (fourteen) to a maximum of 38 (thirty-eight) hours, not including PE.

In order to facilitate learning we use a system of prerequisites for the subjects, which have been grouped for relevance. The annual subjects also give students a chance of having better results as shown in Appendix 1. The annual hour load has been arranged as follows:

1st year: 990 hours
2nd year: 960 hours
3rd year: 900 hours
4th year: 810 hours
5th year: 645 hours

Since the establishment of the course, 938 students have graduated as shown in Table 1.

Table 1: Number of students starting the course on Forestry at the UFPR and number of graduates:

YEAR	STARTED	GRADUATED
1960	20	-
1961	20	-
1962	20	-
1963	20	-
1964	60	14
1965	60	17
1966	60	22
1967	60	13
1968	60	42
1969	60	40
1970	60	47
1971	60	45
1972	60	55
1973 *	30+30	57
1974	30+30	53
1975	30+30	55
1976	30+30	29
1977	30+30	30
1978 1st sem	30	19
2nd sem	30	28
1979 1st sem	30	22
2nd sem	30	19
1980 1st sem	40	23
2nd	40	17
1981 1st sem	30	20
2nd sem	30	17
1982 1st sem	30	27
2nd sem	30	23
1983 1st sem	30	20
2nd sem	30	27
1984 1st sem	30	20
2nd sem	30	20
1985 1st sem	30	20
2nd sem	30	29
1986 1st sem **	60	33
2nd	-	35
1987	60	-
TOTAL	1540	938

* semi-annual subjects started
** return to the annual subjects scheme

In Brazil the main source of jobs for foresters are forest companies followed by the government and universities, with research work coming last as shown in Table 2.

Table 2: Activities of Foresters in Brazil

ACTIVITY	PERCENTAGE
University (teaching and research)	8.68
Research Institutes	3.11
Government	14.41
Private Companies	73.80

The course on Forestry has got exchange programmes for students coming from all Latin American countries and some countries in Africa. Many students have already graduated under these programmes and others are currently taking the graduation course.

2.2. Post Graduation

The post-graduation course on Forestry, the first in Brazil, was created in 1973. At first it relied on the decisive support of German professors of the UFPR/FREIBURG programme. The Brazilian professors took over in 1981.

Four fields of specialization are offered:

- Silviculture
- Technology and use of forest products
- Forest management
- Economics and Forest Politics

Apart from those belonging to the common areas which relate to all fields, subjects are offered separetely (Appendix 2).

Candidates have to pass a selection test and are expected to finish the course in four years in accordance to regulations. They are allowed to postpone the continuation of the course for up to two years.

The obtention of a Master of Science degree demands:

- a minimum of 39 credits
- a pass mark of "B" in subjects taken
- approval of dissertation defense

The obtention of a Doctor's degree demands:

- a minimum of 90 credits, 30 of which refer to the master's dissertation, and another 30 to the credits taken for the master's degree.
- a pass mark of "B" in subjects taken
- approval of doctoral dissertation defense

A student who took all credits but did not defend his thesis is entitled to a specialization certificate.

There are 46 professors teaching the course, 25 of whom are Phds and 21 MScs.

For the master's degree the student must be proficient in one foreign language and for the doctor's in two, which are normally chosen among English, French and German.

The master's programme takes an average of 39.92 months to be completed and the doctor's 39.80, as shown in Table 3.

Table 3. Time required for the obtention of a post-graduation degree in forestry (March 1987) (months)

MAJOR SUBJECT	STUDENTS		AVERAGE	
	Master's	Doctor's	Master's	Doctor's
Forest management	46	2	37.59	37.5
Economics and Politics	4	-	36.75	-
Silviculture	54	3	40.17	41.3
Technology of Forest Products	29		43.62	
AVERAGE			39.92	39.8

Since 1973, 278 students have started the master's programme and 50 the doctor's. 47.8 % of the first have already defended their thesis, 4.4 % received a specialization certificate, 16.5 % gave up, 1.8 % died, 0.7 % transferred to other courses, 6.8 % are working on their thesis, 15.8 % are taking subjects and 6.2 % have postponed the continuation of their studies. (Appendix 3)

From the 50 students who have enrolled for the doctor's programme up to the moment, 10 % have already defended their thesis, 2 % gave up, 42 % are working on their thesis and 46 % are taking subjects. (Appendix 4)

Foreign students have followed post-graduate studies on Forestry at the UFPr through the various exchange programmes we have with Latin American countries. At the master's course, 16.3 % of the students are foreigners and at the doctor's 14 %.

3. RESEARCH WORK ON FORESTRY AT THE UFPR

Most of the research work undertaken by professors of Forestry consisted of forest inventories in the South of Brazil and in the Amazon Forest through agreements made with the Centre of Forest Research (1969-1976).

Studies have also been carried out in the fields of Inventory, Management, Harvesting, Fauna Management and Silviculture in areas of interest for the "Itaipu Binacional" Dam and Power Station. Such works have been sponsored by the Foundation for Forest Reseąrch of Parana (1980).

When most professors who had earned their doctor's degrees abroad returned to Brazil (1981) a remarkable progress in research was noticed at practically all levels of Forestry. A lot of research work linked either to the government or to private companies have been or are being undertaken.

The fields of research are sub-divided into 7 (seven) main groups as follows:

A. SILVICULTURE

- Harvesting, processing and storage of seeds.
- Testing and analysis of seeds.
- Production methods of forest species seedlings.
- Natural and artificial regeneration techniques in open sky and under crown shelter.
- Installation of seed orchards and election of seed production areas
- Genetic improvement and vegetative reproduction.
- A study of the environment-plant complex from the physiological point of view aiming at regeneration, growth and production.
- The development of silvicultural techniques in natural and plantation forests.
- The rationalization of operations of forestry exploitation and transport.
- A choice of species and techniques for specific finalities, including:
  a. erosion control
  b. wind-break curtains
  c. reforestation of roadsides and railway lines
  d. stabilization of dunes

- Development of unconventional silvicultural systems, including:
  a. Taungya method
  b. "silvo-pastoril" method
  c. tree foraging
- Measurement and analysis of precipitation, dripping of water from foliage and loss of running water down trunks of Araucaria angustifolia in plantations
- Water and nutrient cycles in Araucaria forests
- Soil-nutrients-growth relationship in Araucaria angustifolia and Pinus
- An evaluation of sites for Araucaria angustifolia
- Fertilization experiments with Araucaria angustifolia
- A study and drawing of the principal natural forest species of the region of Curitiba aiming at town planning and landscape architecture.
- Study of seasonal variation in the diameter and height growth of Araucaria angustifolia and their correlation with meteorogical factors
- Ecological effects of Pinus thinning out in relation to the improvment of the site and natural regeneration

B. FOREST PROTECTION

- Forest zoology and pathology:
  a. harmful animals: rodends and birds
  b. forest entomology
  c. integrated control of pests (chemical, biological and mechanical)
  d. pests and diseases in native and exotic species
  e. the relation of water content, carbohydrates, proteins and others in the needles of Pinus and Araucaria angustifolia
- Forest fire protection
  a. The effect of fire retardants in the propagation of forest fires
  b. Prediction the weight of foliage in species used in reforestation
  c. methods of inventory of fuel material deposited on the ground of planted forests.
  d. the use of prescribed fire in the reduction of fuel material in forests.
  e. plans for protection against forest fires

C. SOILS

- silicon and aluminum morphes in the particles of soils originating in the sandy, basalt and melaphyre layers in the State of Parana

- the origin of soils of sand derivation in Caiua in the valley of Ribeirao Rato
- soils of basalt derivation in the Campo Mourao region, State of Parana:
  a. chemical and granulometric composition
  b. total chemical composition and amorphous elements
  c. pedogenetic oxides
  d. mineralogy of clay particles
- Soils of basalt derivation of the Pitanga region, State of Parana:
  a. chemical and granulometric composition
  b. total chemical composition and amorphous elements
  c. pedogenetic oxides
  d. mineralogy of clay particles
- The total chemical composition of the particles of soils originating in arenaceous, basalt and melaphyre layers in the State of Parana
- Forest nutrition

D. FOREST MANAGEMENT AND ECONOMICS

- Forest production management planning for reforestation areas.
- Classification and mapping of productivity per stand
- Installation of permanent plots for the study of the stock of growth of hardwood trees
- Forest inventory
- Sustained management of natural forests for specific aims (energy, ecology, economics, sociology)
- Regional and forest company planning

E. WOOD TECHNOLOGY

- Study of the physical and mechanical properties of natural species suitable for reforestation
- Studies of the permeability, drying and preservation process in wood
- Studies regarding industrial uses
- Studies of the physical and mechanical properties of the wood produced in artificial plantations of Pinus taeda, Pinus elliottii and Araucaria angustifolia
- Study on the use of forest biomass for energy production
- Studies on the basic density of wood and the morphology of fibers regarding the production of paper
- Studies of wood anatomy

F. LABOUR SCIENCE (WORK STUDY)

- Time and motion studies
- Determination of the productivity of work techniques on different operations in forestry
- Preparation of work tasks
- Types of work evaluation and wages
- Studies on ergonomics

G. FOREST EXPLOITATION

- Log length optimization
- Procedures for felling trees (cutting and level of finishing)
- Procedures for the extraction of wood (transporting as far as the wood yard by pulling chains)
- Procedures for transportation (transporting from the wood yard to the industry)
- Analysis of wood harvesting systems
- Wood harvesting planning
- Planning of road networks for extraction and transportation in forestry

4. CONCLUSION

- Despite the fact of having been founded only 26 years ago, the UFPr course on Forest Engineering, the first in Brazil, is ranked as one of the best in Latin America.

- International exchange programmes for studies and research have been fundamental to the development of Forest Engineering at the "Universidade Federal do Parana".

- The five-year syllabus will mean for the course a significant increase in quality.

- The relationship between the Faculty and private companies has also been fundamental to the progress of pure and applied research work.

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APPENDIX 1

TABLE OF ANNUAL SUBJECTS OF THE GRADUATION COURSE ON FORESTRY

CODE	SUBJECT	HOUR LOAD WEEKLY	HOUR LOAD ANNUAL	***
1ST YEAR				
AS035	Introduction to Forestry (1st semester)	03	45	
HS023	Rural Antropology (2nd semester)	03	45	
AS401	Forest Climatology & Meteorology	02	60	
CM426	Calculus with Linear Algebra	04	120	
CF421	Physics	04	120	
CD412	Descriptive Geometry & Technical Drawing	04	120	
CQ407	Introduction to Chemistry	04	120	
AF405	Forest experimentation	02	60	
BB401	Vegetal Morphology	04	120	
TG434	Topography	04	120	
BZ401	Zoology	04	120	
TOTAL		33	990	
2ND YEAR				
BZ402	Forest Entomology	03	90	
AS403	Ecology	03	90	
BG402	Genetics Applied to Forestry	02	60	
AS404	Forest Seeds & Seedlings	04	120	
AS405	Dendrometry	04	120	
AS402	Dendrology	02	60	
BQ402	Vegetal Biochemistry	03	90	
BB402	Systematic of Wood Vegetals	03	90	BB401
CQ414	Introduction to Analytical Chemistry	03	90	CQ407
AT403	Wood Anatomy	02	60	
AS412	Photogrammetry & Photointerpretation	03	90	
TOTAL		32	960	

3RD YEAR

AS406	Preservation of Nature & Landscape Gardening	02	60	
AS407	Silvicultural Methods	04	120	
AS408	Forest Melioration	02	60	
AS409	Techniques of Data Analysis I	02	60	
AL410	Forest Soils	06	180	
AT401	Wood Technology	03	90	
BP406	Forest Parasitology	02	60	
BP405	Forest Microbiology	02	60	
AS411	Forest Inventory	03	90	
BB403	Phytophysiology	02	60	BB401
Elective I		02	60	
TOTAL		30	900	

4TH YEAR

AE402	Economics of Forestry	03	90	
AS410	Forest Management	03	90	
AS414	Wild Areas Management	02	60	
AE403	Agrarian Laws	02	60	
AT404	Forest Harvesting & Mechanization	04	120	
AT406	Forest Industrialization	03	90	
AT405	Structures of Wood I	03	90	
AF414	Forest Pathology	03	90	
Elective II & III		04	120	
TOTAL		27	810	

5TH YEAR

AS413	Conservation & Management of Fauna	02	60	
AS415	Forest Fires	02	60	
AT402	Hydrology & Management of Hydrological Basins	03	90	
AE404	Forest Politics	02	60	
AF415	Forest Defence	03	90	BZ402 BP406
AE006	Rural Extension	03	90	
SR401	Study of Brazilian Problems	02	60	
Elective IV, V & VI		06	180	
TOTAL ....1ST SEMESTER		23	345	
2ND SEMESTER		20	300	

ELECTIVE SUBJECTS

AE022 Planning & Management of Forest Companies	03	45	AE402
AS023 Commercialization of Forest Products	03	45	AE402
AT023 Structures of Wood II	04	60	
AT024 Safety in Agroforestal Work	04	60	
AT025 Electrification of Forest Companies	04	60	
AT026 Statistical Control of Quality	04	60	
AT027 Wood Chemistry	04	60	
AT028 Pulp and Paper	04	60	
AT029 Wood Drying	04	60	
AT030 Biodegradation & Preservation of Wood	04	60	
AT031 Project of Forest Companies	04	60	
AT032 Wood Panels	04	60	
AT033 Sawmills and Wood Processing	04	60	
AS031 Remote Sensoring in Forestry	04	60	AS412
AS034 Communication in Forestry	04	60	AE002
AS024 Forest Ecophysiology	04	60	BP403
AE006 Design & Evaluation of Projects	03	45	AE402
AS025 Agroforestal Techniques	04	60	AS407
AS023 Dendrology II	04	60	AS402
AS030 Science of Forest Work	04	60	AT404
AS032 Planning of Forest Inventory	04	60	AS411
AS028 Landscape Gardening	04	60	AS406
AS027 Urban Arborization	04	60	AS406
AS033 Recreation at the Forest	04	60	AS414
AS026 Techniques of Data Analysis	04	60	AS409
AS029 Planning of Forest Yield	04	60	AS410
AS020 Linear Programming in Forestry	04	60	AF405
AS022 Auto-ecology	04	60	AS403
AS021 Sinecology	04	60	AS403
BG010 Quantitative Genetics	04	60	BG402
AL005 Nutrition of Forest Trees	04	60	AL410
HS006 Brasilian Antropology	03	45	HS023
HS008 Urban Antropology	03	45	HS023
AZ016 Apiculture	04	60	BZ402

*** PREREQUISITES

APPENDIX 2. SYLLABUS OF THE UFPR POST-GRADUATION COURSE ON FORESTRY

COMMON SUBJECTS

BASIC SUBJECTS	CREDITS
Mathematics	3
Techniques of Data Analysis	3
Techniques of Data Processing	3
Biometry I	3
Biometry II	3
Regression Analysis	3
Non-parametric Statistical Methods & Multivariate Analysis	3
Photogrammetry	3
Forest Typology of Brazil	3
South-Brazilian Dendrology	3
Study of Brazilian Problems	0

MAJOR SUBJECT - SILVICULTURE

OBLIGATORY SUBJECTS	CREDITS
Forest Soils	3
Forest Ecosystems	3
Tree Physiology	3
Seminars (no credits)	-

ELECTIVE SUBJECTS

Forest Nutrition	3
Seeds and Nurseries	3
Planning of Forest Formation and Regeneration	3
Silviculture	5
Regional Silviculture	3
Silviculture and Landscape Gardening	3
Experimental Silviculture	3
Forest Ecophysiology	3
Experimental Ecophysiology	2
Forest Genetics and Melioration I	3
Forest Genetics and Melioration II	3
Micrometeorology	3
Forest Fires	3
Forest Pathology	3

Forest Entomology	3
Control of Forest Plagues & Diseases	3
Wild Fauna & its Management	3
Forest Work Science	3
Wood Harvesting Systems	3
Planning of Harvesting Operations	3
Special Topics on Silviculture	variable
Seminars on Silviculture	variable
Special Problems in Silviculture	variable
Master's Dissertation	30
Doctor's Thesis	60

MAJOR SUBJECT - FOREST PRODUCTS USE AND TECHNOLOGY

OBLIGATORY	CREDITS
Anatomical Structure & Identification of Wood	4
Wood Properties	3
Wood-Water Relation	3
Seminars (no credits)	-

ELECTIVE SUBJECTS

Technology of Cellulosic Pulp Production	3
Microtechniques & Photomicrography	3
Chemistry of Cellulosic Pulp Production Processes	3
Technology of Paper Production	3
Veneer Lamination, Production & Use	3
Composite Board Production & Use	3
Statics & Strenght of Materials for the Technology of Forest Products	3
Wood Drying	3
Production of Laminated Beams and Their Use	3
Biodegradation & Preservation of Wood	3
Quality Control in Forest Plants	3
Energy from Forest Biomass	3
Special Topics on Forest Products Technology	variable
Seminars on Technology & Use of Forest Products	variable
Special Problems in Technology & Use of Forest Products	variable
Master's Dissertation	30
Doctor's Thesis	60

MAJOR SUBJECT - FOREST MANAGEMENT

OBLIGATORY SUBJECTS	CREDITS
Forest Mensuration	3
Operational Research for Forest Finalities	3
Forest Yield Planning	3
Seminars (no credits)	-

ELECTIVE SUBJECTS

Forest Photointerpretation	3
Remote Sensoring in Forestry	3
Sampling Theory Applied to Forest Research	3
Forest Inventory Planning and Projects	3
Management of Yield in Natural Forests	3
Special Topics on Forest Management	variable
Seminars on Forest Management	variable
Special Problems in the Forest Management	variable
Master's Dissertation	30
Doctor's Thesis	60

MAJOR SUBJECT - FOREST ECONOMICS AND POLITICS

OBLIGATORY SUBJECTS	CREDITS
Microeconomics	3
Macroeconomics	3
Planning of the Forest Sector	3
Seminars (no credit)	-

ELECTIVE SUBJECTS

Regional Planning	2
Integrated Forest Planning	3
Financial Analysis of Forest Companies	2
Management & Organization of Forest Companies I	2
Planning of Forest Companies	3
Forest Market	2
Industrial Planning	3
Economics of Forest Products	2

Special Topics on Forest Economics & Politics	variable
Seminars on Forest Economics & Politics	variable
Special Problems on Forest Economics & Politics	variable
Master's Dissertation	30
Doctor's Thesis	60

NOTE:
1. Study of Brazilian Problems is compulsory by legal determination.
2. These subjects are compulsory:
   - Mathematics
   - Data Analysis Techniques
   - Biometry I
3. The subject DATA PROCESSING TECHNIQUES is compulsory for the major subject FOREST MANAGEMENT.

APPENDIX 3: Distribution and situation of students taking the master programme in Forest Engineering at the UFPR

(March 1987)

DISCRIMINATION	SILVICULTURE		FOREST MANAGEMENT		ECONOMICS		TECHNOLOGY		TOTAL	
	STUDENTS	%	STUDENTS	%	STUDENTS	%	STUDENTS	%	STUDENTS	%
Dissertation defended	54	51.4	46	49.0	4	21.0	29	48.3	133	47.8
Specialization Certificates	7	6.7	4	4.3	-	-	1	1.7	12	4.4
Gave up	10	9.5	23	24.5	-	-	13	21.7	46	16.5
Died	4	3.8	1	1	-	-	-	-	5	1.8
Transferred	2	2.0	-	-	-	-	-	-	2	0.7
Working on thesis	7	6.7	5	5.3	4	21.0	3	5.0	19	6.8
Taking subjects	15	14.2	10	10.6	9	47.4	10	16.7	44	15.8
Continuation postponed	6	5.7	5	5.3	2	10.6	4	6.6	17	6.2
TOTAL	105	100	94	100	19	100	60	100	278	100

APPENDIX 4: Distribution and situation of students taking the doctor programme in Forest Engineering at the UFPR

(March 1987)

DISCRIMINATION	SILVICULTURE		FOREST MANAGEMENT		ECONOMICS		TECHNOLOGY		TOTAL	
	STUDENTS	%	STUDENTS	%	STUDENTS	%	STUDENTS	%	STUDENTS	%
Dissertation defended	3	13.6	2	12.6	-	-	-	-	5	10.0
Gave up	-	-	-	-	-	-	1	11.1	1	2.0
Working on thesis	10	45.4	7	43.7	1	33.3	3	33.3	21	42.0
Taking subjects	9	41.0	7	43.7	2	66.7	5	55.6	23	46.0
TOTAL	22	100	16	100	3	100	9	100	50	100

BRAZIL

SURFACE AREA	8,511,965 SQUARE KILOMETRES
POPULATION	140 MILLION INHABITANTS
FOREST LAND	3,200,000 SQUARE KILOMETRES 38 % FROM LAND AREA

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